# NUCLEAR REFURBISHMENT ENGINEERING

by Gregg McCabe, NR Engineering Director.

## BEHAVIOURS

- Say It, Do It
- Simplify It
- Think Top and Bottom Line




VALUES ▪ SAFETY ▪ INTEGRITY ▪ EXCELLENCE ▪ PEOPLE & CITIZENSHIP ▪

PEOPLE POWERING THE FUTURE
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# NR Engineering

- Refurbishment Engineering is organized much like the Station
- VP Engineer has overall Engineer Authority
- Five sections support all aspect of Engineering
- Design Engineering focuses on NR Core and Campus plan modifications
- System and Components focuses on execution and system health monitors
- Nuclear Safety supports all departments
- Quality Engineering supports all departments

# NR Engineering Lessons Learned

| Lesson | Action Taken |
|---|---|
| Clear scope established for modification and maintenance work | Initial scoping from Darlington staff, Scope Review process established including Station / Project approval |
| Modifications completed well in advance of execution | Milestones established for completion of detailed design |
| Simple Field Change process | OPG Field Initiated Change (FIC) process remodeled as a form to streamline processing |
| Vendor knowledge of OPG process | Resident Engineers established to assist vendors with OPG process and provide guidance on process |
| Vendor knowledge of Darlington | Collaborative review process established to allow for shared Station knowledge and external expertise |
| Clear Execution instructions in Nuclear Environment | Collaboration with Vendors to ensure clear quality work instructions (CWP / work plans) for execution phase |
| Issue & Risk Management | Issues identified recorded and tracked with clear proof of completion, risks documented and tracked |
| Field Support | Transition of Resident Engineers from Design phase to field execution support (I/P) |

# NR Engineering

- Design focuses on the quality of design products
  - Lead by Refurbishment Design Authority
  - 4 Managers to support each aspect of a mega project, core, campus plan, RFR and Field services
  - All activities are per OPG Engineering Change Control governance
  - Gated Project process divides the work into distinct phases with financial and schedule steps
  - Develops and issues requirements for the design process
  - Work collaboratively with EPC Vendors during detailed design
  - Reviewed final design against the requirements
  - Compliant products are accepted and released for construction
  - Produces new stand alone designs within OPG QA program
  - Support execution activities with field engineers

# NR Engineering

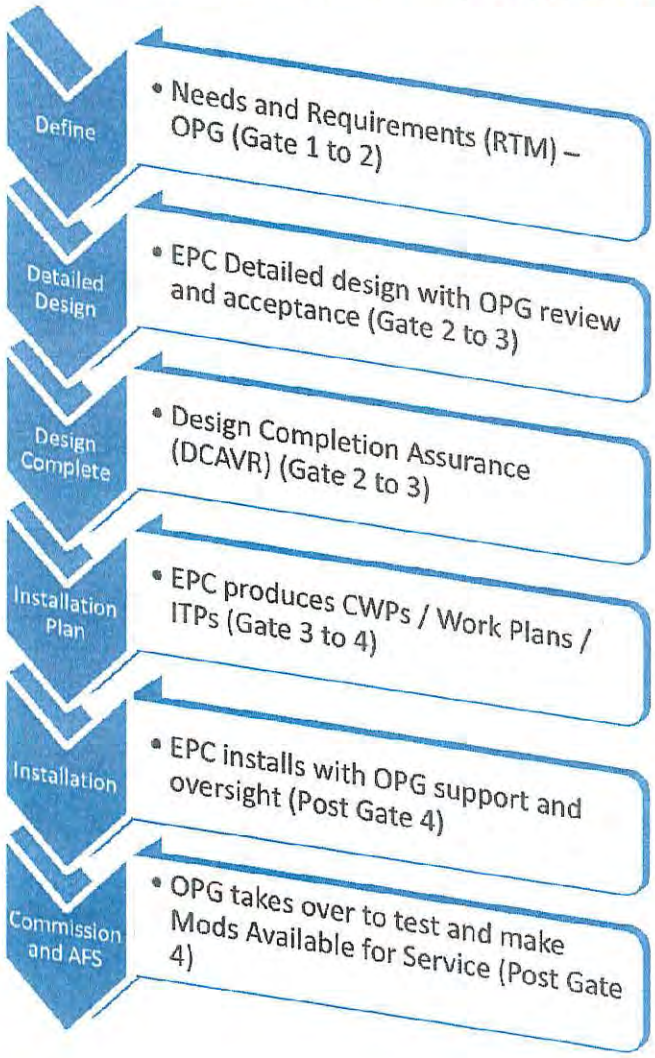
- System and Components focuses on execution and system health
  - Lead by Senior Manager Plant Reliability
  - 4 managers support project activities, Nuclear and Conventional systems, components and Commissioning / Return to Service
  - Complete system and component health program activities
  - Work collaboratively with EPC Vendors for field execution packages
  - Reviews vendor produced Comprehensive Work Packages (CWPs) and installation Work Plans
  - Compliant products are accepted and released for use
  - Produce modification and system commissioning work plans
  - Integrate with NR operations for modification and system commissioning
  - Develop System and Unit Return to Service plans

# NR Engineering

- Nuclear Safety focuses on
  - Lead by Manager Nuclear Safety
  - Provides support for NR Design and S&C for Vendor product review
  - Develops Nuclear Safety requirements for modifications
  - Work collaboratively with EPC vendors on Safety analysis issues
  - Provides input for Refurbishment unit PARA
- Quality Engineering
  - Lead by Manager Quality Engineering
  - Provide support to all NR Engineering Departments to drive quality improvements
  - Work collaboratively with EPC Vendors on training and qualification issues
  - Perform surveillance activities of Engineering Products
  - Monito and report on IIP progress
  - Provides governance support

# Program Overview

- Project Initiation - Complete
  - Defines what is required, codes and standards to follow, expected results Requirements Traceability Matrix
- Detailed Design progressed - Complete
  - EPC vendor produces the design, OPG completes a review and acceptance
- Design Completion Assurance
  - Design Authority inspects and authorizes the design.
- Installation plan – In progress
  - EPC produces Comprehensive Work Packages, Work Plans and inspection and Test plans
  - OPG reviews and accepts
- Installation – In Progress
  - Carried out by EPC
  - Supported by OPG Field Services Engineering & System Engineering
  - Monitored for compliance to safety and quality
- Commissioning and AFS – In progress
  - Completed by OPG staff, tests and turns over modifications to Operations



# Current Status

- Detailed Design has been completed as per the RP130 Milestone
- Design work exempted at that time continues to be completed
- Installation planning is in progress with regular collaborative review of Comprehensive Work Packages, Work Plans and Inspection and Test Plans.
- Field Services Engineering during installation has been planned and is being tested during the Pre-Requisite Phase.
- Detailed Commissioning Planning is in progress. This work will be completed by OPG staff.
- Scope Review progresses as Darlington identifies new or changed issues from the System Health reviews

# Current Status

- New scope is reviewed and processed following the same rigor as successfully used during the definition phase. In this case, the production of the Detailed Designs has been by OPG and EPC.
- CWP and Work Plan review continues as per the OP 2070 milestone recovery plan.

# CHANGES TO SYSTEMS, STRUCTURES, COMPONENTS, SOFTWARE AND ENGINEERED TOOLS

# Design Basis and Safe Operation

To ensure a safe and reliable operation, a Nuclear Power Plant must be operated and maintained within the Design Basis.

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

Design Basis is reflected in any combination of criteria, codes, standards, and specifications.

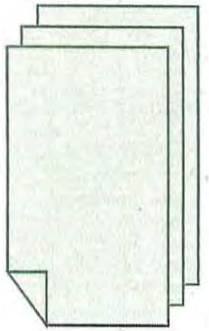
# Design Basis and Safe Operation

However, there are many things that may challenge the Design Basis, such as:

- Aging and degradation of materials
- Incorrect or inferior replacement parts
- Non-conservative operational decisions
- Lack of maintenance
- Human performance error
- Legacy issues
- Modifications
- Lack of configuration management

# Engineering Change Control (ECC)

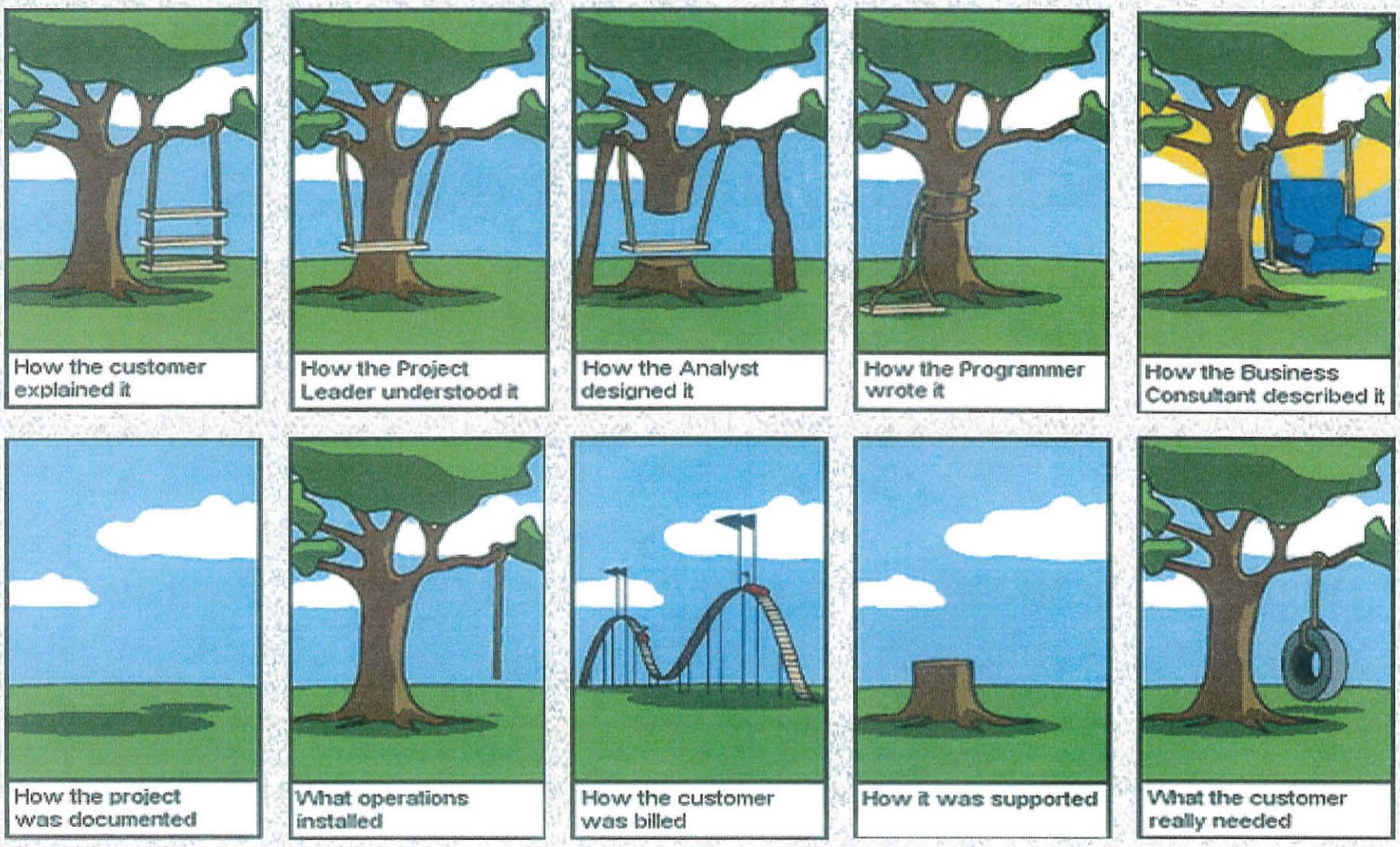
In order to facilitate these challenges, changes to the Systems, Structures, Components, Software and Engineered Tools must follow a rigorous, systematic, and documented process.



The process ensures that Modifications:

- Do not challenge the Operators or Maintainers
- Are of consistent and reliable quality
- Address nuclear and conventional safety concerns
- Provide documentation trail to show due diligence
- Maintain configuration management
- Follow an auditable QA process which meets our regulatory commitments

# Without an ECC Process, here's how a Change to SSC, Software, or Engineered Tool may go



# How Do We Control Changes at OPGN?

So, what high level OPGN document mandates the need of controlling the scope, review, approval and implementation of changes, including modifications?

**OP&Ps (Operating Policies and Principles)**

OPP is the agreement document between OPGN and CNSC, and it mandates Change Control.

# Engineering Change Control (ECC)

To implement this mandate, the modification process is governed by *N-PROG-MP-0001* "Engineering Change Control" and it is implemented through the application of:

- *N-PROC-MP-0090* "Modification Process"
- *N-GUID-00700-10000* "Guide To Modification Process"

# Modification

## Modification

- A Modification is any change to a controlled plant system, structure, component, software, or engineered tool, or a change to a controlled design document, which affects or alters the design, function, or method of performing the function.
- Modifications include removal, abandonment, or retirement of already installed equipment.

# Modification

## Modification

In short, it is a change to the Design Basis of an SSC, Software, or Engineered Tool.

Notes:

- A modification may be permanent (MOD) or temporary (TMOD)
- After implementing a TMOD, the SSC, Software or Engineered Tool must be returned to its original configuration or it must be converted to a permanent MOD (more of this in Module 2)

# Exemptions from Modification Process

Besides all the changes we have talked so far, i.e., Modification (permanent and temporary), Like For Like, Item Equivalency, and NICR, there are two more categories of changes mentioned in *N-PROC-MP-0090* "Modification Process".

These two changes are exempt from the Modification Process (both are governed and tracked by *N-PROC-OP-0027* "Temporary Change Records"), namely:

- Temporary Alterations
- Emergency TMODS

# Temporary Alterations

1 2 3 4

**Operations configuration manipulations within design requirements and parameters required for operation executed in conformance with applicable technical procedures for status control.**

Example: Changing the duty pump as per approved Operating Procedures.

# Temporary Alterations

1 | **2** | 3 | 4

**Recurring Temporary Alterations (RTA) installed and removed by approved facility procedure that have been prepared in accordance with N-PROC-AS-0028, Development, Review, and Approval of Technical Procedures, (including formal engineering review) and supported by permanent design documents or Design Authority (DA) approval as applicable.**

Example: repeated installation and removal of previously designed temporary water supply for flushing a system if the regular supply is not available.

# Temporary Alterations

1 2 **3** 4

**Temporary alterations installed to perform maintenance, testing, or troubleshooting on a specific SSC that is out of service and de-energized in accordance with N-PROC-MA-0012, Work Protection. The temporary alteration shall be removed before the SSC is re-energized or returned to service.**

Example: Removing and dismantling a pump from a shut down and de-energized system for maintenance. Then rebuilding and reinstalling the pump back to the system before returning the system back to service.

# Temporary Alterations

1 2 3 4

**The Design Authority (DA) may deem a temporary change to be a "temporary alteration," exempting it from the modification process. Certain conditions must be met:**

- **Adequate engineering controls are implemented.**
- **Facility Operating Policies and Principles should be consulted to determine if Director of Operations and Maintenance (DOM) approval is required.**
- **The Chief Nuclear Engineer (CNE) shall be included on the written approval distribution list each time a DA invokes this exception.**

Example: Due to lack of surveillance instrumentations in the original design of Pickering A Reactors, the DA may give permission to install temporary surveillance instrumentations as Temporary Alterations.

# Emergency TMOD

## Emergency TMOD

- Emergency TMOD is a temporary modification performed without the formal station engineering reviews required by the modification process.
- It is another exemption to *N-PROC-MP-0090* "*Modification Process.*"
- Emergency TMOD is governed and tracked by, *N-PROC-OP-0027* "*Temporary Change Records.*"

# Emergency TMOD

1 2

In a case of an emergency situation that threatens public or employee safety and for which there is no "safe state", the Shift Manager will order the installation of Emergency TMOD and then will notify the station DA within the same shift.

# Emergency TMOD

1 2

In a case when installation is a direct and necessary result of conservative decision making, the Shift Manager should obtain concurrence from the station DA prior to installation of the Emergency TMOD.

# Emergency TMOD

In both cases, the Emergency TMOD must either be:

Removed
i.e., the SSC must be returned to its original configuration.

OR

Converted
into a fully approved replacement TMOD that meets N-PROC-OP-0027.

# Modification Phases Overview

- OPGN Modification Process consists of several phases.

- To give you an overview of these phases, in this module we will walk you through a 10 phase process of a kitchen renovation analogy.

# Modification Phases Overview

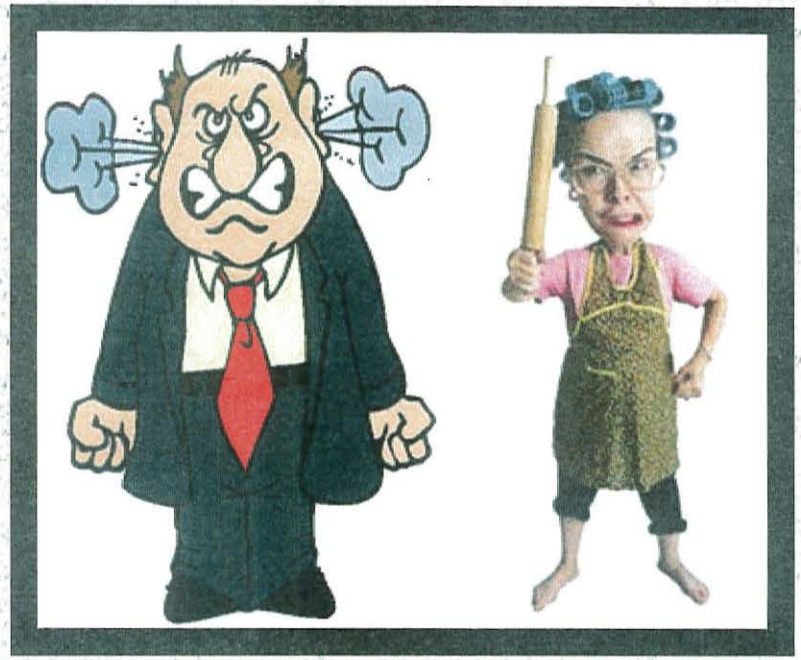
1. Project Initiation
2. Scope Definition
3. Mod Planning / Preliminary Engineering
4. Detailed Design
5. Installation & Commissioning Planning
6. Installation
7. Commissioning
8. Ops Turn Over
9. TMOD Removal (if applicable)
10. Close Out

# Phase 1

1 2 3 4 5 6 7 8 9 10

One day a couple decided that they have had enough of their outdated and troublesome kitchen. They made a list of what they found troubling. The list looked like this:

- The cabinets are too high
- The faucet leaks
- The lights are too dim
- The stove does not heat enough



# Project Initiation - Process

- A Modification can be initiated by anybody (but normally done by a Performance Engineer) by raising an Engineering Change Request (ECR) in ASSET-SUITE
- The Initiator's Section Manager will then review the ECR and hold it for approval
- An AE (Assigned Engineer) determines if a Mod is the appropriate solution
- If a Mod is indeed the appropriate solution, the ECR is forwarded to the Screening Committee
- If the Screening Committee approves the ECR, the Modification can proceed to the next phase

# Phase 2

1 2 3 4 5 6 7 8 9 10

Once the Project is initiated, they need to decide and consult with experts about what they want out of the project, such as:

- Lower cabinets
- New faucet
- Brighter lights
- A hotter stove

# Scope Definition

Just like the name, Risk Based Mod Process, implies – we need to asses the risks associated with each modification, as the risk will determine the actions to be taken later, including oversights required at various phases of the Mod.

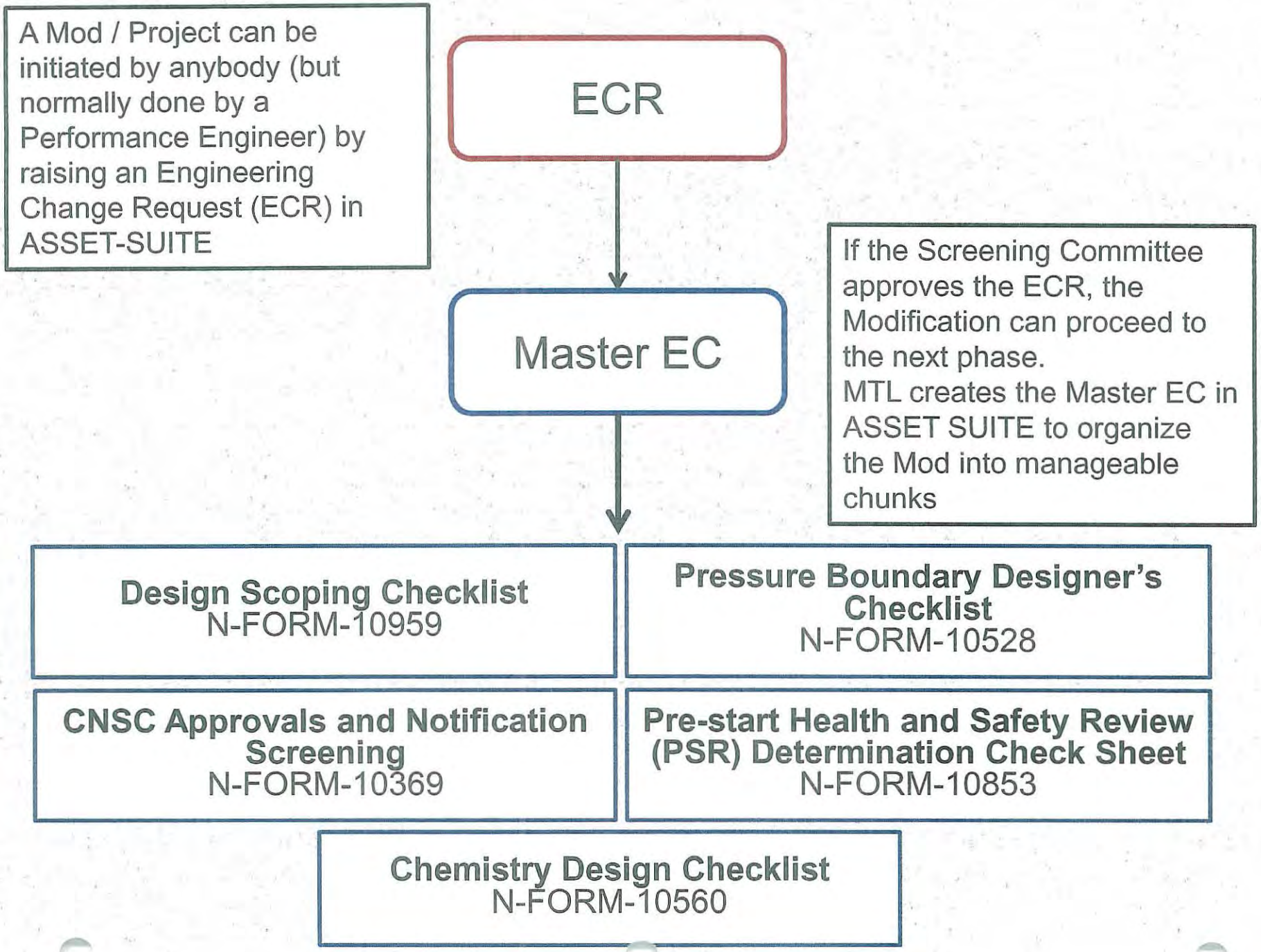
The risk assessment is performed by a Mod Team Leader (MTL) or a Design Team Leader (DTL) by completing Modification Outline, *N-FORM-10958*

# Scope Definition

To ensure proper documentation, the MTL creates a Master EC in the ASSET-SUITE to store the completed Mod Package (which we saw in the previous slide).

In addition, the Master EC also has a link to the Working File Folder, which contains various notes and files related to the Mod.

An important file called Issue Tracking File (ITF) is also stored in this folder to track various issues to be resolved as the Mod progresses. These issues are normally brought up when consulting Subject Matter Experts when filling out the Mod Package and more issues may also be added along the way.


A Mod / Project can be initiated by anybody (but normally done by a Performance Engineer) by raising an Engineering Change Request (ECR) in ASSET-SUITE
ECR
Master EC
If the Screening Committee approves the ECR, the Modification can proceed to the next phase.
MTL creates the Master EC in ASSET SUITE to organize the Mod into manageable chunks
Design Scoping Checklist
N-FORM-10959
Pressure Boundary Designer's Checklist
N-FORM-10528
CNSC Approvals and Notification Screening
N-FORM-10369
Pre-start Health and Safety Review (PSR) Determination Check Sheet
N-FORM-10853
Chemistry Design Checklist
N-FORM-10560

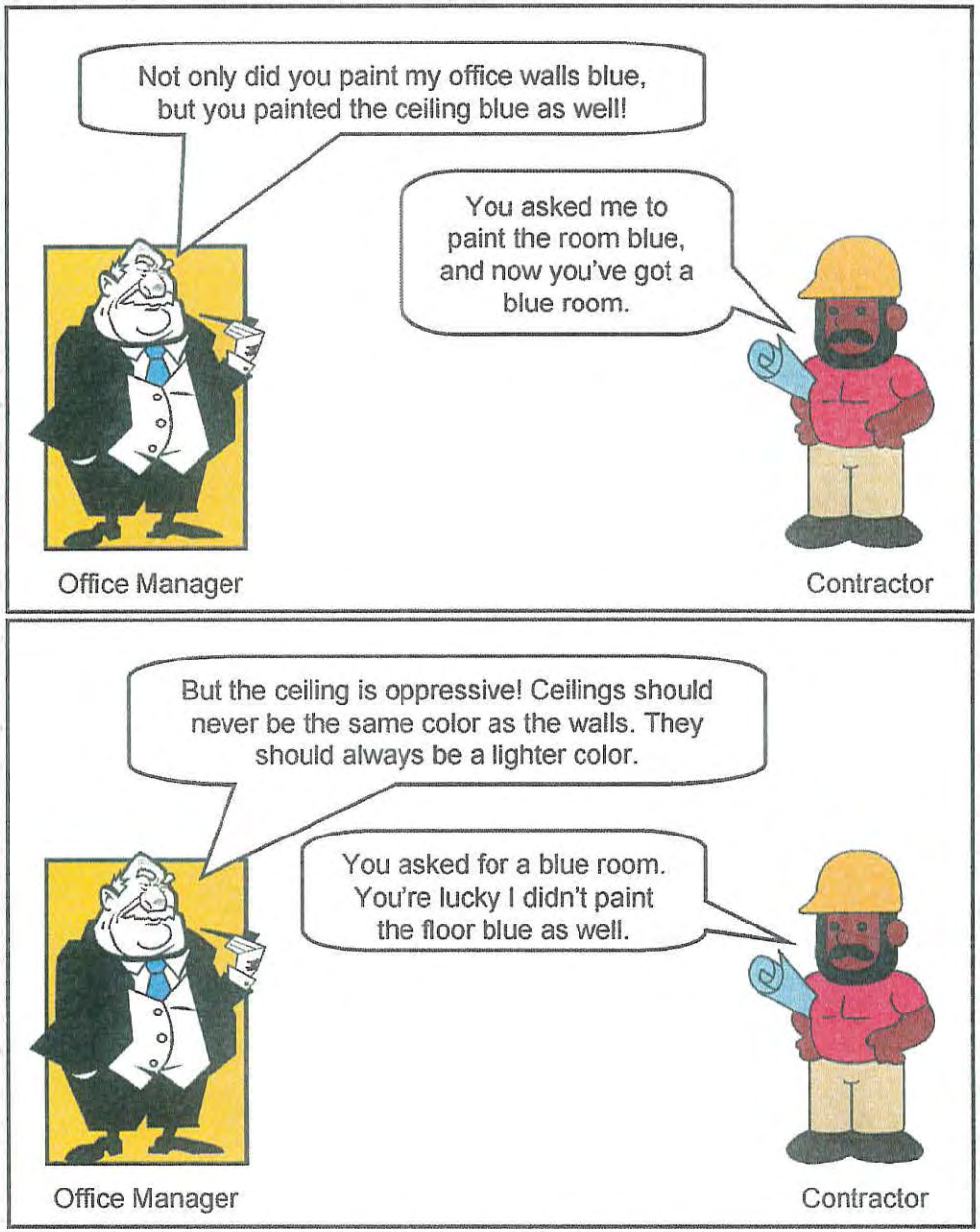
# Scope Definition

Based on the result of the risk assessment, the Mod can be categorized as either:

- **RRAM (Reduced Risk and Approval Modification),** which is a low risk and straight forward Mod with a small scope.
- **Standard Mod,** which is more complex or has higher risk, and often includes a larger scope.

The Standard Mod will require more oversights, more consultation with Subject Matter Experts and more effort to complete than a RRAM.

# Scope Definition – *What Can Go Wrong*

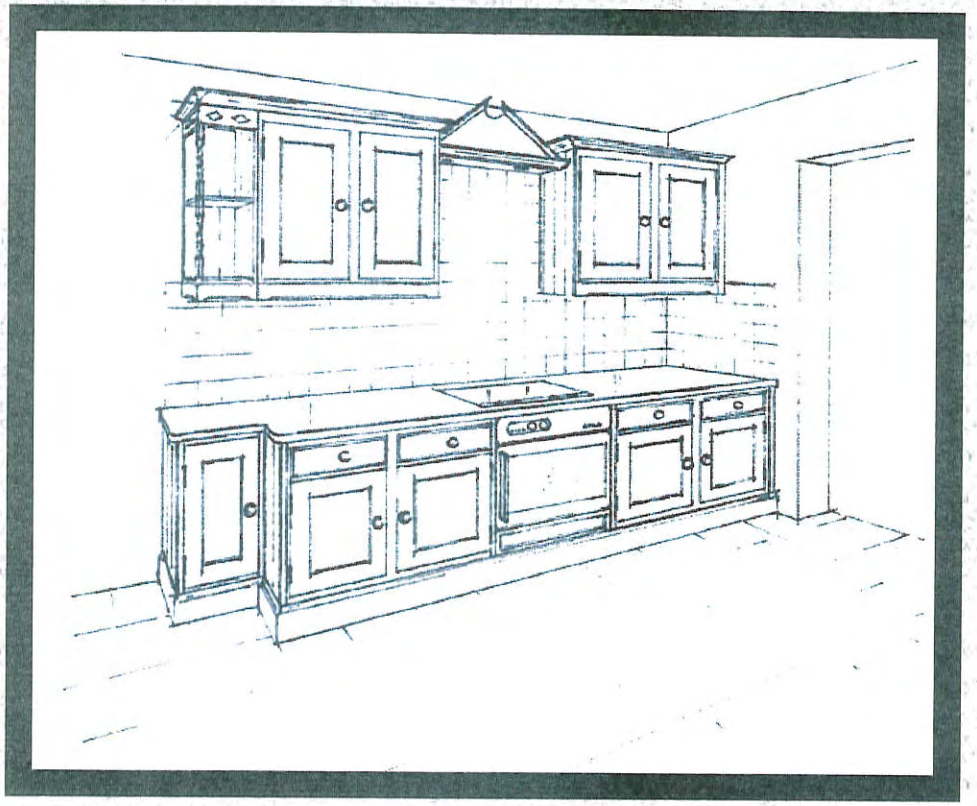


# Phase 3

1 2 3 4 5 6 7 8 9 10

Once the scope is defined, they need to have a big picture idea of how the kitchen will look at the completion of the project.

- Lower cabinets
- New faucet
- Brighter lights
- A hotter stove



# Modification Planning

To ensure the optimal design, the Mod Team and SMEs should do a walk down to ensure drawing-to-field comparisons to ensure configuration management.

The walk down can be done prior to, in parallel with, or after a COMS (Constructability, Operability, Maintenance, Safety) Meeting to identify issues (or potential issues).

If required by Mod Outline, the DTL should ensure a Design Plan is prepared and authorized in accordance with N-PROC-MP-0074.

The DTL creates one (or several) child EC called Design EC, to manage Design related deliverables (e.g. Flow Diagrams)

ECR

Master EC

As required, the MTL creates a Child EC from the Master EC, called Project EC, to manage Non-Design related deliverables

Design EC 1

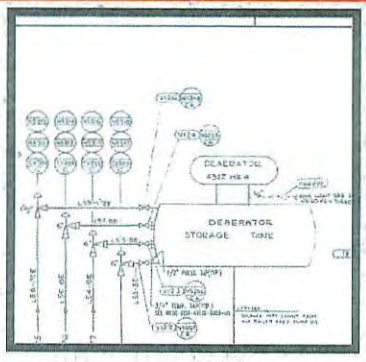
Design EC 2

Design EC 3

Project EC

**Release #1**

**Release #2**




*Non Design Related Deliverables (e.g. Operation Manuals)*

# Phase 4

1 2 3 **4** 5 6 7 8 9 10

Once the vision has been created, they will choose the right components

- Cabinets
- Faucet
- Lights
- Stove

# Detailed Design

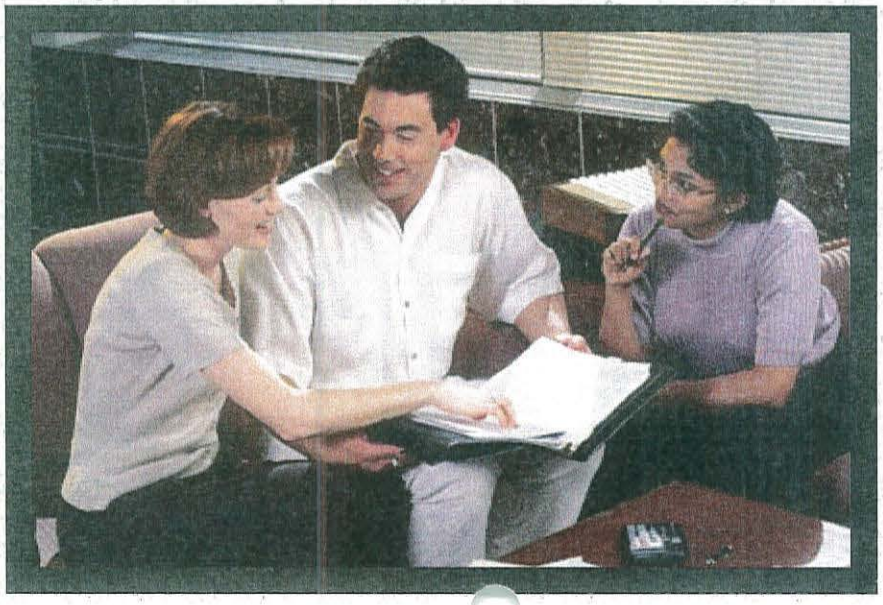
Activities to be completed in this phase include (but are not limited to):

- ❑ Performing Detailed COMS to ensure issues and concerns are taken care of
- ❑ Identifying and ordering Long Lead Items
- ❑ Preparing Change Papers, i.e., the drawings of how the SSC will look like at the completion of the Mod
- ❑ Creating new Cat IDs (as needed) for ordering purpose
- ❑ Populate EC Panels in ASSET SUITE, such as: ADL (Affected Document List), AEL (Affected Equipment List) and ACB (Affected Catalog Bill of Materials)
- ❑ Creating Installation and Commissioning Requirements
- ❑ Approving the ECs
- ❑ Sending documents to Business Services to create EC Record

# Phase 5

1 2 3 4 **5** 6 7 8 9 10

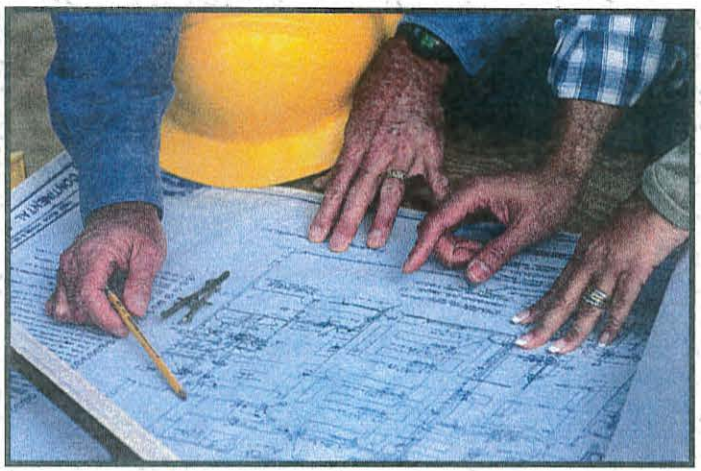
By now they have chosen the components. The next step will be to decide when and how to implement the changes, e.g., should they do it themselves or get a contractor? Where can they stage the new cabinets, faucet, lights, and stove? Shall they do it in the weekends or during week nights?



# Installation & Commissioning Planning

By this time the design has been **completed and approved**, so we must prepare for the installation and commissioning of the Mod. This phase include the preparation and approval of:

- Installation Instructions & Commissioning Specifications
- Installation & Commissioning Contracts (if the work is to be done by Contractors)
- Operations Turnover Plan



# Phase 6

1 2 3 4 5 **6** 7 8 9 10

Once the equipment and components have been purchased and staged and time and resources have been allocated, the mod work can begin as planned. In this case the couple had decided to hire a contractor

# Installation Phase

In the Installation Phase, the main champion is the Field Team Leader (FTL), the role of which is usually performed by the MTL (for Station Mod) or by Field Engineering (for Projects).

The FTL provides continuous oversight to ensure that installation instructions are followed. If issues arise during the installation, the FTL should document and resolve them quickly.

# Phase 7

1 2 3 4 5 6 **7** 8 9 10

The cabinets, faucet, lights and stove have been installed now. The equipment performance is checked

# Commissioning

Commissioning is the phase of the Mod Process to confirm that the Mod has met the intended requirements.

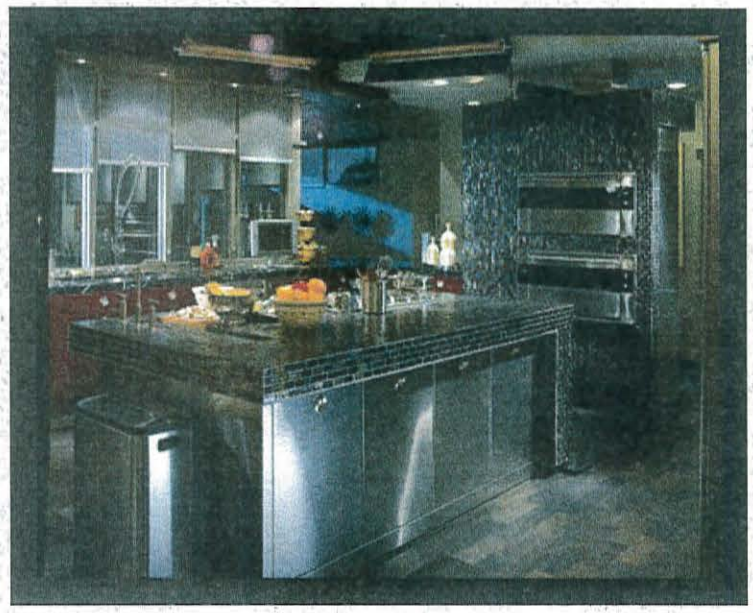
Just like the Installation Phase, the champion of Commissioning Phase is the FTL.

If the commissioning is successful, Design Engineering gives the confirmation to formalize the results. This may be in the form of Commissioning Report approval and issuance (if it is a Standard Mod).

# Phase 8

1 2 3 4 5 6 7 **8** 9 10

Everything seems to work properly. The Contactor turns the kitchen over to couple to formalize the completion of the project.



# Operation Turn Over

Why bother with Operation Turn Over if we installed and commission the Mod successfully?

- Operation Turn Over is the **Quality Assurance Hold Point**.

- It provides assurance to Design, Ops and Maintenance that Mod can be put in service because the Mod meets the **Design Requirements**.

# Operation Turnover

Depending on the risk assessment in the Scope Definition Phase, there are two types of Ops Turnover:

1. Operation Acceptance – less efforts and oversights, due to the lower risks.
2. Available For Service (AFS) – more efforts and oversights, due to the higher risks.

By default, Operation Acceptance is the turnover mechanism for a RRAM. But the Design Engineering Section Manager may request the AFS instead.

The next slide will show how the process is carried out.

# Operation Turnover

MTL and Operations Manager (or delegate) documents the turnover using the Available for Services /Operations Acceptance Declaration, *N-FORM-10091*

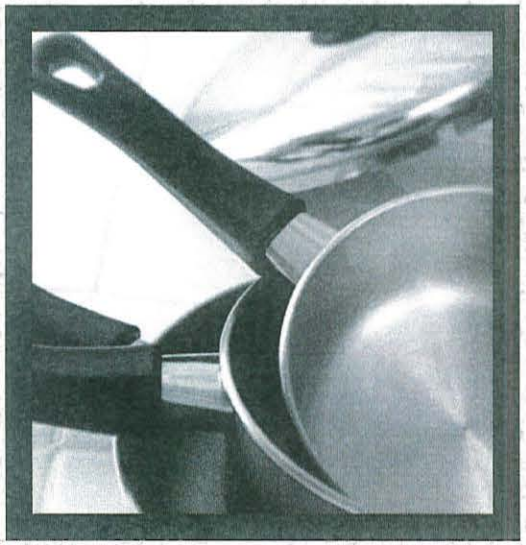
Then MTL enters “Final AFS/Ops Acceptance" milestone date for the impacted Project & Design EC(s). This milestone **starts the 6 month clock** for the Mod Team to close out the Mod.

Following this, the MTL forwards all AFS documentation to Business Services for scanning and attaching to the EC.

# Phase 9

1 2 3 4 5 6 7 8 **9** 10

They now can put the kitchen appliances and glassware (which were being used while the kitchen was being installed) back in place



# TMOD Removal

If the Mod is installed as a **temporary change** to the SSCs, then:

**Within 18 months** the (SSCs) impacted by the **temporary** modification shall be **restored** to their original configuration.

**OR**

The **temporary** modification *must be* converted to a **permanent** modification. This timing limit includes registered temporary modifications *on* PB systems.

# TMOD Removal

Exceptions to the 18-month restriction are if:

- Non-registered pressure boundary TMOD is limited to 12 months
- A unit outage is required for removal
  - The removal should take place at the first available outage
- The unit is laid up
  - Upon re-start the temporary *modification* should be removed or made permanent
- The Chief Nuclear Engineer has agreed in writing to an extension
  - Such agreement should have a defined end date. N-FORM-10005

# Phase 10

1 2 3 4 5 6 7 8 9 10

The couple now puts on a candle dinner and to reminisce and discuss the lessons learned from the project.

# Close Out

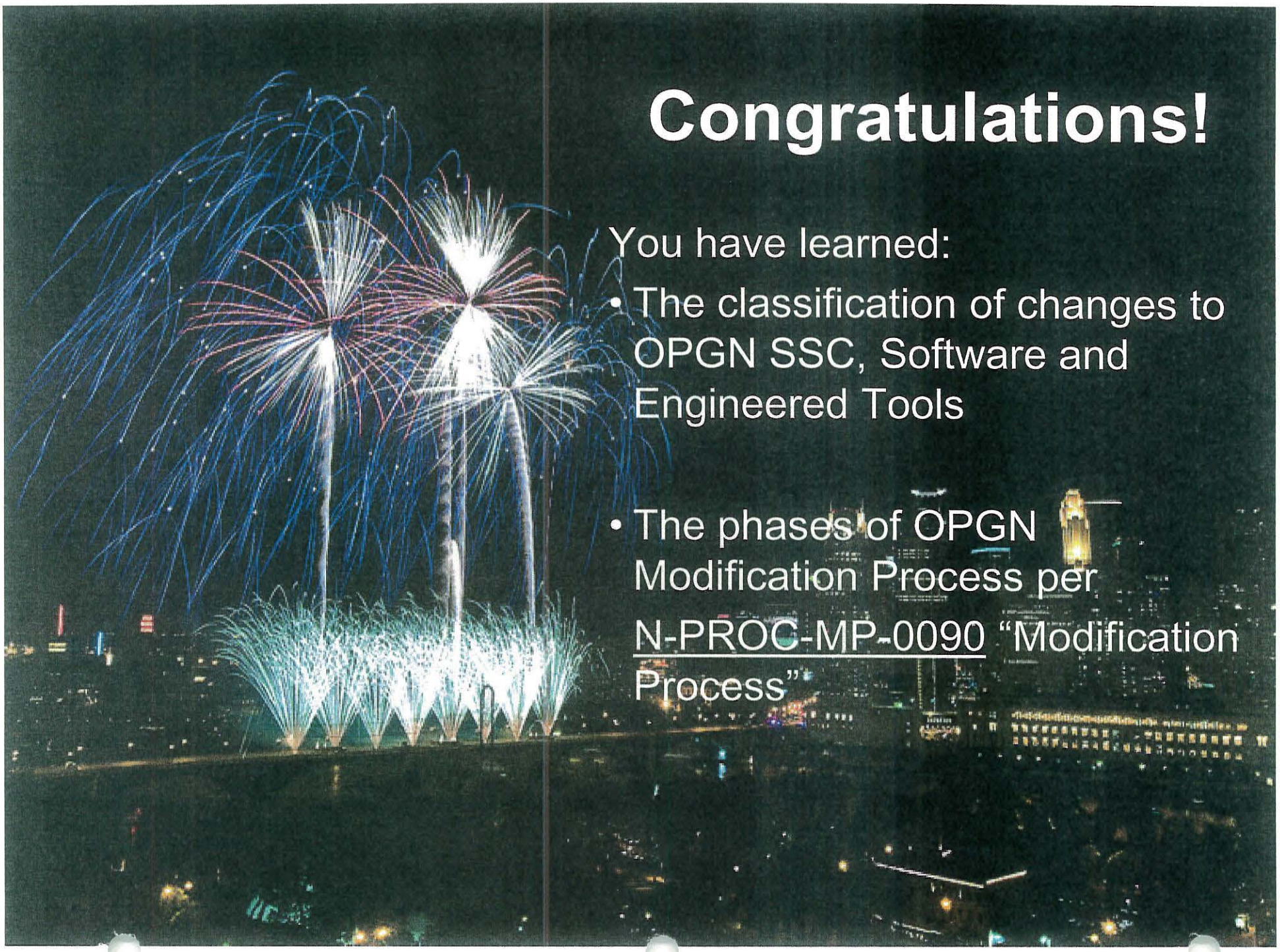
MTL to confirm all open items are completed for each EC (Design or Project) within **6 months** of turnover. Note that:

- FTL ensures MEL (Master Equipment List) group has updated Equipment status to Active/Operating. DE (Design Engineer) should complete the ASSET SUITE "MEL Updated" milestone
- DE set Design EC to “MODIFIED” only after electronic document files are released, equipment revisions are launched, and (if applicable) NON-COMMISSIONABLE attributes are completed

# Close Out

EC documents are closed out as follows:

- DTL closes the Design EC
- MTL closes the Project EC
- MTL's Manager determines whether a post closeout Lessons Learned Meeting is required
- MTL closes the Master EC


Congratulations!
You have learned:
• The classification of changes to OPGN SSC, Software and Engineered Tools
• The phases of OPGN Modification Process per N-PROC-MP-0090 "Modification Process"

# Refurbishment Materials Strategy – "End to End"

## Briefing to RCRB

April 25th, 2016

BEHAVIOURS

- Say It, Do It
- Simplify It
- Think Top Pad Bottom Line



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# Why do we need a Materials Strategy?

