

PROGRAM STRUCTURE

1.0 OVERVIEW

This Ex. D2-2-2 sets out OPG's commercial strategy that establishes OPG as Program owner and defines OPG's relationships with its external contractors, as well as its supporting organizational structure for the Darlington Refurbishment Program ("DRP").

2.0 COMMERCIAL AND CONTRACTING STRATEGIES¹

Darlington Refurbishment Program is a multi-phased program made up of numerous individual projects of various sizes. To manage the work, OPG developed an overall commercial strategy as well as distinct contracting strategies for the major work bundles.

The "commercial strategy" is an overall commercial framework with guiding principles for establishing and maintaining commercial relationships with third parties to support the DRP. The commercial strategy selected by OPG is a "multi-prime contractor" model in which there is more than one prime contractor working on the DRP. OPG, as the owner, has a separate contract with each prime contractor. Each prime contractor is responsible for completion of the work that is within the scope of its particular contract. As the owner, OPG is the integrator among the prime contractors and is responsible for the entire Program.

One unique element of the DRP is that the work will be undertaken in a nuclear facility while either two or three other nuclear units remain operational. Given the need to manage and work in a nuclear power plant in these circumstances, OPG as the owner is in the best position to manage the overall DRP. In this role, OPG is responsible for the safe and reliable design of its nuclear facilities and to ensure plant operation is in accordance with its Canadian Nuclear Safety Commission ("CNSC") license requirements.

The key benefit of this model is that OPG retains control over the entire DRP, including the deliverables, costs and schedule. OPG is also able to assign risks to the parties best able to

¹ The evidence in this section is substantially unchanged from that filed in EB-2013-0321.

1 manage those risks. This strategy allows OPG to negotiate a reasonable balance between
2 the transfer of risk to contractors and the costs of the contracted services.

3
4 OPG's use of the multi-prime contractor model was reviewed and considered by Concentric
5 Energy Advisors ("Concentric") in EB-2013-0321. Concentric concluded that:

6
7 Ontario Power Generation has acted prudently in selecting the multi-prime
8 contractor model strategy. Ontario Power Generation's selection of this
9 commercial strategy appropriately and reasonably considered the operational
10 experiences of refurbishment projects at the Bruce A and Point Lepreau
11 refurbishment projects, and the restart of Pickering A. This model provides
12 Ontario Power Generation with the necessary control over the design and
13 planning of the Project and allows Ontario Power Generation to utilize the
14 expertise of specialty vendors in a cost effective manner.²
15

16 As OPG has not deviated from the multi-prime approach considered by Concentric in EB-
17 2013-0321, the conclusions remain valid. A copy of Concentric's report is provided in
18 Attachment 1.

19
20 Under the multi-prime contractor model, individual standalone contracting strategies have
21 been developed for each of the major work bundles (i.e., Retube and Feeder Replacement
22 ("RFR"), Turbine Generators, Fuel Handling and Defueling, Steam Generators and Balance
23 of Plant). A "contracting strategy" is the means for successful implementation of the project
24 delivery approach for a major work bundle that forms part of the DRP. Each contracting
25 strategy takes into account factors such as the nature and scope of the work, the vendor
26 marketplace, and any potential long term commercial arrangements. Each contracting
27 strategy resulted in a recommendation on the most suitable sourcing approach, contract
28 structure and pricing mechanism for that specific work bundle. The contracting strategies
29 identify the breakdown of work to be assigned to each contractor, allowing OPG to maintain
30 flexibility in tailoring the strategies to the nature and scope of work, applicable market
31 conditions, and post-refurbishment arrangements. The contracts for the major work bundles
32 are described in Ex. D2-2-3.

² Concentric Energy Advisors, *Assessment of Commercial Strategies Developed for the Overall Darlington Refurbishment Project and the Retube & Feeder Replacement Work Package*, September 2013, p. 2.

1 **3.0 OPG STRUCTURE AS OWNER**

2 OPG as the owner retains overall responsibility for deliverables, costs and schedule and
3 continues to serve as the design authority³ for the DRP. OPG will, at all times, remain the
4 license holder and operator of the plant in accordance with CNSC regulations and license
5 requirements. To effectively perform the various aspects of this role, OPG has established an
6 organizational structure comprised of two primary aspects. First, OPG has established
7 dedicated project management teams that are responsible for the management, oversight
8 and delivery of specific major work bundles. Second, OPG has established Functions that
9 are dedicated to performing specific types of work to support all of the major work bundles
10 and integration of the overall Program.

11

12 A diagram of how the organization is structured, taking into account both the dedicated
13 project management teams and the Functions, is provided in Figure 1 below.

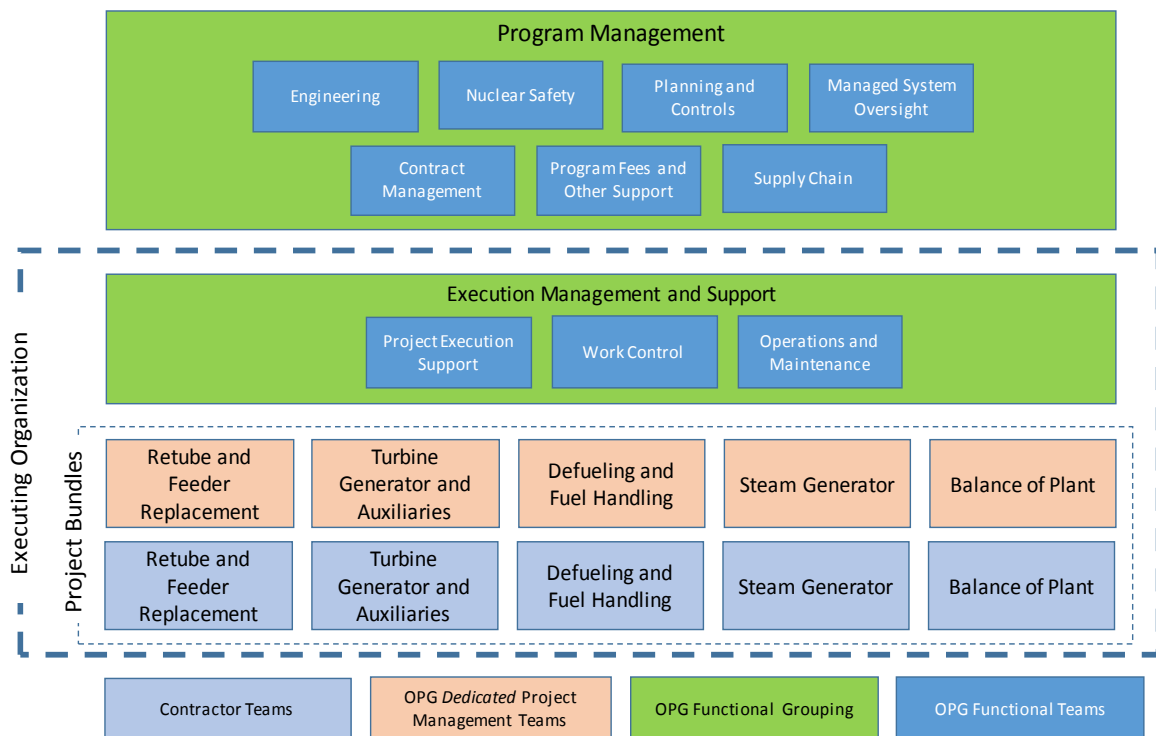
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³ The design authority:

- is accountable for the safe and reliable design of the nuclear facilities;
- ensures all design activities are carried out in a manner that produces high-quality design outputs in accordance with defined regulations, codes, standards, and procedures;
- ensures design configuration control is maintained; and
- maintains the engineering expertise required for the safe operation of its nuclear facilities.

1
2

Figure 1
DRP Organizational Structure



3
4

5 As shown in Figure 1, the Functions are either contained within the Executing Organization
 6 and are responsible for day-to-day execution support, or are at the Program Management
 7 level where they are accountable for the overall delivery of the Program, including planning,
 8 oversight, monitoring, reporting and contract management of each project executed within
 9 the Program. This provides segregation of the day-to-day tactical activities from the overall
 10 management activities and also creates a layer of independence within the DRP team which
 11 is effective for project oversight and project controls.

12

13 **3.1 Project Management Teams**

14 As described in Ex. D2-2-3, scopes of work have been grouped into five major work bundles.
 15 Each of the five major work bundles has an OPG project director. The project director is
 16 responsible for ensuring the effective planning and successful execution of their major work
 17 bundle within the overall Program, and for ensuring that the corresponding contractors
 18 deliver the contracted services safely, to the quality specified, on time and on budget. The

1 project director is supported by a dedicated project management team, as well as by OPG's
2 functional support groups (described below). As explained in Ex. D2-2-8, the costs
3 associated with this project management role form part of the cost for each of the major work
4 bundles.

5
6 The project management teams are appropriately supported by Owner Support Services
7 contractors (AMEC NSS and Worley Parsons Canada), which provide engineering, project
8 management, and functional support, and a Project Planning and Controls contractor
9 (Faithful and Gould), which provides project controls and contract management functional
10 support.

11 12 **3.2 Functional Support Groups**

13 The Functions are dedicated to performing specific types of work to support the major work
14 bundles and the DRP as a whole. Functions set standards, manage the DRP at the overall
15 Program level and provide support in specific areas (such as engineering, oversight, and
16 procurement). The Functions are responsible for providing the required support,
17 coordination, integration and oversight of the work that will be performed by the project
18 management teams and external contractors. The Functions, therefore, are critical to
19 program success.

20
21 Exhibit D2-2-9 describes in greater detail the roles that the execution management and
22 support functions will play in the Execution Phase for Unit 2, such as work control, quality
23 management, construction oversight, chemistry and environmental control, as well as
24 operational support such as worker protection (safety, radiation protection, and permits).

25
26 Each of the Functions is described below. A description of OPG's program management
27 system, which is a framework of controlled documents through which Program objectives,
28 plans, processes, roles, responsibilities and decision-making are documented, is set out in
29 Attachment 2.

30
31

1 3.2.1 Project Execution Support Function

2 This Function provides support across the major work bundles in the areas of (i) construction
3 execution and field support, (ii) quality management, (iii) refurbishment project parts
4 integration, and (iv) Program execution strategy. As this Function plays a very significant role
5 during the Execution Phase, its activities are described in greater detail in Ex. D2-2-9.

6

7 3.2.2 Work Control Function

8 This Function, now referred to as the “Project Office”, is responsible for developing,
9 monitoring, and controlling the individual unit outage integrated execution schedule. While
10 each project and contractor is responsible for producing a valid and executable schedule, the
11 Project Office Function validates each schedule and integrates it into the overall schedule for
12 Unit 2. This Function ensures that work is properly planned prior to execution and unit scope
13 is managed and controlled, co-ordinates day-to-day work control and interfacing activities,
14 resolves issues, initiates and controls changes, and monitors and reports on risks, schedule
15 status and performance metrics. As this Function plays a very significant role during the
16 Execution Phase, its activities are described in greater detail in Ex. D2-2-9.

17

18 3.2.3 Engineering Function

19 This Function has overall engineering and design authority and accountability for all work
20 within the scope of the DRP, including all units while in their refurbishment state. Given that a
21 significant portion of the plant modifications for the DRP will be executed by external
22 contractors, an important aspect of the Program is that the Engineering Function must
23 approve all permanent and temporary design changes associated with the DRP. In doing so,
24 this group ensures that appropriate interfaces and oversight protocols are maintained
25 throughout the design, procurement, installation, commissioning and closeout processes to
26 ensure compliance with design requirements. The group is organized into four departments:

- 27 • *Design Engineering* carries out the design authority role and is responsible for
28 preparing, reviewing and approving all permanent and temporary design changes and
29 design packages. It prepares and approves in-house design deliverables or
30 collaborates with contractors to develop and accept contractor design deliverables.

- 1 • *Plant Reliability Engineering* carries out the engineering authority role. Its
2 responsibilities include life cycle plans, periodic inspection programs, maintenance
3 requirements, in-service inspection requirements, as well as system surveillance,
4 preparation of return to service specifications and close-out reporting.
- 5 • *Quality Engineering* implements process improvements and drives engineering
6 quality improvements. Its responsibilities include preparing a quality engineering
7 ‘dashboard’, developing and approving refurbishment engineering governance,
8 functioning as the primary interface with OPG’s non-refurbishment nuclear
9 engineering group, and carrying out quality-related assessments, such as
10 benchmarking and operating experience reviews.
- 11 • *Nuclear Safety Engineering* is described as a distinct Function below.