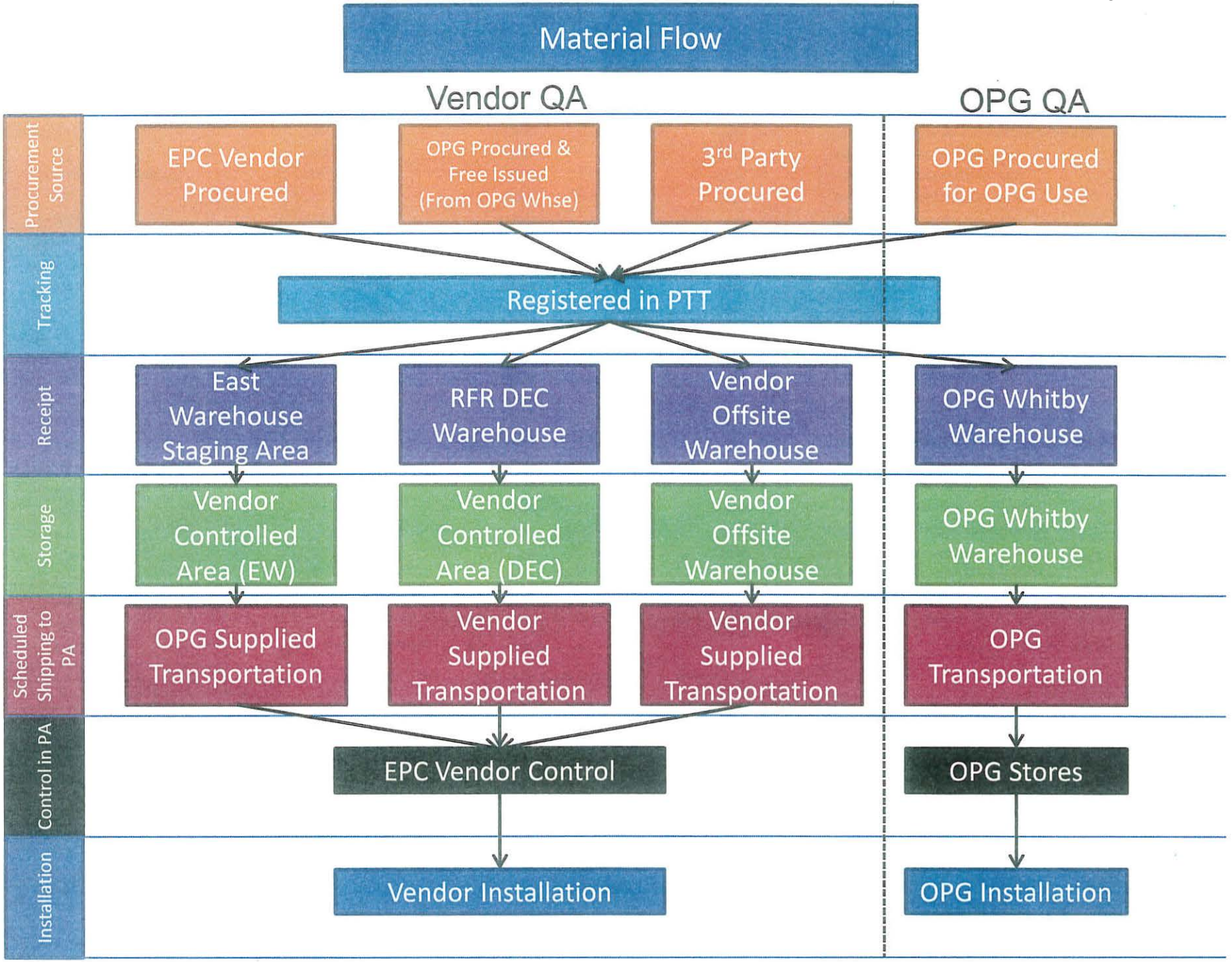
- Every Project has materials issues – Delays & Quality
- Incorporated Lessons Learned / OPEX
  - Only use approved Vendors – Start with the right people
    - Design
    - Procure
    - Construct
  - Designs complete one year prior to Breaker Open – Start on time
    - Rigorous process for Validation
    - Formal Acceptance
  - Procurement Specs established - Start with the Right Material
    - Use 'Installed Equipment Base' as starting point
    - Changes require OPG approval

# Common Approach Across all Bundles and Vendors

- OPG Supply Chain sets the stage – Approved Vendors & Programs
  - E, P &C Vendors on OPG ASL, audited every 3 years
- Refurbishment Project Executes the plan through the EPC Vendors
  - Division of Responsibilities – Vendor / OPG
    - Procurement, Logistics, Care and Control
    - OPG Supply Chain(Materials) is a 'Vendor' to the Project
    - OPG Inventory Reduction
  - Procurement Tracking Tool (PTT) = Visibility & Confidence
    - Tracking from DBOM to Delivery in the plant
    - Vendors' data uploaded, OPG Validates for accuracy
    - PTT is part of Integrated Data Base
    - Procurement Schedule EPC Vendor Requisition, Purchase Order and OEM
    - Tracked by Project/Vendor/Work Pkg/Schedule window
    - Procurement Schedule Driven by P6 Project Schedule
    - Project Mgr Accountable/Intrusive
    - Currently tracking over 26,700 lines representing 550,000 parts

# Common Approach Across all Bundles and Vendors

- Refurbishment Project Executes the plan through the EPC Vendors
  - Warehousing - DEC and East Whses
    - Receipt Inspected by Vendor and brought to On site Whse
    - All bar-coded in the Tool –
    - Item and location are linked to the Work and the Schedule
    - In the Whse 90 days before Execution
    - Verified by trades & supervisor doing the work
  - Logistics
    - Security Screening and Shipment to the Plant on a schedule
    - Priority on schedule at "Sally Port"
    - Delivered, then to moved to an approved laydown area
  - Spares
    - Construction / Commissioning – Held in Refurb Whses
    - Future Plant Spares
- Need to prove we are 'Ready to Execute'; Process to Track all parts
  - Matching DBOM/CWPs to PTT – Do we have them all?
  - Weekly reporting against exceptions
  - Forecast issues and solve them


Material Flow
Vendor QA
OPG QA
Procurement Source
Tracking
Receipt
Storage
Scheduled Shipping to PA
Control in PA
Installation
EPC Vendor Procured
OPG Procured & Free Issued (From OPG Whse)
3rd Party Procured
OPG Procured for OPG Use
Registered in PTT
East Warehouse Staging Area
RFR DEC Warehouse
Vendor Offsite Warehouse
OPG Whitby Warehouse
Vendor Controlled Area (EW)
Vendor Controlled Area (DEC)
Vendor Offsite Warehouse
OPG Whitby Warehouse
OPG Supplied Transportation
Vendor Supplied Transportation
Vendor Supplied Transportation
OPG Transportation
EPC Vendor Control
OPG Stores
Vendor Installation
OPG Installation

# Procurement Tracking Tool – Screen Shot

Procurement Tracking - Microsoft Internet Explorer provided by Ontario Power Generation

http://webapps.corp.opg.com/idbnp/Settings.aspx?Group=IDBNP_PROCURE_NAV&Node=V_7&Page=&Focus=&View=0&Nav=Y

Favorites | RMO Home | IDB | Home - Nuclear Refurb | Planning & Controls | Pages - Workspace | Web Slice Gallery | Fossil | Hydro Electric | PowerOn

Procurement Tracking

Page | Safety | Tools

Logged On: TOOHEYS [ READ ] Quick Links: Hor

## IDBNP Configuration - Nuclear Refurbishment -

Group | Master Project List | P6 EPS Structure | Admin Tables | Procurement Tracking

Procurement Tracking

- Alstom
- AMEC
- AREVA
- BABWIL
- BLMAC
- EPC
- ESFOX
- ESMSA - TBD
- GE
- IMS
- JV (RFR)
- JV (SNC)
- NA
- OPG
- PMV
- PMV.BLMAC
- PMV.ESFOX
- SNC
- TBD
- TBD.OPG
- UN
- WORLEYPARSONS

Procurements | File Uploads | Audit Log

Views - Default (Sys) * | Export

Page: 1 of 27 | Records: 100 of 2621

| # | Vendor Procurement Key | OPG Project # | Vendor Project # | OPG Scope ID | OPG EC # | EC Name |
|---|---|---|---|---|---|---|
| 1 | 00000165 | 73648 | 14-5103 | 7004 | 0000129878 | EMERGENCY HEAT SINK - ALTERNATE SUPPLY TC |
| 2 | 00002698 | 73773 | 14-5140 | 71000 | 0000128660 | Aux Shut Down Cooling |
| 3 | 00002699 | 73773 | 14-5140 | 71000 | 0000128660 | Aux Shut Down Cooling |
| 4 | 00002700 | 73773 | 14-5140 | 71000 | 0000128660 | Aux Shut Down Cooling |
| 5 | 00002701 | 73773 | 14-5140 | 71000 | 0000128660 | Aux Shut Down Cooling |
| 6 | 00002702 | 73773 | 14-5140 | 71000 | 0000128660 | Aux Shut Down Cooling |
| 7 | 00002705 | 73773 | 14-5140 | 71000 | 0000128660 | Aux Shut Down Cooling |
| 8 | 00000923 | 73592 | 14-5092 | 7011 | 0000129181 | Containment VVRS |
| 9 | 00001174 | 73711 | 14-5100 | 5711 | 0000129106 | Work Control |
| 10 | 00000850 | 73592 | 14-5092 | 7012 | 0000129185 | VVRS Containment |
| 11 | 00000851 | 73592 | 14-5092 | 7012 | 0000129185 | VVRS Containment |
| 12 | 00000823 | 73592 | 14-5092 | 7012 | 0000129184 | VVRS Containment |
| 13 | 00000830 | 73592 | 14-5092 | 7012 | 0000129184 | VVRS Containment |
| 14 | 00000840 | 73592 | 14-5092 | 7012 | 0000129184 | VVRS Containment |
| 15 | 00002127 | 73592 | 14-5092 | 7012 | 0000129184 | Containment VVRS |
| 16 | 00002128 | 73592 | 14-5092 | 7012 | 0000129184 | VVRS Containment |
| 17 | 00002130 | 73592 | 14-5092 | 7012 | 0000129184 | VVRS Containment |
| 18 | 00002125 | 73592 | 14-5092 | 7012 | 0000129184 | Containment VVRS |
| 19 | 00000833 | 73592 | 14-5092 | 7012 | 0000129184 | VVRS Containment |
| 20 | 00002129 | 73592 | 14-5092 | 7012 | 0000129184 | VVRS Containment |
| 21 | 00002126 | 73592 | 14-5092 | 7012 | 0000129184 | Containment VVRS |
| 22 | 00000096 | 73663 | 14-5122 | 7081 | 0000128764 | Fire Protection Architectural Details and Maint |

Done | Local intranet | Protected Mode: Off | 125%

# Materials Delivery Reporting

Online Reporting > Nuclear > Nuclear Projects > Nuclear Refurbishment > Ad Hoc Reports > Procurement

Actions | 1 of 1 | Find Next | 100%

ONTARIO POWER GENERATION

## Forecast Delivery of Materials for Scheduled Windows

NR Procurement Tracking Tool - Material Delivery

Report ID: 1404A *Tech Tips*
Report Owner: L Greenland
Process Owner: S. Toohey
Data Refreshed: 13-Apr-16 12:00 AM

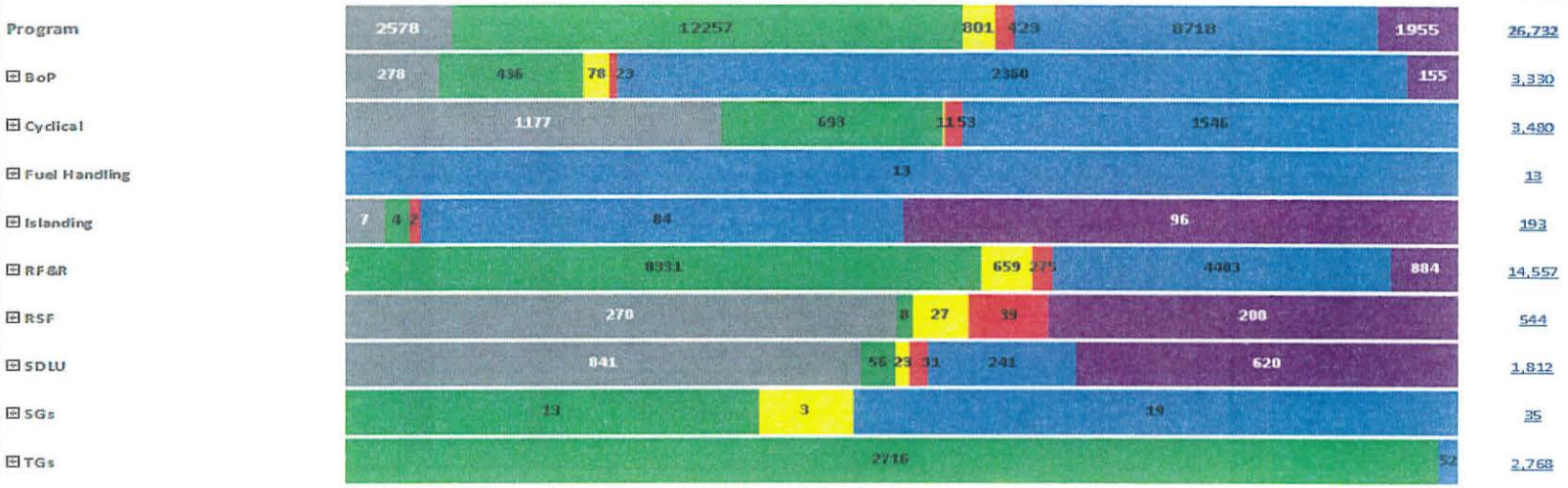
**Filters Applied:**

Pre-Requisite or Outage: Both

Outage Segment: 0, 1, 2, 3, 4, Unknown

Window: 000, 001, 003, 009, 013, 021, 028, 029, 034, 037, 037A, 038, 039, 041, 048, 053, 054, 057, 057A, 061, 068, 073, 083, 085, 089, 099, 100, 103, 104, 119, 122, 124, 129, 161, 166, 169, 170, 173, 174, 175, 176, 179, 180, 183, 184, 186, 500, 501, 502, 504, 505, 506, 507, 509, 511, 512, 513, 515, 516, 517, 518, 519, 531, 536, 538, 539, 547, 549, 551, 553, 555

Vendor: #ESFOX - Non Refurb, BWXT, ESFOX, JV (RFR), JV T/G, OPG Cyclical




| Total Number of Items | Number of Items With Data Issues | Number of Items With Approved PO And No Delivery Date | Number of Items With Incorrect Execution Window Assigned | Number of Items Assigned to an Execution Window Not in P6 |
|---|---|---|---|---|
| 26,735 | 3 | 0 | 0 | 3 |

Note: To see the raw data from the Procurement Tracking file, click here.

Run by: CORP\TOOHEYS at 13-Apr-16 03:20:36 PM | *For Internal Use Only* | Page 1 of 1

# Materials Purchasing Reporting

Online Reporting > Nuclear > Nuclear Projects > Nuclear Refurbishment > Ad Hoc Reports > Procurement

Actions | 1 of 2 | Find Next | 100%

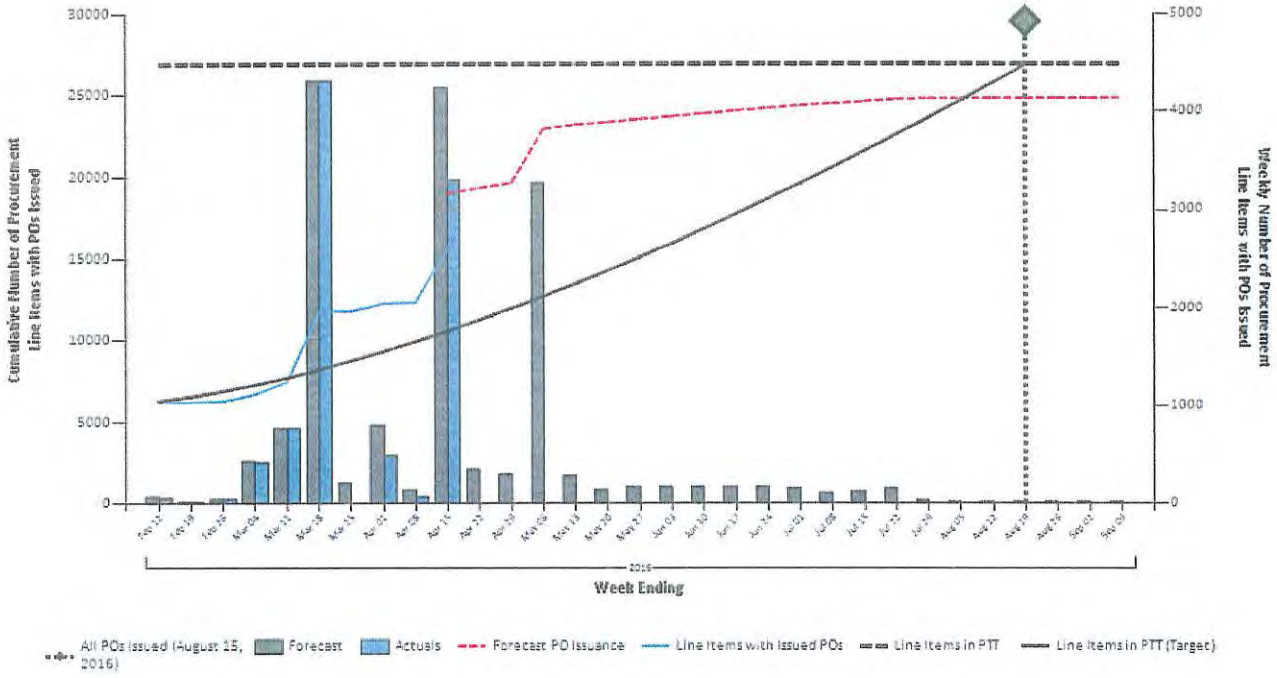
ONTARIO POWER GENERATION

## Material Line Item Purchase Order Issuance Summary

NR Procurement Tracking Tool

| | |
|---|---|
| Report ID: | 1402A *Tech Tips* |
| Report Owner: | L. Greenland |
| Process Owner: | S. Toohey |
| Data Refreshed: | 15-Apr-16 12:00 |

**FiltersApplied:** **Bundle:** BoP, Cyclical, Defueling, Fuel Handling, Islanding, NR Prog, RF&R, RSF, SDLU, SGS, **Vendor:** All Vendors Included
**Project:** All Projects Included




| Total Line Items in PTT | Line Items with POs Issued | Line Items with POs Past Due | Line Items with No POs Issued | Line Items with No Projected PO Dates | % PO Issued of Total | POs Forecast to be Issued Past Milestone | POs Not Issued and < 120 days to Execution Window |
|---|---|---|---|---|---|---|---|
| 26859 | 15653 | 770 | 11206 | 1628 | 58% | 2042 | 2040 |

Run by: CORP\TOOHEYS at 15-Apr-16 03:28:31 PM *For Internal Use Only* Page 1 of 2

# EPC Procurement Audit

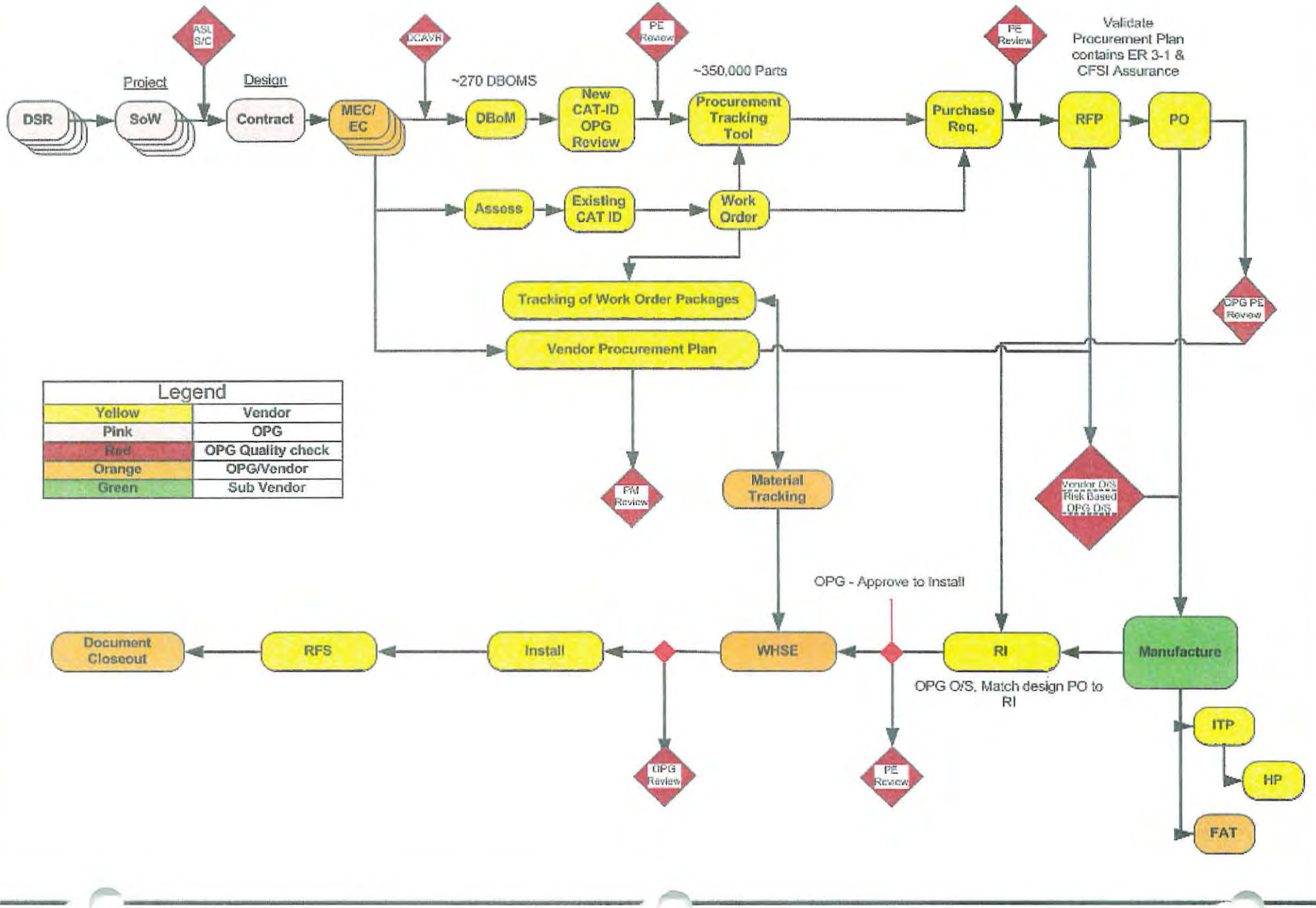
## Internal Audit Review - Generally Acceptable (White)

- Positives
  - Procurement Tracking Tool ("PTT") is a single data source for the management of all materials on the DNR project;
  - Oversight Steering Committee reviews, issues and results, including those related to the procurement of long-lead items;
  - OPG approval is required for Prime Contractors to purchase materials from non-OPG approved suppliers; and
  - Supply Chain oversight and supplier qualification audit evaluate a supplier's management and control of counterfeit, fraudulent and suspect items ("CFSIs") items.
- Findings
  - Procurement oversight activities have not been centrally coordinated or standardized – (Corrected)
  - An access control and monitoring plan has not been implemented for the Procurement Tracking Tool ("PTT") (Corrected)

ONTARIO POWER GENERATION

# Darlington Refurbishment – Material Assurance Flowchart (End to End)

DARLINGTON REFURBISHMENT Repowering Ontario



# Interlocking Materials QA/QS - Model

## Nuclear Management System

**Project Manager**
S. Guthrie

Scope of Work

Schedule

Cost

Quality

Accountability

**Director DNR Quality**
I. Malek
Overall Guidance and Direction on Quality

Quality Plan & Integration

| SCQS | Proc Eng | VO-QA | Construction | Surveillance |
|---|---|---|---|---|
| M. Pletosu | M. Khondaker | M. Small | K. Hobbs | I. Malek |
| Vendor's Program | Vendor's Purchase | Vendor's Items & Process | Vendor's Field Work | Vendor's QC & Records |

**Vendor Quality Program**

**Vendor (BWXT)**

Quality Assurance Plan

QA Program – Engineer/Procure /Manufacture/ Install/ Certify

| OEM's Program | OEM's Purchase | OEM's Items & Process | OEM's Field Work | OEM's End to End QA & Records |
|---|---|---|---|---|

**OEM (Velan)**
QA Program – Design/Procure/Manufacture/Certify

| Sub's Program | Sub's Purchase | Sub's Items | Sub's Field Work | Sub's QA & Records |
|---|---|---|---|---|

**OEM - Sub (Seals Unlimited)**
QA Program –
Design/Procure/Manufacture/ Raw material

**DNR MSO**
D. Stiers
Program Assurance

**Nuclear Oversight**
A. Maki
Governance

**Internal Audit**
J. Ding
BoD Assurance

**Risk**
N. Thomas
Corp Risk

**CNSC**
Regulatory Compliance

**WANO**
Industry Best Practices

# Preventive Measure for Counterfeit, Suspect and Fraudulent Items (CFSI)

- Supply Chain Quality initiative on CFSI launched in 2010.
- Program is fully implemented and assessed as industry best in class by internal and external organizations including:
  - Entergy, NB Power, Bruce Power, CNOO (China), SNN Cernavoda Romania.
  - NIEP (Nuclear Industry Evaluation program) by evaluators from different US utilities – Progress Energy, Exelon
- Developed and implemented processes to prevent, detect, control and disposition CFSI's.
- Updated existing governance framework to bridge gaps identified during benchmarking phase with EPRI, SAE, IAEA, etc
- Implemented contractual requirements in purchase orders to address CFSI requirements – standard procurement clause for CFSI aligned to EPRI guideline

# Preventive Measure for Counterfeit, Suspect and Fraudulent Items (CFSI)

- Increased CFSI awareness in OPG and Suppliers' organizations:
  - OPGN Awareness Sessions and Training: CFSI overview presentation and CBT – linked to qualification for critical personnel
  - Supplier Awareness - letters sent to all Suppliers to request development and implementation of CFSI Program for detection and prevention, which is subject to audit by OPG
  - Ensured suppliers have implemented a process to prevent, detect, control and disposition Counterfeit, Fraudulent and Substandard Items (CFSI's).
  - Supplier assessment by OPG includes:
    - Enhanced audit checklists to address CFSI;
    - Audited suppliers in accordance with enhanced checklists;
    - Initiated corrective action requests for supplier's not meeting expectations.
  - Developed and delivered training (CAL 69095) to cover awareness, detection, and prevention methodologies. Target audience – Supply Inspection Technologists (receiving and source inspection), Auditors, Quality Engineers, P.E., CE/CA, Design, Maintenance, Buyers, etc. CAL 69095).
  - Established portal in the NSC Intranet website to provide information related to CFSI and communicate to stakeholders

DARLINGTON refurbishment

# NUCLEAR REFURBISHMENT TAILBOARD

## WW16

## Tuesday April 26th, 2016

## SAFETY

## 2721 Days worked without a LTA

## Nuclear Safety Trait of the Week

## #2 Questioning Attitude

Page 11 O&M Handbook

## Principle for Excellence in Nuclear Project Construction

## #4 Schedules are Realistic and Understood

Page 17 Principles for Excellence in Nuclear Project Construction

# RCRB-Construction and Safety

Ken Hobbs
Jason Valliere
Bill Owens

BEHAVIOURS

- Say It, Do It
- Simplify It
- Think Forward, Respond Now




VALUES ▪ SAFETY ▪ INTEGRITY ▪ EXCELLENCE ▪ PEOPLE & CITIZENSHIP ▪

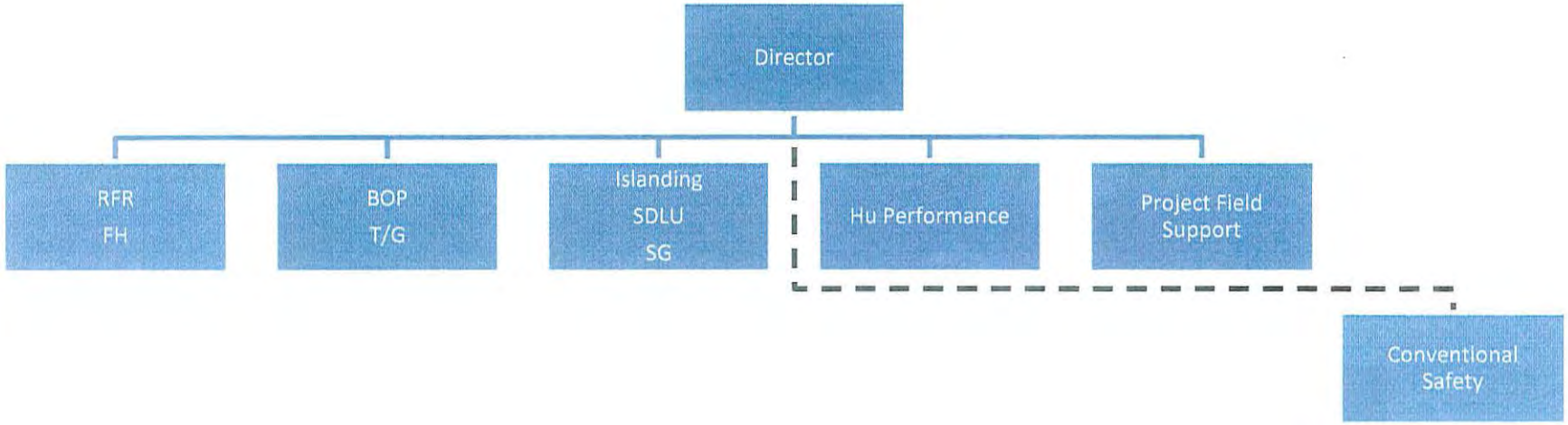
PEOPLE POWERING THE FUTURE
OPG NUCLEAR

ONTARIO POWER GENERATION

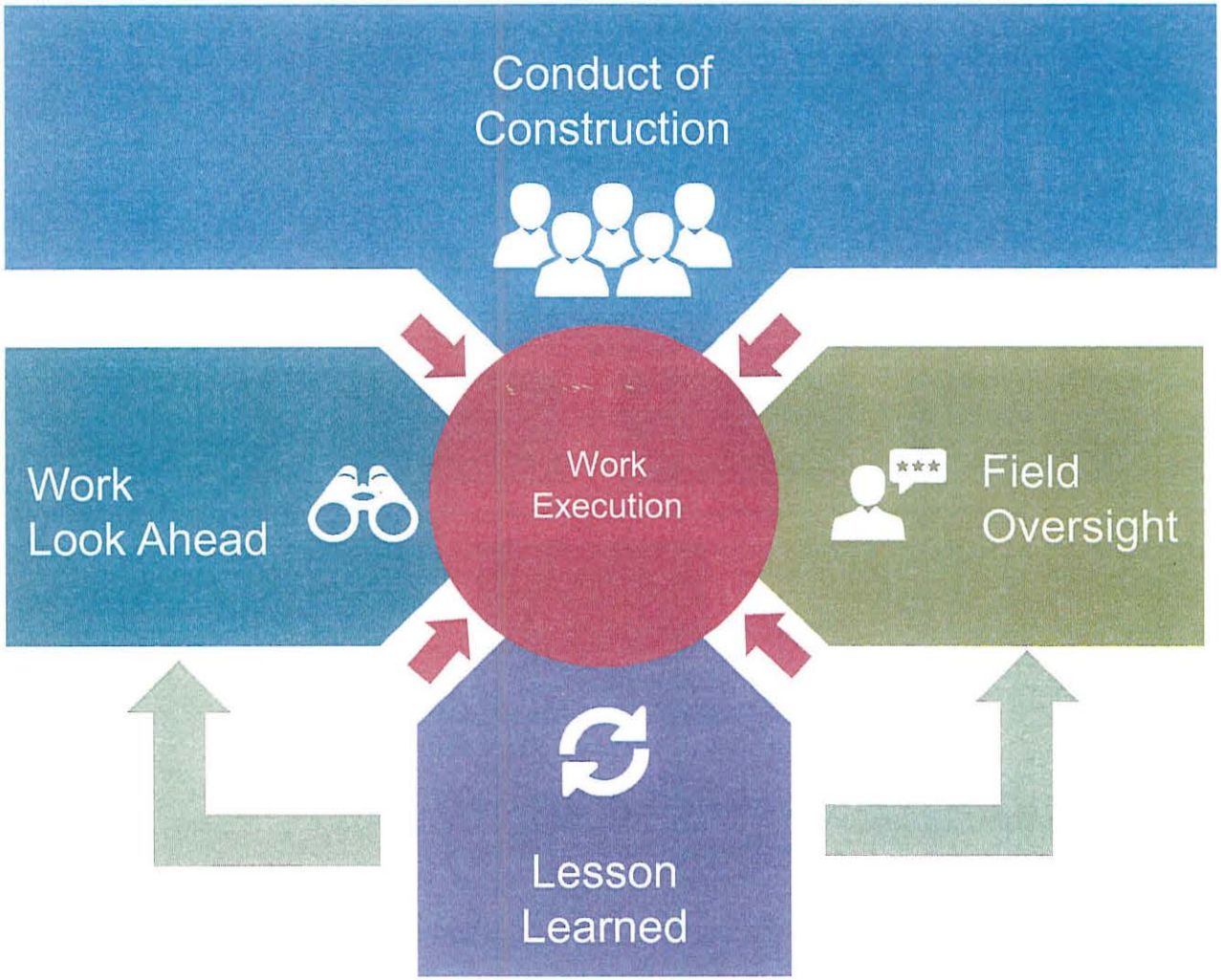
# Agenda

| | |
|---|---|
| ▪ Construction Oversight-Ken Hobbs | 30 Mins |
| ▪ Conventional Safety-Jason Valliere | 30 Mins |
| ▪ Nuclear Safety Culture-Bill Owens | 30 Mins |
| ▪ Questions | 30 Mins |

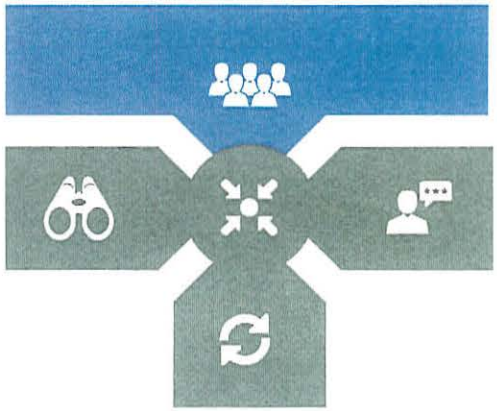
# Construction Execution & Field Support



# Construction Oversight Model



# Developed Using Industry Best Practices

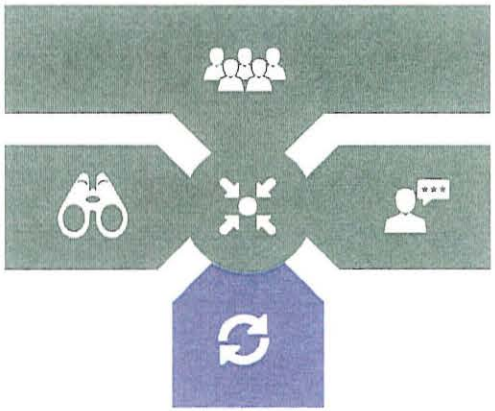


- ✓ INPO / WANO
- ✓ Watt's Bar
- ✓ Bruce
- ✓ Point Lepreau
- ✓ OPG
  - Pickering RTS
  - DN VBO

## Key Elements

1. Look Ahead Process
   - Risk Identification & Characterization
2. Job Oversight Plans
   - Risk Elimination & Mitigation

# Lesson Learned – Key Findings



## Initial Constructability Reviews

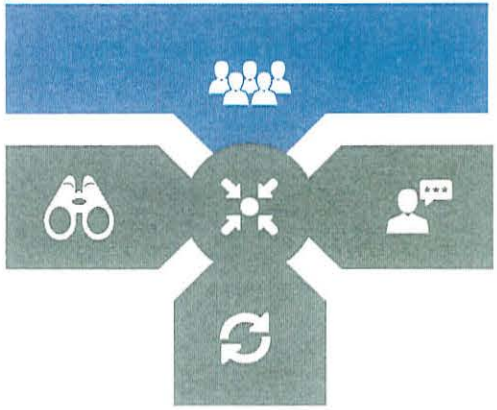
- ✔ Installation Interferences
- ✔ Inadequate Work Plans
- ✔ Inadequate Wiring Field Runs

## Look Ahead and Challenge Meetings

- ✔ Vendor not fully prepared for execution.
- ✔ Vendor personnel not the team executing field activity
- ✔ Vendor Field Supervision not fully engaged
- ✔ Vendor Oversight Plans not available
- ✔ Vendor Training Plans not developed
- ✔ On-the Job Planning less then adequate

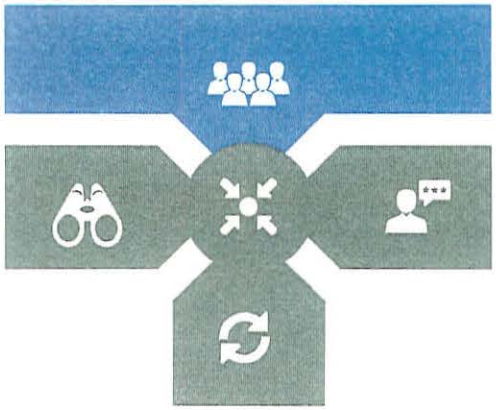
So What Changes We Have Made….