12 13 3.2.4 Nuclear Safety Function

14 This Function performs safety analysis, either directly or through the verification and/or
15 acceptance of contractor work. It also provides ongoing support for refurbishment-related
16 regulatory issues. In addition, this Function provides nuclear safety support for safety
17 improvement opportunities (“SIO”) and the major work bundles, as well as nuclear safety
18 reviews of critical documents. The Nuclear Safety Function also ensures refurbishment work
19 is completed in adherence with OPG’s reactor safety program and manages refurbishment
20 impacts on Darlington’s operating policies and principles and probabilistic risk assessment.

21 22 3.2.5 Planning and Controls Function

23 This Function supports the DRP through the establishment and application of project
24 controls, including cost management, reporting, and risk management at both the Program
25 and project levels. The Planning and Controls Function deploys standards based on best
26 industry practices and recommendations. More specifically, this Function’s responsibilities
27 include front end planning, program level scope control, project controls including
28 implementation of a gated approval process for the major work bundles, cost management,
29 earned value management, forecasting, reporting and metrics, change control management,
30 and risk management. The Planning and Controls Function also includes funding for
31 information technology tools required to execute the refurbishment. In the transition from

1 Definition Phase to Execution Phase, the focus of this Function has shifted from the
2 establishment of governance, tools and processes to monitoring Program performance
3 through the use of project controls, metrics and reporting.

4
5 3.2.6 Managed System Oversight Function

6 This Function provides and/or coordinates performance assurance and oversight of the DRP
7 managed system.

8
9 The oversight role includes management of the low-level reporting tool that allows OPG to
10 assess trends and put in place corrective actions to resolve those trends. This requires OPG
11 to perform root cause analysis and put in place revised processes, training programs, or
12 other measures. This Function performs oversight as set out in the Program's self-
13 assessment plan and within individual project oversight plans. Further, this Function
14 coordinates and facilitates the oversight of all third parties, including OPG's internal audit
15 group, and the external Refurbishment Construction Review Board, the OPG Board of
16 Directors' independent oversight, and the Ministry of Energy's oversight.

17
18 This Function also manages OPG's Managed System, which is the governance framework
19 and process support document framework that has been implemented to manage all
20 activities related to the DRP (see Attachment 2). One of the CNSC's conditions in the Power
21 Reactor Operating License for Darlington is for OPG to meet the requirements of Canadian
22 Standards Association ("CSA") N286, *Management System Requirements for Nuclear Power*
23 *Plants*, in managing all aspects of its work. The DRP Managed System meets the
24 requirements of CSA N286.

25
26 In addition, the Managed System Oversight Function monitors the creation, revision,
27 superseding and obsolescing of new controlled documentation and processes.

28
29 3.2.7 Supply Chain Function

30 This Function supports all procurement related activities in relation to overall cost, schedule
31 and quality of the Program, and provides oversight on procurement activities undertaken by

1 the Engineering, Procurement and Construction contractors. The objectives of this Function
2 are to ensure: (i) cost certainty and optimization of risk transfer under each contract, (ii) value
3 for money, and (iii) to support efficient project delivery, on time and with safety and
4 production risks minimized. This Function is responsible for, among other things, awarding
5 contracts using established procurement processes, assisting projects in the identification
6 and assessment of strategies for long-lead and at-risk materials, ensuring procurement
7 processes comply with applicable OPG policies, exercising oversight over contractor
8 procurement processes based on a risk significance graded approach, and supporting
9 internal and external audits related to procurement and materials management processes.

10 11 3.2.8 Contract Management Function

12 This Function provides commercial support across the DRP in the administration of contracts
13 by ensuring consistency in execution of agreements across projects, interpreting contract
14 terms and conditions, developing contract management plans, facilitating change
15 management under contracts, reviewing invoices, monitoring compliance with contract
16 requirements, monitoring and reporting on performance under master contracts, identifying
17 commercial issues and supporting claims management and dispute resolution. In addition,
18 this Function works to establish and maintain effective commercial relationships with third
19 party contractors.

20 21 3.2.9 Program Fees and Other Support Function

22 This Function, which accounts for 3 per cent of the overall refurbishment budget, provides a
23 diverse range of support to facilitate execution of the DRP, including:

- 24 • Nuclear Refurbishment Finance organization;
- 25 • Nuclear Regulatory Affairs organization;
- 26 • CNSC fees, and other licence fees and insurance costs for the Program;
- 27 • Refurbishment Communications organization;
- 28 • Refurbishment Human Resources and Labour Relations organization; and
- 29 • other miscellaneous support costs, including information technology licensing fees.

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1 3.2.10 Operations and Maintenance Function

2 The nature of this Function is distinct from those set out above because it is both a functional
3 and execution organization. The Operations and Maintenance Function (“O&M Function”)
4 provides functional support to the major work bundles in respect of the unit being refurbished
5 and also serves as the “custodian” of the operating units in the plant by ensuring that the
6 refurbishment work does not adversely impact those operating units. Importantly, the O&M
7 Function will serve as the “controlling authority” for the units undergoing refurbishment within
8 the construction island. As this Function plays a very significant role during the Execution
9 Phase, its activities are described in greater detail in Ex. D2-2-9.

ATTACHMENTS

1

2

3 Attachment 1: Concentric Report: Assessment of Commercial Strategies Developed
4 for the Overall Darlington Refurbishment Project and the Retube &
5 Feeder Replacement Work Package

6 Attachment 2: Program Management System Structure and Program Charter



**ASSESSMENT OF COMMERCIAL STRATEGIES
DEVELOPED FOR THE OVERALL DARLINGTON
REFURBISHMENT PROJECT AND THE RETUBE & FEEDER
REPLACEMENT WORK PACKAGE**

PREPARED FOR ONTARIO POWER GENERATION

SEPTEMBER 2013



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I. EXECUTIVE SUMMARY

On September 9, 2011, Tory's LLP retained Concentric Energy Advisors, Inc. ("Concentric") to review the commercial strategies and contracts developed and implemented for the refurbishment of four CANDU heavy water reactors at Ontario Power Generation, Inc.'s ("Ontario Power Generation's" or the "Company's") Darlington Nuclear Generating Station ("Darlington" or the "Plant").¹ The Darlington Refurbishment Project (the "Project") will include removal and replacement of the reactor calandria tubes and pressure tubes from each reactor, replacement of all feeders (referred to together with the calandria and pressure tube replacement as the "Retube & Feeder Replacement work package"), refurbishment of the existing fuel handling equipment, refurbishment of the existing turbine generators, refurbishment of the existing steam generators, and a set of supporting refurbishment projects aligned with existing station systems. The plant modifications are currently planned to be made during overlapping 36-month outages for each of the four Darlington units between October 2016 and 2024.² However, the Company is currently conducting an evaluation of the business case for un-lapping the refurbishment execution of the first two units. Under this scenario, the first refurbishment outage would be conducted on Unit 2 between Fall 2016 and Fall 2019. The remaining outages will occur between Fall 2019 and Fall 2025 with approximately 17 to 19 months of overlap between each successive outage. The Company expects to reach a decision on whether to proceed with this revised Project calendar in November 2013.

Prior to commencing the execution phase work, Ontario Power Generation has committed to undertaking significant planning activities, which include working to develop and implement appropriate commercial strategies to prepare for a project of this magnitude. Concentric was engaged to review the Company's commercial strategies and how these strategies are being implemented. This letter summarizes Concentric's review and opinion of the overall Project commercial strategy, as well as the commercial strategy of the Retube & Feeder Replacement work package.

The Project is following a standard megaproject progression that includes the following phases: (1) project initiation; (2) definition; (3) execution; (4) commissioning; and (5) project closeout. In the project initiation phase, a project is evaluated for its initial feasibility based on relatively high-level information that is readily available. Should a project prove feasible during the project initiation phase, it will proceed into the definition phase. During the definition phase, the project team undertakes detailed reviews of the project's anticipated scope, cost, and schedule to begin to define the activities that must be completed during the project, when those activities must be completed, and how much those activities are expected to cost. Concurrently, the project team begins to define the commercial strategies expected to be employed. Later during the definition phase, the project team is responsible for: (1) identifying, procuring and fabricating all long lead materials, components and tooling; (2) executing all of the necessary agreements to proceed with the major work packages; (3) completing the detailed scope and project schedule; and (4) developing a "release quality" cost and schedule estimate from which the project's performance can be measured. The release quality estimate and the integrated schedule available at the conclusion of the definition phase are more defined than prior iterations of the cost estimate and integrated schedule, yet both still contain uncertainty. Following the definition phase, a project enters the execution phase during which the actual plant modifications will take

¹ As used in this context, "commercial strategies" refers to the processes by which Ontario Power Generation will procure goods and services for the Darlington Refurbishment Project.

² As a practical matter, initial planning for the Project began in 2006 with the initiation of feasibility studies and plant technical assessments. Thus, from the Project's initiation to closeout, the Project will span nearly 20 years.



place. This stage is followed by the commissioning and project closeout phases. During these phases, the project team brings the project online and completes all of the recordkeeping associated with the project.

The initiation phase of the Project began in late 2007 with the preparation of a business case that evaluated, at a high level, the overall feasibility of completing the Project. In November 2009, the Project sought and received authorization from the Ontario Power Generation Board of Directors to proceed with the planning portion of the definition phase. In February 2010, the Ministry of Energy concurred with the Board of Directors' decision. To execute the work, Ontario Power Generation will retain multiple contractors for discrete portions of the Project work known as work packages. Consistent with this approach, Ontario Power Generation has proposed dividing the work into multiple major work packages, of which the Retube and Feeder Replacement work package is one.

The Retube & Feeder Replacement work package portion of the Project entered the detailed planning portion of the definition stage with the execution of an agreement with a qualified vendor responsible for completely replacing the pressure and calandria tubes and the feeders, should the Project proceed to execution. During the definition phase of the project, Ontario Power Generation and its vendors will complete the planning and design of the Project, execute the remaining project agreements, complete site preparations and a mock-up of the Darlington reactors, develop a release quality estimate, design and fabricate tooling, and test the tooling on mock-ups, among many other activities. Likewise, while the Project has completed a high level scope development process, the detailed design of the Project is still under development, and Ontario Power Generation is continuing to define and refine the Project's integrated schedule.

II. SUMMARY OF CONCLUSIONS

As outlined below, Concentric has concluded that, based on Ontario Power Generation's activities from late 2009 through August 1, 2013, the commercial strategies employed by the Project are appropriate and reasonable and meet the regulatory standard of prudence, given the current status of the Project. With regard to the commercial strategy for the Retube & Feeder Replacement work package specifically, we believe the activities of Ontario Power Generation to date, including Ontario Power Generation's use of Owner's Support Services, are reasonable and prudent.

Concentric's opinion is not without certain caveats and limitations, which are discussed in the sections that follow. Similarly, the basis for our opinions are described throughout the remainder of this document.

III. STANDARD OF REVIEW

To conduct our review of commercial strategies selected by Ontario Power Generation, Concentric sought to answer three primary questions:

- 1) Are the commercial strategies selected by Ontario Power Generation for the Project reasonable?
- 2) Are these commercial strategies being executed in a reasonable manner?
- 3) Do the selected commercial strategies and the execution of those strategies meet the regulatory standard of prudence?



To answer these questions, Concentric adopted a definition for the regulatory standard of prudence based on Concentric's work before state, provincial and federal energy regulators in both Canada and the United States. The definition utilized by Concentric is consistent with decisions rendered by the Ontario Superior Court of Justice,³ the Court of Appeal for Ontario,⁴ the Ontario Energy Board⁵ and the U.S. Supreme Court,⁶ among other jurisdictions. Specifically, Concentric defined the prudence standard as examining the range of actions that a reasonable manager would take given the facts or circumstances that were known or knowable at the time of the decision or action. That definition rejects the use of hindsight as a basis for determining the prudence of a decision or action. In addition, that definition relies on an evaluation of decisions or actions. Project costs are neither prudent nor imprudent; instead, costs are prudently or imprudently incurred as a consequence of the decisions and actions of management.

IV. INFORMATION SOURCES

Our review and the development of our opinions relied on three primary information sources. The first source included data request responses from Ontario Power Generation. Concentric submitted multiple rounds of data requests for information related to the Project and the Retube & Feeder Replacement work package. Second, Concentric performed outside research on topics including lessons learned and the experiences of other CANDU operators performing similar projects, the Canadian nuclear safety regime, and industry trends and practices for other large nuclear refurbishment projects. Finally, Concentric conducted on-site interviews during which Concentric met with members of the Darlington Refurbishment Project team. Follow-up telephone conversations were used to clarify certain facts and supplement the information Concentric received during our on-site interviews.

V. GENERAL LIMITATIONS OF OUR OPINION

The following are general limitations regarding the scope of our review:

- First, our review is limited to Ontario Power Generation's actions and documents prepared between late 2009 and August 1, 2013.⁷ Concentric did not complete a thorough review of Ontario Power Generation's actions related to the Project prior to or after that time period.
- Next, Concentric did not independently verify the appropriateness, sufficiency, or correctness of the Project schedules, cost estimates, or scope. Concentric was informed of the processes used to develop and to define further these planning assumptions. As such, we have considered these processes in the context of our review.

³ 2005 CanLII 4941 (Ont. Div. Ct.).

⁴ Court of Appeal for Ontario Decision, Docket: C55602, C55641 and C55633, June 4, 2013.

⁵ Decision with Reasons, RP-2001-0032, December 13, 2002. This Decision deals with Enbridge Gas Distribution Inc.'s (formerly Enbridge Consumers Gas or ECG) application for a Board Order approving rates for the 2002 Test Year.

⁶ Separate, concurring opinion of Justice Louis Brandeis, *Missouri ex. Rel. Southwestern Bell Telephone Co. v. Public Service Commission*, 262 U.S. 276 (1923).

⁷ The beginning of the period Concentric reviewed is roughly concurrent with Ontario Power Generation's completion of the Economic Feasibility Assessment of Darlington Refurbishment dated November 13, 2009. However, portions of the operational experience material reviewed by Concentric were prepared prior to this time.



- In addition, Concentric assumed Ontario Power Generation will retain adequately qualified personnel to complete the Project generally and the Retube & Feeder Replacement work package specifically. Those resources are critical to the success of the project, and may be sourced internally, hired directly, or engaged through contracts with third parties.
- Concentric did not perform a compliance audit to determine whether Ontario Power Generation and the Project were in compliance with Ontario Power Generation's internal policies, procedures, instructions and guidelines, or applicable provincial and federal regulations. Similarly, Concentric did not conduct a legal review of Ontario Power Generation's agreements or proposed agreements with any contractors. Notwithstanding that limitation, Concentric did review relevant Ontario Power Generation internal policies and procedures, and relevant provincial and federal laws and regulations when developing our opinion. Concentric also notes that Ontario Power Generation has separately retained outside counsel to advise it on the terms of the agreement with the vendor performing the Retube & Feeder Replacement work package.
- Finally, Concentric's review is not an assessment of the Project's likelihood of success. Successful execution of the Project generally and the Retube & Feeder Replacement work package specifically will require the efforts of many entities and individuals over many years, and the development and implementation of the Project's commercial strategies is only one contributor to project success.

VI. OVERALL PROJECT OPINION

A. GENERAL OBSERVATIONS

In performing our review, Concentric developed certain general observations that relate to our opinion:

- First, the Canadian marketplace for the procurement of qualified nuclear engineering, fabrication and construction services is very limited. Of the pool of vendors, only one vendor, Atomic Energy of Canada, Limited ("AECL"), recently provided a full turn-key refurbishment of a CANDU reactor, and the commercial reactor division of this vendor was acquired by SNC Lavalin Group in October 2011.⁸ A limited number of other vendors, including General Electric Hitachi – Canada ("GEH-C") and Babcock & Wilcox Canada Ltd ("B&W"), have performed limited scopes of work on prior refurbishment projects under direct agreements with the project sponsors, or as sub-vendors and consortia members. With regard to certain work packages, only a single supplier has ownership or access to the original design basis documentation necessary to complete the work. Thus, creating competitive tension to produce optimal contractual terms can be difficult.
- Second, no Canadian CANDU refurbishment or return to service project to date represents a model of a successful commercial strategy. Concentric researched and reviewed operational experiences from the three recent Canadian CANDU refurbishment or return to

⁸ SNC-Lavalin Nuclear, Inc., through its affiliate, CANDU Energy, recently acquired AECL's commercial reactor division from the Canadian Government. (SNC Lavalin Third Quarter 2011 Conference Call Notes, 4 November 2011, Pg. 7.)



service projects: 1) Pickering A, Units 1 and 4 in Pickering, Ontario (“Pickering A”); 2) Bruce A, Units 1-4 in Inverhuron, Ontario (“Bruce A”); and 3) Point Lepreau in Point Lepreau, New Brunswick (“Point Lepreau”). These three projects represent the most recent attempts to successfully plan, design, and execute significant refurbishment or repair work on Canadian CANDU reactors, and each project utilized a different commercial strategy. Each project encountered challenges to the successful completion of the refurbishment work. We also reviewed limited information from a refurbishment project at the Wolsong Generating Station in South Korea (“Wolsong”). The Wolsong project was completed in July 2011 and represents the most successful (*e.g.*, cost and schedule performance) CANDU refurbishment project yet. Although Wolsong employed a commercial strategy similar to that employed by NB Power at Point Lepreau, we believe certain differences in the labor and nuclear services markets account for at least a portion of the success at Wolsong. Ontario Power Generation examined, and continues to examine, these prior projects, and plans to incorporate the lessons learned from these projects in the planning, definition, and execution activities of the Project.

- Third, the Project is confronted generally with two types of risk: 1) extrinsic risk (*i.e.*, risks that are outside of Ontario Power Generation’s control); and 2) intrinsic risk (*i.e.*, risks that are within Ontario Power Generation’s control) that largely relate to the technical and commercial aspects of the project. With regard to extrinsic risk, the scale and duration of the Project make it vulnerable to changes in the economic, financial, political, regulatory and social assumptions that support the Project. While certain commercial strategies can result in vendor agreements that mitigate a portion of extrinsic risks, no economically viable commercial strategy can be expected to eliminate the bulk of those risks. In response, Ontario Power Generation is taking steps to mitigate the extrinsic risks through the use of a “gated” review and approval process. This gated review and approval process will phase Ontario Power Generation’s commitment to the Project into discrete periods and costs and will allow Ontario Power Generation to evaluate the ongoing feasibility of the Project at each interval. As it relates to the intrinsic risk, Ontario Power Generation is undertaking several activities to mitigate these risks. These activities include, but are not limited to, completing the Project’s design in advance of construction, evaluating long lead procurement items, constructing full scale reactor mock-ups to test the specialized tooling that must be designed and fabricated for the project, and evaluating the operational experiences of other recent refurbishment projects. When combined with Ontario Power Generation’s gated approval process, these steps will lower the Project’s intrinsic risk as it proceeds into each new phase of the Project, although, inevitably, certain intrinsic risks will remain for the Project and all similar projects.

B. OVERALL PROJECT COMMERCIAL STRATEGY

The overall commercial strategy selected by the Project team is the multi-prime contractor model. Under this model, Ontario Power Generation will retain project management responsibility and design authority for the Project. To execute the work, Ontario Power Generation will retain multiple contractors for discrete portions of the Project work known as work packages. Consistent with this approach, Ontario Power



Generation has divided the work into multiple major work packages, of which Retube & Feeder Replacement is one.

Ontario Power Generation's selection of the multi-prime strategy was based on the recognition that alternative models have not been successful, and that there is a reasonable need to retain control of, and project management responsibility for, the Project. Specifically, Ontario Power Generation will retain control over deliverables, work processes, the scope of work, and the ultimate design of station modifications and replacements. Ontario Power Generation will also retain responsibility for planning and permitting, coordinating the interfaces between each of the prime vendors selected to complete the work packages, and overseeing the Project's multiple prime contractors. Finally, Ontario Power Generation will be responsible for vendor claims for scope changes, owner-caused delays and vendor-caused delays that affect other vendors (setting aside the Company's recourse to the vendor causing the delay). Importantly, the multi-prime strategy will provide Ontario Power Generation with additional flexibility to transfer work between major vendors if such a transfer promotes efficiency and value for money.

By using this model, Ontario Power Generation is accepting the challenge of managing each of the prime vendors and ensuring that each vendor is able to complete its work according to its plan. Given the complexity of the Project and the limited working space within the Darlington site, Ontario Power Generation's coordination of the various work tasks will require extensive planning to prevent claims of delay or increased costs caused by Ontario Power Generation's failure to adequately plan and coordinate the work or interference from another vendor.

C. CONCENTRIC'S OPINION OF THE OVERALL PROJECT COMMERCIAL STRATEGY

Concentric believes Ontario Power Generation has acted prudently in selecting the multi-prime contractor model strategy. Ontario Power Generation's selection of this commercial strategy appropriately and reasonably considered the operational experiences of refurbishment projects at the Bruce A and Point Lepreau refurbishment projects, and the restart of Pickering A. This model provides Ontario Power Generation with the necessary control over the design and planning of the Project and allows Ontario Power Generation to utilize the expertise of specialty vendors in a cost effective manner. We note that a variation of this model is being used to successfully deploy new nuclear facilities in China. In that model, a Chinese state-owned entity is sponsoring nuclear construction projects at Sanmen and Haiying. A local construction company is being utilized to construct the projects while a consortium of the Shaw Group, Inc. and Westinghouse Electric Company, LLC is providing engineering, procurement and construction ("EPC") oversight services. Finally, a recent analysis has shown that this model is likely to result in total project costs that are at least competitive with, if not lower than, alternative commercial strategies.⁹

While Concentric is in agreement with the selected commercial strategy, we do note that this model does not mirror Ontario Power Generation's previous experience with significant projects and that the Project team has limited experience in managing vendors under this model. Ontario Power Generation's limited experience in managing the vendor oversight function in a large, diverse, multi-prime contracting model will increase the importance of accessing external resources. Ontario Power Generation is appropriately meeting this need through a combination of Owner's Support Services vendors, and other outside consultants and

⁹ Rojas, Eddy M., "Single Versus Prime Contracting," *Journal of Construction Engineering and Management*, October 2008, pp. 758-765.



experts. Those vendors will assist Ontario Power Generation with the oversight function by providing relevant expertise developed from other major projects.

Consistent with Ontario Power Generation's gated review and approval process for proceeding with each phase of the Project, Concentric believes all of the agreements that result from this strategy should include sufficient off-ramps and hold points at which continuing with the Project will be fully reconsidered. These milestones include, but are not limited to:

- Issuance of a release quality estimate,
- The start of each unit outage, and
- Instances when prime vendor performance is substantially below expectations.

D. ALTERNATIVES CONSIDERED

Prior to selecting its multi-prime contractor model strategy, Ontario Power Generation considered several alternative commercial strategies. Those alternative strategies included partnering, a lump sum turnkey agreement, and a project management organization structure. Ontario Power Generation rejected each of those strategies for the reasons described below.

Beginning in December 2009, the Project team was focused on a partnering concept that would seek to utilize a single agreement with multiple vendors, possibly combined in a joint venture, for the purpose of designing and executing the work packages. That agreement would have tied the vendors' financial performance to the overall success of the entire project rather than just a vendor's performance on its scope of work. The partnering concept was initially favored because, in its optimal form, the concept would better align the interests of all involved vendors and potentially promote a cooperative work environment. This concept was advocated in the 1990s by several industry participants, but experience with the partnering model has shown that alignment is difficult to achieve, and vendors largely rejected this model due to their inability to "control their own fate." That is to say, vendors have expressed a concern that their financial performance is tied to actions that are beyond their own control (*i.e.*, the performance of another vendor on the project). As a result, projects that utilized the partnering strategy often fostered less cooperative project environments where vendors were engaged in disputes with each other over the cause of delays or cost over-runs.