# Conduct of Construction - Standards



| Standard | Source | Notes |
|---|---|---|
| FME | OPG | |
| Hoisting & Rigging | OPG | |
| Confined Space | OPG | |
| SATM | OPG | |
| Welding Consumables | OPG | Exception: RFR Joint-Venture Vendor Partner |
| Scaffolding | OPG | |
| Radiation Protection | OPG | |
| Work Protection | OPG | Exception: Vendor Lock Out Tag Out processes as pre-approved for their equipment. |
| Human Performance | Vendor & OPG | - HULL Utilized<br>- EFD Reset Process (I/P)<br>- Joint Vendor/ DN Hu Committee Utilized<br>- OPG Hu Manager Hiring I/P<br>- Core 4 (PJB, PU&A, VP, SA) . These will be key KPI's |

# Vendor Training



## 1. Vendor Trades Supervisors

- Nuclear Construction Leadership Academy (2 Day classroom)
- Dynamic Learning Activity for Supervisors
- Paired Observations
- Oral Review Boards

Declaration of Competency

- OPG TIMM Qualification 40034
  " BTU Nuclear Construction Supervisor"

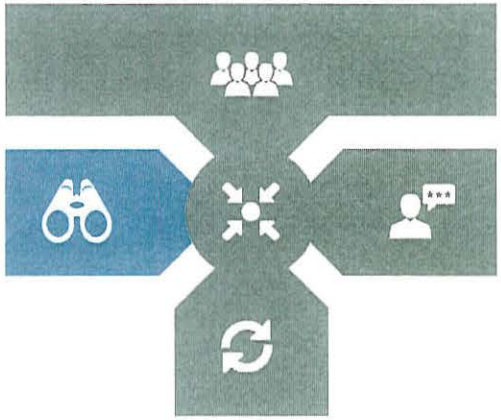
## 2. Supervisor Continuing Training Programs

- On-The-Job Planning (Today, Tomorrow, Next Day)
- Scheduling
- Turnovers
- PJB

## 3. Additional Skill of Trades Training

- CCV, Bolted Joint , Valves , Welding, EQ Splicing

# Look Ahead Preparations



## A. Constructability Reviews – Modifications (Complete – Mar 15th)

- Initial Walkdowns: Identify any interference/risks to installation
- Utilize design drawings, CWP's, WP's, ITP's

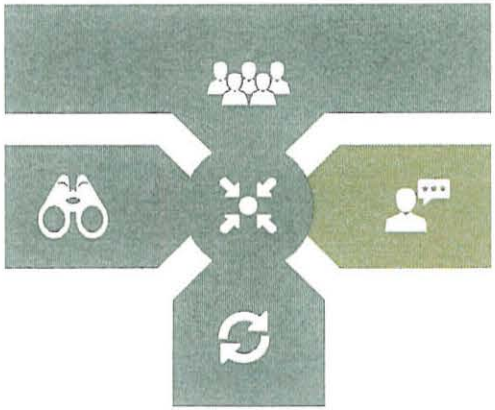
## B. T-6 To T-3 Months (Segment 1 Apr 15 to Jul 15)

- Constructability Reviews and Challenge Meetings
- Field Walkdowns
  - Utilize fully assessed field package
  - Access, Confined Spaces, Rigging Points, Lift Classifications
  - Tie Off Points, Power for Tooling
  - Potential Safety and Radiation Protection Issues
  - Risk model and oversight plans developed
- Deliverable: Develop Vendor Execution Plans
  - Special Tooling
  - Supervisory Staffing Plan
  - Sub-Contractor Oversight plans
  - Special Skill of Craft
  - Material Delivery

## C. T-4 to T-0 Weeks Walkdown & Challenge Meetings

- Turnover - OPG Look Ahead Mgr to OPG Construction Exec Mgr
- Vendor Led Challenge Meetings
- Final Field Walkdowns
- Ongoing Risk Monitoring – Adjust Plan as Require

# Field Oversight



- **Boots On The Ground**
  - OPG personnel in the field per oversight plan and matched to schedule
  - Eyes & Ears for PCC, Project Manager
- **Vendor Support**
  - First Point of Contact. 10-30-60 Rule
  - Assist/guide vendor supervisor barrier removal
- **Reinforce Standards**
  - Counsel & Coaching for Vendor Supervisor
  - Intervene job progress where appropriate

# RCRB-Conventional Safety

Jason Valliere
Senior Manager
Project Health & Safety Field Services

BEHAVIOURS

- Say It, Do It
- Simplify It

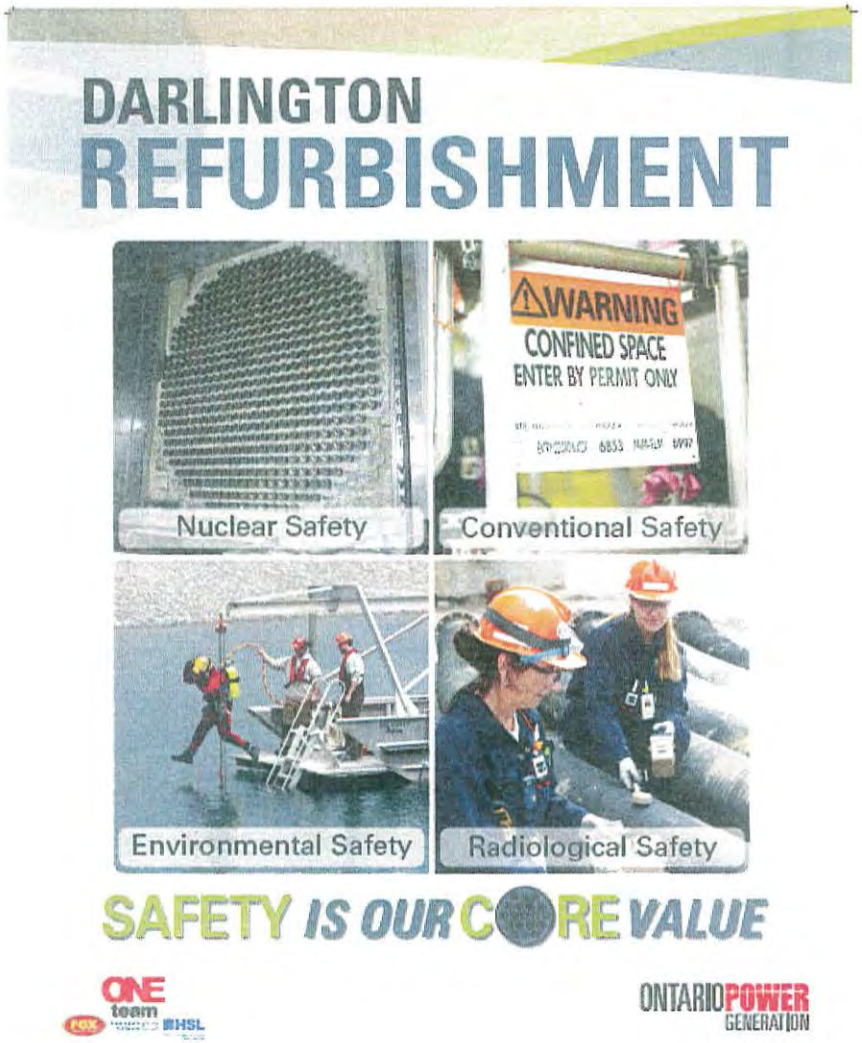



VALUES ▪ SAFETY ▪ INTEGRITY ▪ EXCELLENCE ▪ PEOPLE & CITIZENSHIP ▪

PEOPLE POWERING THE FUTURE
OPG NUCLEAR

ONTARIO POWER GENERATION

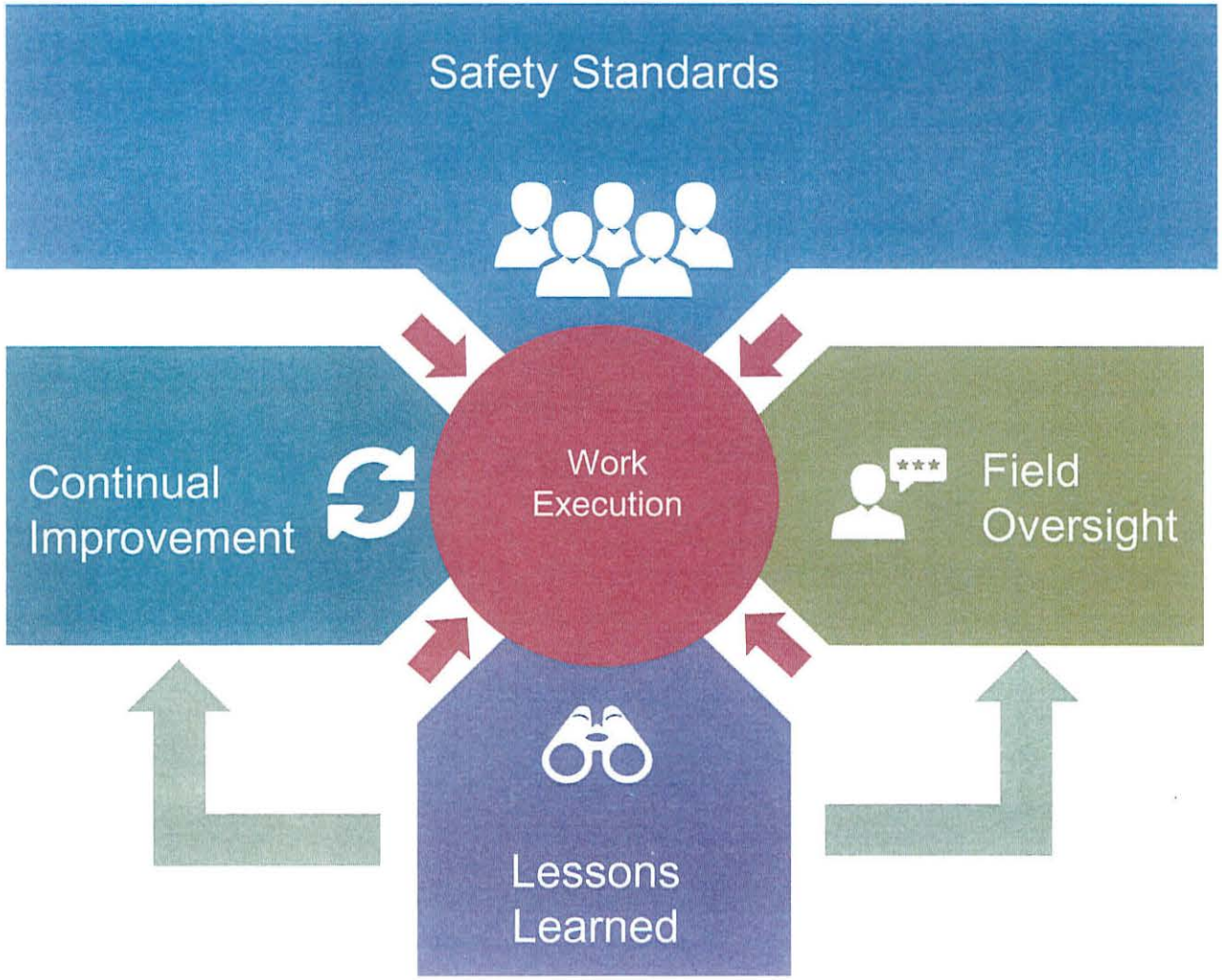
# Our Core Value



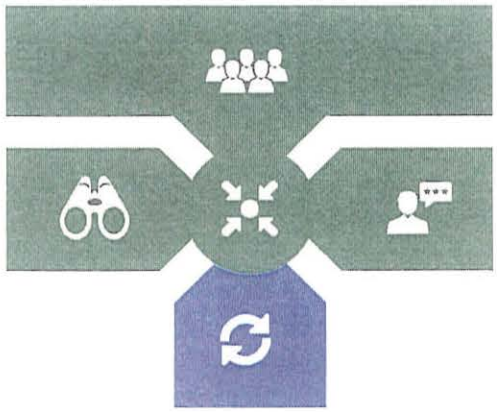

## Safety is our Core Value

- Internal communications
- External messaging
- Expectations
- Contracts

# Safety Management Program

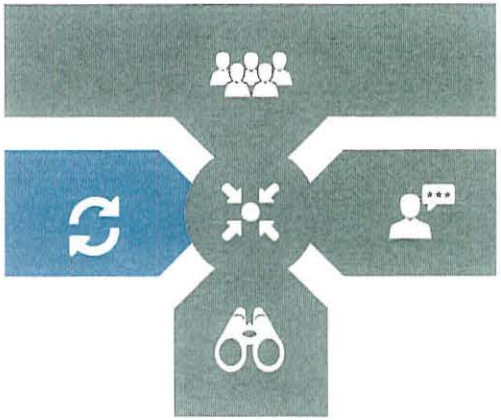


# Lesson Learned – Key Findings



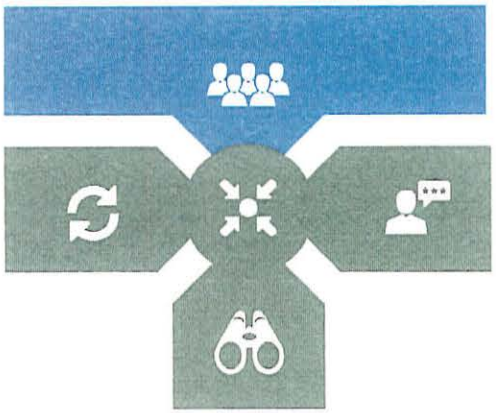
- Incident Management
- Vendor Safe Work Planning
- Vendor Conformance with Hazardous Materials Process
- Constructor Supervisor Role
- Tracking and Trending of Safety Data

# Lessons Learned and Continual Improvement



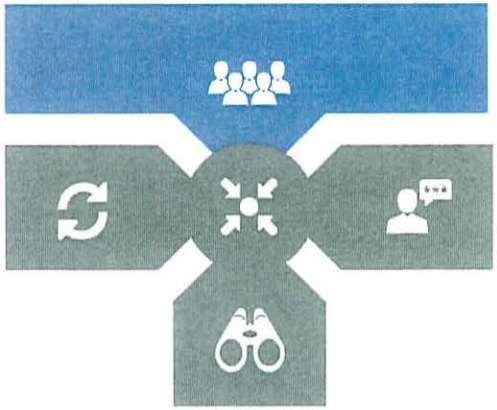
- Incident management coordination
- Quality safe work planning
- Hazardous material management
- Chemical and hazardous material sampling
- Constructor supervisor accountabilities
- Safety data management

# Safety Standards into Contracts



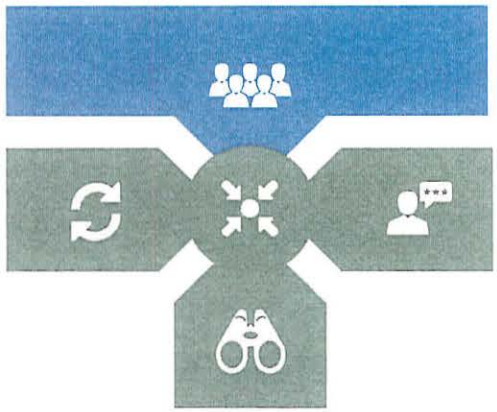
- Pre-qualification of prime and sub contractors
- Hazard controls and safety management system requirements
- Reporting requirements
  - Lagging and leading indicators
  - Corrective action programs

# Detailed Program Reviews



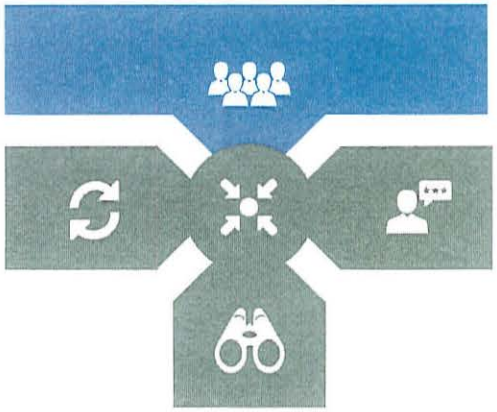
- GAP analysis against the Safety Management Essentials Guide
- Site Specific Safety Management Plans developed and reviewed
- Safe Work Plans and Comprehensive Work Packages developed

# Integrated Safety Program



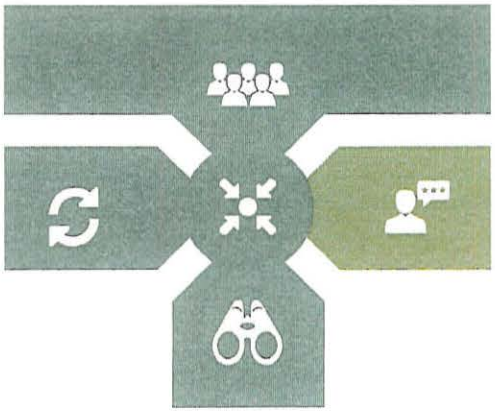
- Delegation of Roles for safety accountabilities
- Management oversight
  - Reporting, trending, management oversight meetings, contractor daily calls, quarterly executive partnership meetings

# Regulatory management



- OPG as constructor
- Center-led Health and Safety organization support
- Regulator relationship building
- Conservative approach to notifications
- Strong Building Trades Union JHSC and Workers Trade Committee relations

# Field Oversight



- Dedicated safety team – with support from across OPG as necessary
- Risk Based
- Vertical and Horizontal
- Ad Hoc
- Multiple groups including contractors

# Questions?

# Nuclear Safety Culture

Bill Owens
VP – Refurb Execution

BEHAVIOURS

- Say It, Do It
- Simplify It




VALUES ▪ SAFETY ▪ INTEGRITY ▪ EXCELLENCE ▪ PEOPLE & CITIZENSHIP ▪

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OPG NUCLEAR

ONTARIO POWER GENERATION

# Assessment Process

- **Safety Culture:**

  ***An organization's values and behaviours—modeled by its leaders and internalized by its members—that serve to make nuclear safety the overriding priority.***

- **Assessment process:**
- **The assessment's model of a safety culture, the structure of the assessment process, and the results of the assessment are expressed in terms of INPO's "*Traits and Attributes of a Healthy Nuclear Safety Culture*"**
  - **Interviews and Field Observations looking at opinions and perceptions**
    - **8 field observations**
    - **>90 interviews (9 Focus Groups)**
    - **>750 comments**
    - **>1500 data points**
    - **81 Question Survey - >1930 Respondents (93% OPG & Contract Partners)**
    - **Documentation Review - Root Causes/Performance metrics, EFDR's etc**

# Survey Results

## 1 Positive Observation
## 1 Strength
## 3 Weaknesses
## 1 Negative Observation

| Safety Trait | Ref Grp | 9 Org Avg |
|---|---|---|
| PA - Personal Accountability | 5.94 | 5.89 |
| QA - Questioning Attitude | 5.79 | 5.84 |
| CO – Effective Safety Communications | 5.32 | 5.45 |
| LA - Leadership Safety Values and Actions | 5.48 | 5.59 |
| DM - Decision Making | 5.64 | 5.76 |
| WE - Respectful Work Environment | 5.40 | 5.53 |
| CL - Continuous Learning | 5.57 | 5.68 |
| PI - Problem Identification and Resolution | 5.39 | 5.47 |
| RC - Environment for Raising Concerns | 5.76 | 5.74 |
| WP - Work Processes | 5.58 | 5.67 |

# Survey Results - Continued

- **Positive Observation -** There is evidence that there is a **strong sense of mission** among staff and a genuine desire to be successful.

**Strength -** Leadership's **commitment to safety** is consistently communicated across all levels of nuclear projects. As a result, staff feel empowered to stop work and raise concerns to line management and supervision when they feel unsure of their activities, or if something appears not to be safe.

# Survey Results Continued

- **Weakness -** Nuclear Safety traits and their importance **are not consistently understood**, internalized or measured. Additionally, there is evidence that the messaging is not seen as relevant at the working level. As a result, potential declining trends in safety culture performance may remain undetected and the project will be at risk of events.
- **Weakness -** Across the Nuclear Projects organization, the operating station and our Contract Partners **there is a lack of respect** and sense of common purpose and values. This has resulted in safety and HU events during the execution of projects.
- **Weakness -** Some staff are **lowering their standards** to meet schedule pressures. There are rigorous processes and procedures in place for the planning and execution of work. In some instances, there are indications they are not being followed.
- **Negative Observation -** Actions to **correct long standing problems** are not being prioritized for timely resolution. Some corrective actions from station evaluations have not been implemented in nuclear projects to prevent repeat events.

# Conclusion

- Commitment to safety
- Respectful work environment
- Understand how impact Nuclear Safety
- Not timely resolution of long standing problems
- Lowering standards in the face of schedule pressure

- The assessment team concludes that Nuclear Projects has a good Nuclear Safety Culture with a respect for nuclear safety.

# Next Steps

- Communication to staff on findings
- Written Draft Report within 30 days, final report 60 days
- Develop Corrective actions based on feedback - June 6th
- Develop terms of reference and establish a Joint Darlington Site Nuclear Safety Monitoring Panel - June 6th
- Blue Card Worker Concern process implemented – May 15th

# Questions?

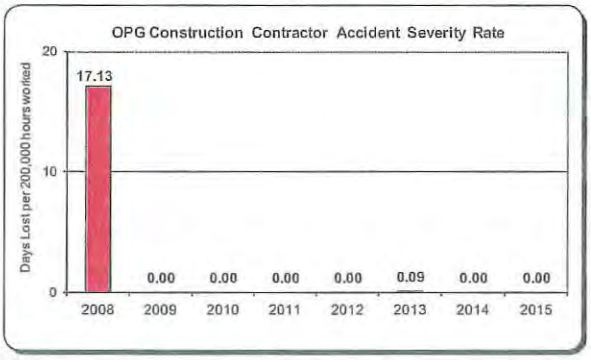
# 2015 OPG Contractor Safety Performance

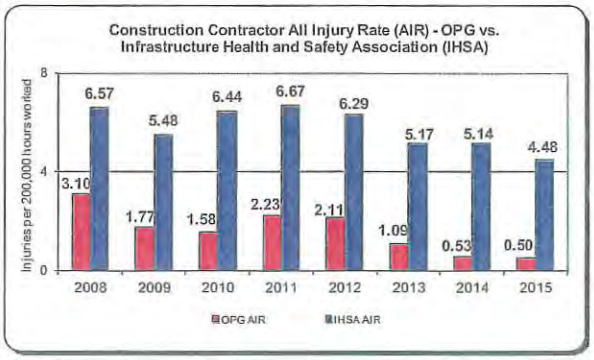
## OPG Performance Summary

| Contractor Events | Construction Contractors[1] (OPG is Constructor) | | Non-Construction Contractors | |
|---|---|---|---|---|
| | 2014 | 2015 | 2014 | 2015 |
| Accident Severity Rate (# days lost per 200,000 hours) | 0.00 | 0.00 | 0 day lost ASR not tracked | 0 day lost ASR not tracked |
| All Injury Rate (# lost time injuries + medical treatment injuries per 200,000 hours) | 0.53 | 0.50 | 3 injuries AIR not tracked | 1 injury AIR not tracked |
| Contractor High MRPH Incidents | 6 | 7 | 1 | 0 |
| Ministry of Labour Orders to Comply | 3 | 2 | 0 | 0 |

- Total hours worked reported by OPG Construction Contractors in 2015 is 32% higher than in 2014 (37% higher in Nuclear and 35% lower in Hydro-Thermal Operations).

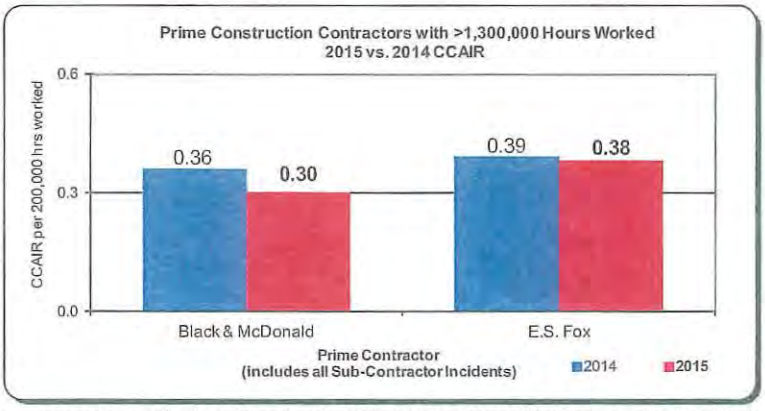
## OPG Construction Contractor ASR and AIR Trends




- OPG Construction Contractor (where OPG is the Constructor) safety performance in 2015 as measured by the Accident Severity Rate (ASR) is zero.
- The last two OPG Construction Contractor lost time injuries occurred on Oct 3, 2013 and Feb 12, 2008.
- OPG's Construction Contractor AIR performance of 0.50 injuries per 200,000 hours worked in 2015 is significantly better than the IHSA AIR of 4.48 in 2015 and is 6% better than 2014 performance of 0.53.
- See Appendix A for detailed Business performance.

## Construction Contractor Trends




- There were 2 prime Construction Contractors (and their sub-contractors) that worked more than 1,300,000 hours at OPG. These 2 prime Construction Contractors worked a total of 3,427,138 hours or 86% of all hours worked.
- There were 10 OPG injuries (10 medical treatment and 0 lost time) for Construction Contractors (7 in Nuclear and 3 in Hydro-Thermal) in 2015:
  - 3 injuries (2 MSDs and 1 impact) at Nuc Projects - Darlington Projects (E.S. Fox)
  - 2 injuries (a caught by/pinned injury for E.S. Fox and an environmental exposure injury for Black & McDonald) at Darlington - Maintenance
  - 1 injury (MSD) at Nuclear Projects - Darlington Refurbishment (Aecon)
  - 1 injury (impact) at Nuclear Projects - Pickering Projects (Black & McDonald)
  - 1 injury (impact) at Central Operations (Killarney, subcontractor to Alltrade)
  - 1 injury ((caught by/pinned) at OSPG, Eastern Operations (M Sullivan & Son)
  - 1 injury (slip/trip) at Atikokan GS, Northwest Operations (Worley Parsons)
- See Appendix B for detailed information for Prime Construction Contractors.

## High MRPH Trends

- There were 7 Contractor (7 Construction and 0 Non-Construction) High MRPH incidents in 2015. There were 7 Contractor (6 Construction and 1 Non-Construction) High MRPH incidents reported in 2014.
- The 7 Construction Contractor High MRPH incidents in 2015 (5 in Nuclear and 2 in Hydro-Thermal) involved:
  - 4 potential fall from height incidents in Nuclear:
    - 1 incident at Darlington Maintenance (E.S. Fox)
    - 1 incident at Decommissioning & Nuclear Waste Management - Maintenance (Bruce Power)
    - 1 incident at Nuclear Projects - Darlington Projects (E.S. Fox)
    - 1 incident at Nuclear Projects - Darlington Refurbishment (Aecon)
  - 1 impact incident at Nuclear Projects - Darlington Projects (E.S. Fox) resulted in a medical treatment injury.
  - 1 motor vehicle incident at Central Operations (Killarney, subcontractor to Alltrade)
  - 1 falling object incident at OSPG, Eastern Operations (M Sullivan & Son)

[1] **Construction Contractor:** Includes all workers who are employed by a company that is contracted by OPG to perform or support work on OPG premises involving construction trades (e.g. scaffolders, boilermakers, ironworkers, labourers, etc.). BTU temporary workers who are directly employed by OPG are included in the OPG employee count and are not included in this definition.

## Appendix A
## 2015 Construction Contractor Safety Performance

| | Construction Contractor Exposure Hours | Construction Contractor High MRPH Incidents | Lost Time Injuries | Days Lost | Medical Treatment Injuries | MOL Orders | Construction Contractor All Injury Rate/ 200,000 Hours | Construction Contractor Accident Severity Rate/ 200,000 Hours |
|---|---|---|---|---|---|---|---|---|
| **NUCLEAR** | **3,827,485.2** | **5** | **0** | **0** | **7** | **2** | **0.37** | **0.00** |
| Darlington - Maintenance | 867,098.0 | 1 | 0 | 0 | 2 | 0 | 0.46 | 0.00 |
| Decommissioning & Nuclear Waste Management - Maintenance | 8,326.0 | 1 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Decommissioning & Nuclear Waste Management - Used Fuel Dry Storage | 40.0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Nuclear Engineering - Modifications | 26,214.0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Nuclear Projects - Darlington Projects | 1,808,756.9 | 2 | 0 | 0 | 3 | 2 | 0.33 | 0.00 |
| Nuclear Projects - Darlington Refurbishment | 310,214.0 | 1 | 0 | 0 | 1 | 0 | 0.64 | 0.00 |
| Nuclear Projects - NWMD Projects | 182.0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Nuclear Projects - Pickering Projects | 481,748.0 | 0 | 0 | 0 | 1 | 0 | 0.42 | 0.00 |
| Pickering - Maintenance - Integrated Operating Plan | 5,169.0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Pickering - Maintenance - Outage | 319,737.3 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| **HYDRO-THERMAL OPERATIONS** | **136,093.2** | **2** | **0** | **0** | **3** | **0** | **4.41** | **0.00** |
| Central Operations | 5,616.5 | 1 | 0 | 0 | 1 | 0 | 35.61 | 0.00 |
| Niagara Operations | 33,439.5 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Northeast Operations | 7,748.0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Eastern Operations | 39,033.0 | 1 | 0 | 0 | 1 | 0 | 5.12 | 0.00 |
| Lennox GS | 2,648.0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Ottawa St. Lawrence PG | 36,385.0 | 1 | 0 | 0 | 1 | 0 | 5.50 | 0.00 |
| Northwest Operations | 33,639.0 | 0 | 0 | 0 | 1 | 0 | 5.95 | 0.00 |
| Northwest PG | 15,827.0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Atikokan GS | 8,814.0 | 0 | 0 | 0 | 1 | 0 | 22.69 | 0.00 |
| Thunder Bay GS | 8,998.0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Southwest Operations | 16,617.2 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Lambton GS | 10,770.2 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Nanticoke GS | 5,847.0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| **BUSINESS & ADMIN SERVICES - FACILITIES & PROJECTS** | **13,441.0** | **0** | **0** | **0** | **0** | **0** | **0.00** | **0.00** |
| **OPG CONSTRUCTION CONTRACTOR TOTALS*** | **3,977,019.4** | **7** | **0** | **0** | **10** | **2** | **0.50** | **0.00** |

NOTES*:
Report based on "best readily available" data provided from sites.
Based on contractor safety performance information provided by site safety staff as of Feb 12, 2016.
Data for Construction Contractors only.

3

## Appendix B
## 2015 OPG Construction Contractor Safety Performance By Prime Contractor

| Prime Contractor (includes all sub-contractor incidents) | Construction Contractor Exposure Hours | High MRPH Incidents | Lost Time Injuries | Days Lost | Medical Treatment Injuries | MOL Orders | Construction Contractor All Injury Rate/ 200,000 Hours | Construction Contractor Accident Severity Rate/ 200,000 Hours |
|---|---|---|---|---|---|---|---|---|
| ABB | [redacted] | | | | | | | |
| Adelt | | | | | | | | |
| Aecon | | | | | | | | |
| Alltrade | | | | | | | | |
| Alstom | | | | | | | | |
| Alstom Power | | | | | | | | |
| Alstom/GE | | | | | | | | |
| Aluma | | | | | | | | |
| Amec Foster Wheeler | | | | | | | | |
| Andritz | | | | | | | | |
| Andritz AFI | | | | | | | | |
| Andritz Hydro | | | | | | | | |
| Asbex | | | | | | | | |
| Babcock & Wilcox | | | | | | | | |
| Beckwith | | | | | | | | |
| Black & McDonald | | | | | | | | |
| Bothwell-Accurate | | | | | | | | |
| Bruce Power (Scaffold Services) | | | | | | | | |
| Brunos | | | | | | | | |
| Charles Turner | | | | | | | | |
| CIMS | | | | | | | | |
| Clara | | | | | | | | |
| Curran | | | | | | | | |
| Dean Chandler | | | | | | | | |
| Dean Chandler Roofing | | | | | | | | |
| Design E | | | | | | | | |
| E.S. Fox | | | | | | | | |
| EEC | | | | | | | | |
| Ellis Don | | | | | | | | |
| Fike | | | | | | | | |
| Focus Enviromental | | | | | | | | |
| GC Rentals | | | | | | | | |
| Hemi Controls | | | | | | | | |
| IEC | | | | | | | | |
| Insultek | | | | | | | | |
| Kel Gor | | | | | | | | |
| Kolostat | | | | | | | | |
| Lakehead insulation | | | | | | | | |
| Lancaster | | | | | | | | |
| LAR | | | | | | | | |
| Lisgar Construction Co | | | | | | | | |
| LTL | | | | | | | | |
| LTL Contracting | | | | | | | | |
| M Sullivan and Son | | | | | | | | |
| Mckay Cocker | | | | | | | | |
| Newman Brothers Ltd | | | | | | | | |
| Nordmin | | | | | | | | |
| Northern Painters | | | | | | | | |
| Otis | | | | | | | | |
| PGL | | | | | | | | |
| Powerline Plus | | | | | | | | |
| Process Baron | | | | | | | | |
| Process Group | | | | | | | | |
| PSSL | | | | | | | | |
| Skeates | | | | | | | | |
| Skyway | | | | | | | | |
| Sparling | | | | | | | | |
| Star Tile | | | | | | | | |
| State Group | | | | | | | | |
| Stradwicks | | | | | | | | |
| Stuart Olson | | | | | | | | |

## Appendix B
## 2015 OPG Construction Contractor Safety Performance By Prime Contractor

| Prime Contractor (includes all sub-contractor incidents) | Construction Contractor Exposure Hours | High MRPH Incidents | Lost Time Injuries | Days Lost | Medical Treatment Injuries | MOL Orders | Construction Contractor All Injury Rate/ 200,000 Hours | Construction Contractor Accident Severity Rate/ 200,000 Hours |
|---|---|---|---|---|---|---|---|---|
| T A Andre | [redacted] | | | | | | | |
| Thomas Wharton | | | | | | | | |
| Tower Scaffold | | | | | | | | |
| Triple M Demolition | | | | | | | | |
| Universal Painting | | | | | | | | |
| Valard Construction | | | | | | | | |
| Vector | | | | | | | | |
| Vector Construction | | | | | | | | |
| Venasky Pouru | | | | | | | | |
| Venshore | | | | | | | | |
| Vipond | | | | | | | | |
| White Pine | | | | | | | | |
| Worley Parsons | | | | | | | | |
| **OPG CONSTRUCTION CONTRACTOR TOTALS*** | | | | | | | | |

**NOTES*:**
Report based on "best readily available" data provided from sites.
Based on contractor safety performance information provided by site safety staff as of Feb 12, 2016.
Data for Construction Contractors only.

ONTARIO POWER GENERATION

# Darlington Nuclear Refurbishment Program Mar '16

DRC Status Report

## SAFETY & QUALITY

**Period Ending:** 31-Mar-16

### SAFETY PERFORMANCE - YEAR TO DATE (YTD)

| | Actual | Target | Status | Trend |
|---|---|---|---|---|
| All Injury Rate (AIR) | | | | |
| Ontario Power Generation NR Staff | 0.00 | 0.24 | | - |

### EXPLANATORY NOTES

Feb: JV TG High MRPH: D-2016-5086 - Turbine Hall Lights Damage

Mar: OT SL First Aid: N-2016-07738 - WCT; Partition made contact with worker

### BUNDLE SAFETY PERFORMANCE - YEAR TO DATE (YTD)

| | | All Injury Rate (AIR) | Accident Severity Rate | Reported Safety Incidents | | | Potential Incidents | | | | Hours Worked |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | Bundles | Actual | Actual | # Lost Time Injury | # Medical Injuries | # First Aid Injuries | # High MRPH | # Medium MRPH | # Lvl 1 Work Protection Events | # Proactive Unsafe Observations | |
| 1 | RFR (Retube Feeder Replacement) | [redacted] | | | | | | | | | |
| 2 | TG (Turbine Generator) | | | | | | | | | | |
| 3 | BOP (Balance of Plant) | | | | | | | | | | |
| 4 | FH /DF (Fuel Handling / Defueling) | | | | | | | | | | |
| 5 | SG (Steam Generator) | | | | | | | | | | |
| 6 | SL (Shutdown Layup) | | | | | | | | | | |
| 7 | IL (Unit Islanding) | | | | | | | | | | |
| 8 | Campus Plan | | | | | | | | | | |
| 9 | **Nuclear Refurbishment Performance** | **0.00** | **0.00** | **0** | **0** | **0** | **1** | **0** | **0** | **95** | **233,676** |

### VENDOR SAFETY PERFORMANCE - YEAR TO DATE (YTD)

| | | All Injury Rate (AIR) | Accident Severity Rate | Reported Safety Incidents | | | Potential Incidents | | | | Hours Worked |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | Bundles | Actual | Actual | # Lost Time Injury | # Medical Injuries | # First Aid Injuries | # High MRPH | # Medium MRPH | # Lvl 1 Work Protection Events | # Proactive Unsafe Observations | |
| 1 | SNC-Lavalin & Aecon [Joint Venture] (JV) | [redacted] | | | | | | | | | |
| 2 | E.S. Fox Ltd. [ONE Team] (OT) | | | | | | | | | | |
| 3 | Babcock & Wilcox [BWXT] (BW) | | | | | | | | | | |
| 4 | Black & McDonald (BM) | | | | | | | | | | |
| 5 | General Electric [Alstom] (GE-A) | | | | | | | | | | |
| 6 | General Electric [Hitachi Nuclear] (GE-HN) | | | | | | | | | | |

### QUALITY

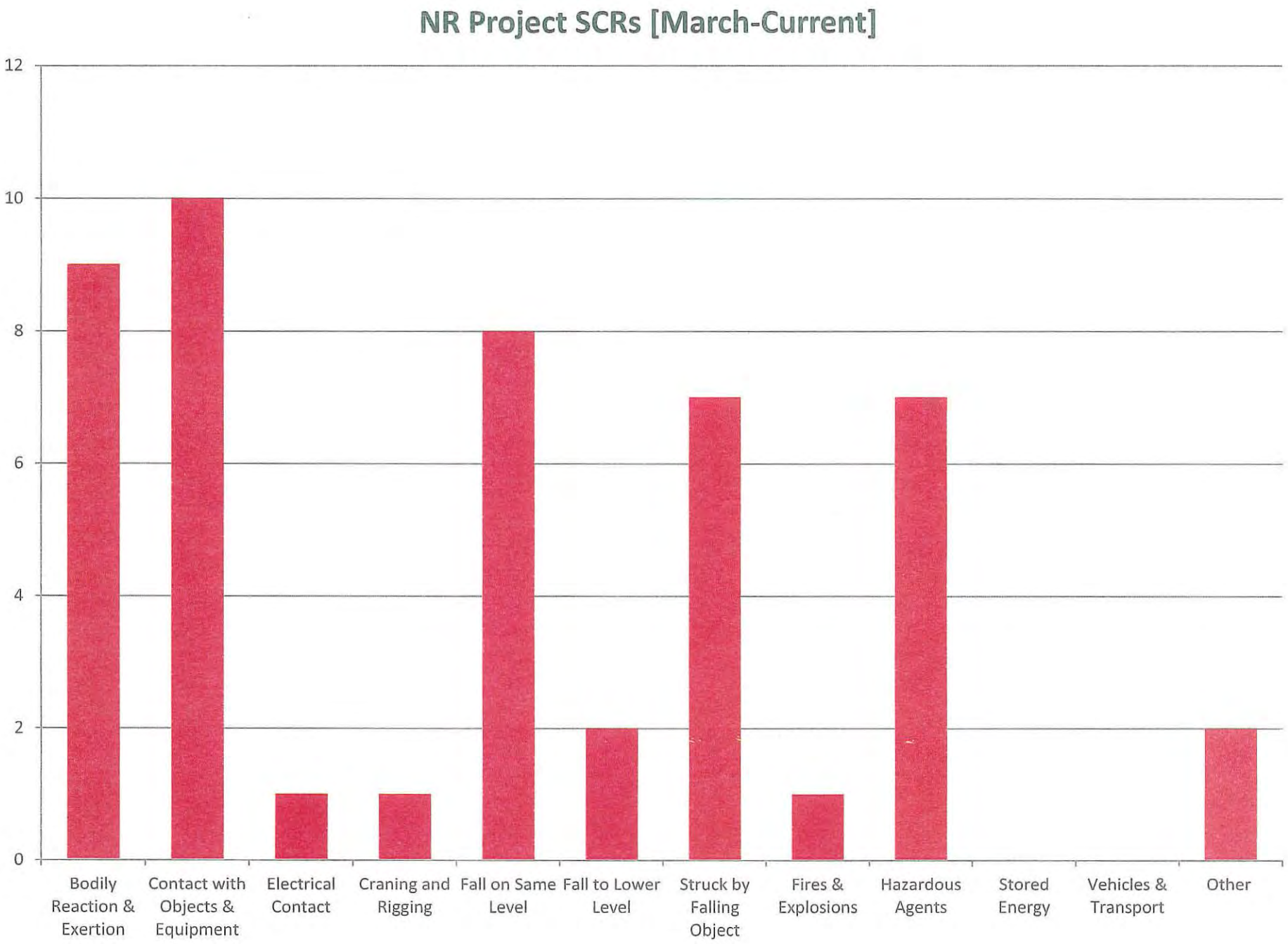
# Contractor Nuclear Refurbishment Safety Performance Metrics 2016

ONTARIO POWER GENERATION

| Vendor: | All EPC Contractors | Project: | Nuclear Refurbishment |
|---|---|---|---|

INSTRUCIONS

| | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | YTD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Calculated Values | AIR | 0.00 | 0.00 | 0.00 | | | | | | | | | | 0.00 |
| | ASR | 0.00 | 0.00 | 0.00 | | | | | | | | | | 0.00 |
| | TRIR / TRIF | 0.00 | 0.00 | 0.00 | | | | | | | | | | 0.00 |
| | DART | 0.00 | 0.00 | 0.00 | | | | | | | | | | 0.00 |
| | LTI Frequency | 0.00 | 0.00 | 0.00 | | | | | | | | | | 0.00 |
| | Hours Worked | 70,622 | 78,089 | 84,965 | | | | | | | | | | 233,676 |
| Lagging Indicators | First Aid Injury | 0 | 0 | 1 | | | | | | | | | | 1 |
| | Medical Injury | 0 | 0 | 0 | | | | | | | | | | 0 |
| | Days Lost | 0 | 0 | 0 | | | | | | | | | | 0 |
| | Lost Time Injury | 0 | 0 | 0 | | | | | | | | | | 0 |
| | Modified Duty | 0 | 0 | 0 | | | | | | | | | | 0 |
| | MOL Reportable Injury | 0 | 0 | 0 | | | | | | | | | | 0 |
| | MOL Reportable Incident | 0 | 0 | 0 | | | | | | | | | | 0 |
| | MOL Compliance Order | 0 | 0 | 0 | | | | | | | | | | 0 |
| | MOL Work Stoppage | 0 | 0 | 0 | | | | | | | | | | 0 |
| | JHSC Work Stoppage | 0 | 0 | 0 | | | | | | | | | | 0 |
| | Work Refusal | 0 | 0 | 0 | | | | | | | | | | 0 |
| | Serious Electrical Incident (ESA) | 0 | 0 | 0 | | | | | | | | | | 0 |
| Leading Indicators | Med MRPH | 0 | 0 | 0 | | | | | | | | | | 0 |
| | High MRPH | 0 | 1 | 0 | | | | | | | | | | 1 |
| | # of proactive unsafe observations | 8 | 51 | 36 | | | | | | | | | | 95 |
| | % of Corrective Actions Closed Out in Time | 100% | 100% | 100% | | | | | | | | | | |
| | # of open issues | 0 | 1 | 1 | | | | | | | | | | |


NR Project SCRs [March-Current]
12
10
8
6
4
2
0
Bodily Reaction & Exertion
Contact with Objects & Equipment
Electrical Contact
Craning and Rigging
Fall on Same Level
Fall to Lower Level
Struck by Falling Object
Fires & Explosions
Hazardous Agents
Stored Energy
Vehicles & Transport
Other

| April 27 (DAY 3) | Presenter/Lead | Time |
|---|---|---|
| **Arrival/Coffee** | RCRB Members | 07:00-07:30 |
| **Schedule** | Karen Fritz | 07:30-10:00 |
| **Break** | | 10:00-10:15 |
| **Station Integration** | Boris Vulanovic and Steve Gregoris | 10:15-11:45 |
| **Lunch** | | 11:45-12:15 |
| **Managed Systems and Oversight** | Dave Stiers | 12:15-13:15 |
| **Quality** | Imtiaz Malek | 13:15-14:15 |
| **Break** | | 14:15-14:30 |
| **Regulatory** | Robin Manley | 14:30-15:30 |
| **Contracts and Contract Management** | Doug Semple | 15:30-16:30 |
| **Mock Up Follow-Up: Tooling and Owner Specified Materials** | Roy Brown | 16:30-17:30 |
| **Member Discussion** | RCRB Members | 17:30-18:00 |

# Darlington Nuclear Refurbishment Program

## RCRB Refurbishment Schedule Overview

**BEHAVIOURS**

- Say It, Do It
- Simplify It
- Think Top and Bottom Line



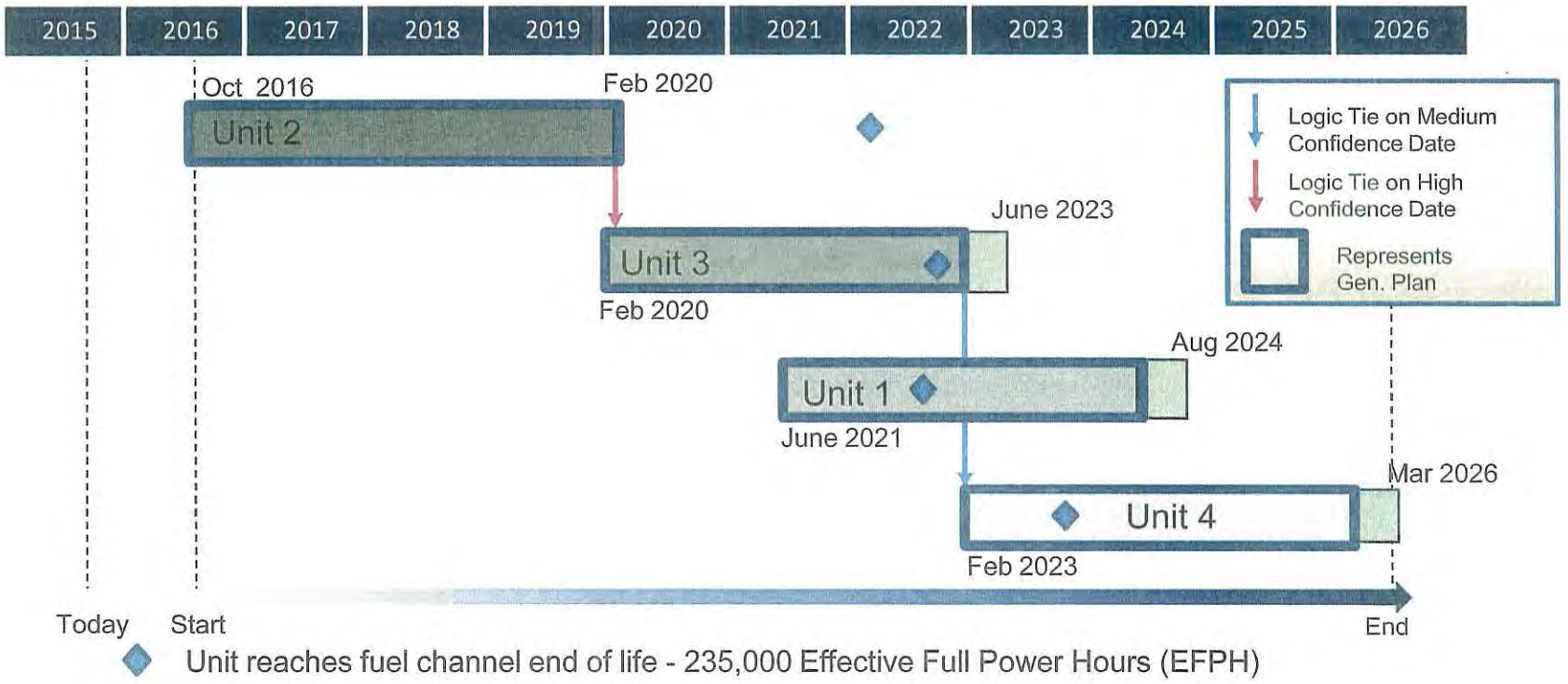

VALUES ▪ SAFETY ▪ INTEGRITY ▪ EXCELLENCE ▪ PEOPLE & CITIZENSHIP ▪

PEOPLE POWERING THE FUTURE
OPG NUCLEAR

ONTARIO POWER GENERATION

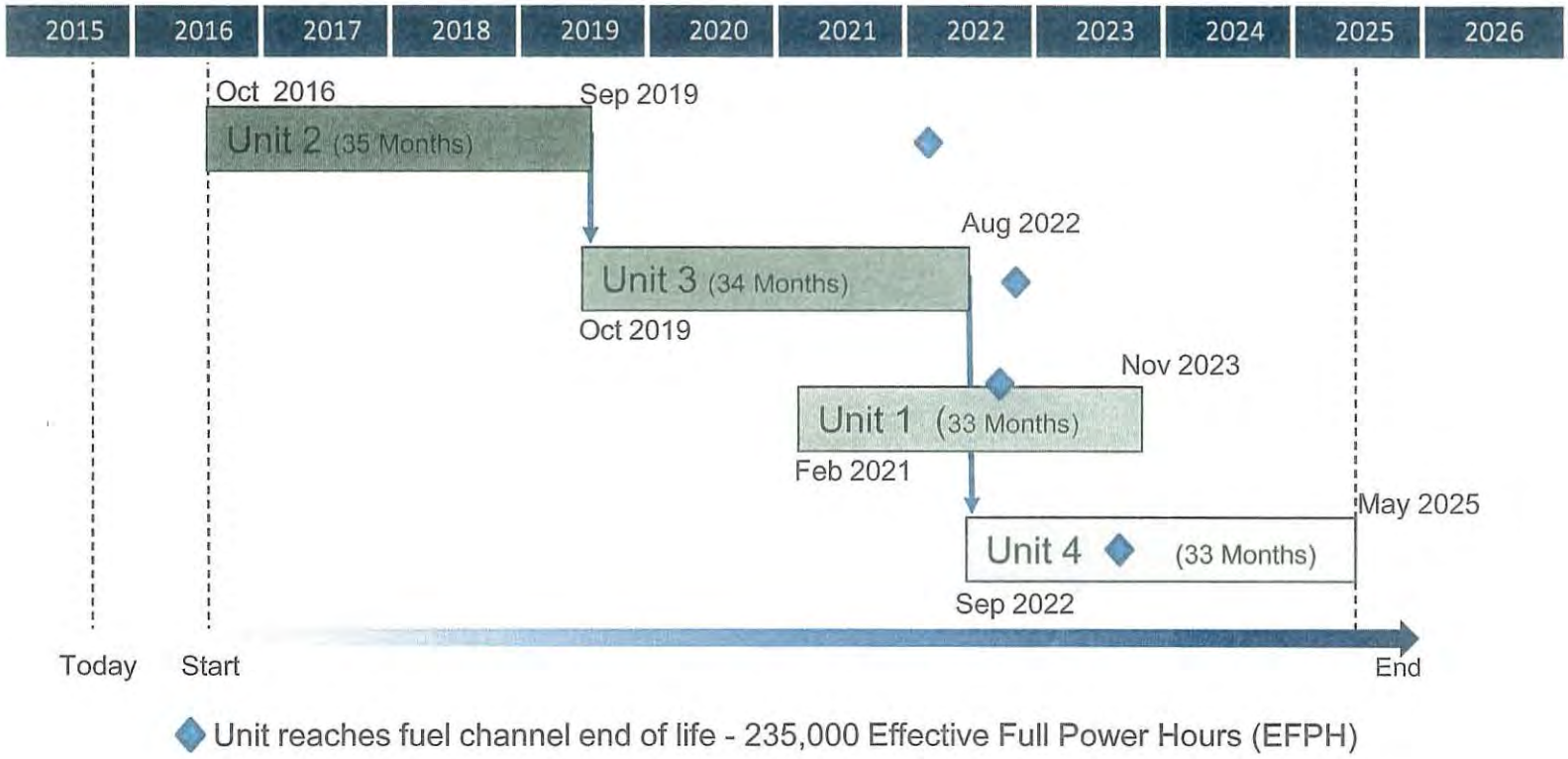
# Schedule: Business/Generation Plan View

- The **APPROVED** high confidence schedule, which includes contingency, assumes the first unit outage will commence in Oct. 2016 with each unit lasting 37 to 40 months.
  - For Generation planning, OPG assumed the high confidence 40 month schedule for the first unit and the medium confidence schedule for the subsequent units.
- The LTEP and the Shareholder require us to incorporate off-ramps, thus, it is imperative that we succeed on each unit in order to get the approval to proceed to the next unit.