The Darlington Refurbishment Project team also considered a fixed price, lump sum, turnkey model similar to that employed by NB Power at Point Lepreau. At a basic level, this strategy would have turned over the entire Project to a single vendor and required the vendor to complete the entire scope of work and return an operable unit back to Ontario Power Generation. This strategy, when coupled with a fixed or target price, is expected to provide greater price certainty and greater risk transfer. However, the fixed-price, lump sum, turnkey strategy would have largely eliminated Ontario Power Generation's control over the final design, pace, and management of the Project. In addition, recent experience with this strategy has demonstrated that although the model proposes to transfer significant risk to a vendor, such risk transfer is largely unachievable in a nuclear safety environment due to exemptions for excused events and force majeure, the owner's liability for nuclear safety, and a lack of complete, detailed designs. As a result, the price premium paid to transfer risk is usually not commensurate with actual risk transferred to a vendor. At Point Lepreau, the fixed price, lump sum, turnkey strategy has largely protected NB Power from cost overruns, but has provided limited protection from schedule slippage and the extensive cost of replacement power that resulted. Lastly, a fixed-



price, lump sum, turnkey agreement for a nuclear power project of this magnitude is not likely to be commercially feasible in the current market. SNC Lavalin, the acquirer of the commercial reactor division assets of Point Lepreau's contractor (AECL), has indicated that it is unwilling to accept the same level of risk that AECL accepted in past contracts.¹⁰

Finally, Ontario Power Generation considered retaining a project management organization similar to the strategy initially employed by Bruce Power for the refurbishment of Bruce A. Pursuant to this model, Ontario Power Generation would have retained a qualified firm experienced in the management of megaprojects similar to this Project. The project management organization would have been responsible for planning the Project, negotiating agreements with prime contractors for the execution of the Project work, and managing the various work packages. This strategy would allow Ontario Power Generation to rely on an experienced project management organization that is expected to utilize industry best practices to plan and implement the Project. However, a project management organization strategy often suffers from a lack of alignment between the project management organization, the owner, and the prime contractors responsible for completing the work. This is particularly true in a tight market for such services, as is the case in Canada's market for nuclear services, because the project management organization may also be responsible for a portion of the execution phase work. Consequently, other vendors would have been expected to reject a project management organization due to concerns over future disputes between the vendors and the project management organization. Even if the model was accepted by capable vendors, Ontario Power Generation could expect to pay a substantial premium for the risk of project management organization and contractor disputes. Bruce Power has encountered difficulties with the project management organization strategy related to conflicts between the project management organization and its vendors and the project management organization's alignment with Bruce Power's interests. As a result, Bruce Power largely abandoned the project management organization strategy after approximately two years and moved to a multi-prime strategy.

As discussed above, Concentric agrees with Ontario Power Generation that it was reasonable and prudent to select the multi-prime model under the current market circumstances and to reject the alternatives considered by the Company.

VII. RETUBE AND FEEDER REPLACEMENT

A. OVERVIEW

The Retube & Feeder Replacement work package is expected to determine the Project's critical path¹¹ and includes the removal and replacement of each reactor's 480 pressure tubes and calandria tubes and the removal and replacement of the existing feeders. Because of the critical nature of this work, Ontario Power Generation has focused significant resources on selecting a reasonable commercial strategy and securing a vendor to perform the Retube & Feeder Replacement work prior to advancing the other work packages. Just

¹⁰ In June 30, 2011 article in *Canadian Business*, SNC Lavalin Executive Vice President Patrick Lamore was quoted as saying, "We don't want to go backwards but obviously we would only bid the projects that have acceptable terms and conditions to our risk profile and where we make the margins that are expected for a commercial business to survive."

¹¹ At a basic level, the critical path of a project is made up of those activities that must be completed on time in order for the project to proceed to each new phase of the project on schedule.



as Ontario Power Generation selected from available contracting strategies at the Project level, it must do the same for the selection of a vendor for the Retube & Feeder Replacement work package.

B. ONTARIO POWER GENERATION'S RETUBE & FEEDER REPLACEMENT COMMERCIAL STRATEGY

The commercial strategy selected by Ontario Power Generation for the Retube & Feeder Replacement agreement is a hybrid EPC agreement that combines elements of fixed/firm pricing for known or highly definable tasks and a target price for the remaining scope of the Retube & Feeder Replacement work package where less detailed information is available.¹² Additionally, Ontario Power Generation's commercial strategy has incorporated a phased project schedule that will divide the work into a definition phase, an execution phase and a commissioning phase. During the definition phase, Ontario Power Generation and its selected vendor will complete the detailed design of the Project, procure long lead materials, fabricate long lead components and tools, test the specialized tooling and complete final planning activities. At the conclusion of the definition phase work, Ontario Power Generation and its selected vendor will complete a cost estimating process to determine the "execution phase target price." The execution phase target price will create an estimate of the total cost to complete the execution phase work with upper and lower cost sharing bands. Within these cost sharing bands, Ontario Power Generation and the selected vendor will jointly share in cost over-runs or under-runs. Outside of these cost sharing bands, the Retube & Feeder Replacement agreement reverts to a cost reimbursable agreement, excluding vendor profit and overhead. Ontario Power Generation will, likewise, include financial incentives for early completion of each unit outage and financial penalties for failure to complete unit outages within the agreed upon schedule. If Ontario Power Generation and the selected vendor are unable to agree on an execution phase target price and schedule, Ontario Power Generation will retain the tooling in order to conduct the execution phase work with an alternate contractor.

Concentric's review of the Project's Retube & Feeder Replacement contracting strategy has highlighted the following advantages and disadvantages of this approach:

- Advantages: Flexibility to adapt to the project's evolving project scope; incentives are created to limit cost increases and schedule delays; control over the design of station modifications.
- Disadvantages: Creates substantial oversight responsibilities; once the cost for each unit exceeds the target price and caps for each unit, the contract is essentially a cost reimbursable (excluding vendor overhead and profit) agreement with a more limited risk transfer relative to a fixed price agreement.

C. BASIS FOR SELECTION

The current hybrid EPC strategy for the Retube & Feeder Replacement work package was selected in order to fulfill several objectives. Specifically, Ontario Power Generation reviewed prior operating experience from similar refurbishment projects and determined the need to retain overall control and responsibility for project management and design authority. The operational experience reviewed included specific lessons learned

¹² This EPC agreement differs from the Engineering, Procurement and Construction agreement employed by NB Power at Point Lepreau in that the agreement relates to only a single work package and includes a hybrid pricing structure.



from refurbishments at Point Lepreau, Bruce A and Wolsong; the restarts of Pickering A and Browns Ferry Unit 1; and the steam generator and reactor vessel head replacement at Fort Calhoun. In addition, consistent with the Ontario Procurement Directive to consider value for money, Ontario Power Generation considered the risk premium expected to be paid to a vendor relative to the actual risk transferred. As a result of these considerations, Ontario Power Generation specifically sought a commercial strategy that would allocate risk to the party with control over that risk, provide transparency of the vendor's expenses, reduce the total number of vendor interfaces to be managed, and integrate planning, design and construction of critical path activities.

D. CONCENTRIC'S OPINION ON THE RETUBE & FEEDER REPLACEMENT PROCUREMENT STRATEGY

We have concluded that Ontario Power Generation's Retube & Feeder Replacement procurement strategy is reasonable and prudent in the context of the Project and current market conditions for these services. While at the present time the general scope of the Retube & Feeder Replacement work package is known, the precise process, materials, and tooling required to complete the work will continue to be defined throughout the definition phase. The limited detailed definition of the technical scope necessitates a commercial strategy with sufficient flexibility to adapt to changes in the detailed scope during the definition phase of the Project.

Additionally, the Retube & Feeder Replacement work package is being proposed in a market that lacks sufficient depth to create adequate competition to support a fixed price agreement that meaningfully transfers the risk of price increases and schedule over-runs to a vendor. In this context, Concentric believes that a proposal for a fixed-price Retube & Feeder Replacement agreement is likely to include provisions for force majeure, excused performance, and a claims process for owner-directed changes or owner-caused delays that would allow the vendor to transfer much of the pricing, schedule and operability risk back to Ontario Power Generation. Otherwise, such an agreement is expected to contain a substantial financial risk premium.¹³ Similarly, given the recent and ongoing experiences at other CANDU refurbishments and recent statements by vendor executives, Concentric does not believe an acceptable fixed price for the entire Retube & Feeder Replacement scope of work is achievable in the current market.

In addition, Ontario Power Generation has recognized the need to supplement its internal resources to provide appropriate oversight of the Retube and Feeder Replacement work. This will be accomplished through a combination of Owner's Support Services vendors and other external expertise.

E. COMMERCIAL STRATEGY ALTERNATIVES CONSIDERED

Before selecting the hybrid EPC structure, Ontario Power Generation considered four alternative procurement strategies including self-performing the project, a design-bid-build model, a fixed price, lump sum turnkey agreement, and partnering.

The self-perform model would have allowed Ontario Power Generation to retain complete control over the project by directly employing and managing the resources required to complete the Retube & Feeder Replacement work package. This model would have required Ontario Power Generation to recruit, hire and

¹³ Prabhu, Aneesh, Swami Venkataraman, Richard W. Cortright, Jr. "Construction Costs To Soar for New US Nuclear Power Plants," *Standard and Poor's*, October 15, 2008.



train thousands of new employees exclusively for the Retube & Feeder Replacement work. As a result, this option was ultimately not considered a viable strategy given the high cost and the significant number of direct hire employees required to complete the project with this strategy.

The design-bid-build strategy would allow Ontario Power Generation and its design engineering vendor to define the Retube & Feeder Replacement scope of work and complete the detailed design before issuing a competitive solicitation for the execution phase work, potentially under a fixed or target price. That aspect of the design-bid-build strategy is similar to Ontario Power Generation's selected strategy. However, due to the lack of constructor involvement during the definition phase, the design produced under the design-bid-build model may not have been executable. This would ultimately lead to a risk of substantial rework to fix designs that could not be constructed. Additionally, the actual risk transferred to the construction vendor under a fixed price agreement may be less than expected despite the risk premium Ontario Power Generation would expect to pay for the price certainty.

Ontario Power Generation also considered seeking a fixed price, lump sum turnkey agreement for the Retube & Feeder Replacement work package in order to achieve greater price certainty and risk transfer. This model was deemed to be unavailable at a reasonable cost based on market feedback and recent experiences at Point Lepreau. In addition, Ontario Power Generation previously entered into fixed price, lump sum turnkey agreements, yet the Company's experience was that those agreements failed to achieve actual price and schedule certainty due to undefined and unknown scope. Thus, Ontario Power Generation rejected this model as failing to provide sufficient value for money.

As discussed previously, the partnering strategy was considered due to the anticipated ability to align Ontario Power Generation's interests with those of the vendor and its sub-vendors. The partnering model was rejected due to Ontario Power Generation's prior experience employing a similar model during the Pickering A Return to Service Project as documented by Ontario Power Generation in its operational experiences for that project. In addition, many vendors have rejected the partnering strategy due to the additional risk posed to each vendor by the partnering model.

F. STRATEGY EXECUTION

During 2010 and 2011, Ontario Power Generation began executing the Retube & Feeder Replacement commercial strategy. To do so, Ontario Power Generation initially conducted market outreach in spring 2010. This included the identification of seven vendors who could potentially execute the Retube & Feeder Replacement scope of work. From this information, Ontario Power Generation issued a request for expressions of interest to the seven potential vendors ("Proponents"). Ontario Power Generation received limited responses and proposed feedback on Ontario Power Generation's terms and conditions from four of the seven Proponents regarding the Retube & Feeder Replacement work package. Two of those Proponents later joined the teams of the remaining two Proponents as either consortium members or sub-vendors of the lead Proponent.

In March 2011, Ontario Power Generation issued a request for proposals ("RFP") to the remaining two Proponents: 1) a consortium consisting of B&W, GEH-C, and Black & MacDonald (the "B&W Consortium"); and 2) a consortium of SNC-Lavalin Nuclear Incorporated and AECON Industrial, a division of AECON Construction Group Incorporated (the "SNC/AECON Consortium"). A meeting with both Proponents was held following the issuance of the RFP and the Proponents were provided with an



opportunity to submit both confidential and non-confidential questions to Ontario Power Generation. The responses to the confidential questions were provided to the Proponent submitting the question while the responses to non-confidential questions were provided to both Proponents.

Responses to the RFP were received from both Proponents on June 26, 2011. Ontario Power Generation then conducted a confidential bid evaluation process in late June and July 2011. At that time, the bid evaluation teams classified both responses as alternative or non-conforming bids, and recommended Ontario Power Generation enter into negotiations with both Proponents due to the significant number of exceptions to the commercial terms noted by both Proponents.

Ontario Power Generation began meeting with the Proponents in July 2011 and agreed to “contract principles” with both parties in mid-August. Those high level principles expressed Ontario Power Generation’s fundamental requirements for the Retube & Feeder Replacement agreement. Ontario Power Generation continued negotiations with both Proponents in an effort to negotiate an acceptable commercial agreement with each Proponent (“Negotiated RFR Project Agreement”). Those negotiations were carried out in accordance with Ontario Power Generation’s Retube & Feeder Replacement Project RFP Submission Negotiation Plan (the “Negotiation Plan”).¹⁴ The Negotiation Plan established a Negotiation Team made up of Ontario Power Generation personnel and a member of Ontario Power Generation’s outside counsel, and was led by Ontario Power Generation’s Director, Commercial Strategy. This team was supported by the Negotiations Support Team consisting of several Ontario Power Generation staff members and Ontario Power Generation’s outside counsel. A Steering Committee provided oversight of the Negotiation Team’s activities throughout the negotiation period and consisted of several senior members of the Darlington Refurbishment Project team and Ontario Power Generation’s staff.