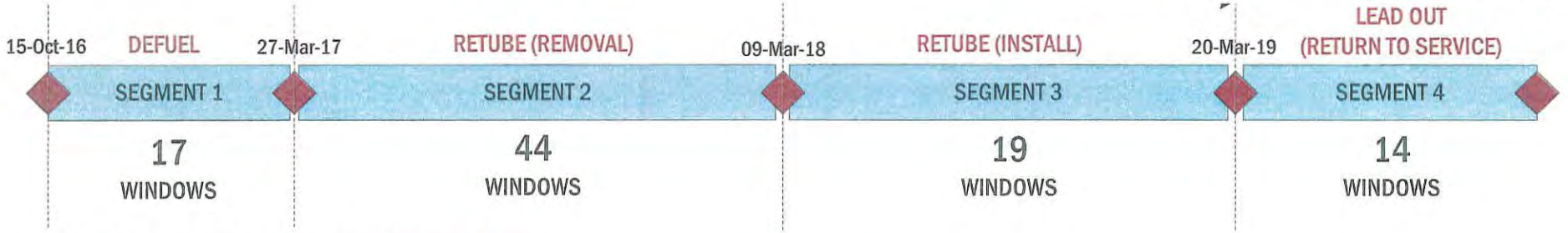


# Schedule: Execution Phase View

- For purposes of managing the project, OPG will pursue a target schedule (as shown below) based on the Level 3 schedules provided by each of the vendors and integrated into OPG's master schedule.



# Unit 2 Schedule: 4 Segments




**Breaker to Breaker: 1060 days**

**895 days between end of Defuel and Approach to Critical**

**60% mark of RFR activities is Day #651 (July 28, 2018)**

**Segment 1: 163 days**

113 days to Defuel

49 days to achieve Containment Isolation (bulkhead install) and containment test

**Segment 2: One Year in duration**

90 days to install bulkhead shielding, remove interferences and bridges & install RTP's

66 days for feeder cabinet removal and feeder removals

192 days for all pressure tube, calandria tube removals

**Segment 3: One Year in duration**

147 days to install calandria tubes

141 days to install fuel channels

87 days to install lower feeders

**Segment 4: 175 days**

114 days to load fuel and restore the vault

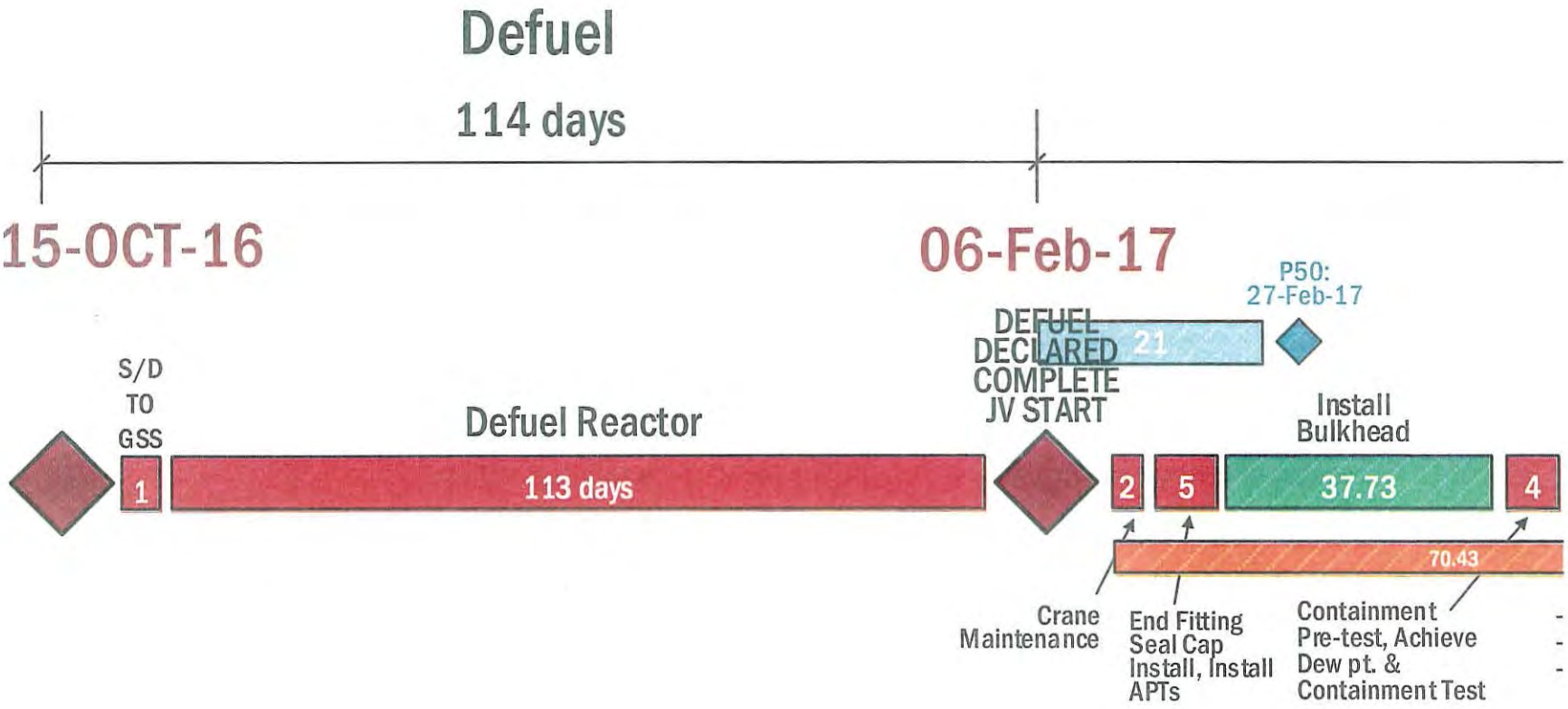
57 days to run-up, sync and perform high power testing

# Unit 2 Schedule: Segment 1

## Segment 1: 163 days

113 days to Defuel

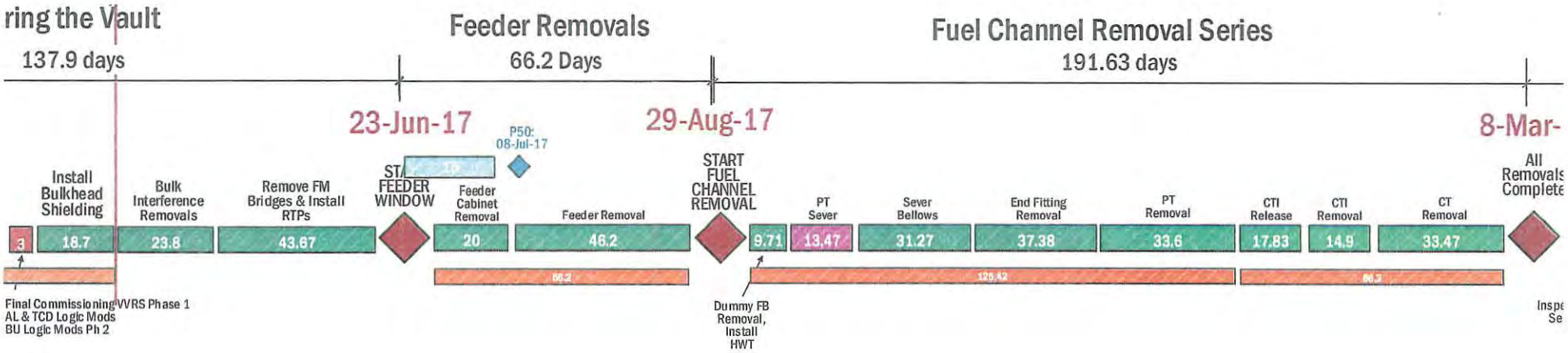
49 days to achieve Containment Isolation (bulkhead install) and containment test



# Unit 2 Schedule: Segment 2

## Segment 2: One Year in duration

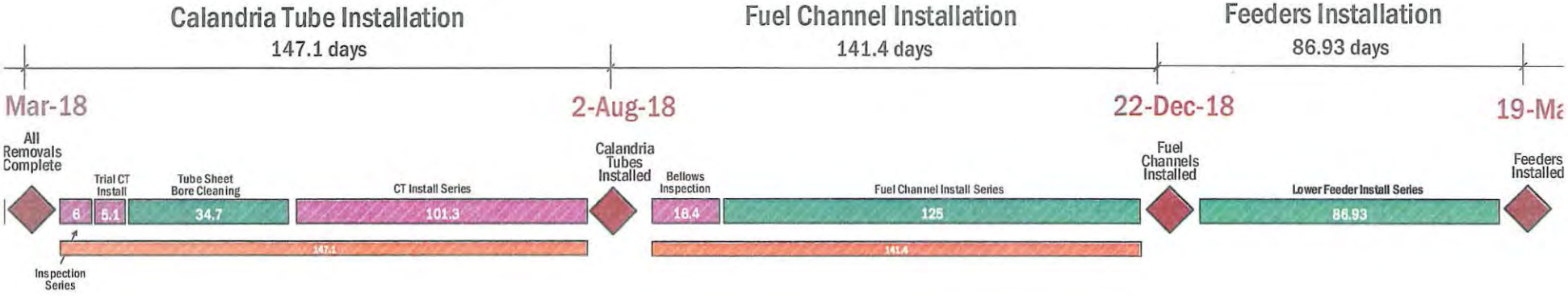
90 days to install bulkhead shielding, remove interferences and bridges & install RTP's
66 days for feeder cabinet removal and feeder removals
192 days for all pressure tube, calandria tube removals



# Unit 2 Schedule: Segment 3

## Segment 3: One Year in duration

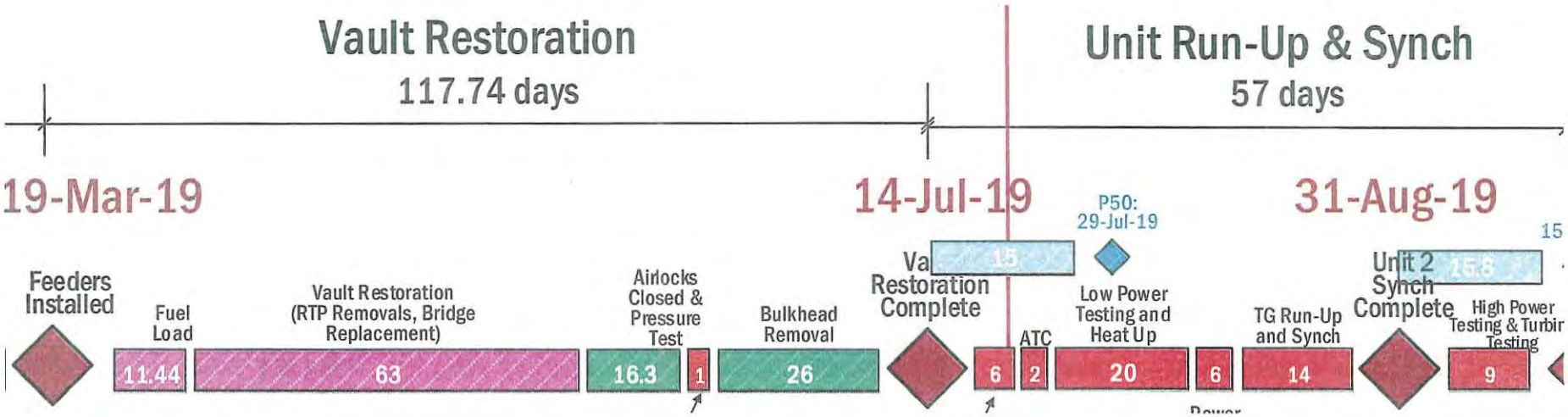
147 days to install calandria tubes
141 days to install fuel channels
87 days to install lower feeders



# Unit 2 Schedule: Segment 4

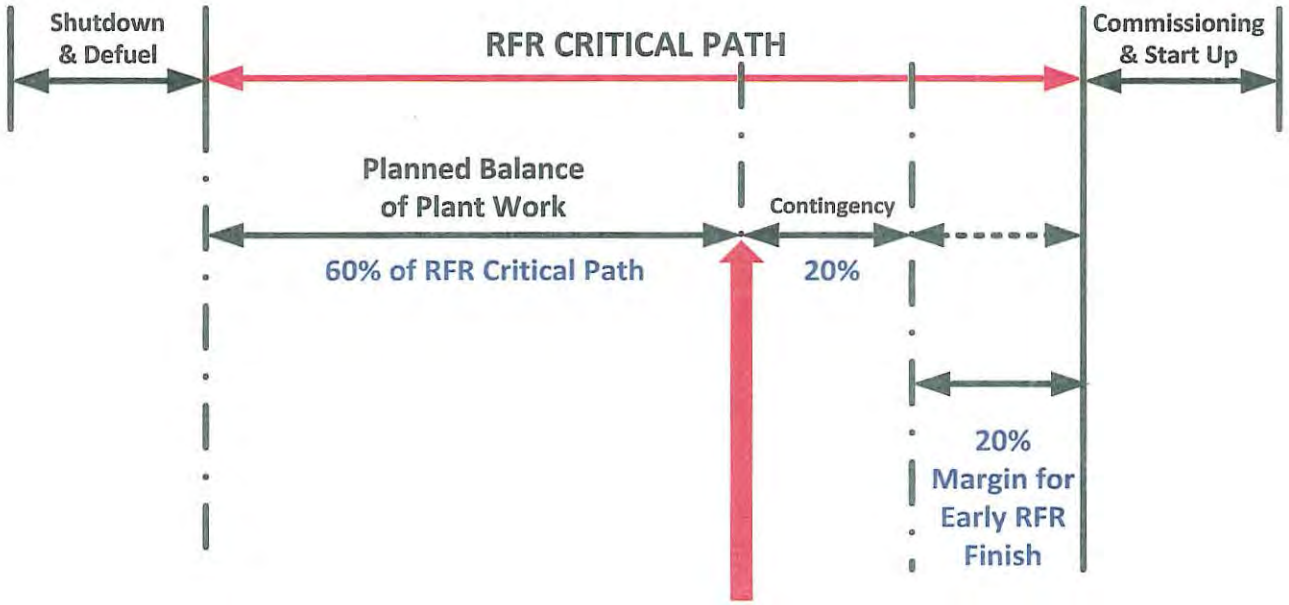
## Segment 4: 175 days

114 days to load fuel and restore the vault
57 days to run-up, sync and perform high power testing



# Schedule Management

- In order to maximize success of Refurbishment, planned non-critical path work (i.e. Balance of Plant work) will not exceed 60% of the critical path (Re-tube and Feeder Replacement) execution window.




- 60% mark is July 18, 2018

# U2 High Level Schedule

DARLINGTON REFURBISHMENT
Repowering Ontario

## Unit 2 Refurbishment Outage

Critical Path Windows
Close to Critical Path/Low Float Windows
Electrical Windows
Turbine/Generator
Reactivity Device Windows
Heat Transport System Windows

UNIT 2 REV B2
April 15, 2016

SEE LARGE PRINT OF LEVEL 1 SCHEDULE

NOTES

1. All schedule logic and level 3 schedules are not yet finalized. Therefore, this schedule and window durations are subject to change within the Unit 2 bounding duration as per the approved November 2015 Release Quality Estimate.
2. RCHP X — Reactor Control Hold Point
3. SGs — Window Name; 062 — Window #
4. W084 — JV Window #
5. Reactor States
   State 1: Reactor Shutdown Evolution
   State 2: Guaranteed Shutdown with Irradiated Fuel Core
   State 3a: Defueled State
   State 3b: Defueled & Isolated from Containment State
   State 4a: Non Irradiated Fuel & Isolated from Containment
   State 4b: Non Irradiated Fuel State
   State 5: Approach to Critical & Return to Service State

REV B2 APPROVALS TO ISSUE

| | |
|---|---|
| Prepared by: | Dan Sawyer, U2 Outage Manager |
| Reviewed by: | Karen Fritz, U2 Outage Director |
| Concurred by: | REQUIRED FOR REV C<br>Boris Vulanovic, Refurbishment DOM |
| Approved by: | REQUIRED FOR REVC<br>Mike Allen, VP Refurbishment Execution |

State 1 | State 2 | State 3a | State 3b | State 4a | State 4b | State 5

# Unit 2 Preparation Strategy

- All Scope identified and defined
- All Engineering Complete
- All Planning Documentation Complete
- Baseline Schedule Complete
- All Permit requirements identified
- All contracts in place/PO's placed
- All parts identified and in tracking tool
- All risk mitigation actions accepted

*Get it ALL ready before breaker open*

# REV 0 Schedule Deliverable

- Unit 2 Outage Duration
  - Big Picture – Level 1 with critical path and critical project milestones identified
  - Window Level P6 generated schedule with interface milestones showing window durations and float
  - 60% RFR limit for BoP work to be complete – overview of strategy
- Methodology to determine critical path duration
  - RFR/RQE/JV methodology
  - RFR/OPG signoffs for each window duration of critical path
  - Critical Path window list with description of each and logic summary
  - Low Float windows and associated risks and schedule management tactics to maintain off critical path
- Schedule Structure
  - Segment Descriptions (include a logic diagram for each segment with a clear start and finish)
  - Schedule State Changes (include a detailed logic diagram for state changes and handoffs)
  - STOP signs – critical hold points
  - Reactor Control Hold Points (RCHP) critical milestones
  - Critical Evolutions – list and approved logic diagrams for each evolution
  - Approved Heat Sink Strategy
  - RTS strategy and process/logic – CCD's, all AFS listings per project, level 3 logic for key RTS windows
  - Windows (window list, durations, start, finish dates, window owners, vendor leaders)
- Schedule Design Basis
  - Approved Window logic justification
- Work Protection Strategy alignment with Scope and Schedule
  - Permit strategy

# REV 0 Schedule Deliverable

- Risks and Issues
  - Top Schedule Risks and associated mitigation plans, accepted by Outage Manager
  - Overall unresolved Schedule Issues list, with owners and resolution dates
- Air/Water/Power
  - Electrical scope schedule strategy (odd/even, breaker overhauls, temporary power mods, vendor supplied power, station power)
  - Critical Water Movements schedule strategy
  - Breathing Air, Service Air usage strategy
- Resources
  - Crew Shift Schedules
  - Resource Profiles for each vendor and OPG
  - Resource optimization plan
  - High float/low logic scope strategy and plan/methodology
- Cyclic Outage
  - Non-Preventative Backlog Management
  - Preventative Maintenance/Cyclic Outage schedule strategy
  - Preventative Maintenance optimization to ensure frequencies and commitments are cost efficient, short cycle PM's
- RTM (layup maintenance) work order optimization and overview
- Strategy to manage systems in service/systems in layup state
- Regulatory Approvals required to perform schedule as planned
- Quality Review of coding and alignment to the WBS
- ALARA/Dose initial strategy, constraints, logic assumptions
- Initial permit strategy, approach (current status of whatever we know)
- Appendix of window logic diagrams for all windows
- Appendix showing all window coding requirements for PEPCCC and DSR Closeout/Tracking

# Unit 2 Schedule Facts

| | |
|---|---|
| Outage Days | 1060 |
| Window Counts | 94 |
| Refurbishment U2 Outage Execution Projects (53- U2 Execution, 1 Cyclical, 16 AISC Projects) | 70 |
| Resource Hours from P6 | 2,577,847 |
| Execution Schedule Activity Counts | 63,101 |
| Comprehensive Work Packages | 679 required for milestone |
| Work Plans (EPC) | 171 |
| TPARs (procedure changes) | 302 |

# Developing an Integrated Schedule

- Outage Manager + Outage Section Manager accountable for integrated schedule
  - Team of 13 Window Managers (for 94 windows)
  - Assigned "Critical Evolution" Managers (roles to be filled)
  - Accountable Issues Manager/team as leads for major issue resolution
  - Schedule Design Basis document to support detailed window logic
- All vendors work in OPG instance of P6
- All schedules within the schedule must follow WBS and all coding
- Metrics and reporting primary pull from the schedule
- Integration managed through Interface Management File
- Key Roles
  - Master Scheduler – accountable for overall integration & interface milestone file management
  - Manager, Scheduling – accountable to manage all OPG schedulers, support all coding and communication with vendor schedulers to enforce standards and quality
  - Vendor Scheduler Leads – accountable to manage the vendor schedules, including all standards and integration

# Developing an Integrated Schedule

## Unit 2 — SG Secondary Side Clean & Install Access Ports Level 2 Logic — Window 037

8 CCW Pumps Avail – requested IPG Schedule no maint during this window via 52W – Feb4/16

Layup 003 being reviewed to put in 037A, eliminates delay for B&W Resources. If we don't need to remove wet skids, only N2 purge. Put BO Waterlance set up in 037 in parallel with N2 purge sample BO1 etc... Build P6 schedule as shown till we know if we need to remove skids.

Window Start — Window Finish

BO1: From Defuel Complete & Cooldown after Vac Dry; Remove Layup; Wind 003 Logic; Pre-Req's; Blowdown Line BO Drain Timing test; Open BO & Setup; Waterlancing; Inspections; Install Access Ports; Inspections; Close BO; Access Port Equip Removal; IMS Equip Setup; Remove Permit & Apply TCR (Up.Man); IMS U-bend Insp; Close Upper Manway; Remove Permit; Leak Check; Sample BO1 Analysis BO1; Post Req's Scaffolding etc.; Samples/ Analysis & Install N2 Layup; Wind 003 Logic; Heat-up & Low Power Testing & CCW Maint Window

Waterlance/ Access Port Equip Setup; BO 1,2,3,4; T-5 day Sample/ Analysis; Sample BO1; Analysis BO1; Drain; Apply Permit; Open Upper Manway; RP Survey; If Fields low enough, partial Fill not req'd. U-bend Insp can be done in parallel.; Perform U-bend Insp; Ongoing Waterlance discharge Analysis req'd.; Waterlance Equip Removal; Install Wet layup skid and reconnect HP demin; Apply Permit & Remove TCR (Up.Man); Partial Fill BO; Fill BO; Drain BO1; Fill BO1; Blowdown Line BO Drain Timing Test; Waterlance/ Access Port Equip Removal

BO3: T-5 day Sample/ Analysis; Analysis BO3; Sample BO3; Apply Permit; Open Upper Manway; RP Survey; If Fields low enough, partial Fill not req'd. U-bend Insp can be done in parallel.; Perform U-bend Insp; Open BO & Setup; Drain; Waterlancing; Inspections; Install Access Ports; Inspections; Close BO; IMS Equip Setup; IMS U-bend Insp; Remove Permit; Leak Check; Remove Permit & Apply TCR (Up.Man); Apply Permit & Remove TCR (Up.Man); Partial Fill BO; Close Upper Manway; Fill BO; SG CCD

BO2: T-5 day Sample/ Analysis; Analysis BO2; Sample BO4; Apply Permit; Open Upper Manway; RP Survey; If Fields low enough, partial Fill not req'd. U-bend Insp can be done in parallel.; Perform U-bend Insp; Open BO & Setup; Drain; Install Access Ports; Inspections; Waterlancing; Inspections; Close BO; IMS Equip Setup; Remove Permit & Apply TCR; IMS U-bend Insp; Remove Permit; IMS FW Nozzle Ut Inspection; Access Port Equip Removal; Ongoing Waterlance discharge Analysis req'd.; Waterlance Equip Removal; Install Wet layup skid and reconnect HP demin; Apply Permit & Remove TCR (Up.Man); Partial Fill BO; Close Upper Manway; Fill BO; SG CCD

BO4: T-5 day Sample/ Analysis; Analysis BO4; Sample BO4; Apply Permit; Open Upper Manway; RP Survey; If Fields low enough, partial Fill not req'd. U-bend Insp can be done in parallel.; Perform U-bend Insp; Open BO & Setup; Drain; Install Access Ports; Inspections; Waterlancing; Inspections; Close BO; IMS Equip Setup; Remove Permit & Apply TCR; IMS U-bend Insp; Remove Permit; IMS Thermal Sleeve Inspection; Ongoing Waterlance discharge Analysis req'd.; Waterlance/ Access Port Equip Removal; Apply Permit & Remove TCR (Up.Man); Partial Fill BO; Close Upper Manway; Fill BO; SG CCD

BO Blowdown Pipes: Apply Permit; Blowdown Pre-Maint tests completed prior to breaker open; Replace Boiler Blowdown Pipes; Blowdown Post-Maint tests completed during RTS; Remove Permit; AWPP in effect CCW Stable Conditions; 4 BO's drained; 4 BO's ready to fill

SGECS & Main Steam Maintenance: Apply Permit; SGECS & Main Steam Maintenance; Remove Permit

Layup Mod & NV Inspection: 2nd Stage Reheat/ IUFT Mods; Inspect IUFT NV Internals

REF OPS WO # added
Draft for review only

Notes:

1. 40 day Chemistry requirements is bounded by boiler acceptable samples / drain & fill
2. U-Bend Insp not to happen at start of Window – N2 purge time increase(BO's drained then filled if at end), Hydrazine high, temp high, B&W contract to be revised, allows blowdown line replacement to start earlier)
3. OPS Tasks in place to assist with cooldown prior to Window 037 – max 30 deg C for B&W equip
4. Waterlancing in series – 2 equip,1 workgroup. Access ports in parallel – 2 equip, 2 workgroups
5. Thermal Sleeve and Nozzle Inspection can happen any time while BO Permits on.
6. BO's can be filled for 40 Chemistry requirements as soon as Permit is removed, Ubend Inspections/Blowdown timing test can happen after chemitry is met.

Schedule Interface Milestone (IM)
Construction Completion Declaration (CCD)

SG SS & SGECS layup (73513)
IMS Inspections (73222)
SG SS Maint (73232)
Cyclic Work (73407)
Boiler Blowdown Pipe Mod (31506)

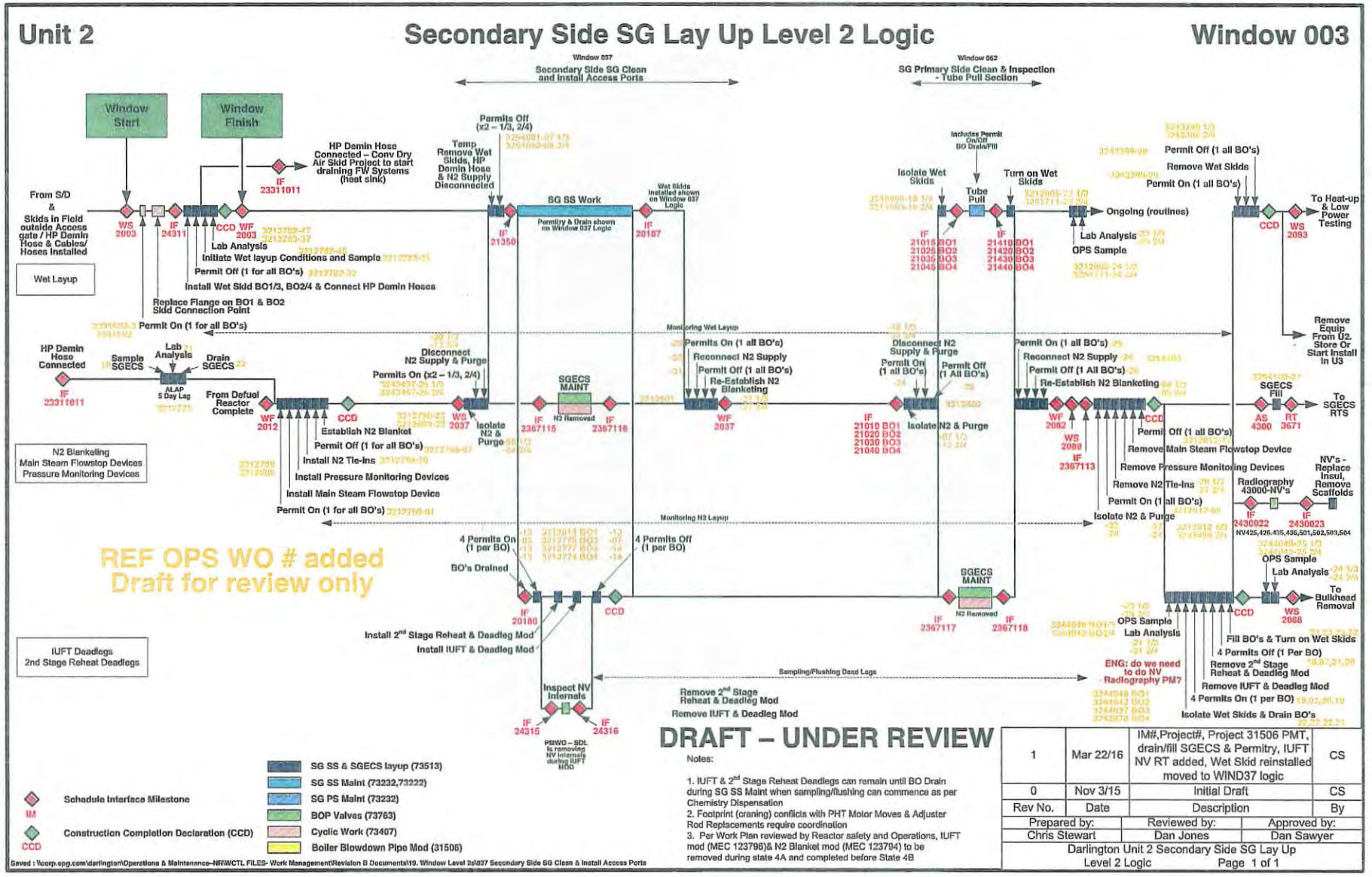
Saved : \\corp.opg.com\darlington\Operations & Maintenance-NR\WCTL FILES- Work Management\Revision B Documents\19. Window Level 2s\037 Secondary Side SG Clean & Install Access Ports

| Rev No. | Date | Description | By |
|---|---|---|---|
| 1 | Apr 6/16 | IM#,Project# & Permitry added, Nozzle & Sleeve inspect moved to different BO, Wet skid,HP Demin install added. | CS |
| 0 | Oct 26/15 | Initial Draft | CS |

| Prepared by: | Reviewed by: | Approved by: |
|---|---|---|
| Chris Stewart | Dan Jones | Dan Sawyer |

Darlington Unit 2 SG Secondary Side Clean & Install Access Ports Level 2 Logic — Page 1 of 1

# Developing an Integrated Schedule



# Unit 2 Preparation Milestones



DARLINGTON REFURBISHMENT
Repowering Ontario

## UNIT 2 REFURBISHMENT OUTAGE PREPARATION MILESTONES

ONTARIO POWER GENERATION

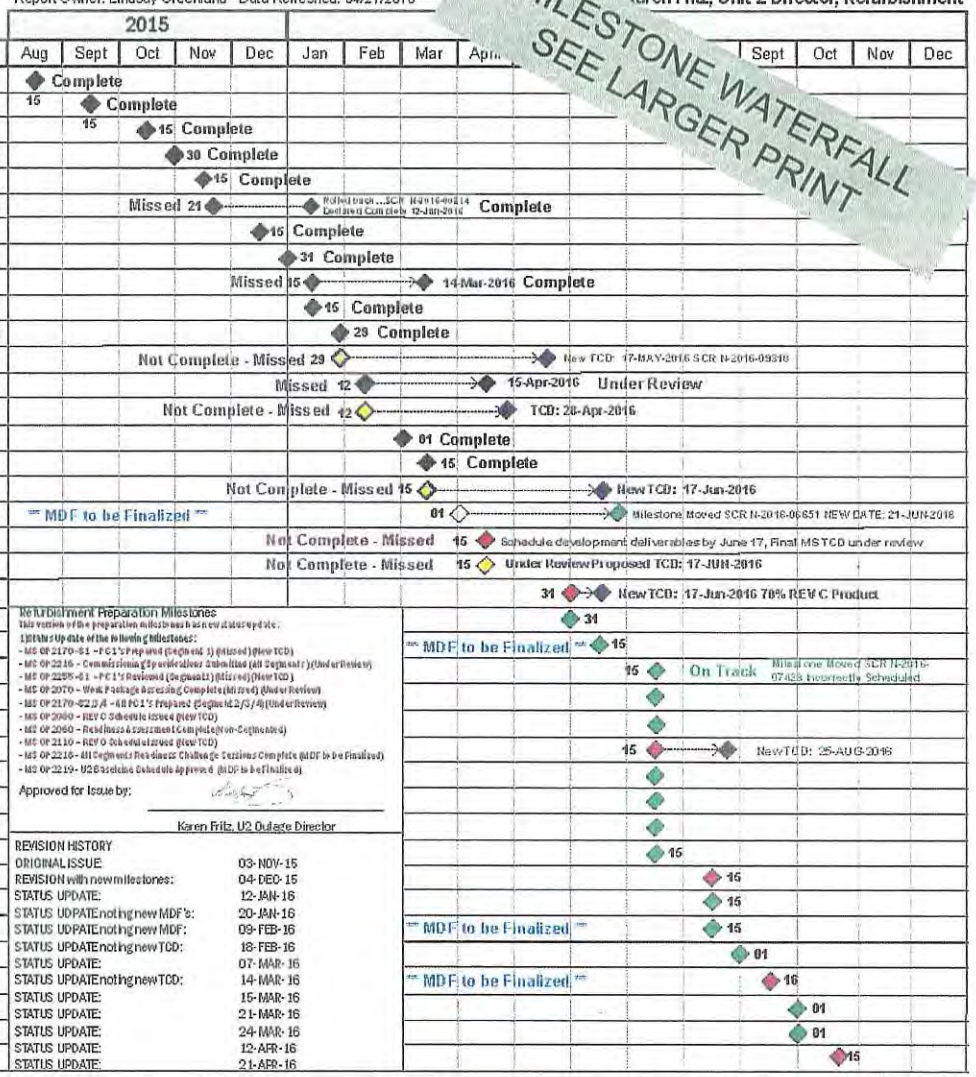
- Key Milestones
- Milestones not met on committed milestone date and still outstanding
- Future Milestones
- Milestone Complete
- Projected Milestone Date

Report ID: 0202A *Tech_Tips* Process Owner: Karen Fritz
Report Owner: Lindsay Greenland Data Refreshed: 04/21/2016

Issue Date: 03-Nov-2015
21-APR-2016
Karen Fritz, Unit 2 Director, Refurbishment

MILESTONE WATERFALL SEE LARGER PRINT

| | Milestone ID | Owner | Milestone Name | Applicability |
|---|---|---|---|---|
| 1 | RP130 | Neil Mitchell | All Project Detailed Engineering Finished | All Segments |
| 2 | OP2040 | Sean Toohey | Long lead or At Risk Material Identified | All Segments |
| 3 | OP2130 | Gary Rose | U2 Pre-Outage Metrics Prepared (Priority 1 Metrics) | All Segments |
| 4 | OP2370 | Karen Fritz | U2 Outage Prerequisites Identified | Up to Breaker Open |
| 5 | OP2050 | Karen Fritz | REV B Schedule Issued | All Segments |
| 6 | OP2180 | Karen Fritz | U2 Outage Prerequisites Scheduled | Up to Breaker Open |
| 7 | OP2200 | Boris Vulanovic | U2 Outage High Level Permitry Level 1 Plan Complete | All Segments |
| 8 | RG120 | R. Maceacheron | IIP Approval by CNSC | All Segments |
| 9 | OP2360 | Karen Fritz | All Level 3 Schedules Quality Acceptance Complete | All Segments |
| 10 | RG125 | R. Maceacheron | Regulatory Final Approvals Requested | All Segments |
| 11 | OP2214 | Gary Rose | U2 Pre-Outage Metrics Prepared (Priority 2 Metrics) | Up to Breaker Open |
| 12 | OP2170-S1 | Mike Allen | PC1's Prepared (Segment 1) | Segment 1 |
| 13 | OP2216 | Mike Allen | Commissioning Specifications Submitted (All Segments) | All Segments |
| 14 | OP2275-S1,2 | Mike Allen | TPARs Submitted (Segments 1,2) | Segments 1/2 |
| 15 | OP2215 | Mike Allen | All ALARA Plans Submitted | All Segments |
| 16 | OP2211 | Ken Hobbs | Field Constructability Reviews Complete | All Segments |
| 17 | OP2255-S1 | Mike Allen | PC1's Reviewed (Segment 1) | Segment 1 |
| 18 | OP2210 | Mike Allen | Risk Mitigation Plans Prepared | All Segments |
| 19 | OP2070 | Mike Allen | Work Package Assessing Complete | All Segments |
| 20 | OP2170-S2,3,4 | Mike Allen | All PC1's Prepared (Segments 2/3/4) | Segments 2/3/4 |
| 21 | OP2080 | Karen Fritz | REV C Schedule Issued | All Segments |
| 22 | OP2217 | Paul Ross | System Detailed Restart Specifications Complete | All Segments |
| 23 | OP2060 | Karen Fritz | Readiness Assessment Complete | All Segments |
| 24 | OP2240 | Boris Vulanovic | Radiation Protection Strategic Plan, Waste Minimization, Environmental Safety Plan Prepared | All Segments |
| 25 | OP2230-S1 | Boris Vulanovic | Work Permits Prepared (Segment 1) | Segment 1 |
| 26 | OP2255-S2 | Mike Allen | PC1's Reviewed (Segment 2) | Segment 2 |
| 27 | OP2110 | Karen Fritz | REV 0 Schedule Issued | All Segments |
| 28 | OP2265-S1 | Ken Hobbs | Construction Readiness Lookaheads Complete (Seg. 1) | Segment 1 |
| 29 | RG130 | R. Maceacheron | Regulatory Final Approvals In-place | All Segments |
| 30 | OP2220 | Mike Allen | Outage Execution Organization Identified | All Segments |
| 31 | OP2250 | Gary Rose | Outage Execution Metrics Prepared | All Segments |
| 32 | OP2213 | Gary Rose | U2 Execution Estimate Complete | All Segments |
| 33 | OP2270 | D. Pawlowski | Outage Briefing Packages Ready | All Segments |
| 34 | OP2218 | Karen Fritz | All Segments Readiness Challenge Sessions Complete | All Segments |
| 35 | OP2260-S1 | Gerry Martin | Reactor Safety Challenge Meeting (Seg.1) | Segment 1 |
| 36 | OP2219 | Karen Fritz | U2 Baseline Schedule Approved | All Segments |
| 37 | RP200-U2 | Silviu Idita | Training Outage Readiness | All Segments |
| 38 | OP2280 | Mike Allen | Outage Prerequisites Complete | All Segments |
| | U2010 | Mike Allen | Unit 2 Breaker Open | |



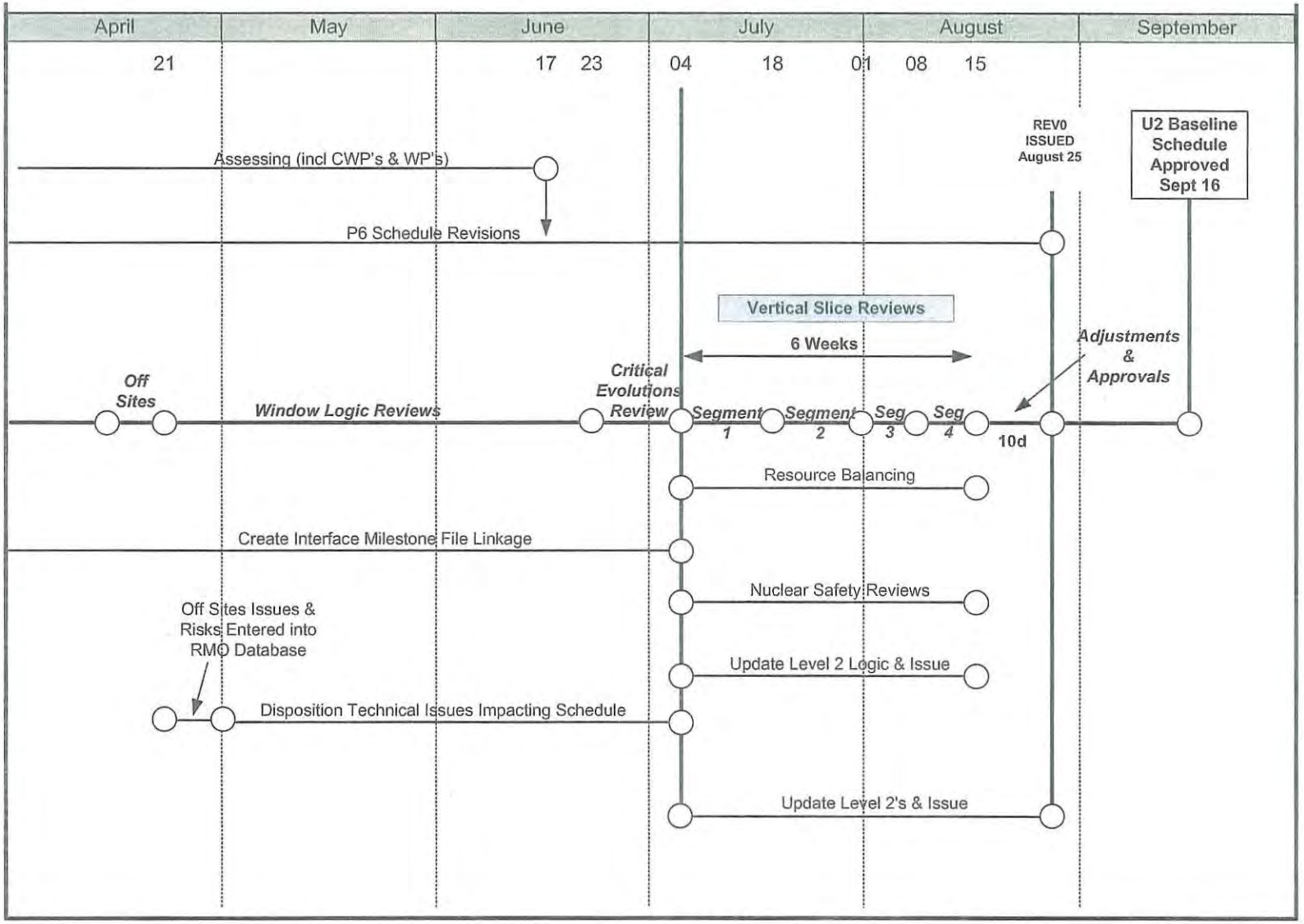

Refurbishment Preparation Milestones
This version of the preparation milestone chart is a new status update.
It Marks Up-date of the following Milestones:
- MS OP 2170-S1 - PC1's Prepared (Segment 1) (Missed) (New TCD)
- MS OP 2216 - Commissioning Specifications Submitted (All Segments) (Under Review)
- MS OP 2255-S1 - PC1's Reviewed (Segment1) (Missed) (New TCD)
- MS OP 2070 - Work Package Assessing Complete (Missed) (Under Review)
- MS OP 2170-S2,3,4 - All PC1's Prepared (Segment 2/3/4) (Under Review)
- MS OP 2080 - REV C Schedule Issued (New TCD)
- MS OP 2060 - Readiness Assessment Complete (Non-Segmented)
- MS OP 2110 - REV 0 Schedule Issued (New TCD)
- MS OP 2218 - All Segments Readiness Challenge Sessions Complete (MDF to be Finalized)
- MS OP 2219 - U2 Baseline Schedule Approved (MDF to be Finalized)

Approved for Issue by:

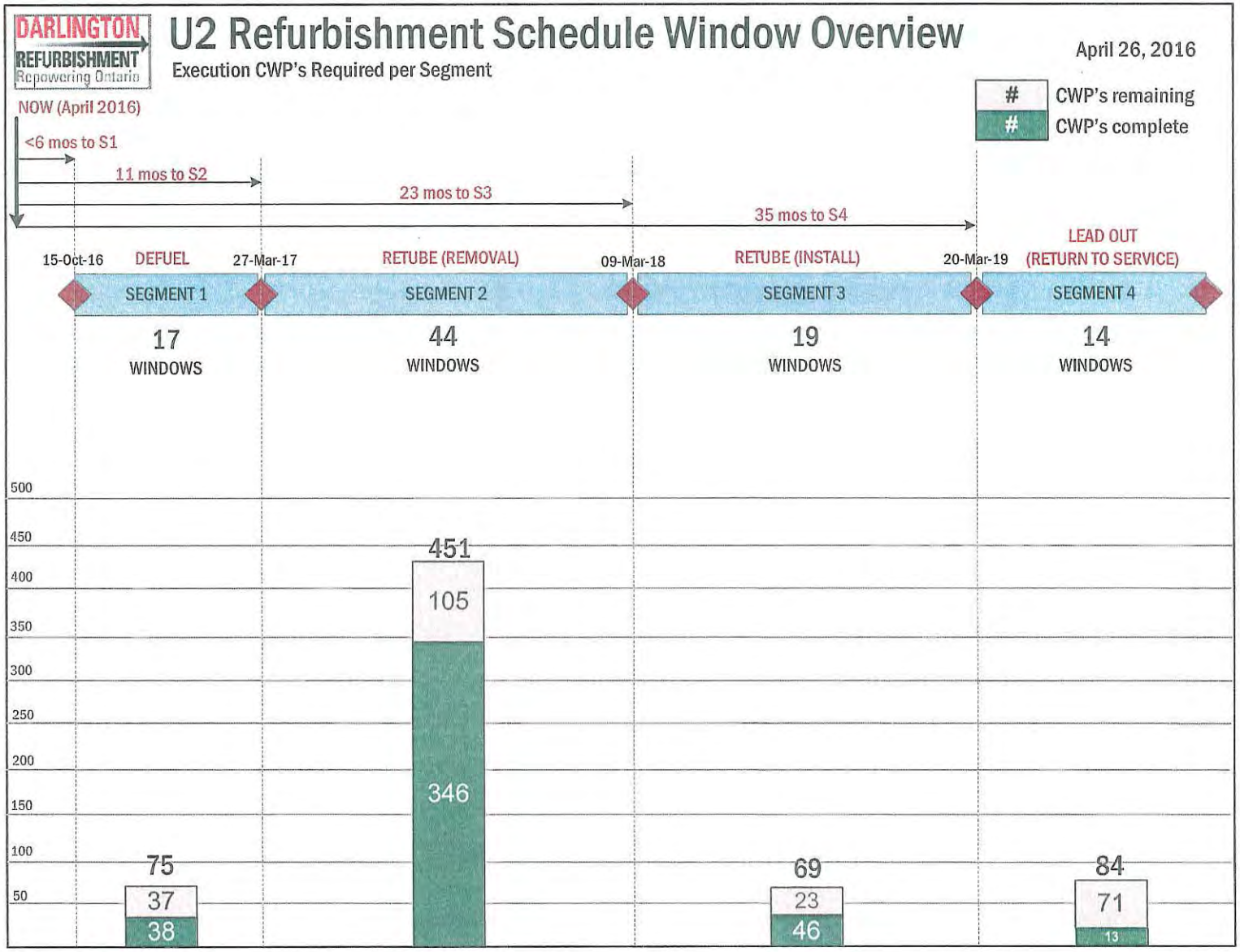
Karen Fritz, U2 Outage Director

| REVISION HISTORY | |
|---|---|
| ORIGINAL ISSUE: | 03-NOV-15 |
| REVISION with new milestones: | 04-DEC-15 |
| STATUS UPDATE: | 12-JAN-16 |
| STATUS UPDATE nothing new MDF's: | 20-JAN-16 |
| STATUS UPDATE nothing new MDF: | 09-FEB-16 |
| STATUS UPDATE nothing new TCD: | 18-FEB-16 |
| STATUS UPDATE: | 07-MAR-16 |
| STATUS UPDATE nothing new TCD: | 14-MAR-16 |
| STATUS UPDATE: | 15-MAR-16 |
| STATUS UPDATE: | 21-MAR-16 |
| STATUS UPDATE: | 24-MAR-16 |
| STATUS UPDATE: | 12-APR-16 |
| STATUS UPDATE: | 21-APR-16 |

# Getting to the Baseline Schedule



# U2 Refurbishment Overview – CWPs



# Getting to a Baseline Schedule

## Key Schedule Development Milestone Projections

**STEP 1.** OP2070 Work Package Assessing Complete: June 17, 2016

- Includes STEP 1 D-FORM. STEP 2 D-FORM still to be projected
- At this time, the REVC schedule product is projected to be **60-70%** complete

**STEP 2.** OP2080 Submit REVC Schedule as 60-70% product (MS Missed) June 17, 2016

- Window durations firm, major technical issues resolved, water movement plan approved, major permit logic approved, CCD/AFS logic in place
- Segment 1 logic and assessments in advanced state
- Limited vertical slice reviews performed, some Resource balancing completed

**STEP 3.** OP2110 Submit REV0 Schedule (the new REVC – MS Missed) Aug 25, 2016

- June-August: 6-8 weeks vertical slice meetings
- Detailed critical evolution logic approved by Outage Director and DOM
- Resource balancing complete and agreed by Project Directors and Vendors
- All segments detailed schedule reviewed and accepted by Outage Director, Project Directors and Vendor Manager
- Presented to SVP, Nuclear Refurbishment, SVP, Nuclear Projects, NPET, DOM and CNO

**STEP 4.** Baseline U2 Schedule Sept 16, 2016

- Allows 3 weeks for all final schedule checks and final quality review
- NPET, CNO, Station and CEO communication of final milestone dates and commitments
- System alignment (OPG and Vendors) for baseline process (P6, ECOsys, Reporting databases)

# Key activities to meet milestones

1. Prioritized work packages with interim due dates for schedule development

2. Daily document tracking conference calls to monitor and help with handoffs, RFR 'war room' and signing party meetings

3. Fleet support for Retube & Feeder Replacement team (30+ individuals)

4. Integrated Schedule Off-site Meetings
   April 20,21,22
   June 21, 23, 24

5. Streamlined project meetings: weekly 'Bundle' meetings with each project team and all support functions

# Planning Status to support Schedule Development

1. Comprehensive Work Packages — 62% Complete (D-FORM1)
2. Work Plans — 38% Complete (65/171)
3. Task Planning — 76% Complete (50,626/66771)
4. Holds (Eng, Procurement, Docs) — 77% Complete (2294/2977)
5. Schedule Development — 80% Level 3+ schedules in P6 (56/70)
6. 500+ Actions developed from Schedule Integration Offsite Meetings

# Station Integration

## 1. Ensuring the station key equipment is ready for Refurbishment

### "DPZ" – Design Project Z

- Work Management manually added by our SPOC for various work orders
- Not directly related to System Health
- Station-owned Work Orders, jointly 'flagged'
- Work Orders in the Station online plan, resourced by station

  System Examples:
  - ALW (Active Liquid Waste)
  - VVRS (Vault Vapour Recovery System)
  - Confinement Driers
  - Breathing Air

## 2. Prereq and Unit 2 Execution Station Integration

- Prereq MoU, Station Online process integration, dedicated team
- U2 Execution – ongoing station integration team

# Unit 2 Preparations: Prereq Projects

PREREQ PROJECTS OVERVIEW – Verbal Update

# Detailed Schedule Review

REFER TO LEVEL 1 SCHEDULE PRINT

DARLINGTON REFURBISHMENT Repowering Ontario

# U2 Darlington Refurbishment Prerequisites

(excludes Campus Plan & Outbuildings)

March 18, 2016
Rev 2

Critical for Breaker Open
ES FOX
IIP IIP Commitment
FH Project
Station staff
No contract
### Pre-req Window number
AECON JV
B&M
Exectuion by P&M

2016

February | March | April | May | June | July | August | September | October | November

5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48

## Critical work

Phase 4 T12 commissioning
D1631
Phase 4 Duefueling Commissioning
Flow Defuel Demonstration on Shutdown Unit with FR0B
Fuelling Empty Channel Demonstration on Shutdown Unit
RTS Verification
T34 Normal Fuelling Demonstration
Phase 5 T34 Commissioning
NFTM(34 (78 Mech Mods
NFTM(34 Mech Mods
Grapple
NFTM(34 Encoder Mods
NFTM((34 (78 Encoder Mods
NFTM(34 (78 Software / OPDATA Checks
NFTM(34 Software / OPDATA Checks
T34 AFS (AFS # 4)
Defuelling AFS (AFS #5)
Grapple AFS (AFS #6)
Phase 6 Contingency Commissioning
05/10
11/07
OPDATA Contingency Window
Shim Operation Implemented 503

On-Line U0 ALW Resin Transfers (5 required. 8 weeks) 550
Spent Resin Slurries (HTS -2, Mod-1, U0 ALW -1)

IIP Unit 4 Installed During Outage in Spring 2016
Shield Tank Overpressure Protection (IP0540-1) 533
D1632 STOP 526
Unit 2 Breaker Open

IIP Install EPG Skid
Commission EPG 3 534

TG crane rail replace
07/03 541
On-Line (AISC)
SDC HX2 Replacement 546
SDC HX1 Replacement
On-Line (AISC)
15/08
Unit Power Distribution System 07/10 543
SUPPORT

## Islanding Work

IIP Containment Filtered Venting System (CFVS) IP030-1
Commission 529
IIP Power House Steam Venting System (SI0040-1) 527
D1641 Outage
09/03 535
PAMS MOD 07/07 18/07 531
26/07 CLRTS MOD 23/08 518
U0/U3
Semi-annual CLRTS SRST 4.1.21 and SRST 4.1.27 NO CONTAIMENT ACCESS
Moderator Header Tie-ins 04/03 523
13/07 EFADS MOD 02/08 511
D2G Management Building 540
07/03 Button-up Valve Mod 501 07/06
Hold out until D1641 complete
04/07 U2 SCID 7010 VVRS 3-way Valve Replacement/U2 SCID 7011 Bypass Fan Mod 502 27/10
18/07 TG West Crane Refurbishment CR1 01/09 542
06/09 TG East Crane Refurbishment CR2 560
01/07 PHT Header Tie-ins 02/08 508
02/05 LPSW Valve reorientation 04/06 513
IIP 02/04 Oil Storage Tk Inspections– SG Berm 29/05 532
IIP 06/06 Turbine Lube Oil Tank Inspections
Unit 2 only 01/09 532
IIP 20/06 U2 SCID 7083 Fire Alarm Upgrades IP1220-2/4/8 & IP1270-1 31/10 515

## Facilities & Layup Work

10/05 Install WIFI for station (U2) 20/06 514
IIP 04/07 U2 SCID 7085 Fire Fault isolators/U2 SCID 5/10 516
04/02 Non Contam. Shops and Work Areas - Install and Tie-in (CP0410-1,2,3,7&8) 12/05 512
FACILITY
05/08 Washrooms Install & Tie-in 05/10 521
FACILITY
Work Control Area Install and Tie-in (CP0410-11) 31/03 507
FACILITY
06/06 Radiation Protection Offices for Teledosimetry (CP0480-1) 15/08 504
FACILITY
06/09 Emergency Heat Sink to PHT - 19/10 538
15/07 Decontamination Rm S107 Upgrades 15/10 510
FACILITY
06/06 Breathing Air - Install (TS0800-3) Installation of Header —Partial AFS not tied into U2 03/11 505
SUPPORT
SUPPORT
22/02 Service Air – Install and Tie-in (TS0930-1) 10/06 506
SUPPORT
18/08 Barriers & Fencing 07/10 500
01/08 Contaminated Shops and Work Areas Install & Tie-in 01/10 509
Installed in Unit 3 (CP0410-4&9)
FACILITY
15/10 17/10 537
Emergency Heat Sink to PHT - Pre-reqs.-cyclic
30/06 Install Dry Air Skids, Pull Cables & Partial Tie in TS0830-1/2/3/4/5/7/9 06/10 519
SUPPORT
TG pre-reqs to breaker open- Onsite 661
12/09 SGECS Boiler Wet Recirc Skids (pre-run cables/pipes) 12/11 525
15/06 18/06 Relocate Electrical Interferences 549
01/08 Cyclic Electrical 15/10 545
19/07 29/07 Set up off gas tent (breathing air) 553
08/09 RFR Miscellaneous 09/10 513
23/05 30/05 Relocate condensate line 547
15/08 18/08 548
Cyclical TMODS
SUPPORT

## RFR Work

03/03 Excavate and Grade RCC 07/04 536
15/06 RCC LAN/SCADA 25/08 536
28/04 Install RCC modules and tie-ins including temp TPDS 31/05 536
FACILITY
15/06 (RCC) & Weather Enclosure 11/07 536
15/06 Temporary Power Distribution System 24/09 539
SUPPORT
07/03 16/03 RFRISA Electrical Tie-ins 544
15/06 24/06 VVRS Tie in 551
19/09 07/10 Pre Isolation Equipment 555
Retube Waste Processing Building AFS Date June 30th, 2017
FACILITY

**Refurbishment Prerequisite Schedule: OP2180 REV00:**

This Level 1 Schedule Rev 1 has been established using the information provided from all Refurbishment scope owners by Mar 1/2016. This schedule as NOT been approved by the Darlington station Work Control Director.

Prepared by:
Cyndy Sawyer, Manager of Pre-requisites

Reviewed by:
Karen Fritz, U2 Outage Director

DARLINGTON REFURBISHMENT
Repowering Ontario

# Unit 2 Refurbishment Outage

Critical Path Windows
Close to Critical Path/Low Float Windows
Electrical Windows
Turbine/Generator
Reactivity Device Windows
Heat Transport System Windows

UNIT 2 REV B2
April 15, 2016

OCT 2016 | NOV 2016 | DEC 2016 | JAN 2017 | FEB 2017 | MAR 2017 | APR 2017 | MAY 2017 | JUN 2017 | JUL 2017 | AUG 2017 | SEP 2017 | OCT 2017 | NOV 2017 | DEC 2017 | JAN 2018 | FEB 2018 | MAR 2018 | APR 2018 | MAY 2018 | JUN 2018 | JUL 2018 | AUG 2018 | SEP 2018 | OCT 2018 | NOV 2018 | DEC 2018 | JAN 2019 | FEB 2019 | MAR 2019 | APR 2019 | MAY 2019 | JUNE 2019 | JUL 2019 | AUG 2019 | SEP 2019 | OCT 2019

Outage Day: 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600 620 640 660 680 700 720 740 760 780 800 820 840 860 880 900 920 940 960 980 1000 1020 1040 1060 1080 200

LEAD IN SEGMENT | REMOVAL SEGMENT | INSTALL SEGMENT | LEAD OUT SEGMENT

U1 Outage 2017 (D1711)
TRF - Cryogenic Systems Only
Short upgrader outage possible during TRF outage
Resource Holdout
U3 Outage 2018 (D1831)
Tritium Removal Facility Gas Outage
U4 Outage 2019 (D1941)

100 Feedwater T/G & Condenser Scope Phase 1
100 Condenser Work & CT/HV Bushing
061 Turbine Generator Major Overhaul
HX Inspections (LPSW Side) & CT Replacement
002 Conventional Side Layup
Bulkhead Installed & D1711 Complete
052 Power Track 3/4 Replacement
** IPG schedule Fuel Handling coordination required
Power Track 1/2 Replacement Window 1
039
** IPG schedule Fuel Handling coordination required
Power Track 1/2 Replacement Window 2
047
** IPG schedule Fuel Handling coordination required
Hold out until 6 months before ATC
LZCS 032 To RCHP 5
ECI Valve Maintenance
147 To RCHP 4
SG Lay-Up Primary Side
034
Hold out for motor availability
Install All HTS Pump 060 Motors
Note: HTS Motors and Steam Generators parallel work constraint (hoist way conflicts)
ECI Vault Work
128 To RCHP 4
Primary Side SG Clean & Inspect
West Side 062 SGs | East Side SGs
VVRS Mods and Rehab
009
Airlock Mtce & Testing
006
HTS Aux Vac Dry
035
HTS Auxiliaries - Drain Dead Legs & Purge & HTS Rehab
048 Drain & Purge
HTS Rehab
To HTS Fill
To Tie-In for Mod Vac Dry
013 HTS Bulk Drain
029 HTS Vac Dry 40d
Vac Dry (Cont'd)
Pre-Req's
To Mod Drain
Earliest Date To Credit TCB 30 days on U1 SD timer or U1 STOP Mods complete.
CNSC Approval for Core Defueling Strategy Received
104 Vault Projects
Full Vault Access
027 Bulk Interference Removals
101 Remove FM Bridges & Install RTPs
111 Feeder Cabinet Removal
042 Feeder Removal
140 Dummy FB Removal
104 Vault Projects
112 PT Sever
113 Sever Bellows
114 End Fitting Removal
Vault ACU Replacements
064 West Side
070 East Side
074 Inspection Series
149 Tube Sheet Bore Cleaning
116 CTI Removal
115 PT Removal
098 CTI Release
117 CT Removal
To Window 68 Emergency Heatsink Pipework in East Vault must be installed after ACU work
118 Calandia Tube Install Series
021 Install AA Drives
RCHP 1
Pressure Tube Install progressed to below Row M
068 Complete Emergency Heat Sink pipework (E. Vault)
Gross Air Leak Test
079
078 Remove Mod Dry Equip & Reconnect Mod Pipework
080 Fill Calandria
129 Temp Fission Chamber Guide Tube Install
Cold Testing & Establish GSS
081
Temp Fission Chamber Fission Chamber Install
119 Fuel Channel Installation Series
083 Lower Feeder Install Series
RCHP 2
084 Fuel Load
082 RTP Removals, Bridge Replacement
085 Airlocks Closed & Pressure Test 16d
RCHP 3
097 Bulkhead Postreqs
088 Bulkhead Removal
RCHP 5
093 Heat-up & Low Power Testing
095 Run-up & Sync & Balance
RCHP 8
012 Defuel Reactor
023 Install Bulkhead
STOP
113 days | 5 | 38 | 19 | 24 | 44 | 20 | 46 | 10 | 13 | 31 | 37 | 34 | 18 | 15 | 33 | 6 | 5 | 34 | 101 | 16 | 125 | 11 | 63 | 16 | 26 | 6 | 20 | 6 | 14 | 9
W160 | W161 | W027 | W101 | W164 | W165 | W166 | W167 | W168 | W083 | W084 | W082 | W172

U2 SD 1d 001
2d
015 Crane Maintenance
017 Install APT & End Fitting Caps
024 Containment Pre-test, Achieve Dew pt. & Containment Test
137 -Final Commissioning VVRS Phase 1 -AL & TCD Logic Mods -BU Logic Mods Phase 2
025 Install Shielding
Replace Adjuster Rods
021
028 Replace Vertical Flux Detector
Hold out for 28 d training period
045 Nozzle Inspection & Weld Prep
076 Upper Feeder Installation (180 days)
Trial CT Install
072 Bellows Inspections
To S/G Primary Side Inspections
To Remove Mod Dry Equip.
073 HFD Replacements
W084
146 NPC Logic Restoration
092 ATC
Power Escalation 094
096 High Power Testing & Turbine Testing
RCHP 4
RCHP 6
RCHP 7
089 29 HTS Air Hold, Fill & Hydro Test
090 14 HTS Operational Testing
Isolate Calandria From Main Pipework & Hookup Drying Equip.
Establish Upper Calandria Purge Flow & E/W Valve Maintenance
Note: Calandria purge will be maintained until all five calandria tubes have been replaced.
SA & CA Rods
031 To RCHP1
SDS1/2 Computer Replacements
007
Hold out for Project readiness
Mod Drain & Flush
from HTS Vac Dry Complete
038 108 103
from HTS Auxiliaries Vac Dry Complete
Tie in HTS Vac Dry Skid to Mod Pipework
067 121 Vac Dry Lower Moderator Pipe work
122 Moderator Valve Rehab
PULSW SDC HX Line Replacement
Remove Vac Dry Equip
SDC Valve Work
123 124 124 124 Aux Shutdown Cooling Pumps
To HTS Fill
Instrument Air Mtce
Hold out to summer of 2018
054
046 LISS Rehab
Hold out for Valve Mtce Resources
To Remove Mod Dry Equip.
To RCHP 1 Mod Fill
BU16 Maintenance
125 To VVRS Commissioning & Odd Electrical Outage
126 127 To TPDS & Odd Electrical Outage
T9/T11 T10/T12 Maintenance
(TPDS Tie-ins completed as pre-requisites)
022 Remove All HTS Pump Motors
Note: PM removals have to be coordinated with PM swaps in D1711
EPS MCC Rehab
005
Resource Tied to Class III Elec. Mtce Work
CL 3 Elec. Maintenance
041
CL 2 Elec. Maintenance
040 A/B/C
Hold out for Reduced Ops Pre-req's & MC resources
004 MOT/UST/IPB/Switchyard Rehab
Hold out for Warmer Temperatures
CL 4 Elec. Maintenance
051
To RCHP 5
Hold out for system Configuration & Vault Projects Window Complete
LPSW Outage
057
ESW Winter 2018 (need cold water temps)
053 Rehab
To HTS heat-up
Hold out for Cooler Temperatures
Temp Power Req'd for South Side Drainage Sumps
056 PULSW Outage (Line)
056 PULSW Outage (Valves)
CCW Rehab
055
To HTS heat-up
SG Layup (Recirc. Skids)
003
D1711 BO Work Complete & Cooldown After Vac Dry(14d)
Secondary Side SG Clean & Install Access Ports
037
Water in SG for HTS Pump Bump & Containment Boundary for Tube Pull
RBO ties to CW AWPP
60% RFR Complete

State 1 | State 2 | State 3a | State 3b | State 4a | State 4b | State 5

## NOTES

1. All schedule logic and level 3 schedules are not yet finalized. Therefore, this schedule and window durations are subject to change within the Unit 2 bounding duration as per the approved November 2015 Release Quality Estimate.
2. RCHP X Reactor Control Hold Point
3. SGs ← Window Name; 062 ← Window #
4. W084 ← JV Window #
5. Reactor States
   State 1: Reactor Shutdown Evolution
   State 2: Guaranteed Shutdown with Irradiated Fuel Core
   State 3a: Defueled State
   State 3b: Defueled & Isolated from Containment State
   State 4a: Non Irradiated Fuel & Isolated from Containment
   State 4b: Non Irradiated Fuel State
   State 5: Approach to Critical & Return to Service State

## REV B2 APPROVALS TO ISSUE

Prepared by: Dan Sawyer, U2 Outage Manager
Reviewed by: Karen Fritz, U2 Outage Director
Concurred by: *REQUIRED FOR REV C* Boris Vulanovic, Refurbishment DOM
Approved by: *REQUIRED FOR REVC* Mike Allen, VP Refurbishment Execution

# Site Integration

## Refurbishment Construction Review Board

**BEHAVIOURS**

- Say It, Do It
- Simplify It
- Think Top and Bottom Line




VALUES • SAFETY • INTEGRITY • EXCELLENCE • PEOPLE & CITIZENSHIP •

PEOPLE POWERING THE FUTURE
OPG NUCLEAR

ONTARIO POWER GENERATION

# One Team One Mission

- Darlington Refurbishment will be a long and complex project. A significant amount of work has been undertaken to ensure effective integration between the Station and Refurbishment organizations

# Integration

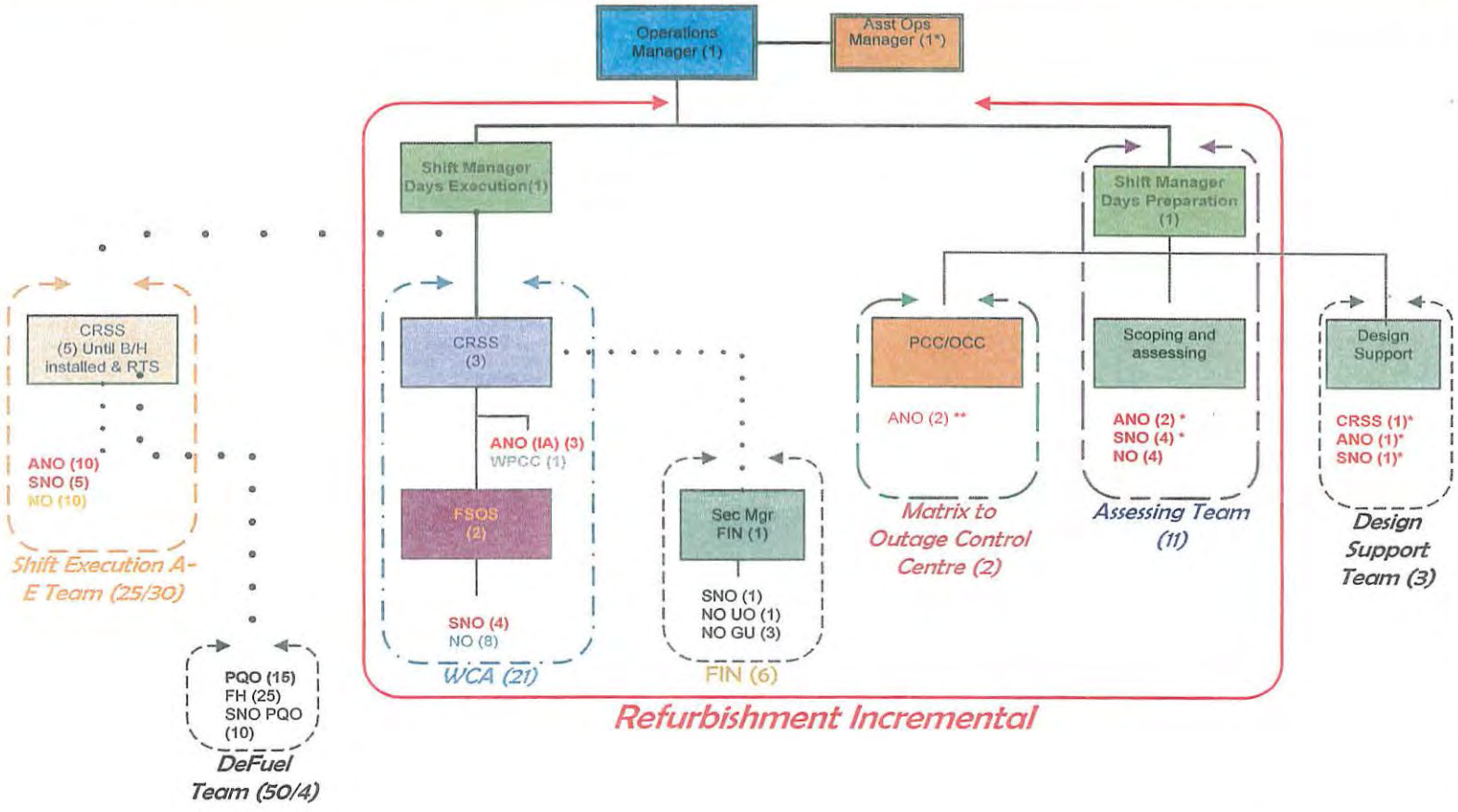
- In addition to regulatory requirements, operating experience reveals a need early in a project for a cohesive Site Integrated Transition Plan to delineate the requirements, expectations and schedule for the transition of processes, programs and staff from and back to the operating Station:
  - Nuclear Refurbishment Site Integrated Transition Plan
  - Integrated Workforce Transition Plan
  - Fuel Handling Integration/Transition Plan
  - Fire Protection Ownership Transfer Plan
  - Chemistry and Environment Ownership Transfer Plan
  - Operations Ownership Transfer Plan
  - Maintenance Ownership Transfer Plan
  - Radiation Protection Ownership Transfer Plan
  - Refurbishment Emergency Preparedness Ownership Transfer Plan

# Utilization of OPEX

- Best practices and lessons-learned benchmarked from utilities conducting refurbishment projects (NB Power, Watts Bar, Bruce Power)
- A "Ready to Execute" (RTE) Plan has been developed to incorporate many of these best practices and lessons-learned
- RTE has an embedded test period to prove processes on real work during Pre-Requisites to determine where we have it right and where we need to adjust before Unit 2 Breaker Open in October

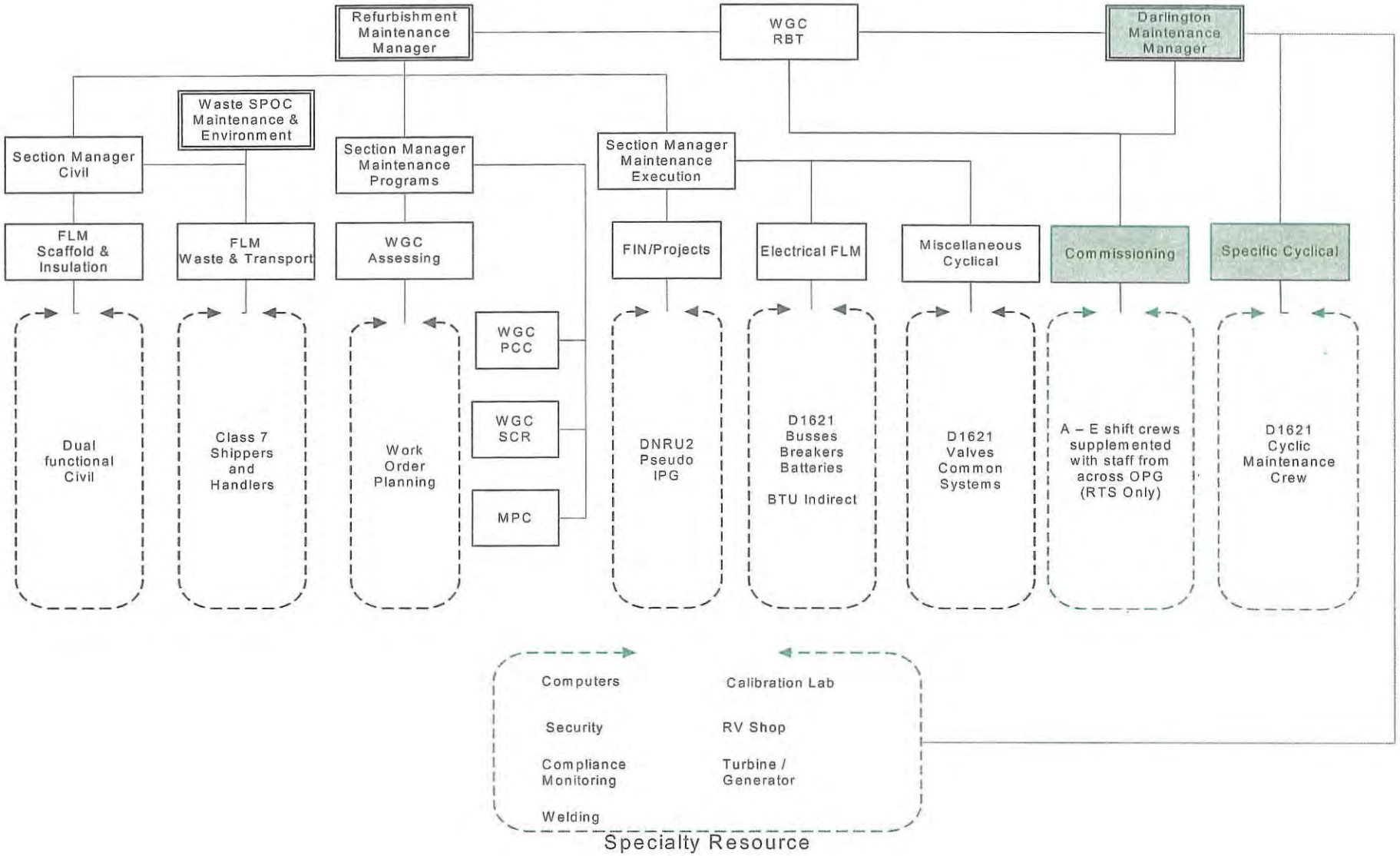
# Operations Organization Structure – During Execution

## Darlington Refurbishment Operations
### One Unit Under Refurbishment

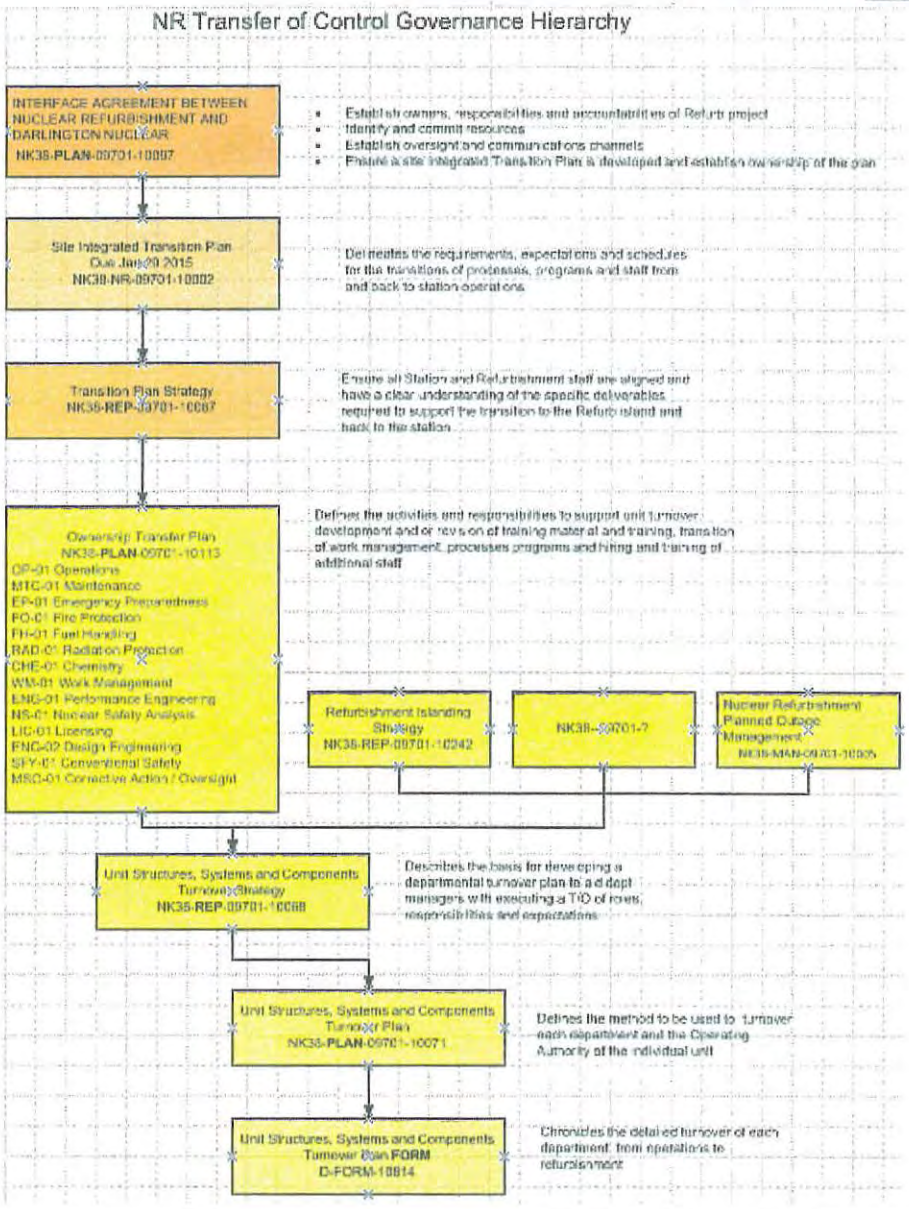


# Combined MTCE Organization

Proposed Refurbishment Maintenance Organization and Indirect Links



# NR Transfer of Control Governance Hierarchy



# Controlling Authority

- Controlling Authority (CA) is a term specific to the OPGN work protection code
  - assigned by Management
  - responsible for the control of specific equipment
    - includes performing, directing or authorizing
    - changes in condition / position of the equipment
  - ensure the safe administration of the Work Protection procedures

There may be more than one CA for each site.

- CA equipment boundaries shall be clearly identified.
- CA duties may be delegated.
- The CA ensures proper delegation of authority.
- The CA ensures personnel and equipment safety

# Operating Control

- Operating Control is a term used to describe the reporting and chain of command structure for a particular unit(s).
- Darlington SVP / DOM is the license holder and senior license on the facility
  - This will not change even with units in refurbishment
- Due to large work load associated with the project
  - It will be necessary to delegate some DOM authority
  - And that of the DN operating organization
  - To the refurbishment project
- Operating Units duty Manager will provide direction to operating units and give approvals
- Refurb dedicated Duty Managers (DOM delegates)provide direction and approvals for refurb staff

# Operating Control

- For decisions that impact the other or both orgs.
  - Duty managers to obtain alignment on direction before communicating to each other's line orgs
- DN DOM will be the final decision maker
- Anyone acting in duty manager role will be qualified and approved to the same standard across the plant (operating and refurbishment.

# SSC Turnover

Unit Structures, Systems and Components (SSC) Turnover is the process used to

- Document the unit status
- Document each departments status
  - Including agreement, MOU, commitments, AR's
- Formalize the assignment of the refurbishment unit *Operating Authority.*

This can occur prior to or after unit shut down for refurbishment

- depending on the needs of the organization.

# Refurb CA and OA

Prior to the Nuclear Refurbishment (NR) Organization assuming the assigned *Operating Authority*

- Each DN and associated NR department must execute a Unit Systems, Structures and Components (SSC's) Turnover

- Status recorded on designated form (controlled record)
- This will form the basis of each departments turnover
- Each dept completes all applicable portions of the form

# Interface and Islanding

- N-JTA-901-00001: Comprehensive Training Needs Analysis For Interface And Islanding Training For Darlington Unit 2 Refurbishment" issued detailing the comprehensive training needs analysis for the Unit 2 Refurbishment. Target audience:
  - All staff that have access to the DNGS protected area
  - NR – OM Staff
  - DNGS – OM and support staff
  - Contractors supporting refurbishment
- Unit 2 Execution Change Management Strategy Prepared to ensure:
  - Changes to process and accountabilities clearly defined
  - Stakeholder impacts identified and addressed
  - Learning needs identified and addressed
  - Risks identified and mitigated
  - Appropriate Leadership teams aligned
  - Required behaviors identified and reinforced
  - Organizational design supports the changes and flow of work
  - Change adoption is monitored and assessed during and after implementation

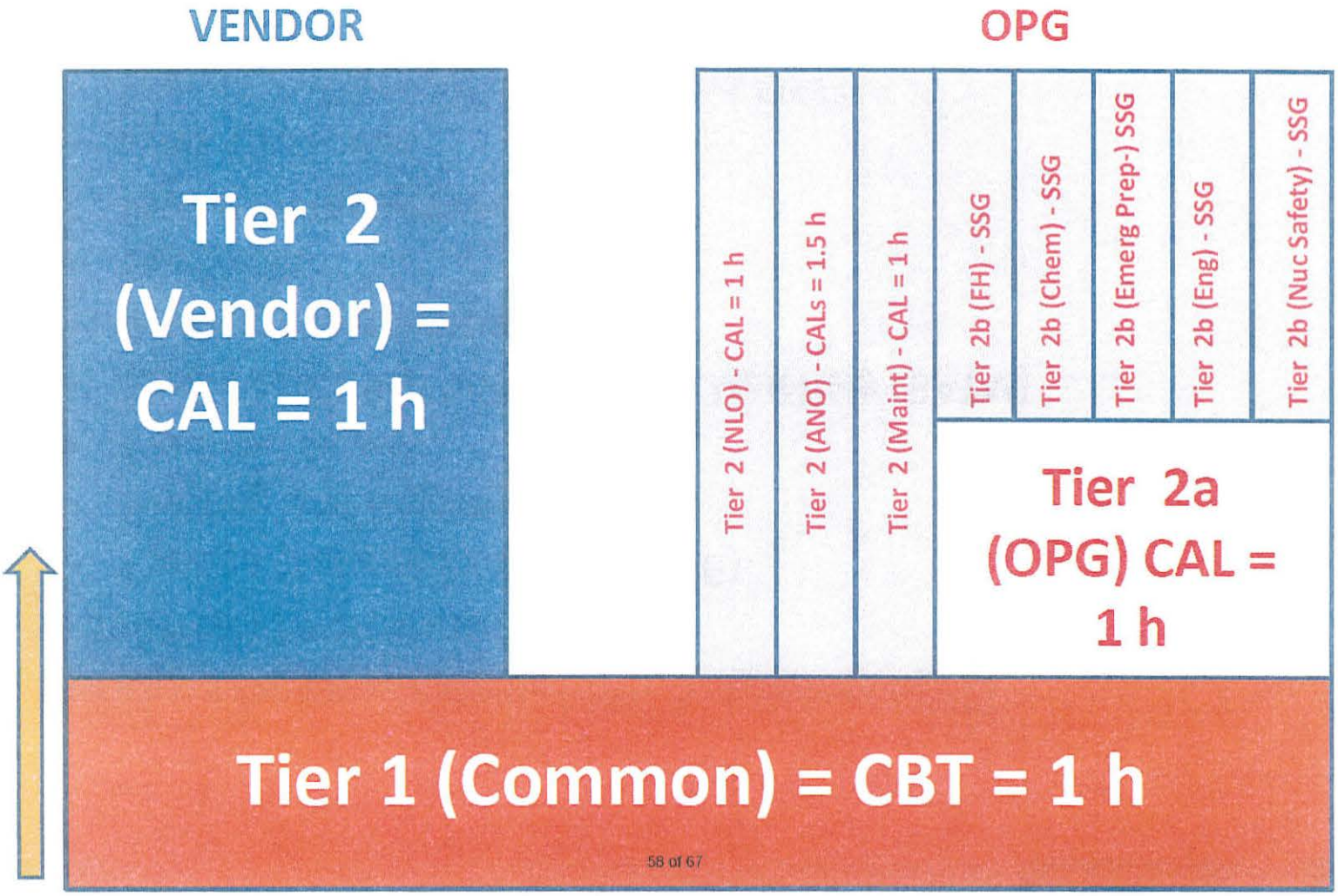
# Interface and Islanding

Educating OPG & Vendors on:

- Refurbishment Island (RI) - definition, physical barriers and administrative controls.
- Interface (& protocols) between NR and Station.
- Changes to Systems, Structures and Components (SSCs) and their operation, requirements and restrictions due to islanding.
- Facilities locations in the station.
- Pathways.

# Interface and Islanding

## IIT Qualification Structure



# Programs and Processes

- Vendors have accepted the following OPG Governance/Standards
  - Foreign Material Exclusion (FME)
  - Hoisting and Rigging
  - Confined Space
  - Space Allocation and Transient Materials (SATM)
  - Welding Consumables
  - Scaffolding
  - Radiation Protection
  - Work Protection
  - Human Performance (vendor and OPG)

# Division of Responsibilities

## Success of execution with the new organization requires:

- Key Principles for Getting Work Done
- Mapping Division of Responsibilities
- Table Top Scenarios and Readiness to Execute (RTE) Testing
- Escalation of Issues
- Execution Runstream
- Change Management Plan and Communications

## Alignment for Success:

- Support and Monitoring of Work Execution In The Field
- Schedule
- Work Readiness Look Ahead
- Scope Management
- Risk Management
- Cost Management

# Division of Responsibilities

- Key Principles
  - Communicate safety. Take personal accountability to work safely. Stop when unsure.
  - Be in the Field and Coach To Standards (Safety, Quality, Hu, RP, FME, PB, H&R)
  - Ensure Staff are Qualified to Perform Work
  - Procedural Use and Adherence and other EFT Tools
  - Project Director Authorizes Changes in Work Direction
  - Only Perform Work per the Schedule
  - Identify, Mitigate and Monitor High Risk Activities
  - Use OPEX to improve the safety, quality and productivity
  - Be Aware of the License Requirements. Do Not Surprise the Regulator (CNSC, MOL, MOE, TSSA).
  - Rapid Escalation and Resolution of Issues through Proper Channels.

# Division of Responsibilities

## Refurbishment Project – Execution Work Activities – Post Breaker Open

### Vendors

**Support and Monitoring of Work Executed**

**Safety / Quality / Work Practices**
- Manage, coach and correct staff performance/compliance to key OPG programs

**Progress of Work**
- Maintain competent field/trade supervision to manage successful completion of scheduled work per the milestones.

**Schedule**
- Submit CCD and AFS as required
- Prepare schedule logic and forecast schedule

**Work Readiness / Look Ahead**

**T-6 / T-3 Months**
- Assign crew to perform walkdown of field packages using same crews who will be performing work

**Walkdown W-4 to W-0 Weeks**
- Assign crew performing work the walkdown duties
- Ensure walkdowns performed per standard.

**Scope Management**
- Submit Field Changes as required

**Risk Management**
- Conduct assessing and preps for contingency items as required
- Submit and execute chemistry, environment and waste plans.
- Submit plan and monitor "laid-up" unit systems.

**Cost Management**
- Perform commodity tracking
- Monitor and maintain resource plans. Submit hiring requests to PM as required.

### Project Managers

**Support and Monitoring of Work Executed**

**Safety / Quality / Work Practices**
- Project Director/Manager frequent observations on job sites with Engineers constant presence
- Review construction field reports for performance improvements
- Ensure CARs/SCRs/corrective actions processed/administered as required

**Progress of Work**
- Supervisor of the Work / Intervene work activities as required

**Schedule**
- CCD , MAFS, AFS acceptance from vendor
- Logic review and acceptance.

**Work Readiness / Look Ahead**

**T-6 / T-3 Months**
- Participate in the look ahead teams and challenge meetings/critical evolution meetings.

**Walkdown W-4 to W-0 Weeks**
- Ensure vendor walkdowns performed and documented. Participate in walkdown as requested.
- Sole authority to ensure work program readiness and risk mitigation

**Scope Management**
- Engineering review for rapid field changes

**Risk Management**
- Contingency readiness for breakage/ unanticipated findings – tied to risk register
- Accept vendor envirn, chemistry and lay-up plans; ensure compliance

**Cost Management**
- Review and process vendor cost and schedule forecasting
- Using Schedule , EV and cost metrics, remain within baseline schedule/cost funding envelope

### Construction Oversight

**Support and Monitoring of Work Executed**

**Safety / Quality / Work Practices**
- Monitor Vendor trades performance/ compliance to key OPG and Vendor Programs including Hu, Safety and FME.
- Intervene work activities where field observations deem appropriate

**Progress of Work**
- First point of contact for vendor field supervisors (10-30-60)

**Schedule**
- Daily monitoring of schedule. Review and align resource to support oversight and coordination activities.

**Work Readiness / Look Ahead**

**T-6 / T-3 Months**
- Lead vendor team on comprehensive walkdown looking for barriers preventing execution.

**Walkdown W-4 to W-0 Weeks**
- Perform walkdown of tasks just prior to execution with Vendor Execution Team ensuring no barriers to prevent execution of task and work is field ready to execute. Recommend to proceed/reject to PM

**Scope Management**
- Provide input to vendor on field change submittals

**Risk Management**
- Risk Rank Projects T-6 to T-3 Months prior to segment (FOAK, FIAW)
- SPOC for JHSC, Union Halls, Stewards, EPSCA, CPAA, Bargaining, labour and MOL issues.