To evaluate the final Proponent submissions, Ontario Power Generation developed a detailed evaluation plan.¹⁵ This plan required the creation of an Evaluation Team to review the final Proponent submissions, an Executive Advisory Committee and commercial, financial, risk, project management, and technical support teams (“Functional Support Teams”). The Evaluation Team was responsible for scoring the Proponent submittals and called upon the Functional Support Teams for additional information or support. For strategic advice, the Evaluation Team could seek advice from the Executive Advisory Committee. Throughout the evaluation process, the Evaluation Team had access to the Process Advisor (external counsel) to ensure the evaluation process was conducted fairly and in compliance with applicable laws and regulations. The Executive Advisory Committee was permitted to request additional assistance from outside consultants on an as-needed basis.

In its request for final proposals, Ontario Power Generation required each Proponent to submit final pricing for the Negotiated RFR Project Agreements and option pricing for three additional scopes of work. Ontario Power Generation also encouraged each Proponent to provide two additional pricing submittals: 1) a Preferred Innovation Submission that described the fixed fee reduction a Proponent could offer if the Proponent’s fixed fee at risk was reduced from 90 percent to either 80 or 70 percent of the fixed fee that is at risk, and 2) an Innovation Submission that described a cost reduction in exchange for a specific exception or amendment to the terms of the Negotiated RFR Project Agreement (collectively, the “Alternative Pricing Submissions”). The Evaluation Team ultimately selected an Alternative Pricing Submission from the

¹⁴ Retube & Feeder Replacement Project RFP Submission Negotiation Plan, R0.

¹⁵ Retube and Feeder Replacement Project RFP Submission Evaluation Plan for Final Proposals, dated November 30, 2011.



SNC/AECON consortium. This Alternative Pricing Submission lowered the consortium's fee at risk in exchange for a reduction in pricing. Finally, the Evaluation Team and Executive Vice President, Nuclear Projects, provided a final recommendation to proceed with the preferred proposal on December 15, 2011. That recommendation was accepted by Ontario Power Generation, and Ontario Power Generation executed a final agreement with the SNC/AECON consortium on March 1, 2012.

Since the execution of the final agreement with SNC/AECON, four Project Change Directives ("PCD's") have been issued by Ontario Power Generation. The first PCD was for a change to the mock-ups scope based on a proposal by the contractor to reduce the cost of the mock-ups work. The second PCD was to award bulkhead and associated isolations work scope to SNC/AECON. The bulkhead and associated isolations work scope was an optional component of SNC/AECON's proposal, and the Company was exercising that option before it expired. Due to the size of this additional scope, Ontario Power Generation developed a separate contracting strategy for this work and evaluated alternatives using a Kepner-Tregoe decision analysis, among other assessments. The Company determined that awarding the bulkhead and associated isolations work to the Retube & Feeder Replacement contractor was appropriate given the critical path dependency of this work, the significant interaction that will be required between the bulkhead design/installation and Retube & Feeder Replacement teams, the fact that bringing this work under the Retube & Feeder Replacement contract would allow for a single point of contact and accountability, and the fact that a contract was already negotiated and executed with the Retube & Feeder Replacement contractor. The Project sought the approval of Ontario Power Generation's Chief Executive Officer, in accordance with the Company's Organizational Authority Register ("OAR").

The third PCD was for the engineering, procurement, and construction of the retube and waste processing building. This scope of work also was an optional component of SNC/AECON's proposal, and the Company was exercising that option before it expired. Similar to the bulkhead and associated isolations scope of work, the Company performed an analysis of its alternatives, including a Kepner-Tregoe decision analysis, and sought the requisite approvals in accordance with the OAR. The Company determined that awarding the retube and waste processing building work to the Retube & Feeder Replacement contractor was appropriate given dependencies between the waste reduction tooling work performed under the Retube & Feeder Replacement agreement and the retube and waste processing building, the single point of contact and accountability permitted under this proposed structure, and the fact that negotiating a new contract with a third party would not be required.

The fourth PCD was for additional inspections and testing related to the bulkhead and associated isolations work.

G. CONCENTRIC'S OPINION OF THE EXECUTION OF THE RETUBE & FEEDER REPLACEMENT COMMERCIAL STRATEGY

Concentric believes that Ontario Power Generation has reasonably and prudently executed the Retube & Feeder Replacement commercial strategy to date, including the development and implementation of its competitive solicitation process, pre-defined offer evaluation process, the retention of a capable Process Advisor for the competitive solicitation and a detailed negotiation process that first identified Ontario Power Generation's fundamental requirements, sought and obtained final agreements that complied with those requirements, and conducted a fair and reasonable evaluation of the Proponent Submissions. Ontario Power Generation's evaluation and selection process for the final Retube & Feeder Replacement offers was, in



Concentric's opinion, reasonable and prudent. In addition, in making modifications to the scope of work under the contract, the Company has been using a formalized and robust process to identify alternatives and seek necessary internal approvals.

VIII. CONCLUSIONS

Concentric was retained to review Ontario Power Generation's development and implementation of its commercial strategies for the Project. At a cost of \$6 to \$10 billion in 2009 dollars, excluding inflation and interest, and a duration of more than 18 years from the start of planning to the conclusion of commissioning and project closeout activities, the Project is clearly a major undertaking for Ontario Power Generation, and it is subject to financial, economic, regulatory, political, and execution risks. While effective commercial strategies are necessary to assist Ontario Power Generation in mitigating these risks, no commercial strategy can fully eliminate these risks.

To conduct our review of the Project's commercial strategies, Concentric undertook a detailed process to determine whether the strategies selected by the Darlington Refurbishment Project were reasonable, whether the strategies were executed in a reasonable manner and whether Ontario Power Generation's actions related to the selection and execution of those strategies meet the regulatory prudence standard. Our opinion of these strategies relies upon information provided by Ontario Power Generation in response to our data requests, in-person interviews, our independent research and Concentric's experience advising other megaproject sponsors. Overall, our review confirmed the reasonableness and prudence of Ontario Power Generation's selected procurement strategies.

PROGRAM MANAGEMENT SYSTEM STRUCTURE AND PROGRAM CHARTER

An important component of OPG's role as Program owner is its program management system. The system is a controlled document framework for the Darlington Refurbishment Program ("DRP") through which program objectives, plans, processes, roles, responsibilities and decision-making are documented.

The overall structure of the program management system is described in a program management document entitled *Darlington Refurbishment Program Structure* (NK38-NR-PLAN-09701-10001-0001), which is included in this Attachment 2. This document establishes the framework for the Darlington Refurbishment Program Management Plans, which are a series of documents that describe how the DRP is organized to meet the intent of OPG's Nuclear Management System, while also establishing program-specific requirements. The *Refurbishment Program Structure* establishes the following hierarchy of documents:

- Tier 1 - the *Darlington Refurbishment Program Charter* ("Program Charter"), which is also included in this Attachment 2;
- Tier 2 - the *Refurbishment Program Structure* document and the Program Management Plans; and
- Tier 3 - numerous manuals, guides, instructions, plans, constructor/owner interface requirements and forms.

Document Number: NK38-NR-PLAN-09701-10001	Usage Classification: N/A
Sheet Number: 0001	Revision: R001

Title:
DARLINGTON REFURBISHMENT PROGRAM STRUCTURE

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**Darlington Refurbishment Program
Structure**

NK38-NR-PLAN-09701-10001-0001-R001
2015-09-08

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Other Reference Number:

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Plan

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Revision Summary

Revision Number	Date	Comments
R001	2015-09-08	<p>Revised program framework. Updated Table 1 for latest PgMPs. Section 2.1, revised NR framework. Section 3.1, added accountabilities of VP, NR oversight. Section 4.1, added definitions.</p>
R000	2014-01-31	<p>This document supersedes NK38-PLAN-09701-10067 Sheet 0001. The changes between NK38-PLAN-09701-10067 Sheet 0001 and this document are as follows:</p> <ul style="list-style-type: none"> • The document number has been changed to meet the requirements of NK38-NR-MAN-09701-10001, • The security classification has been removed so that the document can be submitted to the CNSC, and • Figure 1 and Table 1 have been updated to reflect the current list of Program Management Plans. • References have been updated.

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Records Table

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

Record Created	Associated Form or Template Number	QA Record? Y/N	Filing Information/Retention (AIMS Type/Sub-Type)
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DARLINGTON REFURBISHMENT PROGRAM STRUCTURE

1.0 PURPOSE

The purpose of this document is to set the framework for the Darlington Refurbishment Program Management Plans (PgMPs) which describe how the Darlington Refurbishment Program meets the intent of OPG’s Nuclear Management System while establishing program-specific requirements.

Darlington Refurbishment Program Management Plans are designed to provide assurance that all aspects of the Program (e.g. engineering, procurement, construction, turnover, and program life cycle phases) will be conducted in accordance with the requirements of:

- Canadian Standards Association Standard N286-05, Management System Requirements for Nuclear Power Plants;
- Canadian Nuclear Safety Commission’s Regulatory Document RD-360, Life Extension of Nuclear Power Plants;
- N-CHAR-AS-0002, Nuclear Management System; and
- OPG Corporate and Nuclear governance.

Darlington Refurbishment Program Management Plans integrate requirements from other Management System standards for health, safety, environment, security, economics and quality and is defined to meet the principle that safety is the paramount consideration guiding all decisions and actions.

2.0 DIRECTION

Owners of Darlington Refurbishment PgMPs are to follow the minimum structure and content requirements specified in this document to ensure consistency across the entire suite of Darlington Refurbishment PgMPs.

2.1 Darlington Refurbishment Program Management Plans

Darlington Refurbishment Program Management Plans are accessible to all staff that have access to OPG’s Information Management System through Asset Suite. They can also be accessed through PowerSearch or on the Darlington Refurbishment SharePoint Team Site which are both linked to Asset Suite.

2.1.1 Darlington Refurbishment Program Framework

The hierarchy of Darlington Refurbishment Program documents is shown in Figure 1 below.

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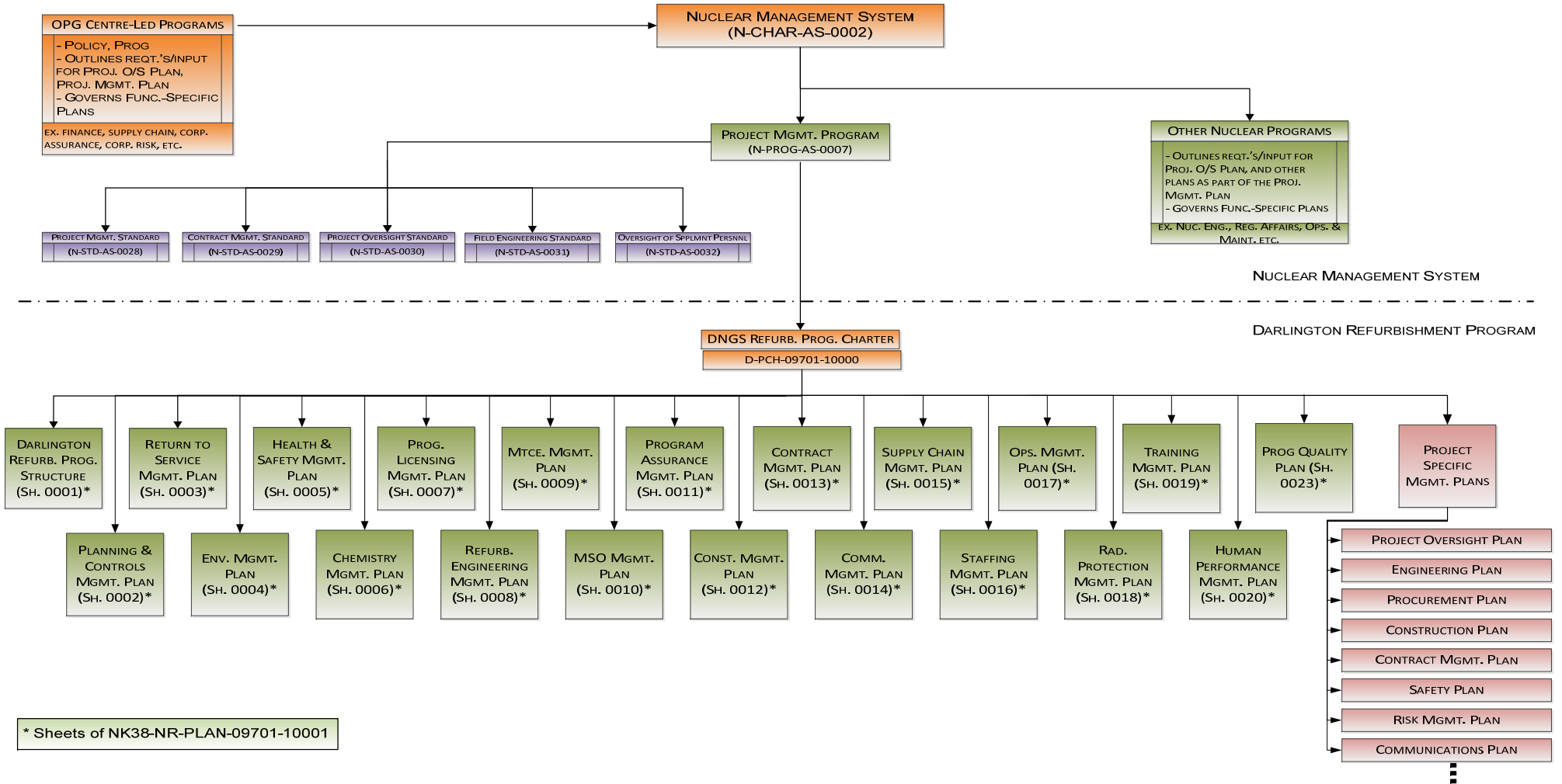