**Cost Management**
- Assist with completion validation. % complete in the field.

### Project Office

**Support and Monitoring of Work Executed**

**Safety / Quality / Work Practices**
- Communicate expectations for PCC behaviours and coach as required

**Progress of Work**
- Outage Manager manages overall compliance and execution of schedule

**Schedule**
- Prepare and publish schedule.
- Perform integrated schedule analysis including critical path, total float, low float, contingency mgnt, resource scenarios, crew schedule mgnt, coding integrity

**Work Readiness / Look Ahead**
- Perform overall window schedule integration between all work groups.
- Ensures that CCD, MAFS, SAFS and RTS logic is correct for each window/mod/ non-mod and accepted by Operations and RTS Manager

**Scope Management**
- Conduct New Work Screening, implement PSRB decisions, scope transfers/changes

**Risk Management**
- Ensure contingency plans are in place and acceptable and ready for the execution window/risk time period
- Central SPOC for integrated risk resolution and robust risk mitigation plans

**Cost Management**
- PV, EV, CPI and commodity reporting
- Stewardship for roll up of Cost and Schedule Reporting/Forecasting

### Dir Ops & Mtce

**Support and Monitoring of Work Executed**

**Safety / Quality / Work Practices**
- Monitor use of Event Free Tools / Hu Performance for Ops & Mtce & RP, Chemistry and Environment for PWU staff
- Perform in-service unit monitoring for operating /chem/env parameters

**Progress of Work**
- Maintain field supervision to manage successful completion of scheduled work including D1621 .

**Schedule**
- Perform reactor safety review of schedule
- Utilize FIN team to protect schedule for their own work
- Approve CCD , MAFS, AFS

**Work Readiness / Look Ahead**

**T-6 / T-3 Months**
- Participate in the look ahead teams and challenge /critical evolution meetings.
- Co-ordinate with CNSC to req'd transitions through regulatory RCHP's via QM group

**W-4 to W-0 Weeks**
- Perform walkdown of O&M tasks as required. Participate in Vendor task walkdown as requested/required (permitry, materials, REP etc)

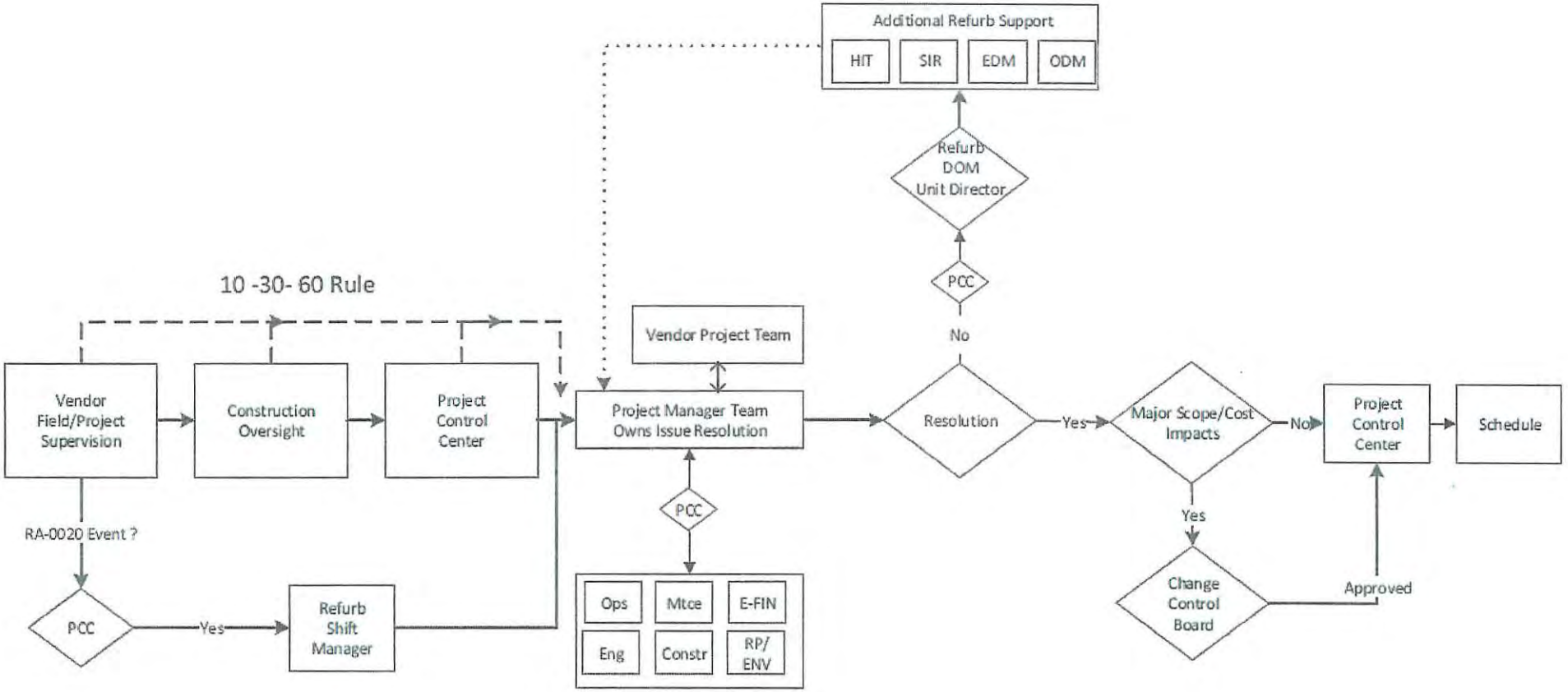
**Scope Management**
- Manage scope growth (corrective) resulting from preventive maintenance tasks

**Risk Management**
- Conduct assessing and preps for contingency items as required
- Provide standards and validate vendor chemistry, environment and waste plans.
- SPOC for MOE with the station

**Cost Management**
- Using Schedule cost metrics, remain within baseline schedule/cost funding envelope
- Monitor and maintain resource plans

# Division of Responsibilities

- Pre-decision Matrices



# Division of Responsibilities

- Daily Runstream

DARLINGTON REFURBISHMENT
Repowering Ontario

**Execution Schedule Run-Stream**

**Date: Updated Mar 15, 2016 (KF)**

| | Meetings – Monday | Meetings – Tuesday | Meetings – Wednesday | Meetings – Thursday | Meetings – Friday | Vendor's Updates Daily | OPG Updates Daily | IT Tools/Reporting Daily |
|---|---|---|---|---|---|---|---|---|
| 06:30-07:00 | POC daily recorded call by 07:00, POC finalize 6 Shift mark up for POC turnover | POC daily recorded call by 07:00, POC finalize 6 Shift mark up for POC turnover | POC daily recorded call by 07:00, POC finalize 6 Shift mark up for POC turnover | POC daily recorded call by 07:00, POC finalize 6 Shift mark up for POC turnover | POC daily recorded call by 07:00, POC finalize 6 Shift mark up for POC turnover | Vendor Start of Shift/End of Shift update meeting | | AS7 to P6 Global Download |
| 07:00-07:30 | PCC Turnovers; Dir Align Mtg; WOTL: Work Report Review / Turnover | PCC Turnovers; Dir Align Mtg; WOTL: Work Report Review / Turnover | PCC Turnovers; Dir Align Mtg; WOTL: Work Report Review / Turnover | PCC Turnovers; Dir Align Mtg; WOTL: Work Report Review / Turnover | PCC Turnovers; Dir Align Mtg; WOTL: Work Report Review / Turnover | Verify AS7 Updates and Status P6 activities | | Reports Available from BI (04:0 |
| 07:30-08:00 | POC Daily Plan Update with POC SPOOS | POC Daily Plan Update with POC SPOOS | POC Daily Plan Update with POC SPOOS | POC Daily Plan Update with POC SPOOS | POC Daily Plan Update with POC SPOOS | | | |
| 08:00-08:30 | Daily Refurb POC Morning Meeting (T-0 Plan & 6-Shift); SMSB (one Project Office SPOO only attend) | Daily Refurb POC Morning Meeting (T-0 Plan & 6-Shift); SMSB (one Project Office SPOO only | Daily Refurb POC Morning Meeting (T-0 Plan & 6-Shift); SMSB (one Project Office SPOO only | Daily Refurb POC Morning Meeting (T-0 Plan & 6-Shift); SMSB (one Project Office SPOO only | Daily Refurb POC Morning Meeting (T-0 Plan & 6-Shift); SMSB (one Project Office SPOO only attend) | | | |
| 08:30-09:00 | Field Time | Field Time | New Work Mtg; Field Time | Field Time | Final Acceptance of T-0 | | | |
| 09:00-09:30 | New Work Mtg | New Work Mtg | Weekly line by line review of Current T-0 Plan and T+1 (all projects, all vendors) | New Work Mtg | New Work Mtg | Final T-0 Schedule Updates (Fridays) | | AS7 to P6 Status Update (Every 2 hours) |
| 09:30-10:00 | | | | | | | | |
| 10:00 - 10:30 | Weekly Metrics Review Schedule, Cost Performance, Dashboards Review | | | | | | | |
| 10:30-11:00 | | | | | | | | |
| 11:00 - 11:30 | | | | | Publish T-0, Weekend 6-Shift and lookahead schedules | | F9 all schedules with the Interface Milestones | Read Only Access to P6 |
| 11:30-12:00 | POC Call | POC Call | POC Call | POC Call | POC Call | | | |
| 12:00-12:30 | CNO Call | CNO Call | CNO Call | CNO Call | CNO Call | | | |
| 12:30 - 13:00 | Field Time | W-Meetings; Field Time | W-Meetings; Field Time | Weekly Issues Resolution; Field Time | | Walkdowns competed and updated in walkdown | | |
| 13:00 - 13:30 | | | | | | | | |
| 13:30 - 14:00 | | | Field Readiness Mtg (per Schedule) | | Field Time | | | |
| 14:00 - 14:30 | 4 week lookahead Schedule Review / Walkdown Challenge Meeting; POND | 3 Month Schedule Lookahead Plan Review Meeting; PO ND; New Work Review | T-21 Schedule Review / HOLDS Meeting; POND | POND; New Work Review | POND | | | |
| 14:30 - 15:00 | | | | | | | | |
| 15:00 - 15:30 | | | Milestone Impact Analysis | | | | | |
| 15:30 - 16:00 | Vendor specific performance review (one vendor each day) | Vendor specific performance review (one vendor each day) | Vendor specific performance review (one vendor each day) | Vendor specific performance review (one vendor each day) | Vendor specific performance review (one vendor each day) | Daily Data Date Change (P6) | Daily Data Date Change (P6) | |
| 16:00-16:30 | Dir Align Mtg | Dir Align Mtg | Dir Align Mtg; T-1 Schedule Publishing | Dir Align Mtg; T-1 Schedule Publishing | Dir Align Mtg | | Updates to all the Toolkits (Scope Management) | |
| 16:30-17:00 | | | | | | (AS7) | | |
| 17:00-17:30 | Issue Updated 6 Shift prior to POC turnover | Issue Updated 6 Shift prior to POC turnover; T-1 Reactor Safety Review | Issue Updated 6 Shift prior to POC turnover | Issue Updated 6 Shift prior to POC turnover; T-1 Reactor Safety Review | Issue Updated 6 Shift prior to POC turnover | | | |
| 20:00-20:30 | | | | | | | | AS7 to P6 Global Download |
| 20:30-21:00 | | | | | | | | P6 to AS7 Dates Upload |
| 22:30-04:00 | | | | | | | | SABI Data from P6 to BI |
| Over night | | | | | | | | |

# Schedule Alignment

- Level 1 schedule integration using a resource balancing tool
- Schedule look-ahead process to identify potential resource impacts
- Resource Summit meetings to address both tactical and strategic resource outlook.
- Project Control Centre in place
- Plan Of the Next Day Meeting (POND)
- SMSB (Shift Manager Station Brief)
- Integrated schedule reviews via T-meetings
- Break plan process

# Return to Service

## Refurbishment Construction Review Board

**BEHAVIOURS**

- Say It, Do It
- Simplify It
- Think Top and Bottom Line




VALUES • SAFETY • INTEGRITY • EXCELLENCE • PEOPLE & CITIZENSHIP •

PEOPLE POWERING THE FUTURE
OPG NUCLEAR

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# Safety Pre-Job Brief

- Fire/First Air
  - Medical Emergency – Dial 9-911
- Emergency Exits Walk, Do Not Run
- Assembly Area
  - Proceed to our assembly area (Sign poster in East Parking Lot)
  - DO NOT RE-ENTER THE BUILDING
- Address: Darlington Energy Center
  1855 Energy Drive, Courtice

# Refurbishment Weekly Message

## Week of March 28

## Focus on Nuclear Safety


### Nuclear Projects Nuclear Safety Culture Assessment

- The survey portion of the assessment ends Friday.
- Surveys are information—the information we need to run our organization in the safest, most efficient & effective manner possible.
- If you still have the survey on your "to do" list, take the little time needed to complete it now – do your part in improving the safety culture for all of us.

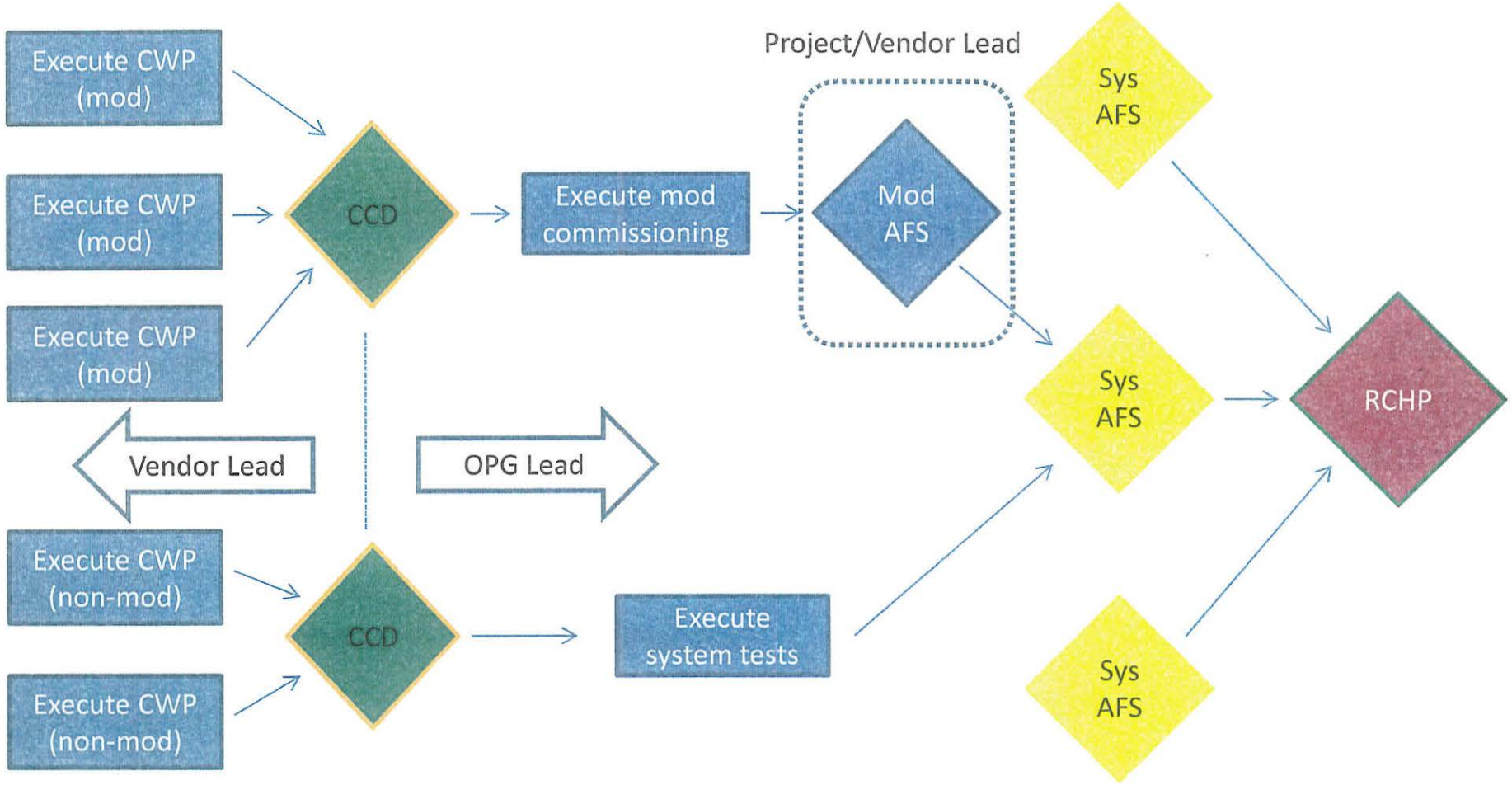
### Nuclear Safety Trait:

**# 8 Problem Identification & Resolution:** Issues potentially impacting safety are promptly identified, fully evaluated, and promptly addressed and corrected commensurate with their significance.

### INPO Principles for Excellence In Nuclear Project Construction:

**#8 Deviations and Concerns are Identified, Communicated & Resolved:** Personnel are required to report issues that can have an adverse effect on construction quality or personal safety.

# Return to Service Processes Flow



# Construction Completion Declaration (CCD)

- CCD is a declaration that construction work on a system is complete
  - For modifications this means that installation is complete and "static" testing is complete
  - For non-modifications this means that inspections, maintenance, repairs, and so on is complete
- CCD is not an Available for Service or Operations Acceptance
- CCD allows for:
  - Early identification of issues
  - Asset preservation (i.e. Layup)
  - Testing of modifications or system restart (when required and when support material is available)

# Available for Service (AFS)

- AFS done to confirm:
  - Test results met pass/fail criteria
  - Operations/Maintenance documentation is available
  - Staff are trained
- AFS done for:
  - Modifications as per N-PROC-MP-0090, "Modification Process"
  - Systems as per NK38-INS-09701-10005, "Nuclear Refurbishment System Available For Service"

# Unit Readiness for Service

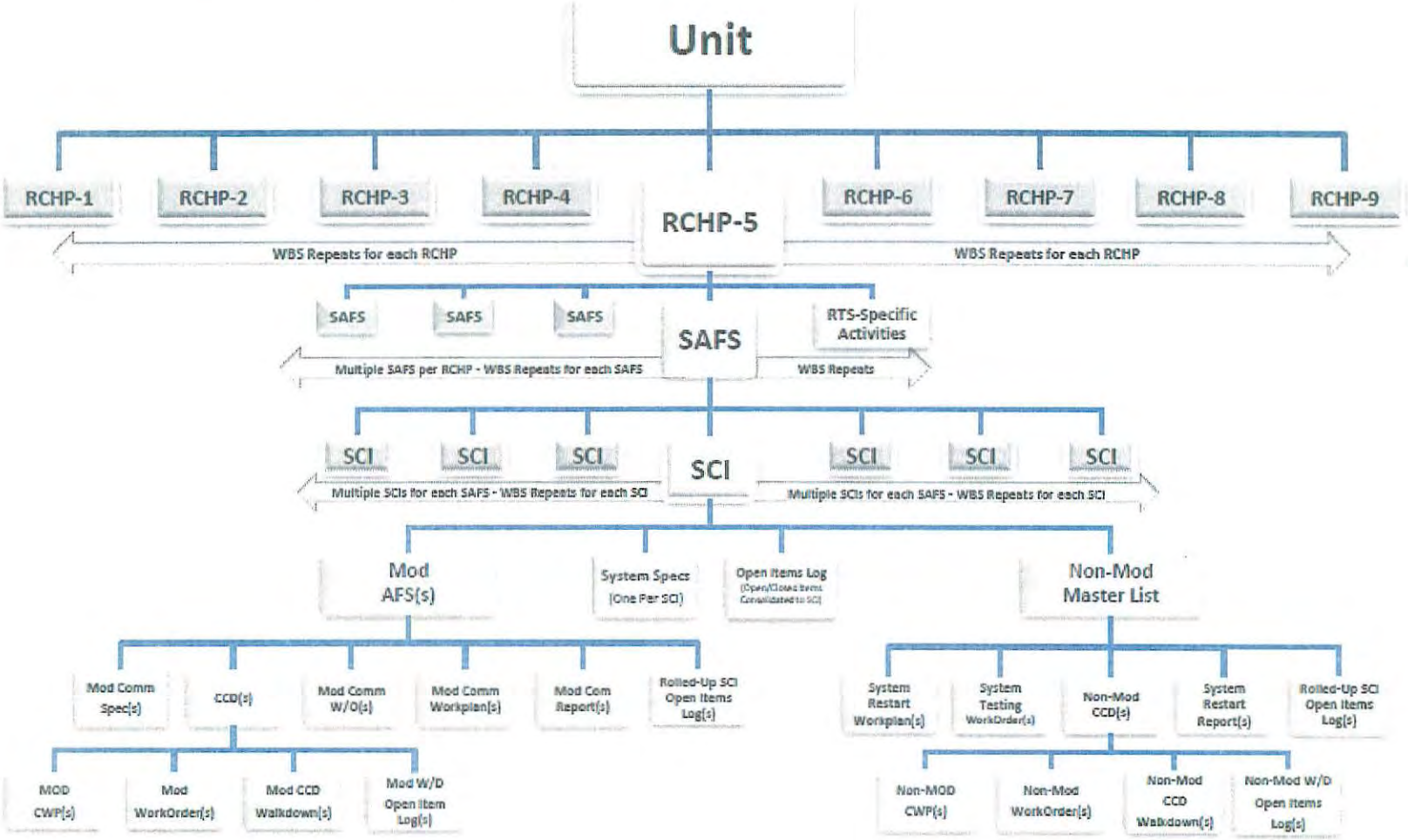
- A process has been created, NK38-INS-09701-10006, to provide assurance at identified Restart Control Hold Points (RCHPs) that:
  - Integrated system testing is complete and acceptable
  - Systems, conditions and pre-requisites are acceptable to progress past the RCHP

| RCHP # | RCHP Title |
|---|---|
| 1 | Prior to Moderator Fill |
| 2 | Prior to Fuel Load (**CNSC**) |
| 3 | Prior to Bulkhead Removal |
| 4 | Prior to Heat Transport Fill |
| 5 | Prior to GSS Removal (**CNSC**) |
| 6 | Prior to Exceeding 1% Full Power (**CNSC**) |
| 7 | Prior to Turbine Testing & First Synchronization |
| 8 | Prior to Exceeding 35% Full Power (**CNSC**) |
| 9 | Prior to Unit Available for Commercial Operation |

# RTS Hierarchy

Version 1.0
06 Aug 2015

## RTS Document Hierarchy



# RTS Schedule Integration

DARLINGTON REFURBISHMENT
Repowering Ontario

CONTROL TEMPLATE #: 009
TEMPLATE: COMMISSIONING (AFS, RTS) – REHAB/MOD
REVISION #: R000
ISSUE DATE: 30-OCT-2015

## SCHEDULE CONTROL CODING

Reviewed By: Aris Kalafatis
Process Owner or Delegate

Approved For Issue By: Dan Sawyer
Unit 2 Outage Manager

Approved For Issue By: Derek McAuley
Scheduling Manager

ADJUSTER ROD REPLACEMENT PROJECT - 73550

Modification

IFB Rack Pre-req to Adjuster Rod Replacement Window

EC 130059

IFB Rack CWP

SEE CONSTRUCTION TEMPLATE FOR DETAILS

NOT APPLICAPLE FOR THE RACK MODIFICATION

Pre-req to Replacement Window

Non Modification- Repair & Replace

Adjuster Rod Replacement Window

SEE CONSTRUCTION TEMPLATE FOR DETAILS

NOT APPLICAPLE FOR THE REPLACEMENT

LEGEND

Coding: Milestone Type, Reporting Event
Schedule: L3 OPG's Schedule, L3 Vendor's Schedule
Accountability: Vendor, OPG
Milestones: AFS Milestone, RCHP Milestone, Construction Complete, System Available for RTS, IIP

Note 1: For a full list of mandatory codes, please refer to the mandatory code list in Sharepoint

Note 2 : All OPG Review/Accept activities should have the appropriate OPG Functional resources in the Vendor schedule

# Program Assurance and Management Systems

Dave Stiers

Director Management Systems Oversight

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# Lessons Learned for Program Assurance and Oversight

| Pickering A Return to Service, (PARTs) Lessons Learned | DRP Action |
|---|---|
| **Lack of Management Oversight**<br>• Throughout the preparation and execution of Unit 4, there was no independent management group providing oversight and challenge to the Pickering-A management team. Communications external to the site were not adequately challenged, and independent risk assessment did not occur. | •Multiple Layers of Oversight on the DRP including Internal and External Oversight entities |
| **Lack of Intrusive Performance Assessments**<br>• The lack of intrusive assessments on quality of work and quality of process allowed problems to multiply throughout the project. | •Internal Quality Management and Program Assurance Group (PA)G departments established within DRP |
| **Performance Assurance Independent Assessment**<br>• There were significant quality issues that came to light late in the project that were systemic in nature. The Performance Assurance independent assessment process was not fully effective at identifying and/or causing appropriate actions to occur to resolve these issues earlier in the project. | •Engineering and Work Planning completed before Breaker Open<br>•Contractor Owner Interface requirements, (COIR)<br>•Ready to Execute Plan, (RTE) |



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# Lessons Learned for Program Assurance and Oversight

| Lessons Learned | DRP Actions |
|---|---|
| At Point Lepreau the Owner did not have sufficient involvement and oversight of the EPC Contractor:<br>• General contractor rationalized test results that were out of specification and installed a whole series of Calandria tubes that had to be all replaced, costing the project hundreds of millions of dollars and over a one year delay | •Inspection and Test Plans, Witness Points<br>•Project Team Oversight with a strong engineering presence |
| Project management in key areas was ineffective as identified by the Inspector General for Oversight for Watts Bar:<br>• Perform effective oversight of the engineering, procurement, and construction contractor<br>• Address certain warning signs that the project was in trouble<br>• Adequately mitigate known problems related to staffing, work order packages, timeliness and quality of information provided to the Nuclear Regulatory Commission, and the procurement of materials that require a long lead time to obtain<br>• WBN management (Oversight) became directly involved in day-to-day project management and decision-making with respect to production, budget, and cost. This resulted in the small TVA team to "run from one fire to the next" with little to no effective oversight provided of the EPC and major contractors | •Program level implementation of Lessons learned across all elements of the DRP<br>•Non OPG Project Senior Management actively involved in oversight of the project<br>•Program Assurance and Oversight bodies are not part of the Project Execution line. |



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# Oversight and Program Assurance

- The DRP Oversight and Assurance program, by design, incorporates multiple layers of oversight to support building and maintaining internal and external confidence.
  - Each layer must be constructed in a manner that avoids supplanting the management decision making process, and that reinforces accountability for finding and fixing problems at the lowest applicable organizational level. These successive layers of oversight must focus on evaluating the effectiveness of subordinate programs, and on testing the accuracy and completeness of information
- The intent of the Program Assurance Model for the DRP is to ensure the Darlington Refurbishment Program:
  - Meets all safety, quality, cost, and schedule expectations
  - Issues will be identified and resolved expeditiously
  - Transparent and accurate information flows up to the Board in a way that supports Board oversight effectiveness and decision making.
- OPG has regulatory obligations to ensure appropriate oversight/assurance is in place
  - CNSC prescribes all Nuclear Licensees to implement management systems as per CSA Standard N286 and CNSC Document RD-360, "Life Extension of Nuclear Power Plants" Section 7.3 "Project Monitoring" expectations are:
    - "The licensee is expected to monitor the project for progress, safety, and quality at all phases of execution."



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Illustration of Oversight Model for Darlington Refurbishment

External Assurance

CNSC

Nuclear Oversight (NO)

Project Assurance

Project Mgmt | POP[1] | In Process QC | Quality Surv.

Ministry of Labour (MOL)

Internal Audit (IA)

Program Assurance

PAG

SCQS[2]

PEI[3]

Contractor's Quality Assurance Program

Ministry of the Environ-ment (MOE)

Board of Directors (Burns McDonnell)

RCRB

Internal Oversight / Assurance

Minister of Energy (Milt Caplan)

IAEA

WANO

[1]POP = Project Oversight Plan
[2]SCQS = Supply Chain Quality Services
[3]PEI = Project Execution Integrators

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# 90 Day Look ahead For Audits and Assessments

| Auditor/ Assessor | Min. of Energy | RCRB | Board OS | Internal Audit | Nuclear OS Audits | WANO Inter-actions | Divisional Self Assess. (Internal) | Program Assurance Group (Internal) | Total |
|---|---|---|---|---|---|---|---|---|---|
| Total | 2 | 2 | 1 | 5 | 9 | 5 | 2 | 12 | 38 |



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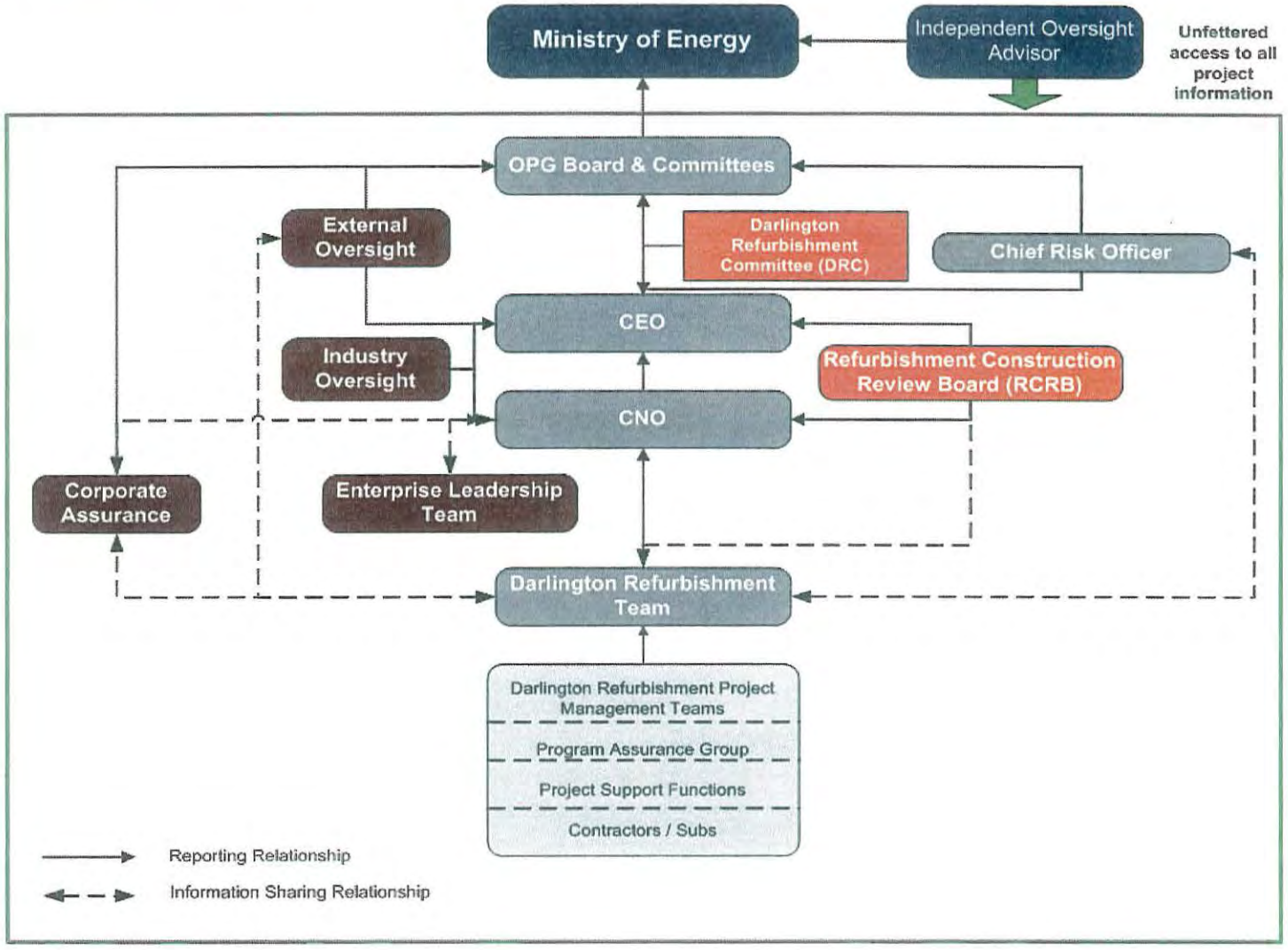
# What OPG's Planned Oversight of the Execution Phase looks like



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# SVP Nuclear Projects Accountabilities and Reporting

| | |
|---|---|
| **Nuclear Projects Leadership Team** | Actively monitors and assesses project performance to determine if activities are progressing on plan and that safety, quality schedule and cost requirements are being met. |
| **Project Planning & Controls Organization** | Ensures cost and schedule compliance, complete and accurate metric and progress reports, conducts surveillances of the project and contractors and raises any gaps promptly. |
| **Quality Management Organization** | Through direct assessment and intervention confirms that contractors, subcontractors and suppliers are meeting quality expectations and that all needed regulatory documentation is being created and maintained. Performs specialized and regulatory required quality inspections. |
| **Project Assurance Organization** | Maintains Management System and associated programs and projects, conducts assessments to determine effectiveness and facilitates implementation of any corrective actions. Provides support for management of contracts used in execution of the Darlington Nuclear Refurbishment Project. |
| **Project Management** | Oversees project deliverables and the day-to-day progress of the projects, removing barriers to expedite the work and ensuring that quality requirements are achieved on time and on budget. Project Managers maintain specific metrics for safety, quality, cost and schedule and promptly document and escalate any significant performance shortfall |
| **Contractor Executive Steering Committees** | Steering committees have been established for each major supplier to address any emerging issues, ensure issues are escalated, ensure ongoing dialogue at all levels and share oversight findings. |
| **Contractor Quality** | During contract formation, provisions were included that require implementation oversight and assurance processes on the part each contractor. EPC contractors are responsible for establishing and executing these programs to ensure that their activities, and those of their subcontractors, meet expectations. OPG will Monitor contractor compliance in this area. |



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# CNO and Nuclear Management Systems Accountabilities and Reporting

| | |
|---|---|
| Nuclear Leadership Team | Provides assurance that project performance is following Nuclear Management System and that the Refurbishment Leadership Team is consistently finding and correcting their own issues. |
| Regulatory Affairs | External regulators such as the CNSC, MOL, MOE, perform assessments of compliance. OPG anticipates and addresses issues in a way that maintains and builds regulatory confidence. |
| Industry Assistance and Assessment (INPO/WANO) | Nuclear industry organizations are utilized to provide assistance in risk significant areas to help the team understand the current state of performance compared to industry standards and to help develop needed gap closure plans. They periodically evaluate corporate and safety performance; comparing performance to established industry standards and highlighting significant gaps. The results of these evaluations are reported to the CNO and CEO who direct the development and implementation of plans addressing the areas for improvement. This information is shared with the Board of Directors. |
| Nuclear Safety Review Board (NSRB) | NSRB provides independent assessment of continued safety of operating units, application of the Nuclear program, quality assurance, and the safe return to service of units. |
| Nuclear Oversight Organization | Conducts audits, surveillances and assessments to ensure that the Darlington Nuclear Refurbishment Project meets the requirements of the Nuclear Management System. The findings are reported to the CNO for action and are shared with the NSRB/RPRB, and the Nuclear Oversight and Darlington Refurbishment Committees of the Board. |



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# CEO and Enterprise Leadership Team, (ELT) Accountabilities and Reporting

| | |
|---|---|
| Enterprise Leadership Team Quarterly Review | Reviews the performance of the Darlington Nuclear Refurbishment Program on a quarterly basis, including:<br>• Chief Nuclear Officer report on quality, safety, schedule and cost<br>• Chief Financial Officer report on financial controls application, and other financial implications<br>• Chief Risk Officer report on enterprise risks that stem from or impact the Darlington Refurbishment Project<br>• General Counsel report on legal and ethics issues<br>• Human Resources report on staffing, training, and safety performance<br>• Internal and external audit and assessment reports<br>• Insights provided by the Refurbishment Program Review Board (RPRB) |
| Refurbishment Construction Review Board | RCRB is being created to provide independent oversight of the project, similar to the role of the NSRB at the operating stations. Senior experts with regulatory, mega-project and plant expertise will review the status of the project and report to CEO and CNO on a quarterly basis. |
| Internal Audit | Internal Audit verifies that management has designed and operating process and controls to meet project enterprise objectives. The Strategic Audit Plan includes risk-based audits aligned with top risks and objectives identified by management. The ELT will review and act to resolve the findings and recommendations resulting from the Strategic Audit Plan. |



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# Board of Directors Accountabilities and Reporting

| | |
|---|---|
| **Board of Directors Independent External Assessment Resource** | The Board of Directors, through the Darlington Refurbishment Committee, has retained an expert (Burns & McDonnell) for the Execution Phase and who are co-located with the project team and regularly report to the Board. |
| **Minister of Energy's Independent Assessment Resource** | The Minister of Energy has retained an individual through Infrastructure Ontario (Milt Caplan) to participate on the Darlington Refurbishment Committee in an "ex-officio" capacity, co-reporting to the Minister with the Chair of the Darlington Refurbishment Committee |
| **Internal Audit** | The Internal Audit team has functional independence from management. Audit results regarding key gaps in meeting operational, compliance or regulatory objectives are reported quarterly to the Board. |
| **Nuclear Safety Review Board (NSRB) -** Annual Report to the Nuclear Oversight Committee | NSRB will provide an annual presentation to the Board regarding their independent view of nuclear plant operations, the impact of Darlington Refurbishment on the operating units, and readiness of the unit in refurbishment outage for return to service. |
| **Refurbishment Construction Review Board (RCRB) -** Annual Report to Darlington Refurbishment Committee | The RCRB will provide to the Board an annual report on incremental oversight of the scope and execution of the Darlington Nuclear Refurbishment program. |



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# Management Systems

- A requirement of the Power Reactor Operating License (PROL) is for OPG to meet the requirements of Canadian Standards Association (CSA) N286, Management System
- The Darlington Refurbishment Program, (DRP) performs work in accordance with 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.
- The DRP also makes extensive use of Corporate and Nuclear Line of Business management system documents where applicable.
- The Purpose of DRP Charter, D-PCH-09701-10000, is to establish and communicate the expectations of the Senior Vice President (SVP), Nuclear Projects regarding the management of the DRP.
- 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) and Project Management Plans (PMPs)



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# OPG Mgmt. System + DNGS Refurb. Program

OPG Centre-Led Programs
- Policy, Prog
- Outlines Reqt.'s/Input for Proj. O/S Plan, Proj. Mgmt. Plan
- Governs Func.-Specific Plans

Ex. Finance, Supply Chain, Corp. Assurance, Corp. Risk, etc.

Nuclear Management System (N-CHAR-AS-0002)

Project Mgmt. Program (N-PROG-AS-0007)

Other Nuclear Programs
- Outlines Reqt.'s/Input for Proj. O/S Plan, and other plans as part of the Proj. Mgmt. Plan
- Governs Func.-Specific Plans

Ex. Nuc. Eng., Reg. Affairs, Ops. & Maint. etc.

Project Mgmt. Standard (N-STD-AS-0028)

Contract Mgmt. Standard (N-STD-AS-0029)

Project Oversight Standard (N-STD-AS-0030)

Field Engineering Standard (N-STD-AS-0031)

Oversight of Shipment Personnel (N-STD-AS-0032)

Nuclear Management System

Darlington Refurbishment Program

DNGS Refurb. Prog. Charter D-PCH-09701-10000

- Darlington Refurb. Prog. Structure (Sh. 0001)*
- Return to Service Mgmt. Plan (Sh. 0003)*
- Health & Safety Mgmt. Plan (Sh. 0005)*
- Prog. Licensing Mgmt. Plan (Sh. 0007)*
- Mtce. Mgmt. Plan (Sh. 0009)*
- Program Assurance Mgmt. Plan (Sh. 0011)*
- Contract Mgmt. Plan (Sh. 0013)*
- Supply Chain Mgmt. Plan (Sh. 0015)*
- Ops. Mgmt. Plan (Sh. 0017)*
- Training Mgmt. Plan (Sh. 0019)*
- Project Specific Mgmt. Plans
  - Project Management Plan
  - RFR Plan
  - Defueling Plan
  - Islanding Plan
  - Steam Generator Plan
  - BOP Plan
  - Shutdown Layup Plan
  - Turbine Generator Plan
- Planning & Controls Mgmt. Plan (Sh. 0002)*
- Env. Mgmt. Plan (Sh. 0004)*
- Chemistry Mgmt. Plan (Sh. 0006)*
- Refurb. Engineering Mgmt. Plan (Sh. 0008)*
- MSO Mgmt. Plan (Sh. 0010)*
- Const. Mgmt. Plan (Sh. 0012)*
- Comm. Mgmt. Plan (Sh. 0014)*
- Staffing Mgmt. Plan (Sh. 0016)*
- Rad. Protection Mgmt. Plan (Sh. 0018)*
- Human Performance Mgmt. Plan (Sh. 0020)*
- Prog Quality Plan (Sh. 0023)*

* Sheets of NK38-NR-PLAN-09701-10001

Ontario Power Generation

# Program and Project Management Plans

- DRP Program Management Plans (PgMPs) 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, (CSA) N286, Management System Requirements for Nuclear Power Plants;
  - Canadian Nuclear Safety Commission's (CNSC) Regulatory Document RD-360, Life Extension of Nuclear Power Plants;
  - N-CHAR-AS-0002, Nuclear Management System; and OPG Corporate and Nuclear governance.
  - PgMPs integrate requirements from other Management System standards for health, safety, environment, security, economics
- The Project Management Plans (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).



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# DRP Principals of Corrective Action Program, (CAP)

- OPG staff follow Nuclear governance and processes for CAP
- Vendors follow their CAP Programs, (CSA-N286 standard)
- Overall goal is for the Vendors to develop and use a healthy and robust CAP that facilitates low level reporting and performance improvement
  - An overall project plan for implementation was developed, including blue card implementation
  - Embedded the CAP Manager in the Vendors Shop, Q1 2016
  - "What good looks like" workshop, March 2016
  - Objective criteria to measure if we are getting traction with vendor low level reporting
  - Off ramp and decision criteria built in
- Interface between the OPG and Vendors CAP is documented in a Guide
  - Rules when OPG SCR are required, e.g., Equipment damage
  - All Vendor CARs will be screened for operability, reportability and appropriateness
  - Vendor CARs are input into an IT system for facilitate OPEX searching



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# To Achieve Low Level Reporting/Trending by Vendor

- Blue Card for Adverse Condition/Worker Concern Reporting
  - Handwritten card for those who do not have access to Vendor database
  - Info to be provided to Vendor to input to their database
  - Significant issues meeting SCR criteria in N-GUID-00120-10012 to be entered in SCR database as well for OPG follow-up
- Vendor initiation of Corrective Action Record (CAR) in their database at OPG request
  - In addition to above Vendor to enter CAR at OPG request
- Screening of Vendor CAR
  - Vendor CARs to be screened by OPG per N-GUID-00120-10012
- Vendor reporting of CAR metrics and trends at Refurb CARB
  - Vendor to attend periodically for reporting metrics and trends and to present all root cause evaluation reports



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- Questions?

# Darlington Refurbishment Project – Quality Management

Presented by: Imtiaz Malek
Director Quality Management
Date: April, 2016

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# Agenda

1. Overview: Why QM exists
2. Objectives
3. Effectiveness & Learning
4. Approach to Quality Surveillance
5. Organization & Integration
6. Expected Work Flow
7. Reporting
8. What we are finding
9. Summary

# 1.0 Overview: Why QM exists

- Self checking approach to Quality internal to Project
  - Report to Project Directors and escalate to SVP
  - Improve Profile of QA within the Project & vendors who OWN IT
  - Monitor QA activities within projects & vendors on E,P and C
  - Review OPEX and Low level trends
- Identify adverse trends and Escalate to project Directors
- Assist in and observe corrective actions on key issues
- Liaise & support Vendors on key issues
  - VENDM, Welding rods, ITPs, QS/QC resources
- Focus on key regulatory activities on behalf of the project
  - TSSA, CNSC (IIP, Inspections, Strategy on responses)

Uncover issues internal to the project and correct before external oversight

# 2. Objectives

1. Implement centralized organization within Execution in addition to:
   - Vendor QA
   - Project Directors
   - Construction Support
2. Implement continuous surveillance process:
   - From initial Engineering to Procurement, Construction, commissioning and Configuration Control for Return to service
3. QS Checks on configuration management
4. Coordinate with other internal and external oversight groups
   - Engineering QA
   - Supply Chain
   - Construction oversight and Vendors
   - Vendor QA

# 2. Objectives: Focus areas

Surveillance activities to focus on:

1. Safety significant items
   - Systems Important to Safety (SIS)
   - Safe Operating Envelope (SOE) Systems
2. Regulatory items
   - Safety Improvement Opportunities (SIOs)
   - Integrated Implementation Plan (IIP)
   - Regulatory Hold Points
3. Other Production and Reliability related project items
   - Restart Hold Points
   - Impediments to Breaker Open & Breaker Closed

*QM Focus Pre Breaker Open:*

- *Quality of Vendor preparations for Breaker Open: Documentation control, Regulatory reporting, strength of vendor QS/QC staff and training*



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# 3. Effectiveness & Learning

- Self Assessment
  - Pre test period of Procedures
  - Size of Organization
  - Integration with DNR
- Benchmarking (Bruce Power, NB Power)
  - NBP, WATTS BAR, CB & I, Bruce Power
  - Things that went wrong, effective processes
  - Regulatory Interface
  - Documentation
  - US QA forum
- OPEX
  - SCRs,
  - Low level trending
- Observation and Coaching
- Vendor QA Forum



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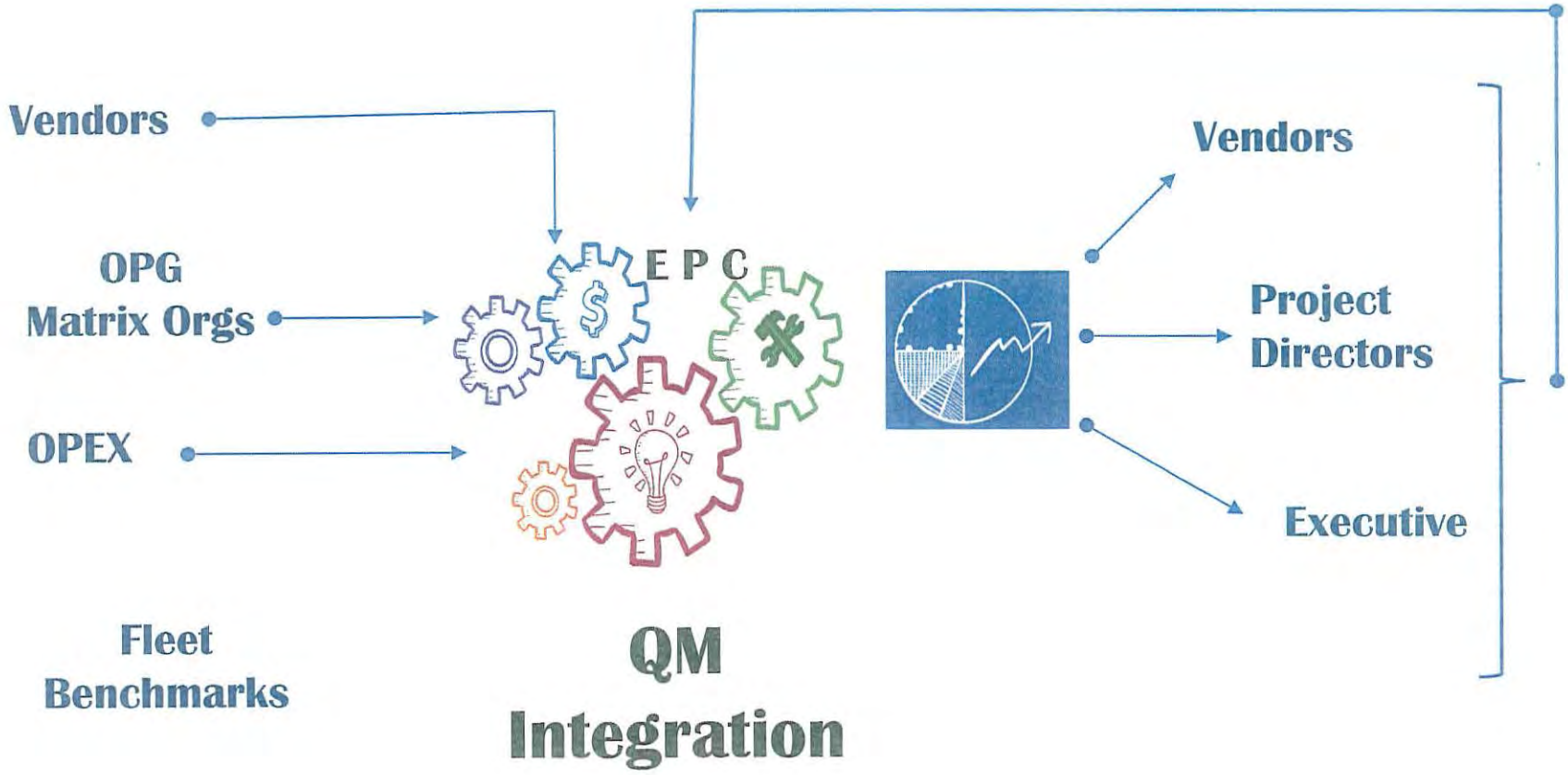
# 3.Approach to Quality Surveillance

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# 5. Organization & Integration

## Nuclear Management System

**Project Managers**

- Scope of Work
- Schedule
- Cost
- Quality
- Accountability

**Director DNR Quality Management**

DNR Quality Plan
- Overall Quality Surveillance and Escalation of Issues

- Supply Chain(SCQS)
- Procurement
- Engineering
- Construction
- Commissioning
- Records & Configuration Management
- Regulatory Interface

**Vendor Quality Program**

Vendors & their sub-contractors

**Assurance**
- Nuclear Oversight
- Internal Audit

**Risk**

**External**
(Regulatory, NSRB, WANO)

**Management System Oversight**



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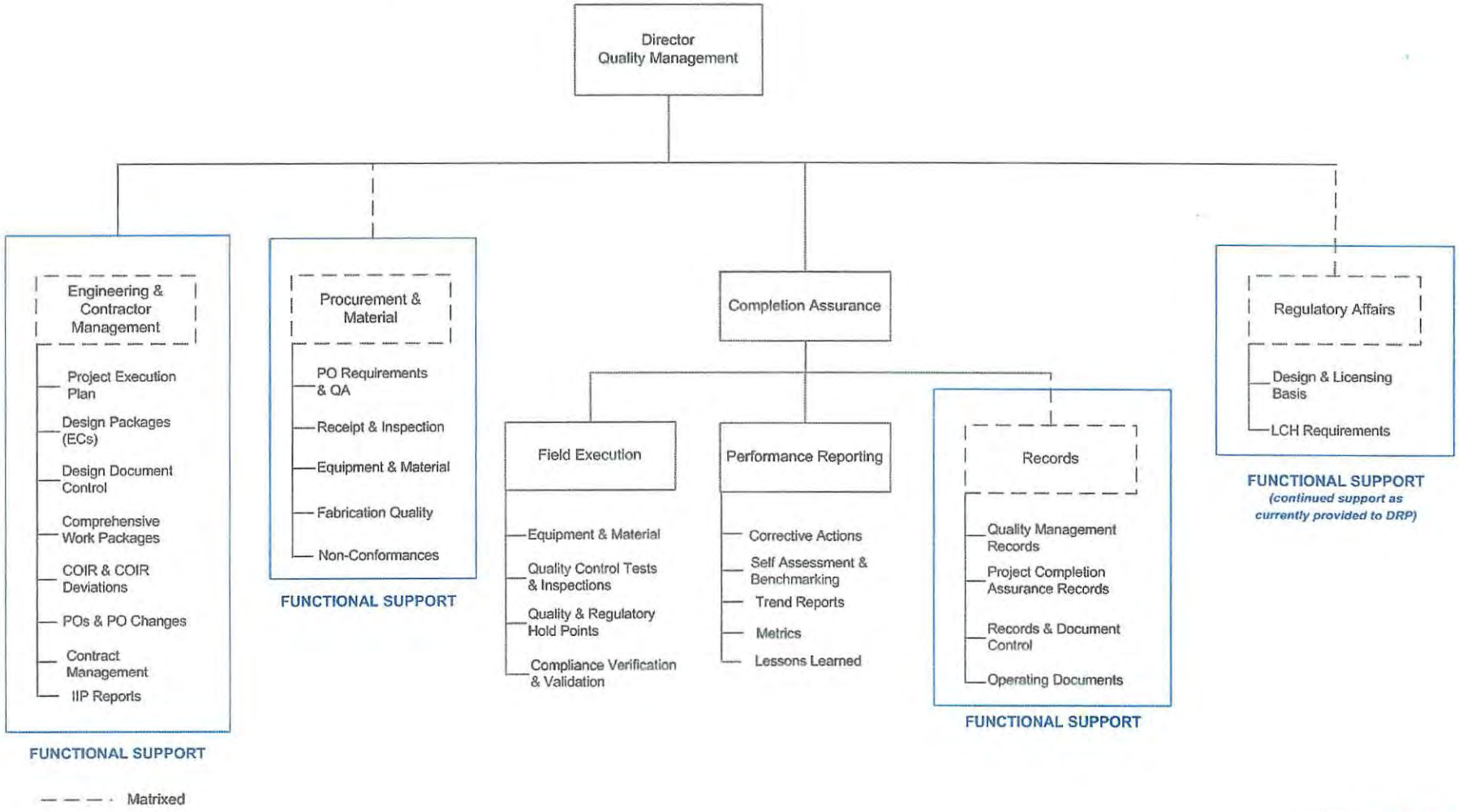
# 5. Organization & Integration

## QUALITY MANAGEMENT ORGANIZATION



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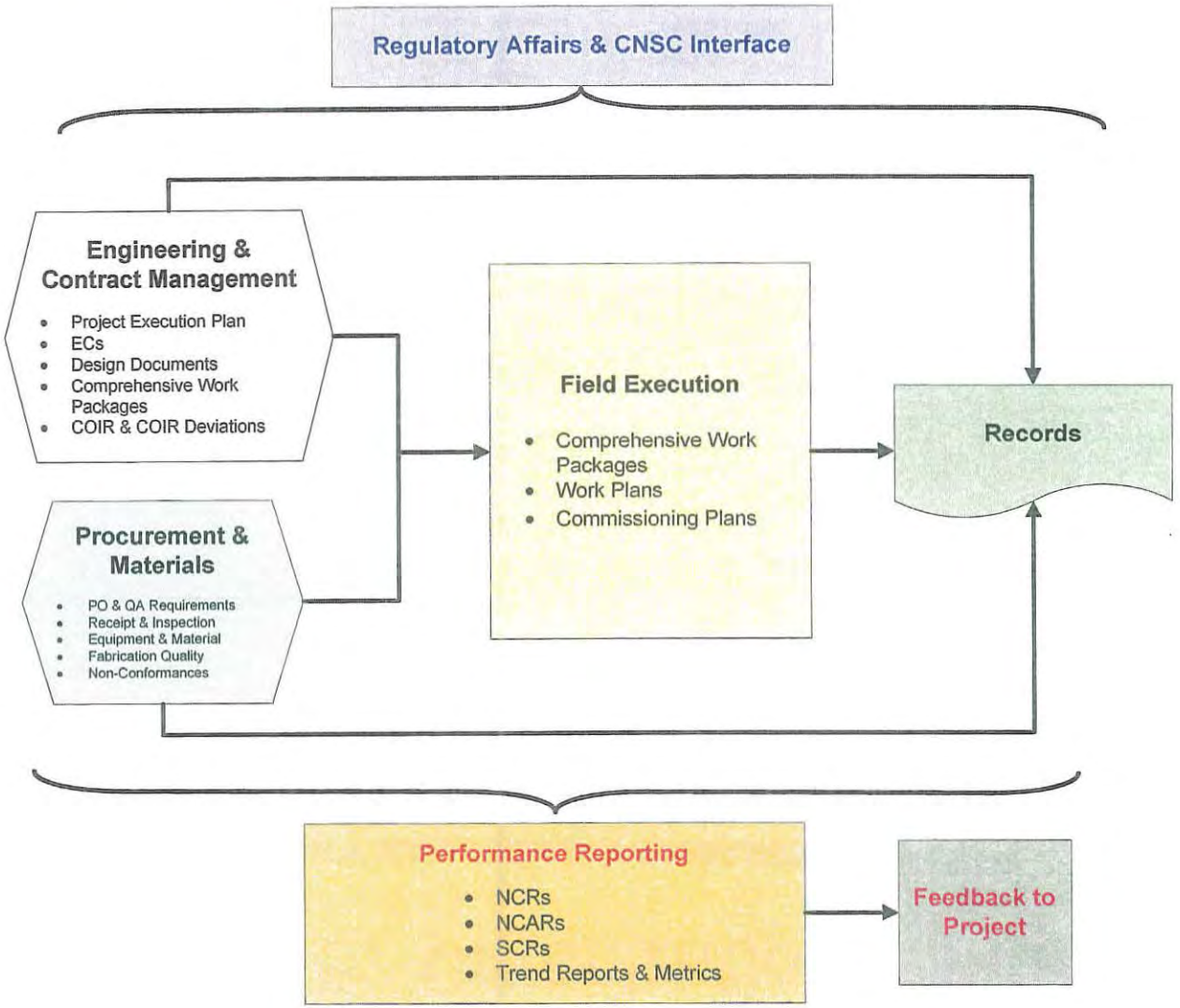
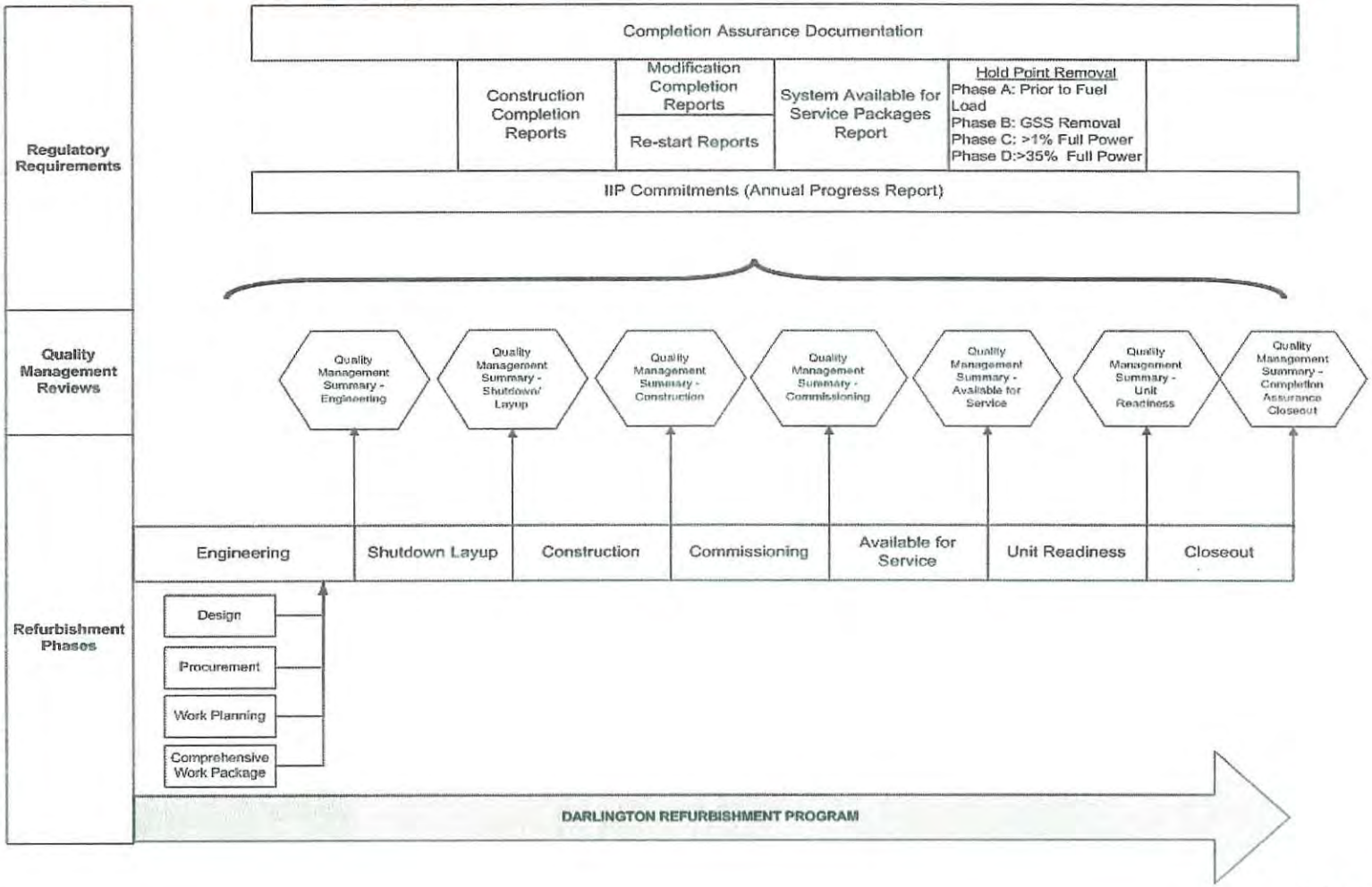
# 6. Expected Work Flow



# 6. Expected work Flow...continued

## Surveillance Approach






ONTARIO POWER GENERATION

# 7 Reporting

## Inputs

- SIS/SOE Systems
- Regulatory Commitments (SIOs & IIPs)
- Other Project & Reliability Related Projects
- QM Metrics
- SCRs
- Risks *RMO Tool*
- Vendor Issues
- Integrated Project Schedule *P6 Schedule*
- Other Oversight Activities (POPs, NO, IA, MSO) *RMO Tool*

## QM Schedule & Reports

- Weekly review of findings
  (Email & mtg with PDs)
- Look ahead: P6, Schedule
  (3 month lookahead and agreement with PDs)
- Trends
  (Input to MSO Trend report)
- Feedback to vendors
  (Monthly QA Vendor mtgs)
- Internal reporting
  (RMO/SCRs)
- Refocus: Events & OPEX
  (BP monthly mtg,. US Connections)
- Dashboard review
  (Internal Indicator, dashboard & Vendor dashboard, ELT reporting)
- Records
- Regulatory interface



ONTARIO POWER GENERATION

# 8. What we are finding...so far

- Paperless approach to Records: *incomplete Understanding*
- ITP Quality: *Requires work, training to improve*
- Readiness to execute (TSSA, Vendors): *Resources & experience*
- Quality of Execution: *production of records, culture of reporting*
- Safety Culture

## Possible future areas to focus on

- Based on Risks and Trends
- Critical tasks in P6
- Documentation Control
- Regulatory commitments
- Safe approach to Hold points
- Human performance: qualifications & experience



ONTARIO POWER GENERATION

# 9. Summary

## What does QM mean to DNR?

- Maintain oversight of configuration management (paper and plant)
- Review of safety significant and regulatory items from cradle to grave
- Maintain and oversee Integrated Implementation Plan for regulatory interface per the licensing basis
- Escalate and alert organization early on quality issues related to vendors, project, operation etc.
- Coordinate in an efficient manner with other internal and external assessment groups

➢ *Identify early, implement correction and prevent recurrence*

ONTARIO POWER GENERATION

Darlington Nuclear Refurbishment Program

# QUALITY

Bundle and Vendor Performance Year-To-Date

31-Mar-16

ELT ONLY

## QUALITY PERFORMANCE - YEAR TO DATE (YTD)

| Overall Quality Performance | # Program Event Free Day Resets | # Regulatory Non-Compliance Events | Status | Trend |
|---|---|---|---|---|
| **Nuclear Refurbishment Program** | | | | |
| Significant Quality Events | 0 | 1 | | - |

## EXPLANATORY NOTES

The trend in quality is yellow and stable. It is driven by issues around documentation quality and the investigation on quality issues with ES Fox Quality Assurance records on Projects & Modifications work (a non-Refurbishment project).

## BUNDLE QUALITY PERFORMANCE - YEAR TO DATE (YTD)

| Line | Bundles | # Program Event Free Day Resets | # Regulatory Non-Compliance Events | # NCARs Initiated in Period | # CARs Initiated in Period | % Rework | Avg. # Field Initiated Changes | # ITP Non Compliance |
|---|---|---|---|---|---|---|---|---|
| 1 | Re-tube Feeder Replacement | [redacted] | | | | | | |
| 2 | Turbine Generator | | | | | | | |
| 3 | Fuel Handling & Defueling | | | | | | | |
| 4 | Steam Generator | | | | | | | |
| 5 | Balance of Plant & Refurb. Support Facilities | | | | | | | |
| 6 | Campus Plan - F&IP and SIO Projects | | | | | | | |
| 7 | **Nuclear Refurbishment Performance** | 0 | 0 | 1 | 50 | TBD | 0.99 | 19 |

## VENDOR QUALITY PERFORMANCE - YEAR TO DATE (YTD)

| Line | Vendors | # Program Event Free Day Resets | # Regulatory Non-Compliance Events | # NCARs Initiated in Period | # CARs Initiated in Period | % Rework | Avg. # Field Initiated Changes | # ITP Non Compliance |
|---|---|---|---|---|---|---|---|---|
| 1 | SNC-Lavalin & Aecon | [redacted] | | | | | | |
| 2 | E.S. Fox Ltd. | | | | | | | |
| 3 | BWXT | | | | | | | |
| 4 | GE-Alstom | | | | | | | |
| 5 | GE Hitachi Nuclear | | | | | | | |

## EXPLANATORY NOTES

[redacted]

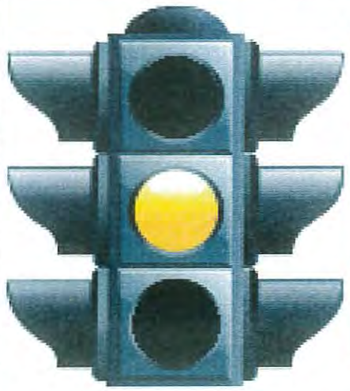
*NCAR = Non-conformance Corrective Action Request; CAR= Corrective Action Request; ITP = Inspection and Test Plan

ONTARIO POWER GENERATION

# QUALITY MANAGEMENT MONTHLY DASHBOARD - REFURBISHMENT EXECUTION

| | |
|---|---|
| Report ID: | 01701A Tech Tips |
| Issue Date: | March 29, 2016 |
| Report Owner: | Lindsay Greenland |
| Process Owner: | Imtiaz Malek |

## (1) Quality Management Indicator



| Colour | Criteria | |
|---|---|---|
| RED | Records Management at **RED**, and | |
| | All 3 Surveillances at **RED** | |
| YELLOW | Conditions for RED and GREEN not met | ✓ |
| GREEN | Records Management at **GREEN**, and | |
| | None of the 3 Surveillances at **RED**, or no more than 2 at **YELLOW** | |

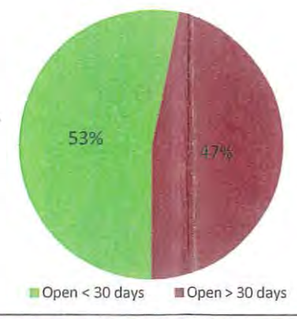
## (2) Quality Management Challenges

| | | |
|---|---|---|
| Records | Unacceptable rate of receiving and accepting documents | Box 3 |
| | VenDM process not followed | |
| | Discrepancy between documents on ADL and what was submitted | |
| | Previous revisions missing | |
| Surveillances | Required deliverable is not available in Asset Suite | Box 4 |
| | P.Eng stamps are missing on the change paper or deliverable | |
| | Printed names on the change paper stamps are illegible | |
| | NCAR issued to Vendor for not having CSA Z299.4 material manufacturer on their ASL | Box 5 |
| | Missing or incomplete FME documents | Box 6 |
| | Vendor personnel unqualified - (P&M) | |
| | Missing M&TE UTC data in Asset Suite - (P&M) | |

## (3) Records Management

### VenDM - Documents Requiring Acceptance

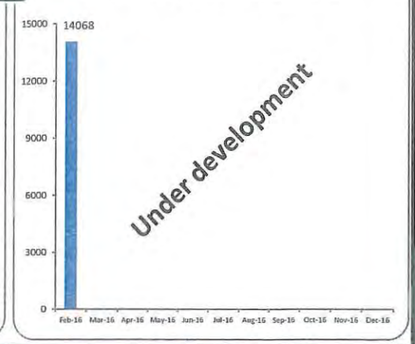
Number of Open Documents = 1617
(end of Feb 2016)




### Configuration Control

(Data start: end of February, 2016)

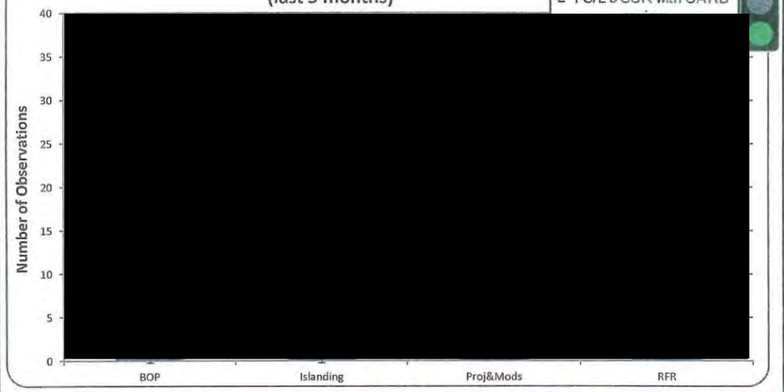
Documents to be Issued in Asset Suite




## (4) Engineering Surveillances - Bundles

Surveillance Observation Bins
(last 5 months)

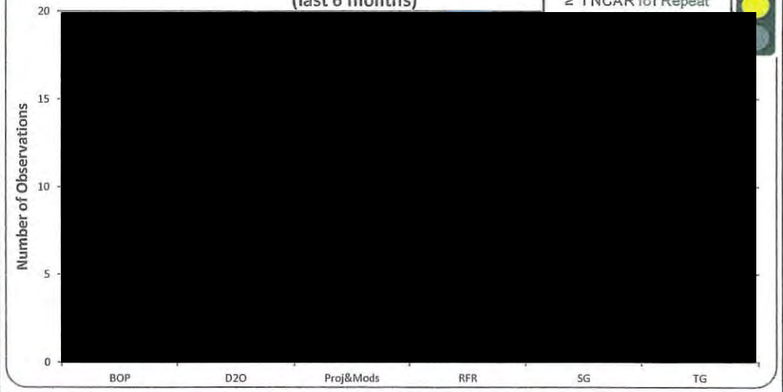
≥ 1 Significance Level 2 SCR
≥ 1 S/L 3 SCR with CARB




## (5) Procurement Surveillances - Bundles

Observation Severity Levels
(last 6 months)

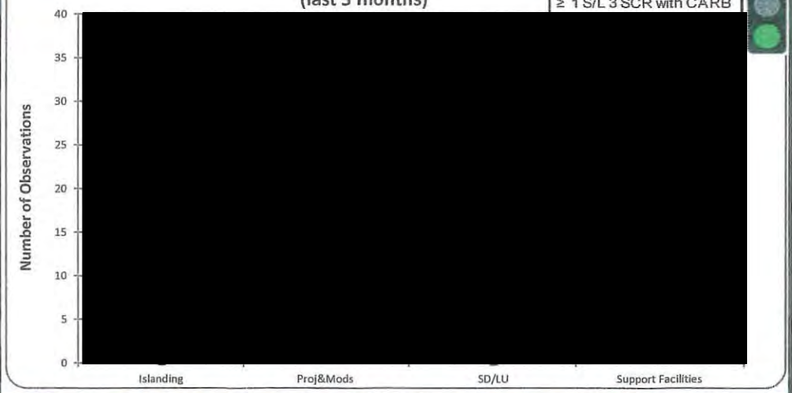
≥ 1 Breakthrough or Major NCAR from Oversight
≥ 1 NCAR for Repeat




## (6) Field Execution Surveillances - Bundles

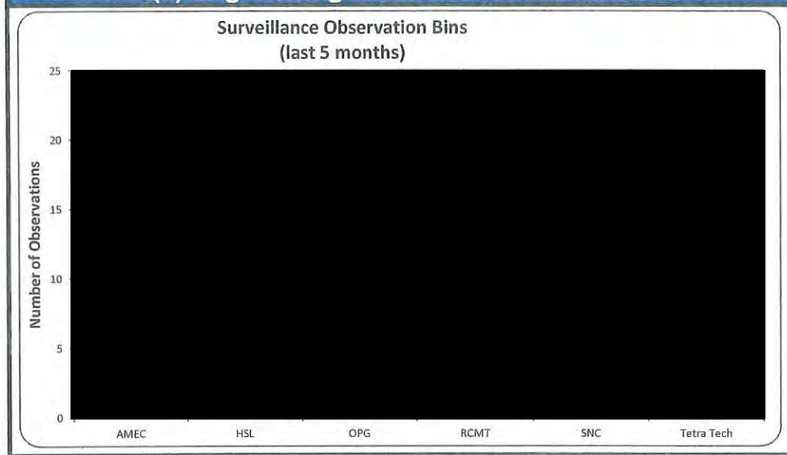
Surveillance Observation Bins
(last 3 months)

≥ 1 Significance Level 2 SCR
≥ 1 S/L 3 SCR with CARB



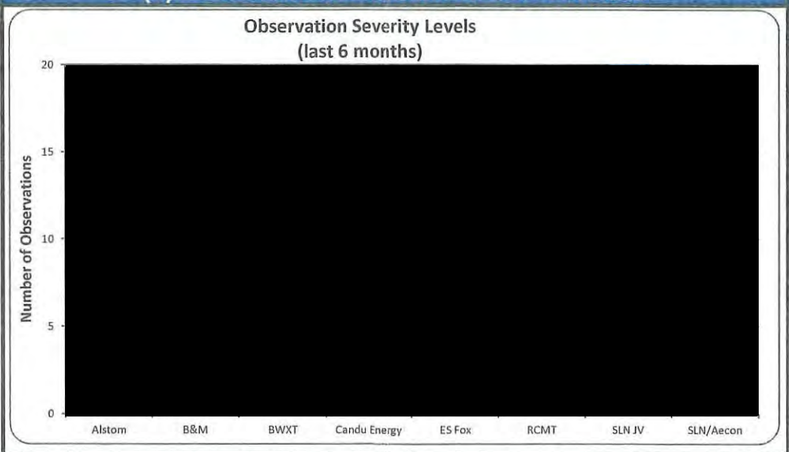

## (7) Engineering Surveillances - Vendors

Surveillance Observation Bins
(last 5 months)



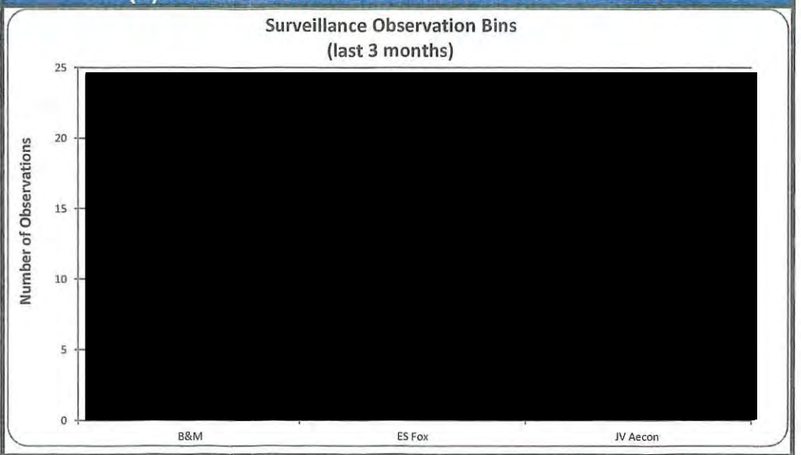

## (8) Procurement Surveillances - Vendors

Observation Severity Levels
(last 6 months)




## (9) Field Execution Surveillances - Vendors

Surveillance Observation Bins
(last 3 months)



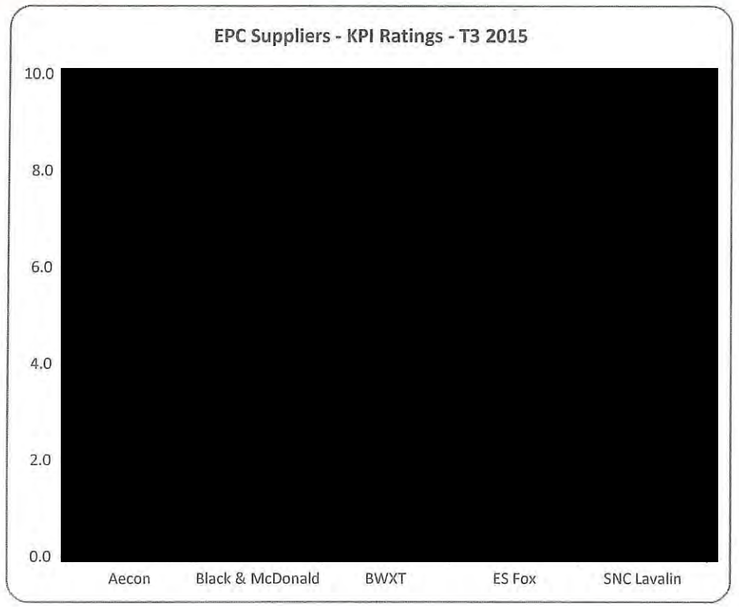

NOTE: For additional information refer to the Backing Information Sheet provided.

ONTARIO POWER GENERATION

# VENDOR SCORECARD - REFURBISHMENT EXECUTION

Owner: Imtiaz Malek

## (1) Vendor KPI Ratings




## (2) AECON

| Key Process | Performance Indicator | Target | Actual | Status | Trend |
|---|---|---|---|---|---|
| Human Performance Events | Reportable Events in past 12 months | [redacted] | | | |
| | Significant Events in past 12 months | | | | |
| Quality System | Breakthrough or Major NCARs issued in past 12 months | | | | |
| | Audit NCARs issued during 3 year audit cycle | | | | |
| | Average Age of Nonconformance and CARs (prior 3 years) | | | | |
| | NCAR for Repeat Findings or Warning Letter issued in past 12 months | | | | |
| Engineering and Field Execution Surveillance Oversight | Significance Level 2 SCRs issued in past 12 months | | | | |
| | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | |
| Procurement Surveillance Oversight | Breakthrough or Major NCARs issued in past 12 months | | | | |
| | NCAR for Repeat Findings issued in past 12 months | | | | |

## (3) BLACK & McDONALD

| Key Process | Performance Indicator | Target | Actual | Status | Trend |
|---|---|---|---|---|---|
| Human Performance Events | Reportable Events in past 12 months | [redacted] | | | |
| | Significant Events in past 12 months | | | | |
| Quality System | Breakthrough or Major NCARs issued in past 12 months | | | | |
| | Audit NCARs issued during 3 year audit cycle | | | | |
| | Average Age of Nonconformance and CARs (prior 3 years) | | | | |
| | NCAR for Repeat Findings or Warning Letter issued in past 12 months | | | | |
| Engineering and Field Execution Surveillance Oversight | Significance Level 2 SCRs issued in past 12 months | | | | |
| | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | |
| Procurement Surveillance Oversight | Breakthrough or Major NCARs issued in past 12 months | | | | |
| | NCAR for Repeat Findings issued in past 12 months | | | | |

## (4) BWXT CANADA

| Key Process | Performance Indicator | Target | Actual | Status | Trend |
|---|---|---|---|---|---|
| Human Performance Events | Reportable Events in past 12 months | [redacted] | | | |
| | Significant Events in past 12 months | | | | |
| Quality System | Breakthrough or Major NCARs issued in past 12 months | | | | |
| | Audit NCARs issued during 3 year audit cycle | | | | |
| | Average Age of Nonconformance and CARs (prior 3 years) | | | | |
| | NCAR for Repeat Findings or Warning Letter issued in past 12 months | | | | |
| Engineering and Field Execution Surveillance Oversight | Significance Level 2 SCRs issued in past 12 months | | | | |
| | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | |
| Procurement Surveillance Oversight | Breakthrough or Major NCARs issued in past 12 months | | | | |
| | NCAR for Repeat Findings issued in past 12 months | | | | |

## (5) ES FOX

| Key Process | Performance Indicator | Target | Actual | Status | Trend |
|---|---|---|---|---|---|
| Human Performance Events | Reportable Events in past 12 months | [redacted] | | | |
| | Significant Events in past 12 months | | | | |
| Quality System | Breakthrough or Major NCARs issued in past 12 months | | | | |
| | Audit NCARs issued during 3 year audit cycle | | | | |
| | Average Age of Nonconformance and CARs (prior 3 years) | | | | |
| | NCAR for Repeat Findings or Warning Letter issued in past 12 months | | | | |
| Engineering and Field Execution Surveillance Oversight | Significance Level 2 SCRs issued in past 12 months | | | | |
| | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | |
| Procurement Surveillance Oversight | Breakthrough or Major NCARs issued in past 12 months | | | | |
| | NCAR for Repeat Findings issued in past 12 months | | | | |

## (6) SNC LAVALIN

| Key Process | Performance Indicator | Target | Actual | Status | Trend |
|---|---|---|---|---|---|
| Human Performance Events | Reportable Events in past 12 months | [redacted] | | | |
| | Significant Events in past 12 months | | | | |
| Quality System | Breakthrough or Major NCARs issued in past 12 months | | | | |
| | Audit NCARs issued during 3 year audit cycle | | | | |
| | Average Age of Nonconformance and CARs (prior 3 years) | | | | |
| | NCAR for Repeat Findings or Warning Letter issued in past 12 months | | | | |
| Engineering and Field Execution Surveillance Oversight | Significance Level 2 SCRs issued in past 12 months | | | | |
| | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | |
| Procurement Surveillance Oversight | Breakthrough or Major NCARs issued in past 12 months | | | | |
| | NCAR for Repeat Findings issued in past 12 months | | | | |

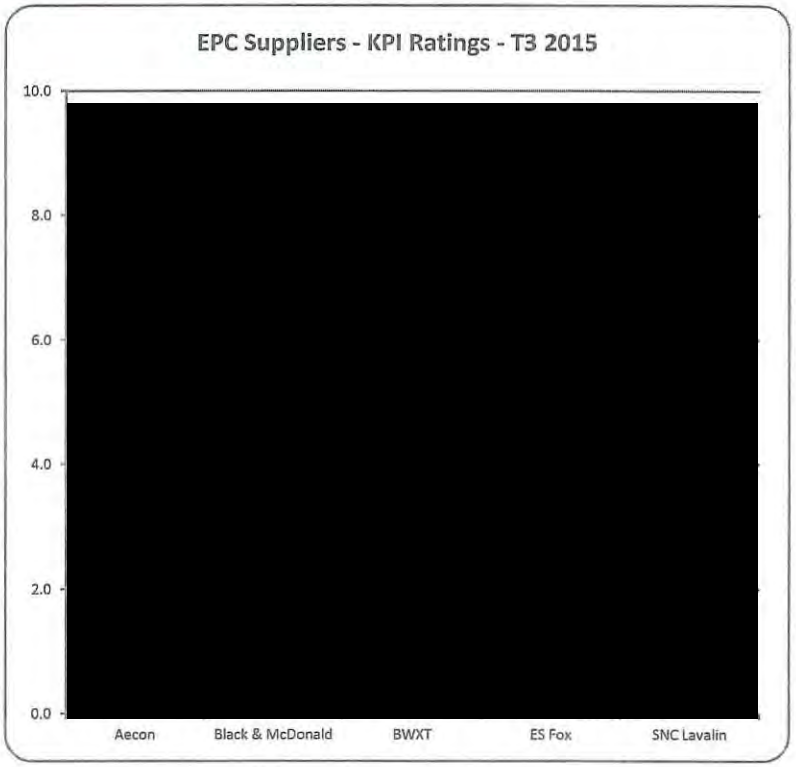


NOTE: For additional information refer to the Backing Information Sheet provided.

KPIs

| Vendor | KPI rating (colour) |
|---|---|
| Aecon | [redacted] |
| Black & McDonald | |
| BWXT | |
| ES Fox | |
| SNC Lavalin | |
| | |
| | |
| | |
| | |
| | |

| Categories | Aecon | Black & McDonald | BWXT | ES Fox | SNC Lavalin |
|---|---|---|---|---|---|
| GREEN | [redacted] | | | | |
| WHITE | | | | | |
| YELLOW | | | | | |
| RED | | | | | |

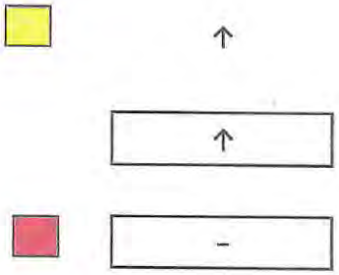


| Colour | KPI Value |
|---|---|
| RED | < 5.0 |
| YELLOW | 5.0 – 7.4 |
| WHITE | 7.5 – 8.9 |
| GREEN | ≥9.0 |

| KPI Value |
|---|
| ≥9.0 |
| 7.5 – 8.9 |
| 5.0 – 7.4 |
| < 5.0 |

**Vendor:** AECON

| Key Process | Performance Indicator | Target | Actual | Bundle | Status | Trend |
|---|---|---|---|---|---|---|
| Human Performance Events | Reportable Events in past 12 months | 0 | [redacted] | | | |
| | Significant Events in past 12 months | 0 | | | | |
| Quality System | Breakthrough or Major NCARs issued in past 12 months | 0 | | | | |
| | Audit NCARs issued during 3 year audit cycle | < 4 | | | | |
| | Average Age of Nonconformance and CARs (prior 3 years) | < 75 | | | | |
| | NCAR for Repeat Findings or Warning Letter issued in past 12 months | 0 | | | | |
| Engineering Surveillance Oversight | Significance Level 2 SCRs issued in past 12 months | 0 | | | | |
| | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | | |
| Procurement Surveillance Oversight | Breakthrough or Major NCARs issued in past 12 months | | | | | |
| | NCAR for Repeat Findings issued in past 12 months | | | | | |
| Field Execution Surveillance Oversight | Significance Level 2 SCRs issued in past 12 months | | | | | |
| | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | | |
| Low Level Reporting | TBD | | | | | |
| | TBD | | | | | |



**Vendor: Black & McDonald**

| Key Process | Performance Indicator | Target | Actual | Bundle | Status | Trend |
|---|---|---|---|---|---|---|
| Human Performance Events | Reportable Events in past 12 months | 0 | [redacted] | | | |
| | Significant Events in past 12 months | | | | | |
| Quality System | Breakthrough or Major NCARs issued in past 12 months | | | | | |
| | Audit NCARs issued during 3 year audit cycle | | | | | |
| | Average Age of Nonconformance and CARs (prior 3 years) | | | | | |
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| | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | | |
| Procurement Surveillance Oversight | Breakthrough or Major NCARs issued in past 12 months | | | | | |
| | NCAR for Repeat Findings issued in past 12 months | | | | | |
| Field Execution Surveillance Oversight | Significance Level 2 SCRs issued in past 12 months | | | | | |
| | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | | |
| Low Level Reporting | TBD | | | | | |
| | TBD | | | | | |

**Vendor:** **BWXT**

| Key Process | Performance Indicator | Target | Actual | Bundle | Status | Trend |
|---|---|---|---|---|---|---|
| Human Performance Events | Reportable Events in past 12 months | | [redacted] | | | |
| | Significant Events in past 12 months | | | | | |
| Quality System | Breakthrough or Major NCARs issued in past 12 months | | | | | |
| | Audit NCARs issued during 3 year audit cycle | | | | | |
| | Average Age of Nonconformance and CARs (prior 3 years) | | | | | |
| | NCAR for Repeat Findings or Warning Letter issued in past 12 months | | | | | |
| Engineering Surveillance Oversight | Significance Level 2 SCRs issued in past 12 months | | | | | |
| | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | | |
| Procurement Surveillance Oversight | Breakthrough or Major NCARs issued in past 12 months | | | | | |
| | NCAR for Repeat Findings issued in past 12 months | | | | | |
| Field Execution Surveillance Oversight | Significance Level 2 SCRs issued in past 12 months | | | | | |
| | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | | |
| Low Level Reporting | TBD | | | | | |
| | TBD | | | | | |

**Vendor:** **ES Fox**

| Key Process | Performance Indicator | Target | Actual | Bundle | Status | Trend |
|---|---|---|---|---|---|---|
| Human Performance Events | Reportable Events in past 12 months | | [redacted] | | | |
| | Significant Events in past 12 months | | | | | |
| Quality System | Breakthrough or Major NCARs issued in past 12 months | | | | | |
| | Audit NCARs issued during 3 year audit cycle | | | | | |
| | Average Age of Nonconformance and CARs (prior 3 years) | | | | | |
| | NCAR for Repeat Findings or Warning Letter issued in past 12 months | | | | | |
| Engineering Surveillance Oversight | Significance Level 2 SCRs issued in past 12 months | | | | | |
| | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | | |
| Procurement Surveillance Oversight | Breakthrough or Major NCARs issued in past 12 months | | | | | |
| | NCAR for Repeat Findings issued in past 12 months | | | | | |
| Field Execution Surveillance Oversight | Significance Level 2 SCRs issued in past 12 months | | | | | |
| | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | | |
| Low Level Reporting | TBD | | | | | |
| | TBD | | | | | |

**Vendor:** **SNC Lavalin**

| Key Process | Performance Indicator | Target | Actual | Bundle | Status | Trend |
|---|---|---|---|---|---|---|
| Human Performance Events | Reportable Events in past 12 months | | [redacted] | | | |
| | Significant Events in past 12 months | | | | | |
| Quality System | Breakthrough or Major NCARs issued in past 12 months | | | | | |
| | Audit NCARs issued during 3 year audit cycle | | | | | |
| | Average Age of Nonconformance and CARs (prior 3 years) | | | | | |
| | NCAR for Repeat Findings or Warning Letter issued in past 12 months | | | | | |
| Engineering Surveillance Oversight | Significance Level 2 SCRs issued in past 12 months | | | | | |
| | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | | |
| Procurement Surveillance Oversight | Breakthrough or Major NCARs issued in past 12 months | | | | | |
| | NCAR for Repeat Findings issued in past 12 months | | | | | |
| Field Execution Surveillance Oversight | Significance Level 2 SCRs issued in past 12 months | | | | | |
| | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | | |
| Low Level Reporting | TBD | | | | | |
| | TBD | | | | | |

**Vendor:** Enter Here

| Data Source | Key Process | Performance Indicator | Target | Actual | Bundle | Status | Trend | Notes |
|---|---|---|---|---|---|---|---|---|
| MSA / Daniel Simone | Human Performance Events | Reportable Events in past 12 months | 0 | [redacted] | | | | Monthly reporting; Vendor data to be acquired |
| | | Significant Events in past 12 months | 0 | | | | | |
| SCQS / Mihai Pletosu | Quality System | Breakthrough or Major NCARs issued in past 12 months | 0 | | | | | Reporting period unknown; Data available as of Dec 31, 2015 for only 3 out of 5 Vendors |
| | | Audit NCARs issued during 3 year audit cycle | < 4 | | | | | |
| | | Average Age of Nonconformance and CARs (prior 3 years) | < 75 | | | | | |
| | | NCAR for Repeat Findings or Warning Letter issued in past 12 months | 0 | | | | | |
| QM / Nienke Smith; Mark Small; George Tsakiris; Frank Dias | Engineering Surveillance Oversight | Significance Level 2 SCRs issued in past 12 months | | | | | | Targets to be determined; Low Level Reporting Indicators to be determined; Monthly reporting; Vendor data to be acquired |
| | | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | | | |
| | Procurement Surveillance Oversight | Breakthrough or Major NCARs issued in past 12 months | | | | | | |
| | | NCAR for Repeat Findings issued in past 12 months | | | | | | |
| | Field Execution Surveillance Oversight | Significance Level 2 SCRs issued in past 12 months | | | | | | |
| | | Significance Level 3 SCRs with CARB review issued in the past 12 months | | | | | | |
| | Low Level Reporting | TBD | | | | | | |
| | | TBD | | | | | | |