Figure 1: Darlington Refurbishment Program Framework



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As shown in the above figure, the top tier document of the Darlington Refurbishment Program is D-PCH-09701-10000, Darlington Refurbishment Project Charter. The 2nd tier documents consist of this document and the remaining PgMPs in the form of sheets to NK38-NR-PLAN-09701-10001. The 3rd tier documents (not shown in the framework) include documents such as Manuals, Guides, Instructions, Plans, Contractor/Owner Interface Requirements and Forms which are considered “Process Support Controlled Documents” as defined in NK38-MAN-09701-10006, “Nuclear Refurbishment - Requirements For Process Support Controlled Documents”.

The Darlington Refurbishment Program also makes extensive use of Corporate and Nuclear Line of Business management system documents where applicable.

2.1.2 Program Management Plans

The Darlington Refurbishment PgMPs stipulate function-specific requirements and processes for Darlington Refurbishment project execution.

The PgMPs are meant to convey how employees working within the Darlington Refurbishment Program will do their work while meeting the intent of the existing OPG Management System.

The structure and minimum content requirements for PgMPs are as follows:

Section 1.0, Purpose

- A clear and concise description of the fundamental intent or focus of the Program Management Plan.
- Limit rationale, background and process details.

Section 2.0, Program Requirements

This section is the most important section of the PgMP and should be considered a “roadmap” which conveys how employees working within the Darlington Refurbishment Program will meet the Program’s requirements.

- Identify and briefly describe any Nuclear, Corporate, or other business unit governance, governance support and non-governance documents that provide implementing details for requirements, activities and processes described by the PgMP.
- State requirements which have been mandated by Darlington Refurbishment Functions for Darlington Refurbishment Projects to follow as part of contract development and project execution.
- Include a figure illustrating the entire PgMP framework, including implementing and interfacing documents.
- Specify the performance indicators or monitoring activities that are necessary to ensure the overall PgMP requirements are met.

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Section 3.0, Roles & Accountabilities

- Identify and provide a high-level summary of accountabilities for Manager level (Stratum IV) or higher positions or roles concerning the accomplishment of activities related to the implementation of the document.
- Do not:
 - Duplicate actions, activities or tasks already covered by Section 2.0 of the PgMP.
 - Use personal names.

Section 4.0, Definitions & Acronyms

Definitions

- If there are no definitions, state “None”.
- Limit each definition to one or two sentences.
- Place definitions in alphabetical order.
- Do not define:
 - Generic terms if the dictionary definition conveys the meaning of a term.
 - Terms commonly used within the applicable business area.
 - Organizational positions or roles.

Acronyms

- If there are no acronyms, state “None”.
- List acronyms used within the document along with their expanded forms.
- Place acronyms in alphabetical order.

Section 5.0, References

- Only list those documents the user **needs** to use in conjunction with the PgMP.
- Identify each reference document number and title in alpha-numeric order. Do not include revision numbers.

2.1.3 Project Management Plans

Project Management Plans (PMPs) describe how a specific project will develop its scope and execute the work. When Darlington Refurbishment Project Teams are developing or revising their PMPs they will reference relevant sections from applicable PgMPs.

2.2 Darlington Refurbishment PgMPs and Owners

The following table summarizes the various Darlington Refurbishment PgMPs and their owners.

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Sheet	Title	Owner
0001	Darlington Refurbishment Program Structure	Director, Refurbishment MSO
0002	Planning And Controls PgMP	Director, Planning & Controls
0003	Return to Service PgMP	Director, Operations & Maintenance
0004	Environmental PgMP	Director, Operations & Maintenance
0005	Health and Safety PgMP	Director, Operations & Maintenance
0006	Chemistry PgMP	Director, Operations & Maintenance
0007	Licensing PgMP	Manager, Refurbishment Licensing Support
0008	Engineering PgMP	VP, Refurbishment Engineering
0009	Maintenance PgMP	Director, Operations & Maintenance
0010	Management System Oversight PgMP	Director, Management System Oversight
0011	Program Assurance PgMP	Director, Management System Oversight
0012	Construction PgMP	VP, Refurbishment Execution
0013	Contract Management PgMP	Director, Contract Management
0014	Communications PgMP	Director, Corporate Relations and Communications
0015	Supply Chain PgMP	Director, Supply Chain
0016	Staffing PgMP	Manager, Human Resources Nuclear Refurbishment
0017	Operations PgMP	Director, Operations & Maintenance
0018	Radiation Protection PgMP	Director, Operations & Maintenance
0019	Training PgMP	Director, Operations & Maintenance
0020	Human Performance PgMP	Director, Operations & Maintenance
0023	Quality PgMP	VP, Refurbishment Execution

Table 1: Darlington Refurbishment PgMPs (NK38-NR-PLAN-09701-10001)

3.0 ROLES AND ACCOUNTABILITIES

3.1 Director, Refurbishment Management System Oversight

Is the document owner and is accountable for its definition and implementation.

3.2 Darlington Refurbishment Function Teams

Are accountable for ensuring that PgMPs and subtier documents owned by the Function Team are in compliance with existing Management Systems and that any gaps are resolved to meet the needs of the Darlington Refurbishment Program.

3.3 Darlington Refurbishment Project Teams

Are accountable for the development and maintenance of project-specific Project Management Plans.

Are accountable for executing projects to PgMP requirements and for providing input to PgMP owners if any gaps or incompatibilities exist.

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4.0 DEFINITIONS AND ACRONYMS

4.1 Definitions

Program Management Plan The document that describes how function supports the Refurbishment Program with specific requirements that meet the intent of the Nuclear Management System.

Project Management Plan The document that describes how the project in Darlington Refurbishment Program will be planned, executed, monitored and controlled, and closed.

Function The matrix organization grouped by areas of specialization. The function is accountable for developing and maintaining functional excellence, setting standards, and providing required service to Darlington Refurbishment Program.

4.2 Acronyms

PgMP - Program Management Plan
PMP - Project Management Plan

5.0 REFERENCES

- [1] N-CHAR-AS-0002, Nuclear Management System
- [2] NK38-NR-PLAN-09701-10001 Sheets 1-23, Darlington Refurbishment Program Management Plans
- [3] NK38-MAN-09701-10006, Nuclear Refurbishment – Requirements for Process Support Controlled Documents

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DARLINGTON REFURBISHMENT CHARTER

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Darlington Refurbishment Charter**D-PCH-09701-10000-R003**
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Revision Summary

Revision Number	Date	Comments
R003	2016-01-26	Revised Governance Framework. Updated Org Structure. Incorporated DCR 0000132503000 Added Section 5.0, DRP Scope and Section 9.0 Contracting Strategy Revised Section 10.0 Schedule Minor other editorial changes throughout.
R002	2014-12-05	Contents of charter refreshed to reflect current status of program and to include a description of the Darlington Refurbishment Management System. The Security Classification has also been reduced from "OPG Confidential" to "Internal Use Only".
R001	2009-06-02	Revision changing direction of document to contain complete project This document contains 4 physical pages
R000	2008-06-19	First issue

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Records Table

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1.0 PURPOSE

The Purpose of the Darlington Refurbishment Program (DRP) Charter is to establish and communicate the expectations of the Senior Vice President (SVP), Nuclear Projects regarding the management of the Darlington Refurbishment Program (DRP).

The expectations of the SVP, Nuclear Projects are aligned with and expand on the Nuclear Management System established and communicated under OPG-POL-0032, Safe Operations Policy; N-POL-0001, Nuclear Safety Policy; and N-CHAR-AS-0002, Nuclear Management System.

This document, in conjunction with the referenced policies, programs, standards and other controlled documents, establishes the overall Management framework of the DRP that assures that all aspects of DRP work and activities are of the required quality throughout all phases of the DRP.

2.0 BACKGROUND

OPG’s nuclear facilities are ageing and there is a need to assess and make recommendations with respect to the feasibility of continuing to operate these stations beyond the current predicted end-of-service life dates. Current high confidence estimates, based on Darlington pressure tubes fitness for service, predict that the Darlington Nuclear Generating Station (DNNGS) reactors will reach the end of their current operating lives between 2018 and 2020 (based on 210,000 Effective Full Power Hours).

The Fuel Life Channel Extension has evaluated the ability to extend the end-of-service life dates by an additional three years (to 235,000 Effective Full Power Hours) allowing OPG to unlap the first unit refurbishment and commence the final unit’s refurbishment prior to the final unit reaching its extended end-of-service life.

The Plant Life Extension Project group was established in February 2006 to undertake feasibility studies for refurbishing and extending the life of the nuclear units at the Pickering and Darlington sites. The organization’s name was changed to Nuclear Generation Development in December 2006 and to Nuclear Refurbishment in November 2008.

OPG Senior Management, with approval by the Board of Directors and Shareholder, has tasked Nuclear Refurbishment (NR) with assessing the feasibility of refurbishing DNNGS to enable operations for an additional 30 years or more.

Due to the unique requirements associated with a refurbishment outage and the large scope of the project, it is recognized that additions and modifications to the normal Ontario Power Generation Nuclear (OPGN) processes are required to ensure that the refurbishment is completed in a safe, timely, economic manner and to the required quality expectations. NR will implement and follow appropriate processes to ensure successful completion of each phase of the project.

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3.0 SCOPE

This charter is applicable to all aspects of the NR business and includes the organizations and functions¹ involved in completing all program work associated with the refurbishment of the DNGS. The program management processes are applicable to all of the projects within the DRP and to all of the parties supporting and contributing to these projects. The process support documents² framework implemented within the Darlington Refurbishment Program is described in Appendix A, Darlington Refurbishment Program.

4.0 DIRECTION

SVP, Nuclear Projects – Expectations for the Darlington Refurbishment Program

As personnel within NR and organizations and functions¹ supporting the DRP, we have the responsibility to conduct ourselves in a manner which places safety, our core values, and effective business management at the forefront of our priorities. We clearly understand our roles and accountabilities and focus our efforts on providing results which meet or exceed expectations. Our strategic directions and business activities contribute to positioning our company to provide maximum value to the Province of Ontario while at the same time understanding that the safe, reliable, cost-effective generation of electricity must be the central focus of our operation.

Many of our responsibilities have a direct impact on the future of OPG’s nuclear line-of-business. The decisions we make and the manner in which the DRP is executed will be done such that all available options are evaluated in a business-like manner ensuring risks are clearly understood and appropriate management systems are established to ensure execution according to plan. This charter is applicable to the organization and functions involved in DRP.

The DRP will perform work in accordance with the managed systems defined in OPG-POL-0032, Safe Operations Policy, N-POL-0001, Nuclear Safety Policy, N-CHAR-AS-0002, Nuclear Management System and this charter.

Our mission is the successful refurbishment of Darlington Nuclear: Safely, On time, On budget, with 100% of scope completed, and to the quality expected within a Nuclear station.

The Director, Management System Oversight is responsible for interpreting the requirements of this Charter and its sub-tier documents.

SVP, Nuclear Projects

¹ OPG has adopted a matrix organization design with centre-led functions supporting operating business units. The *centre-led functions* are generally accountable for developing and maintaining functional excellence, setting standards, and providing cross-company services. Please refer to OPG-POL-0033, OPG Business Model, which lists all the operating units and functions.

² For a definition of “process support documents” refer to NK38-MAN-09701-10006.

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4.1 Program Deliverables

The NR organization has been established with the responsibility of assessing and making recommendations with respect to the feasibility of refurbishment and continuing to operate the nuclear generating stations beyond the current predicted end of life and executing all activities associated with refurbishment.

For DNGS, NR will undertake the DRP, in phases as authorized by OPG Management, the OPG Board of Directors, and the Shareholders to:

- Assess the feasibility of refurbishing Darlington and operating it for an additional 30 years or more,
- Fully define refurbishment scope,
- Execute front-end planning including cost and schedule development and a full risk assessment,
- Manage the pre-outage planning and preparation activities for the refurbishment outage,
- Execute the refurbishment outage(s),
- Return the refurbished nuclear unit(s) to Nuclear Operations, and
- Manage refurbishment closeout.

4.2 DRP Objectives

The principal objective of the DRP is to:

- Confirm the business case for the refurbishment of DNGS,
- Obtain the approvals for the business case, and
- Plan and execute the refurbishment in order to enable continued operations of DNGS for an additional 30 years or more

Subsidiary objectives needed to ensure the principal objective is achieved are as follows:

- Obtain the necessary corporate, government and regulatory approvals (e.g., Environmental Assessments, Integrated Safety Review, and Integrated Improvement Plan) for refurbishment in a timely and cost effective manner.
- Establish regulatory certainty, to the degree possible, for the refurbishment program and subsequently bound the uncertainty prior to submitting the recommendation to the OPG Board.
- Complete timely and comprehensive technical studies and a plant condition assessment to determine the appropriate refurbishment scope.

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- Implement appropriate contract and procurement strategies to execute the work and obtain all required materials in advance of the refurbishment outage.
- Implement appropriate processes for each phase of work for the refurbishment program.
- Complete engineering and detailed refurbishment outage planning in order to finalize the refurbishment program scope, cost, and schedule.
- Form the DRP team that will manage the execution of the DNGS units' refurbishment.
- Execute the refurbishment outage in a managed and controlled fashion that results in meeting the safety, quality, cost and schedule projections.
- Provide adequate and accurate information to all OPG Management, the Board of Directors, and the Shareholder, in order to obtain the phased based funding for the refurbishment program.

5.0 DRP SCOPE

During the Refurbishment phase, major components in each reactor will be inspected, serviced, and replaced. The key refurbishment activities will include:

- Pressure tube, calandria tube, and feeder replacement
- Steam Generator inspection, maintenance, and cleaning
- Turbine Generator refurbishment including replacement of the control system
- Valve Rehabilitation/replacement
- Flux Detector and Adjuster Rod Replacement
- Auxiliary Shutdown Heat sink Upgrades
- Electrical System Rehabilitation
- Safety improvement upgrades including installation of an third Emergency Power Generator, a Containment Filtered Venting System, and a Powerhouse Steam venting system.
- Upgrades to existing site infrastructure to support the refurbishment activities.

A Program Scope Review Board with supporting governance was put in place to approve the scope of the DRP. The technical scope for the DRP was initially confirmed in May 2012. Since that time, as a result of engineering studies and analysis, results of planned inspections, and completion of regulatory submittals including the Integrated Safety Review (ISR) and the Environmental Assessment (EA), scope has been finalized.

A Change Control Board with supporting governance has been established to manage the cost, schedule, and scope changes. If there is significant new or changed scope, approval will be required through the PSRB.

The project scope includes four phases and is subdivided into five main execution bundles. The four phases includes lead in, removal, inspection & installation and lead out. The five bundles

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include Retube & Feeder Replacement, Steam Generators, Turbine Generators, Fuel Handling and Balance of Plant³. There are number of Facilities & Infrastructure and Safety Improvement Opportunity projects which are being executed as pre-requisites to the refurbishment scope.

6.0 DRP PROGRAM MANAGEMENT PROCESSES

As a Canadian nuclear operator, OPG is regulated by the Nuclear Safety and Control Act and Regulations through the Canadian Nuclear Safety Commission (CNSC) which issues OPG a Power Reactor Operating Licence (PROL). One of the conditions in the PROL is for OPG to meet the requirements of Canadian Standards Association (CSA) N286, Management System Requirements for Nuclear Power Plants, in managing all aspects of nuclear activities. The DRP will perform work in accordance with this charter which is developed following the principles of N-POL-0001, Nuclear Safety Policy and N-CHAR-AS-0002, Nuclear Management System, and meets the requirements of CSA N286.

N-PROG-AS-0007, Project Management, and its associated implementing standards, provide the principles and requirements for planning, organizing, executing, and controlling resources to ensure safe and effective execution and completion of projects. Safety and quality shall be the overriding priority and will not be compromised for cost or schedule.

The DRP also takes into consideration the CNSC's Regulatory Document, RD-360, Life Extension of Nuclear Power Plants, providing guidance on requirements for refurbishments and the need for the licensee to prepare a Project Execution Plan (PEP). Similarly, N-STD-AS-0028, Project Management Standard, also requires a Project Management Plan be prepared.

The DRP charter supporting processes to execute the refurbishment program activities for DNGS were developed utilizing the Project Management Institute's (PMI) Program Management format. This consists of a suite of Program Management Plans (PgMPs), as described in Section 5.1, and Project Management Plans (PMPs), as described in Section 5.2. This suite of PgMPs and PMPs are equivalent to the PEP.

The DRP charter supporting processes and their link to the N-CHAR-AS-0002, Nuclear Management System is shown in Appendix A.

6.1 Program Management Plans (PgMPs)

PgMPs describe the high-level processes that will deliver the program benefits (these are business level requirements including strategies for management, oversight, and execution, not technical design requirements) and they take their authority from this program charter.

The purpose of the PgMP is to:

³ Balance of Plant is managed as 4 sub-bundles: Shutdown and Layup, Refurbishment Support Facilities, Unit Islanding, and Balance of Plant Refurbishment which includes valves, electrical upgrades, etc.

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- Ensure that all key issues relevant to the successful execution of the Program are identified, defined and understood at the earliest possible stage.
- Provide the DRP team members, end users, line authority and stakeholders with a common understanding of the program and the planned method of execution.
- Provide a reference to OPGN governance and refurbishment specific process support controlled documents for the DRP.

The level of detail in the PgMPs is consistent with each phase of the Project, based on the time frame. The documents will initially focus on the definition and preliminary planning phases and provide fewer details around the later phases. In addition to the items above, the PgMPs provide:

- Direction on project controls.
- Direction on managing risk.
- Direction on document management processes that are not included in governing documents.

PgMPs are intended to be living documents. They will be reviewed and updated as necessary during the definition and execution phases of the DRP, nominally every 12 months.

Each PgMP is assigned to a functional owner who is responsible for developing and maintaining their PgMP in consultation with the Director of Management System Oversight.

The PgMPs are all listed as individual sheets under NK38-NR-PLAN-09701-10001 and available through Asset Suite.

Additional PgMPs or related documents (e.g. commissioning plan), including those that may be required per the CNSC’s Regulatory Document – RD360, may be added to the suite of documents at any time during program execution.

6.2 Project Management Plans (PMPs)

The PMPs describe how a specific project (or bundle) in the DRP will develop and execute its work scope and how it will operationalize the program processes to deliver a successful project (these are business level requirements, not technical design requirements).

Note: Where a project will follow a Program process exactly as written, it is sufficient to confirm and reference the Program document in the Project Management Plan.

The DRP has organized the identified and approved scope into projects or project bundles for the purposes of initiating the work and providing staff to execute the initial conceptual planning. As planning progressed, projects and/or project bundles were merged and/or shifted into different project bundles as per N-MAN-00120-10001-SCH-04, Nuclear Refurbishment Program Work Breakdown Structure Guide.

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Each project, within the ‘bundle’ will have a PMP developed as per N-MAN-00120-10001-GRB, Nuclear Projects - Gated Process.

7.0 DRP RESOURCING

The SVP, Nuclear Refurbishment with support from the SVP, Darlington Nuclear Generating Station will establish the organization and resources necessary for successful completion of the DRP. Internal resources, complemented by externally available expertise will be used to execute the scope of work.

8.0 DRP FUNDING

During the initiation phase of the DRP, the funding, which was from the OM&A stream, was obtained and managed through the OPG business planning process.

After successful completion of the initiation phase and following the OPG Board of Directors approval of the DRP, a capital project has been created and funding will be requested and released in phases based on successful completion of key work programs and program milestones in accordance with an approved release strategy that is documented in the DRP’s Business Case.

In the definition phase, OPG developed a detailed cost estimate (budget) for all of the work associated with Darlington’s refurbishment. This was approved by OPG’s Board of Directors in November 2015 and forms the overall control budget for which cost performance will be measured.

9.0 DRP CONTRACTING STRATEGY

The DRP is a multi-phase project made up of individual projects of various sizes. As part of the Definition Phase, OPG developed an overall commercial strategy (the “Commercial Strategy”) and separate contracting strategies for all major project work packages, taking into account factors such as the nature and scope of the work, the vendor marketplace, and any potential long term commercial arrangements. Each contracting strategy results in a recommendation on the most suitable sourcing approach, contract structure and pricing mechanism for that specific work package.

The Commercial Strategy sets out an overall commercial framework with guiding principles for establishing and maintaining commercial relationships with third parties to support the DRP. The Commercial Strategy is a multi-prime contractor model in which there is more than one prime contractor working on the DRP. The owner has a separate contract with each prime contractor. Each prime contractor is responsible for the completion of the work under its particular contract, but not for the entire DRP. The owner is the integrator between the prime contractors and is responsible for the entire DRP. Under this model OPG retains project management responsibility and design authority for the DRP.

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To execute the work, OPG retains a number of contractors who are responsible for major project work packages. To guide OPG in project oversight and contracting activities, OPG has engaged external technical and project management experts to assist with the overall project management. The benefits of this model are that OPG retains control over the entire DRP, including the deliverables, costs and schedule. Retaining control by OPG is important given the scale, technical complexity and integrated nature of the DRP. OPG will also be able to assign risks to the party that is best able to manage the risk and mitigate its impact on the DRP. This will provide OPG with a better balance between the transfer of risk and the costs of the contractor services.

10.0 DRP SCHEDULE

Refurbishment timing is developed as part of the DRP definition and front end planning process and based on the following elements:

- Risk/uncertainty in technical life limits for major components,
- Lead time for obtaining regulatory certainty and acquiring tooling and materials necessary for the refurbishment,
- Value of energy and capacity and impact on OPG’s revenue, market share, and sustainability, and
- Industry capability to execute the refurbishment, given timing of other refurbishments or new nuclear projects and taking into consideration effective risk management strategies.

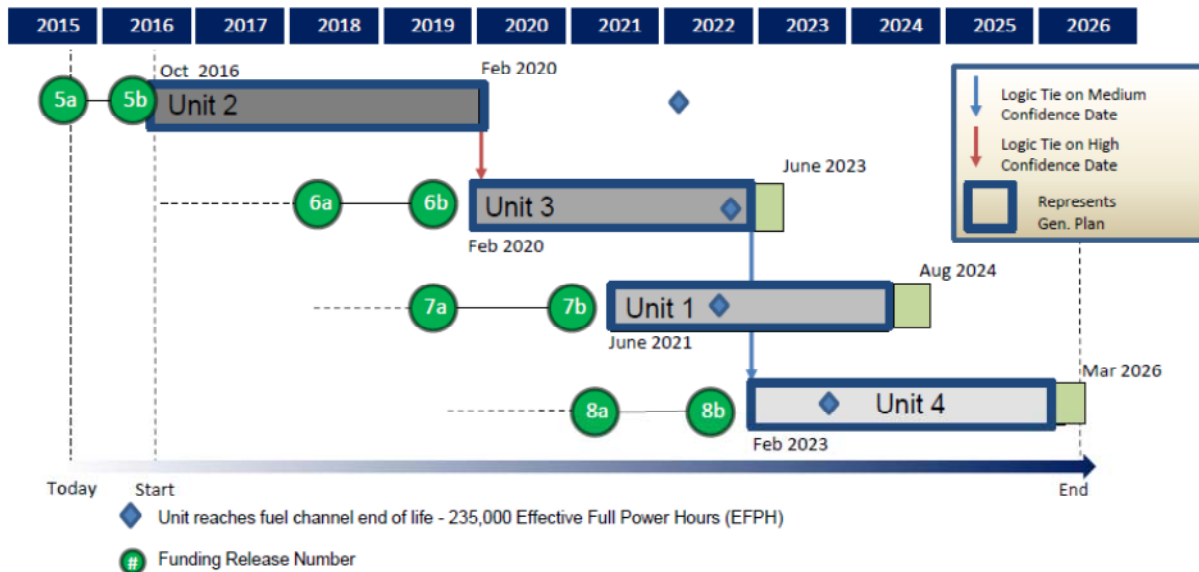
As part of Definition Phase, OPG has integrated all vendor schedules, determined the critical path for the project and created a schedule that covers all four units. OPG evaluated risks for each segment of the schedule, determined the amount of contingency required to deliver the project, and produced a high confidence schedule. The high confidence duration for each unit outage is 37 to 40 months. The schedule begins with the Darlington Unit 2 outage in October 2016. Unit 2 is expected to be substantially complete before the Unit 3 start to allow effective lessons learned implementation. It will take up to 113 months to complete refurbishment of all four reactors. Based on the current assumptions that each of the Darlington units will operate to 235,000 Effective Full Power Hours (EFPH), this schedule results in no idle time on operating units.

OPG has established a release strategy that provides opportunities to review project performance prior to allowing the project to proceed to the next phase. Funding will be released on a unit by unit basis in accordance with the release strategy shown, this is also aligned to the principles outlined in the December 2013 Ministry of Energy’s Long Term Energy Plan (LTEP).

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This schedule was accepted by OPG’s Board of Director’s in November 2015 and the Execution phase of the project was formally launched in January 2016. This high confidence schedule, which includes contingency, assumes the first unit outage will commence in October 2016 with each unit lasting 37 to 40 months. The release strategy is also defined, with a unit specific release for assessing and readiness work followed by a request for full release of funds to execute the outage work. For Generation planning, OPG assumed the high confidence 40 month schedule for the first unit and the medium confidence schedule for the subsequent units.

11.0 DRP ASSUMPTIONS AND RISKS

A formal Risk Management process has been implemented for the DRP. Risks are actively identified and managed, and reported on a routine basis. All key assumptions are also managed in a central database and form the basis of planning as well as risk management.

Key risks within the program include:

Cost and scheduling related Risks - There is a risk to the costs and timelines for refurbishment due to other nuclear projects that may be occurring simultaneously i.e. other major CANDU projects in Canada.

Resource Risk – There is a risk is that labour may not be available at the time of the DRP due to the other potential nuclear programs taking place in the same time frame.

Lessons Learned – Operating Experience from other mega projects and lessons learned from the Pickering Refurbishment planning activities should be factored into the planning of the DRP.

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12.0 ROLES AND ACCOUNTABILITIES

SVP, Nuclear Projects approves this Refurbishment Program Charter and acts as the DRP Sponsor at the corporate level. The SVP, Nuclear Projects and the associated leadership team is responsible for developing the program scope, obtaining regulatory certainty, developing the program estimates and obtaining program approval and phase based releases of funds, and establishing the refurbishment program organization to plan and execute the DRP.

SVP, Refurbishment Execution is accountable for the execution of the refurbishment outages in accordance with this Charter.

SVP, Darlington Nuclear Generating Station is responsible for the life cycle of the facility and is, therefore, a vital partner for the input and confirmation of the adequacy of the proposed refurbishment program. The SVP, Darlington Nuclear Generating Station, is responsible for planning the scope and schedule for shutdown or continued operation of the Darlington units.

The Chief Nuclear Engineer is responsible for the life cycle of the Steam Generators, Feeders, Fuel Channels, and Reactor Components and determines the Predicted End of Service Life dates. This is the critical input for confirming the adequacy of the refurbishment program and continued operation scope and schedule for these components.

Design Authority

- (a) Design Authority for the Refurbishment Program resides with the Director, Refurbishment Engineering in accordance with N-STD-MP-0024, Engineering and Design Authority.
- (b) Design Authority for the Darlington Waste Management Facility, where waste from refurbishment may be stored as well as on-going dry storage of used fuel, resides with the Manager, Nuclear Waste Engineering and Design Authority, Nuclear Waste Management Division in accordance with N-STD-MP-0024, Engineering and Design Authority.

Nuclear Refurbishment - Organization Structure

See Appendix B for the current NR organizational structure. This organizational chart provides a high level overview of the NR organization and also identifies the key functions and roles that provide direct service or support to the Refurbishment Program. All associated role documents are documented in the series N-MAN-08131-10000.

13.0 GLOSSARY OF TERMS

CNSC	Canadian Nuclear Safety Commission
DNGS	Darlington Nuclear Generating Station
DRP	Darlington Refurbishment Program
EA	Environmental Assessment
ISR	Integrated Safety Review

Charter

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- NR** Nuclear Refurbishment
- OPG** Ontario Power Generation
- OPGN** Ontario Power Generation Nuclear
- PgMP** Program Management Plan
- PMP** Project Management Plan
- PSRB** Program Scope Review Board
- SVP** Senior Vice President

14.0 DEFINITIONS

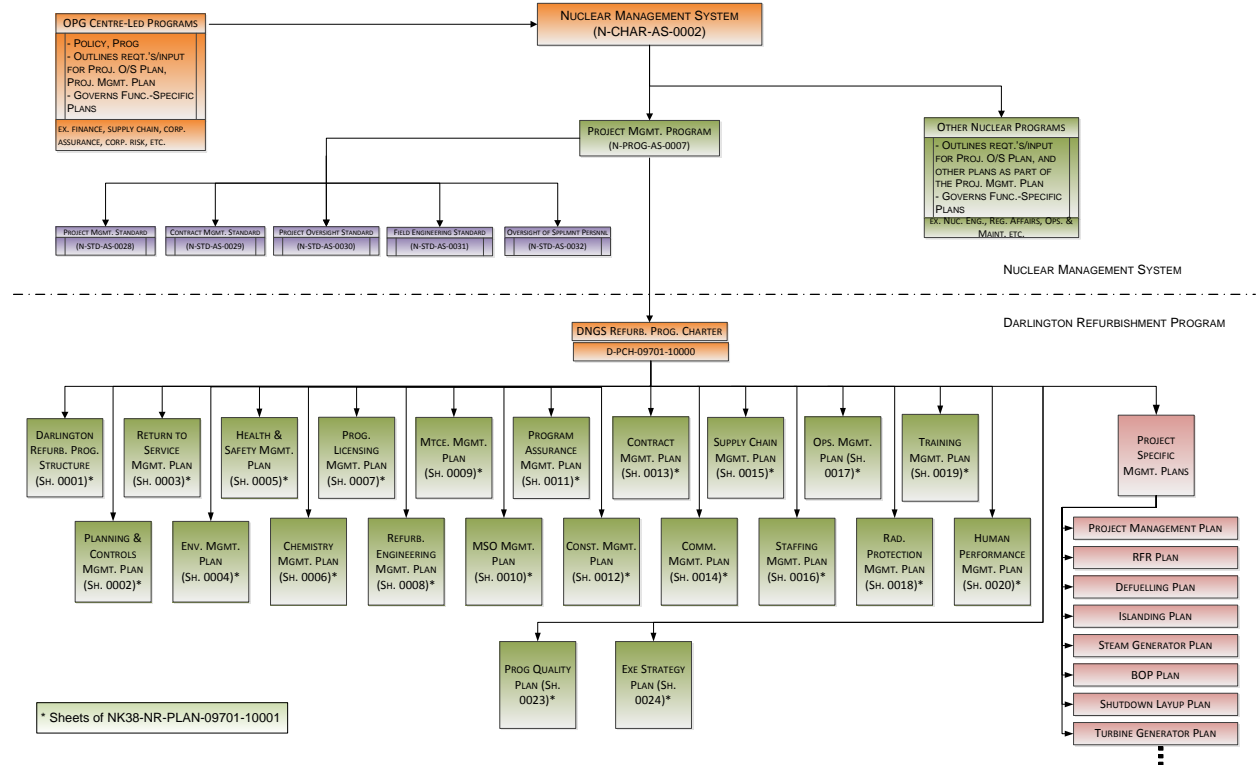
Program: The Darlington Refurbishment activities are being managed, consistent with Project Management Institute (PMI) practices, as a program. A program is a group of related projects and program activities that are managed in a coordinated way to obtain program level benefits not achievable individually; i.e. for Refurbishment to be successful, all of the related projects must be successful.

Project: A project refers to a set of scope(s) of work or temporary endeavour being performed within the overall Darlington Refurbishment Program. The Project, also referred to as a Project Bundle, may include multiple EPC contracts plus OPG Oversight and Integration Work in order to achieve DRP results or to deliver the required service. Examples include the Re-tube and Feeder Replacement Project and the Steam Generator Refurbishment Project.

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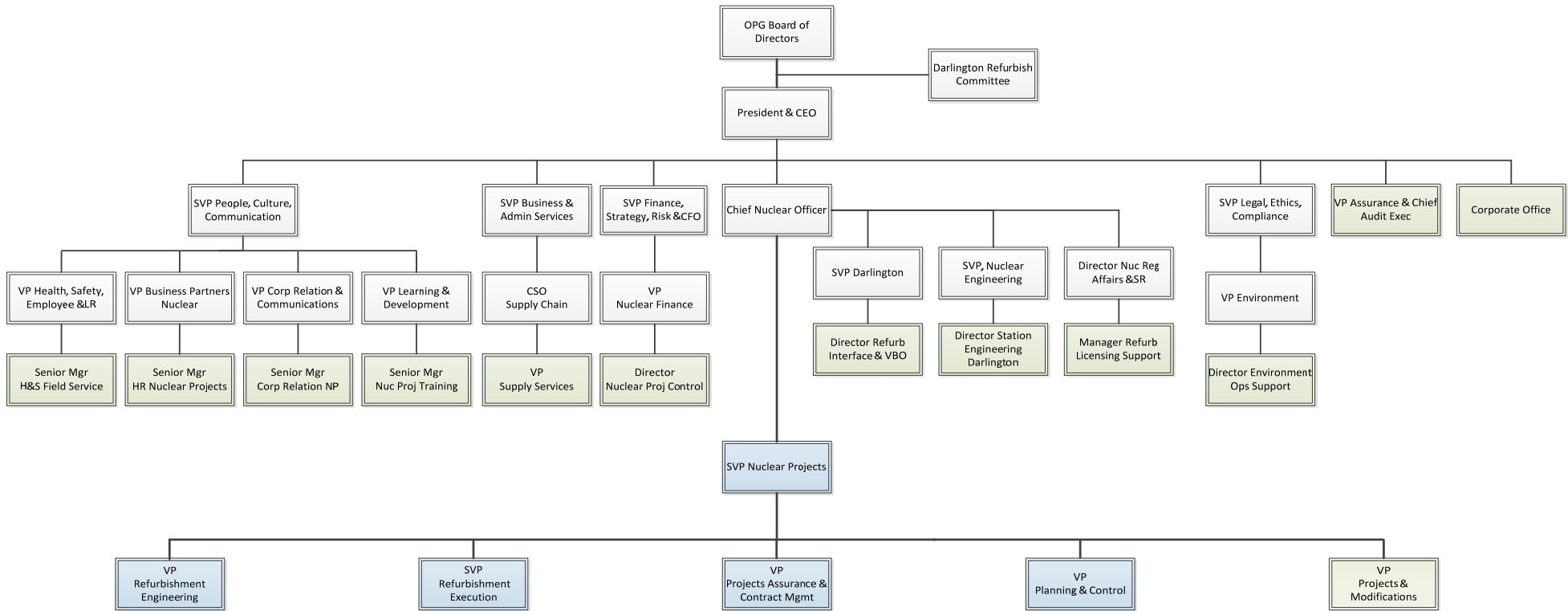
Appendix A: Darlington Refurbishment Program Framework



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DARLINGTON REFURBISHMENT CHARTER

Appendix B: Nuclear Refurbishment Organizational Structure



Legend:

- Nuclear Refurbishment
- Support to Nuclear Refurbishment

This chart provides a high level overview of the Refurbishment organizations and key functions and roles that provide direct service/support to the NR Program. Please refer to OPG Org chart for the latest information.