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# Refurbishment Construction Review Board (RCRB) – Regulatory Update

Robin Manley, Vice-President, Nuclear Regulatory Affairs & Stakeholder Relations

April 27, 2016

ONTARIO POWER GENERATION

# Refurbishment Regulatory Update

- CNSC 101 – Canadian NPP Regulatory Framework
- Licensing history/background
- Key relicensing messages from CNSC perspective
- Requirements to obtain regulatory approval to refurbish
- Regulatory Hold Points
- Licence and Licence Conditions Handbooks
- CNSC Updates and Refurbishment Timeline
- Conclusions and Questions



ONTARIO POWER GENERATION

# CNSC 101 – Canadian NPP Regulatory Framework

- Nuclear Safety and Control Act passed on Parliament
- Regulations, Licences, Regulatory Documents
- President (Michael Binder), 5-7 Commissioners, about 800 staff
- Staff (Inspectors or others delegated by the Commission) authority to issue Orders, Directives, Action Notices, Administrative Monetary Penalties
- Licence and Licence Conditions Handbook, 14 Safety and Control Areas (eg Operating Performance, Design, RP...)
- Requirements (Compliance Verification Criteria) and Guidance
- Inspections by on-site resident inspectors (Licensing branch) and specialists from Ottawa (Technical branch)



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# Licensing History/Background

- 2008 – OPG began feasibility studies for mid-life refurbishment of DNGS
- 2011 – CNSC issued Environmental Assessment (EA) Scoping Information Document
- 2012 – Public hearing held to consider EA Screening Report and 22-month licence renewal
- 2013 – EA and 22-month licence renewal decisions issued
- 2015 – Public hearings to consider longer term licence application to authorize refurbishment and continued operations
- 2016 – Darlington's operating licence was extended for a period of 10 years

# Key Relicensing messages from CNSC perspective

- Meets all the regulatory requirements
- Substantial safety improvements (eg 3rd Emergency Power Generator) committed
- Comprehensive assessments show safe operation to 2055 is practical and achievable
- CNSC assessments routinely found Darlington met or exceeded regulatory requirements ("Fully Satisfactory" for the past seven years)
- Probabilistic Safety Assessment numbers
- More severe accident scenario ("SARP") report shows low public risk
- Emergency preparedness measures in place
- Regulatory and public scrutiny will be maintained



ONTARIO POWER GENERATION

# Requirements to obtain regulatory approval to refurbish

- RD-360, *Life Extension of Nuclear Power Plants* provided CNSC's regulatory expectations for life extension projects (now superseded by RD-2.3.3)
- Describes the steps to take to identify and address environmental and safety regulatory aspects to extend the life of a nuclear power plant including;
- Environmental Assessment
- Integrated Safety Review
- Global Assessment Report
- Integrated Implementation Plan
- Includes expectations for project execution and return to service (such as regulatory Hold Points)



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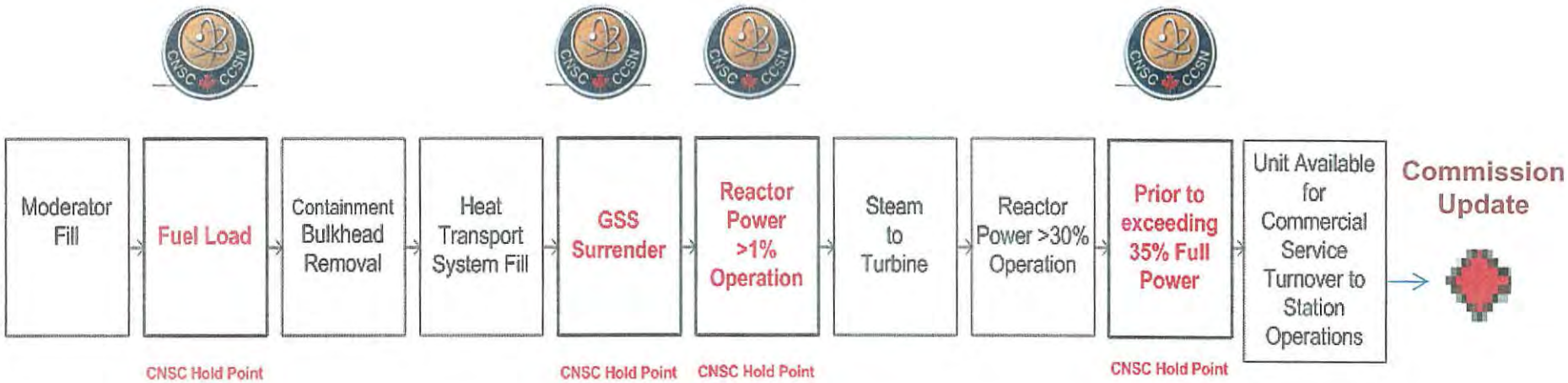
# Regulatory Holdpoints




- Four CNSC regulatory restart hold points
- Nine OPG quality check points
- Pre-requisite commitments required to be met prior to release of hold point
- Authority to remove regulatory hold points granted by CNSC Exec VP
- Commission update after each unit refurbishment outage



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# Licence and Licence Conditions Handbook

- CNSC granted a 10-year licence term for the DNGS Power Reactor Operating Licence (PROL) to Nov 30, 2025
- Standard licence conditions referring to licensee programs
- CNSC regulatory documents and Canadian standards moved from PROL to Licence Conditions Handbook (LCH)
  - Compliance Verification Criteria
  - Recommendations and Guidance
- New licence conditions:
  - 3.4: Periodic Safety Review [periodic ISR update per RD-2.3.3]
  - 15.2: Return to Service Plan
  - 15.3: Completion of IIP
  - 15.4: Regulatory Hold Points



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# CNSC updates and Refurbishment Timeline

2013 2016 2024 2027

**SIOs**

CFVS+ STOP
PSVS
EPG3
EHS

2016 2019 Unit2 Refurb — Commission Update

2019 2022 Unit1 Refurb — Commission Update

**Other**(1)

VBO

2021 2024 Unit3 Refurb — Commission Update

2022 2025 Unit4 Refurb — Commission Update

Pre Life Extension | Life Extension(2) | Safety Basis Update

Legend

Scheduled Unit Outage

(1) Includes other Pre Life Extension activities as identified in the IIP

(2) Based on current planning assumptions



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# Conclusions and Questions



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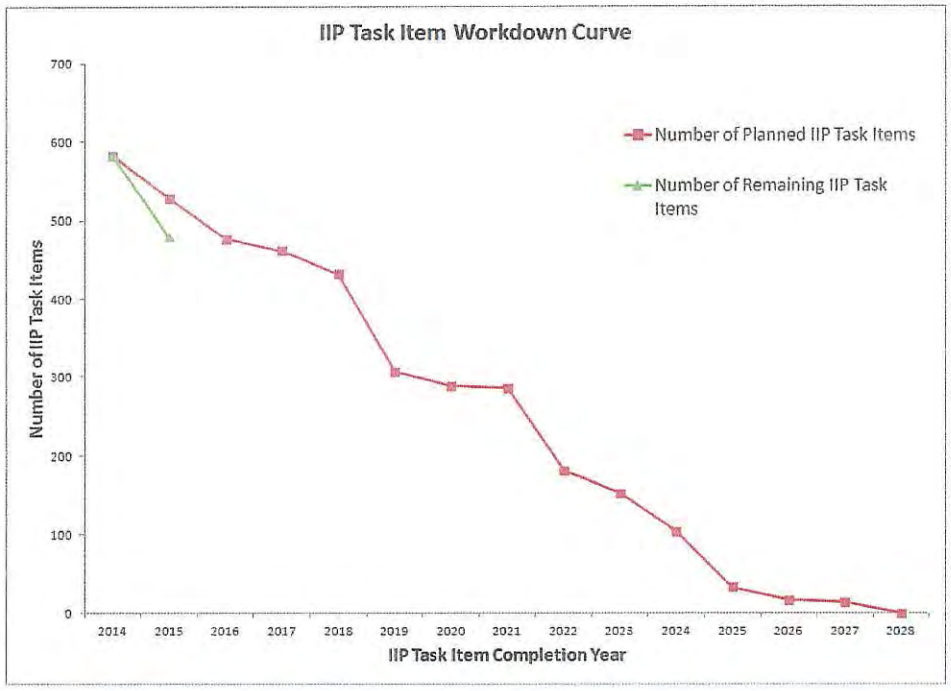
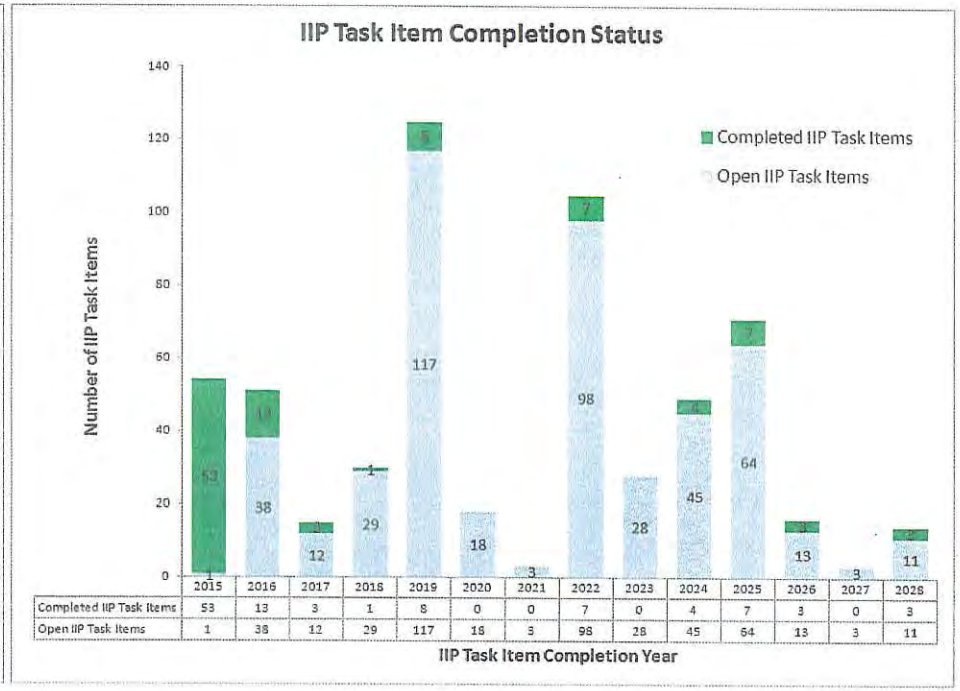
# Q1 2016 IIP Task Completion Status




| IIP Year | On-Track | At Risk | Complete | Total |
|---|---|---|---|---|
| 2015 | 0 | 1 **(Note 1)** | 53 | 54 |
| 2016 | 38 | 0 | 13 | 51 |
| 2017 | 12 | 0 | 3 | 15 |

Notes:

**1. IIP-EA 009**: The IIP Change Request Form for IIP-EA 009 U3 STOP (was to be completed by 2015, now extended to time of crediting the U2 TCB in 2017) was submitted to the CNSC and concurrence was received on April 18, 2016.

# DNGS Refurbishment Contract Management Overview

April 27, 2016

**BEHAVIOURS**

- Say It, Do It
- Simplify It
- Think Top and Bottom Line




VALUES • SAFETY • INTEGRITY • EXCELLENCE • PEOPLE & CITIZENSHIP •

PEOPLE POWERING THE FUTURE
OPG NUCLEAR

ONTARIO POWER GENERATION

# Overview

**The purpose of this document is to describe Contract and Contract Management Lessons Learned, terms of the main contracts entered into by Ontario Power Generation (OPG) with respect to the Darlington Refurbishment Program (DRP), the roles and responsibilities of Contract Management and the pending Contract Management Support Services.**

1. Contracts & Contract Management - Lessons Learned
2. Contracts Overview – Refurbishment Contracts
3. Contract Overview – ES MSA
4. Contract Management – Organization, Roles and Responsibilities
5. Contract Management Support Services

# 1. CONTRACTS & CONTRACT MANAGEMENT LESSONS LEARNED

# 1. Contracts & Contract Management Major Lessons Learned

**OPG has compiled Contract Management lessons learned from DNGS, large projects, past CANDU refurbishments, and Definition Phase work to ensure a successful outcome**

| Lesson | Actions Taken |
|---|---|
| **Management Team must be as Experienced and Qualified as possible, and hire third-party experts where appropriate** | • A high caliber team with significant major projects and refurbishment experience is in place |
| **Select the right contract partners and contract models** | • Contracting Strategies were developed and approved for each major project bundle. Contractors were selected through a comprehensive bidding process with appropriate financial incentives and disincentives as appropriate based on the contracting strategy. |
| **Implement a robust and independent program oversight function** | • Project Assurance and Contract Management functions have been established separate from the project execution team.<br>• Strong oversight and governance is in place |
| **Contract Claims Management** | • The effort, capability, and timeliness required to monitor and control contract issues and related claims is being enhanced and integrated with project controls systems. Additionally external assistance is being sought to improve this area. |
| **Close collaboration between Contract Management and project team.** | • Contract management attend internal and contractor project team meetings. Incorporate commercial items in action matrices. Actively manage contracts and relationships to resolve issues before they become disputes or claims. |
| **Alignment between internal stakeholders prior to sharing positions with Contractor.** | • Ensure internal discussions and aligned positions (supply chain, finance, project) before issues being addressed with Contract partners. |

# 2. MAJOR REFURBISHMENT CONTRACTS

# 2. Overview - Scope of DRP

## The DRP has been divided into 5 main work packages ("bundles"), each with their own contracts

- The 5 main work packages are:
  - **Retube and Feeder Replacement (RFR):** removal and replacement of 480 pressure tubes and calandria tubes, as well as replacement of 960 feeder pipes in each of the four reactors
  - **Turbine Generators (TG):** inspection, repair and replacement of specific components of the four turbine generator sets and control system upgrades from analog to digital system
  - **Fuel Handling (FH) and Refurbishment (includes Specialized Projects):**
    - defueling of the reactor core, including the development and supply of special tooling
    - refurbishment of some fuel handling, vault and related equipment, and
    - development, testing and installation of replacements for both shut down system (SDS) computers
  - **Steam Generators (SG):** inspection and maintenance work in order to extend the useful life of the generators for an additional 30 years
  - **Balance of Plant (BOP):** various smaller equipment repair and replacement projects including valves

# 2. Overview - Commercial Principles and Project Objectives

## A key OPG priority is to ensure that contracting strategies align with OPG's commercial principles to enable the organization to achieve the project objectives

- OPG established commercial principles to govern relationships with third parties:
  - **Accountability:** OPG is accountable to the people of Ontario for Darlington nuclear assets and, as such, will have clearly defined authority and responsibility to implement effective contracting strategies
  - **Value for money:** contracting strategies will be cost effective, efficient, and in adherence with safety, environment and operational requirements
  - **Transparency:** OPG will maintain clear lines of communication with government bodies, regulators, industry peers and the people of Ontario and upholding a fair and transparent working relationship with contractors will provide greater confidence
  - **Risk transfer/sharing:** risk will be allocated to the party most appropriate to bear the risk, and incentive and disincentive mechanisms will be utilized in order to reduce negative impacts for which OPG is ultimately accountable (scheduling delays, cost overruns, etc.)
- OPG set out the following project objectives and priorities for the DRP:
  - Meet regulatory requirements (OHSA, EA, CNSC quality and safety standards)
  - Maintain OPG control over the entire project
  - Minimize the impact of the refurbishment on operating units
  - Achieve project schedule and budget
  - Demonstrate success to shareholders and the public

# 2. Overview - OPG Contracting Strategy

**OPG made a strategic decision to retain control over the DRP and chose a multi-prime contractor model as the overarching strategy for procuring work under the five major work packages**

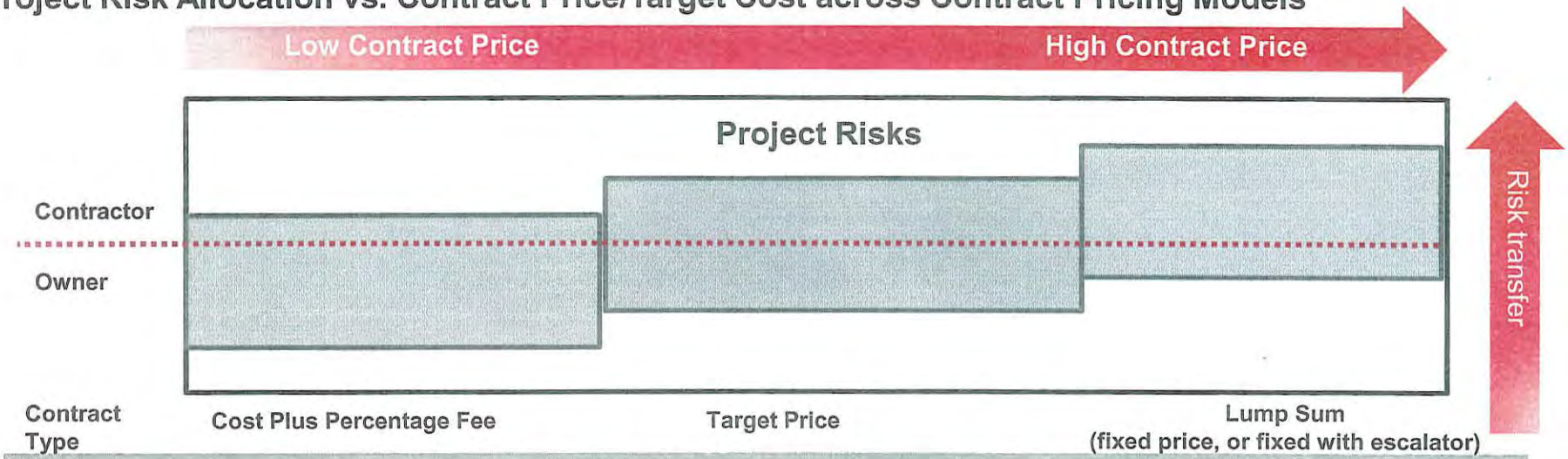
- Different procurement methods, contracting strategies and pricing models have been applied within each of the five major work packages in order to best address varying degrees of complexity, uncertainty and need for collaboration
- Rather than award a single project management contract to one contractor, multiple contractors are working on the project – each with their own distinct responsibilities and separate contracts
- OPG is acting as an integrator between the various prime contractors
- OPG's direct involvement in overseeing the project is expected to lead to higher transparency
- It is also anticipated that there will be less need for knowledge transfer at commissioning, resulting in a smoother transition from construction to operations

# 2. Overview - Pricing Models for Work Packages

**In contracting the various work packages, OPG evaluated several pricing models, opting to implement multiple, parallel pricing to optimize risk transfer and value-for-money**

- In determining the appropriate pricing model for each work package, the need/ability of OPG to transfer risk to the contractors was balanced against the benefit of achieving a lower contract price or target cost
- High levels of complexity and uncertainty in certain work packages (eg, RFR) made the transfer of significant pricing risk to the contractor less commercially feasible

**Project Risk Allocation vs. Contract Price/Target Cost across Contract Pricing Models**




OPG commercially sensitive and confidential

# 2. Overview - Key Work Packages

**The relative complexity, size and uncertainty of each work package guided OPG's selection of appropriate contracting and pricing models for each work package**

| Work Package (Contractor) | Description | Contract Model | Pricing Model | Value vs Total Contract Price |
|---|---|---|---|---|
| RFR SNC/Aecon | • Definition Phase Work<br>• Refurbishment of units 2, 1, 3 & 4 (Execution Phase Work):<br>o Removal/replacement of 480 pressure and caldaria tubes<br>o Replacement of 960 feeder pipes<br>• Support Services & Equipment | EPC | Target Price | $3.6B total |
| RFR SNC/Aecon | • Construction of the mock-up facility<br>• Design and production of tooling | EPC | Fixed Price | |
| RFR SNC/Aecon | • Owner Specified Materials (OSM) and Goods<br>• Commissioning | EPC | Cost + Markup | |
| Turbine Generators Alstom | • Engineering Support and Equipment Supply Agreement | ESESA | Fixed/Firm Price + limited target price | $333M |
| Turbine Generators SNC/Aecon | • Fieldwork required for inspections, repairs and retrofits of hardware and hydraulics on the turbine generators<br>• Control system upgrades from analog to digital system | EPC | Target Price | $284M |

# 2. Overview - Key Work Packages (cont'd)

| Work Package (Contractor) | Description | Contract Model | Pricing Model | Value of Contract |
|---|---|---|---|---|
| Fuel Handling - Defueling<br>• Defuel hardware, software and services<br>•GE-Hitachi | Design, supply and technical support for OPG work for defueling of all 4 reactors:<br>1. Universal Carriers (UC) added to the fueling machines for bi-directional defueling<br>2. Dummy Fuel Bundles (DFB), Flow Restricting Outlet Bundles (FROB), and Fuel Push Tool, (FPT),<br>3. Fueling machine software updates,<br>4. New Fuel Transfer Mechanism (NFTM) modifications. | ESESA | •Fixed Price (no escalation)<br>•Firm Price (with economic cost adjustment)<br>•Reimbursable Work + Fee<br>•Schedule incentive (+/-) | $23M |
| Fuel Handling - Refurbishment<br>• Power track<br>• ES Fox | Supply and install replacements for the main components of the fueling machine power track system, for each of the 3 trolley pairs:<br>1. Chain replacement<br>2. Intermediate rollers and end drum replacement<br>3. Power, control and CCTV cable replacement | ESMSA – Procure / Construct | Target Price | $126M |

# 2. Overview - Key Work Packages (cont'd)

| Work Package (Contractor) | Description | Contract Model | Pricing Model | Value of Contract |
|---|---|---|---|---|
| Steam Generators<br>B&W – Now BWXT + Candu | • Inspections and maintenance work | EPC | Fixed Price | $110M |
| Balance of Plant<br>ES Fox | • Various smaller equipment repair and replacement projects and system upgrades | ESMSA, EPC | Target Price | $314M aggregate with Valves |

# 2. Overview - RFR - Description

## Contracting Model

- OPG selected the EPC contracting model using fixed pricing for highly definable tasks and target pricing for scope where work is complex but less easily defined
- The use of fixed pricing, where appropriate, provides greater price certainty (for example, construction of the mockup and development and testing of tooling)
- The shared risk of a target pricing model (definition phase work, execution phase work related to removal and replacement of tubes and pipes on all 4 units, SS&E work) promotes cost control by the contractor compared to a cost-plus model and avoids the risk premium of a fixed price model where cost s are more difficult to estimate
- Cost plus markup pricing has been implemented for owner specified materials & goods, and commissioning work
- The project is broken into phases - Definition, Execution and Commissioning - to help define work processes and allow for OPG "off-ramps" at key intervals

# 2. Overview - RFR – Cost Breakdown

## Major Cost Breakdown

| Phase | Definition | Execution | Commissioning |
|---|---|---|---|
| Target Cost | $93 mil | $1 591 mil | $8 mil – estimated (from class 2) |
| RWPB Target Cost | $66 mil | | |
| Fixed Fee | $48 mil | $ 480 mil | |
| RWPB Fixed Fee | $21 mil | | |
| SS&E Target Cost | $26 mil | $68 mil | |
| SS&E Fixed Fee | $4.5 mil | $ 12 mil | |
| Mock-up Fixed Price | $38 mil | | |
| Non-target Reimbursable Work/Costs | | | $6 mil – estimated (from class 2) |
| Tooling Fixed Price | $375 mil | | |
| OSM with Fee(estimate) | $185 mil | $394 mil | |
| Goods with Fee(estimate) | $15 mil | $33 mil | |
| Mark-up for Owner-Specified Materials – 10% | | | |
| Mark-up for Goods – 5% | | | |

Profit percentage for Commissioning Phase Reimbursable Work – 11.1%

# 2. Overview - RFR – Incentives/Disincentives

## Cost Incentives / Disincentives in Execution Phase

| Max: 40% of Fixed Fee | Under budget - $75M | Neutral Band | Target Cost | Neutral Band | Over budget + $75M | Max: 80% of Fixed Fee |
|---|---|---|---|---|---|---|
| % of Cost Savings (Graded) | | | | | | % of Cost Overruns (Graded) |
| Incentives | | | | | | Disincentives |

*Note: SS&E cost incentives and disincentives have a 10% neutral band with a non-graded 50% of the SS&E cost savings/overruns at risk.

## Schedule Incentives / Disincentives in Execution Phase

| Max: 40% of Fixed Fee * | $125K per day < Target Schedule | Neutral Band | Target Schedule | $250K per day > 110% of Target Schedule | Max: 80% of Fixed Fee * |
|---|---|---|---|---|---|
| Incentives | | | | Disincentives | |

* Less cost incentives / disincentives

*Note: Aggregate cost incentives/disincentives are capped at 24% and 48%, respectively.

# 2. Overview - TG – General Description

## Summary of the Contracting Strategy

- OPG had initially explored the option of giving the full TG scope of work to the OEM (Alstom); however, Alstom and OPG were unable to agree upon an appropriate risk sharing arrangement
- As a result, the TG work was divided into two separate work packages enabling OPG to benefit from the experience and expertise of the OEM for the purchase of the equipment while achieving value for money through a competitively procured EPC contract for the field work
- The strategy avoided the potential compatibility risk of having a non-OEM contractor reverse engineer / completely redesign components
- A Memorandum of Understanding (MOU) among OPG, Alstom and SNC/Aecon JV requires that the three parties work closely together
- The selection of an ESES model with fixed pricing for equipment supply (Alstom) and an EPC model with target pricing for fieldwork (JV) addresses OPG's need to balance risk transfer and cost in order to achieve value for money

**Procurement Process Timeline**

| ESES Award | EPC RFP Issued | EPC Contract Award |
|---|---|---|
| **March 2013** | **May 2013** | **January 2014** |
| Alstom (OEM) selected | 4 bidders | SNC / Aecon JV selected |

# 2. Overview - TG – ESES

## TG ESES - Contracting / Pricing Model

- Alstom provides the equipment, component parts and control systems. There is optional scope for components that need to be replaced during inspection. Alstom provides limited oversight services to support the JV during installation and commissioning
- The equipment supply component of the work, including preliminary design and factory testing, is conducted using a fixed/firm price model and accounts for the majority of the contract value (approx 85%). The first unit is fixed price and the other units are firm price with escalation for inflation
- For firm priced work where Alstom's costs are paid in Euro's, Alstom has hedged the currency risk. OPG pays hedging costs
- Installation Support Work, Static Commissioning Work and Dynamic Commissioning Work, are conducted using a reimbursable cost model accounting for ~15% of the Contract Price. Most of the Reimbursable Work is done on a Target Cost basis, with separate targets for different scopes of work
- The Agreement has a single phase, without the Execution Phases of the RFR and TG EPC Agreements

# 2. Overview - TG – ESES

## Cost Incentives / Disincentives for Reimbursable Work Per Unit


## Schedule Disincentives for Fixed and Firm Price Work


- Cost Incentives/Disincentives and Schedule Disincentives are calculated on a Unit-by-Unit basis
- Separate Cost Incentives/Disincentives are calculated for the following work:
  - Support Work and Static Commissioning Work
  - Dynamic Commissioning Work
- Separate Schedule Disincentives are calculated for the following work:
  - Design Engineering Completion Date
  - FAT Completion Date
  - Unit Goods Delivered Completion Date

# 2. Overview - TG – EPC

## TG EPC - Contracting / Pricing Model

- As an EPC Agreement, the Contractor (JV), must engineer plans, processes, modifications and other submittals to safely and efficiently conduct the Work. The JV must procure all materials required to complete the Work not provided by the OEM under the ESES Agreement. The JV must also execute the physical repair, retrofit and upgrade Work and perform commissioning Work
- The majority of the Work under the Agreement is conducted using a Reimbursable cost model with a fixed fee for all profit, risk and overhead of the Contractor (Currently 100%, projected to be nearly 100%)
- Limited Work under the Agreement is conducted using a fixed price model, and includes preliminary design work, component manufacturing and factory acceptance testing. (Currently $0)
- As with the RFR Agreement, there is a multi-phase approach, with the Definition Phase to plan and prepare for the following Execution Phase
- The Execution Phase amendment , the Execution Cost Estimate and the Execution Phase Notice to Proceed required for the Execution Phase has not been executed

# 2. Overview - TG – EPC

## Cost Incentives / Disincentives


- SS&E Target Cost incentives and disincentives are calculated separately with a 10% neutral band and a non-graded 50% of cost savings or overruns being at risk

## Schedule Incentives / Disincentives


- Cost incentives/disincentives are capped at 24% and 48%, respectively.
- There are separate, smaller Schedule Disincentives (only) calculated for key milestones

# 3. CONTRACTS OVERVIEW – ES MSA CONTRACTS

# 3. Overview – Darlington Refurbishment - ES MSA Contracts

**Summary:**

- Extended Services Master Services Agreements (ES MSA's) are flexible contracting structures that are adaptable to project needs.

- For engineering, construction and procurement at OPG's nuclear facilities, OPG has retained three contractors in ES MSA's.
  - Black & MacDonald
  - E.S. Fox Limited
  - SNC-Lavalin/Aecon Joint Venture

- By retaining three Contractors with the ability to perform similar work, OPG can increase competition and mitigate capacity risks.
- For the refurbishment project, the ES MSA's are utilized for balance of plant work, the lay-up work, the Powertrack work, the campus plan, and construction of support facilities such as the RPO and the RFRISA

# 3. Overview – Darlington Refurbishment - ES MSA Contracts

## Contract Summary:

- Under the ES MSA's, the contractors must retain a core team throughout the term of the agreement to be compensated apart from any work packages or purchase orders. Other resources, including augmented staff, fluctuate based on project needs.
- Based on specific tasks/work to be performed by the contractor, OPG can either have a competitive process or sole-source the work.
- Subject to the terms of the ES MSA's, OPG also has flexibility in the pricing models utilized for the work packages.
- The ES MSA, provides for the calculation of a continuous performance score based on cost, schedule, safety and human performance of the contractor.
- There is also a pool of potential performance incentives under the ES MSA (6% of any application for payment), that is withheld at time of application for payment and is to be paid annually. The calculation of the performance incentive is based on the performance score.
- Under the ES MSA, OPG enjoys broad audit rights to assess records and finances of the contractor, subject to certain limitations for fixed price work.

# 4. CONTRACT MANAGEMENT ORGANIZATION, ROLES AND RESPONSIBILITIES

# 4. Contract Management - Roles and Accountabilities for CM, PM, and SC

## Summary:

- Contract Management, Supply Chain and Project Management provide complementary support to ensure adherence to contracts and internal processes and successful and timely project completion.
- Roles and Accountabilities for DRP Supply Chain and Contract Management organizations were agreed upon by the VP Supply Services and VP Nuclear Projects Oversight on August 6, 2015
- Contract Management is involved in all strategic contracts or contracts that exceed $40 M as well as the ES MSA's, DESA and SPATSA. Otherwise the contract management accountabilities are managed by the Project Management.

# 4. Contract Management - Roles and Accountabilities - Governance Structure

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

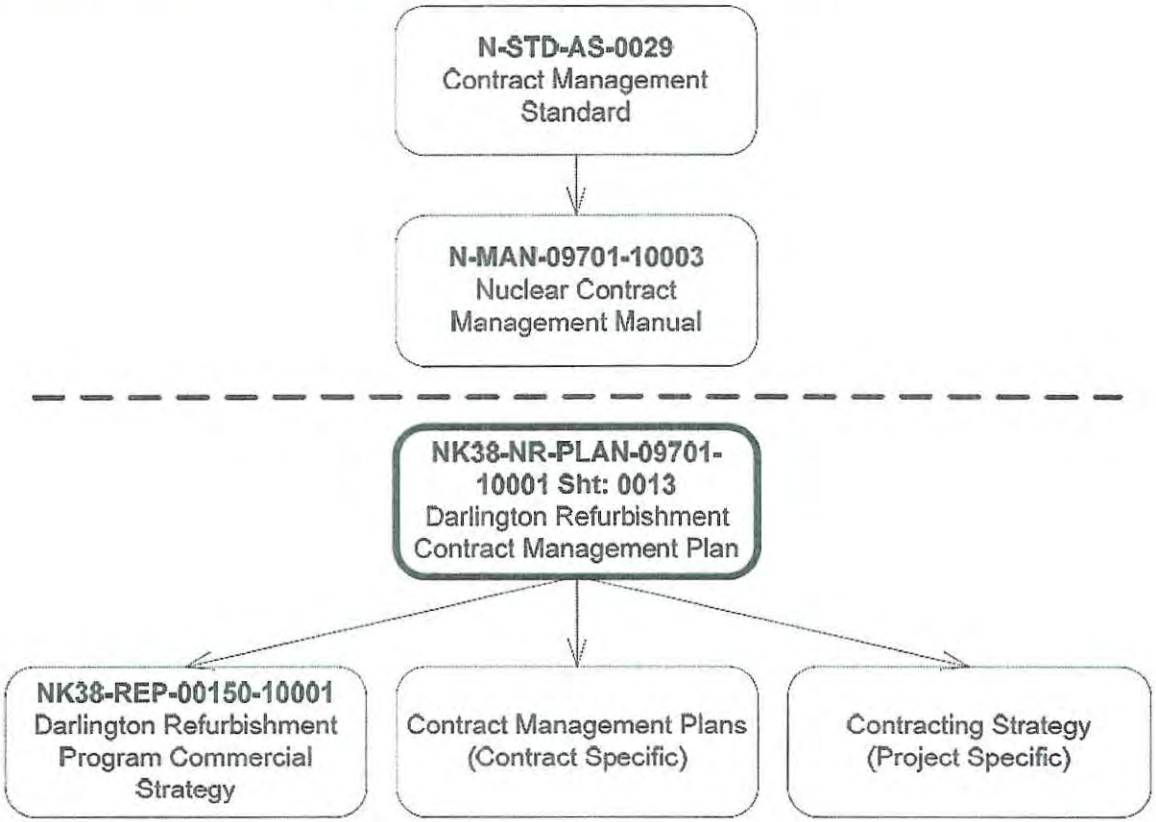



**Figure 1: Contract Management Documentation Framework**

# 4. Roles and Accountabilities

| Stage of Work | | Contract Management (CM) Responsibilities |
|---|---|---|
| **Preparation/Planning /Procurement** | 1 | PM identifies need (services and materials) and CM develops Contracting Strategy. |
| | 2 | PM prepares Scope of Work. CM reviews Scope of Work (and assists with developing Scope of Work for MSAs). |
| | 3 | CM reviews and provides input to the Procurement Strategy for SC. |
| | 4 | CM provides input to procurement documents, proposal criteria and bid evaluation. |
| | 5 | CM Participates in SC led bid evaluation. For ES MSA work, evaluation in led by PM with CM and SC support. |
| | 6 | CM provides input to Negotiation Strategy and Plan, and participates in negotiations as required. |

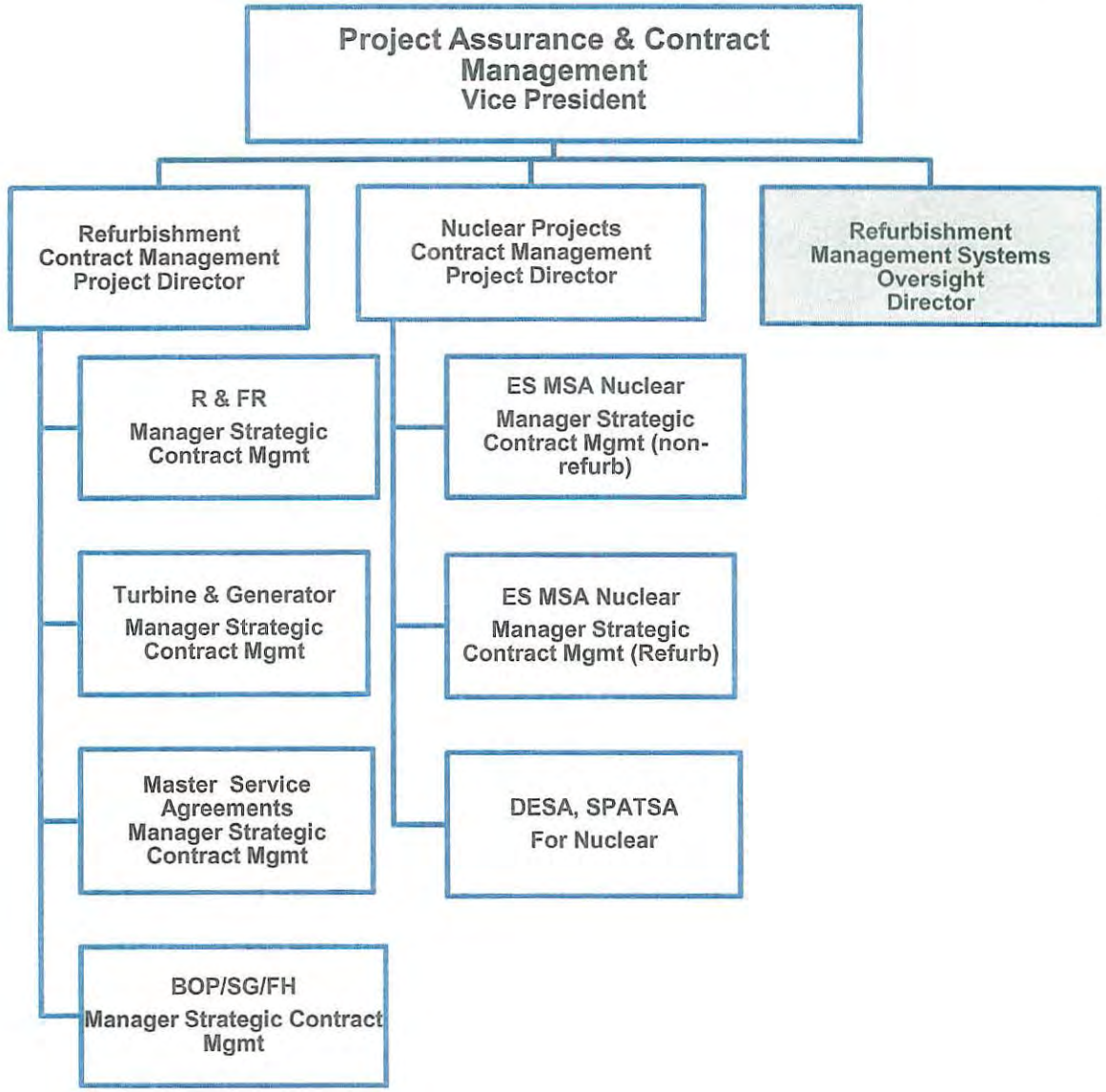
# 4. Roles and Accountabilities

| Stage of Work | | Contract Management (CM) Responsibilities |
|---|---|---|
| **Ongoing Contract Management** | 7 | CM develops and executes Contract Management Plans. |
| | 8 | CM provides ongoing education of PM organization on contract terms and conditions. |
| | 9 | CM provides ongoing interpretation of contract terms & conditions (with support of SC and Law as applicable). |
| | 10 | CM conducts ongoing contract performance monitoring and reporting. |
| | 11 | CM provides commercial contract input on invoices, as requested. |
| | 12 | CM manages project change processes on behalf of the PM and engages SC as necessary. |
| | 13 | CM coordinates with SC the drafting and implementation of contract amendments. CM assists with drafting amendments as agreed with SC. |

# 4. Roles and Accountabilities

| Stage of Work | | Contract Management (CM) & Project Management (PM) |
|---|---|---|
| **Claims and Contract Close-Out** | 14 | PM/CM invoke warranty and other terms and conditions of the work with input from Supply Chain. |
| | 15 | CM manages initial dispute resolution process.<br>CM to inform SC of complaints /disputes at an early stage. |
| | 16 | CM works with PM to provide evidence to support formal claims.<br>SC is to address formal claims. |
| | 17 | PM to identify when work is complete and when milestones have been met. PM/CM to notify SC of completion of contract deliverables and of final payment, so SC can close out purchase orders.. |
| | 18 | CM develops and formalizes contract audit plans and manages contract audits. |
| | 19 | CM supports OEB reporting |

# 4. Contract Management - Organization



# 5. Contract Management Support Services

# 5. Contract Management Support Services

- As the Execution Phase of the DRP gets underway and the Definition Phase nears completion, Contract Management will require support to avoid potential claims, as well as reporting, documentation and surveillance to ensure contract compliance and successful claims rebuttals.

- OPG is seeking a third party contract management service organization to provide the support.

- The RFP Issued February 26, closed March 25, currently under evaluation with a target award date of June 30

# 5. Contract Management Support Services

## Scope of Work Summary:

- **Contract Management**
  - Train/support OPG contract management (CM) and project management (PM) staff in claims avoidance/prevention best practices
  - Train/support OPG CM staff in documentation, performance metrics/tracking, record keeping
  - Work with OPG Project Controls to address and implement potential improvements in performance metrics/tracking
  - Recommend and establish additional systems of metrics tracking, as may be appropriate
  - Provide OPG with feedback about the invoice assessment process to improve OPG's internal processes. Support improvements as required.
  - Assist OPG to improve compliance/share best practices of suppliers/contractors

- **Contract Issues Management**
  - Support to OPG CM/PM team to de-escalate or resolve issues to avoid formal dispute resolution
  - Collect and synthesize data as required for purposes of claims avoidance/prevention
  - Support OPG Supply Chain if required
  - Support OPG CM in resolving construction liens

# 5. Contract Management Support Services

## Scope of Work (cont'd)

- **Reporting**
  - Regular reporting to the OPG Director of Contract Management, including status of issues. Summary of sample reports to be provided.
  - Support with respect to any of OPG's regulatory obligations, as requested
  - Any additional services/processes as the Contractor may suggest to improve the contract and claims avoidance/prevention management processes, as approved by OPG.
- **Contract Administration Support**
  - Ensure that processes, activities and controls are in place to manage and approve changes to contract;
  - Ensure that contract management plans with contractors are maintained and updated where applicable;
  - Establish processes to maintain an open line of communication along the entire workflow chain with contractors and subcontractors;
  - Ensure that Contractor action items and issues are tracked with related correspondence and evidence to support timely closure/resolution of items;
  - Ensure that proper tracking and documentation retention mechanisms are in place for unresolved issues or any communications of service/quality issues to support future disputes or claims; and
  - Ensure that established protocols are in place and adhered to for managing and escalation of disputes.

# 5. Contract Management Support Services

## Scope of Work (cont'd)

- **Surveillances/Reviews/Other Support**
  - Assess contractor invoices before payment for compliance/performance/value for money, as requested
  - Collect and synthesize data (build a case), as required for purposes of claims avoidance/prevention
  - Identify potential high risk situations and advise OPG with respect to oversight allocation
  - Review paid invoices for compliance, prudence practices (forensic audits), as requested

| April 28 (DAY 4) | Presenter/Lead | Time |
|---|---|---|
| **Arrival/Coffee** | RCRB Members | 07:00-07:30 |
| **Staffing/Resourcing/On-boarding** | Connie Hergert and Nicole Lichowit | 07:30-08:30 |
| **Risk, Planning & Controls, Reporting** | Gary Rose | 08:30-10:30 |
| **Break (to accommodate Day of Mourning Ceremony)** | | 10:30-11:10 |
| **90-Day Lookahead and Closing Comments** | Dietmar Reiner and Mike Allen | 11:10-11:40 |
| **Lunch** | | 11:40-12:15 |
| **Round Table Discussion** | RCRB Members | 12:15-14:30 |
| **Exchange with Senior Managers** | RCRB Members | 14:30-16:30 |
| **Meeting with Glenn Jager** | RCRB Chair | 16:30-17:15 |

# Resourcing Strategy: Nuclear Operations and Refurbishment

April 28, 2016

Connie Hergert

Vice President HR Business Partners (Nuclear)

VALUES • SAFETY • INTEGRITY • EXCELLENCE • PEOPLE AND CITIZENSHIP




BEHAVIOURS • SAY IT DO IT • SIMPLIFY IT • THINK TOP AND BOTTOM LINE • INTEGRATE AND COLLABORATE • TELL IT AS IT IS

OPG Business Transformation

ONTARIO POWER GENERATION

# Resourcing Strategy

## THE CHALLENGE

**Stand up an organization to get the right people hired and ready to deliver for Nuclear**

- Darlington Refurbishment Project
- On-going safe operation of our Nuclear facilities
- Context of PECO

## OUR OPPORTUNITY

Nuclear business unit and OPG at large to address key strategic priorities:

- Strengthening our leadership pipeline with a diverse and future-relevant skill set
- Ramping up the people required to maintain our high standard of safety and operational excellence
- Positively enhance our culture through how we bring people in and what we do to support them in getting their job done

# What Great Looks Like

- Workforce planning which is reflective of current and future need
- Hiring the right people – Skills, Capability, Behavior, Fit
- Diverse candidate pool; diverse employee population
- Delivering a positive candidate experience
- High touch welcome and relevant and timely on-boarding
- Streamlined administration
- Additional support to give time back to line management to make good hiring decisions, coach for development, retain the right people and feed our succession pipeline
- Client feedback to ensure process is delivering in the context of continuous improvement

# Getting to Great

## TODAY

- Lack of clarity of resourcing needs, resourcing types, internal processes and tools and accountability for specific work
- Result is a distributed resourcing practice across the business where those in need have taken process work arounds to get things done
- Many approaches with complex and time consuming processes results in confusion and lengthy time to fill

## TRANSITION

- Cross functional team taking a one company view to the solution with clearly defined roles and accountability for work and process optimization
- Working Group Leads:

**HRBP**: Candice Kay

**Staffing**: Kris Oomen

**On-boarding**: Andy Forsyth

**Training**: Mary Duarte

**Resource Planning**: Jay Dellandrea, Emerissa Babin, Frank Guglielmi, Gary Rose

## FUTURE

- Simple, efficient and effective end-to-end resourcing and recruitment process
- Aligned to the needs of the business
- Functional partners working seamlessly to minimize time to fill and maximize candidate experience through selection and on-boarding

# One End to End Process

Identification of hiring needs → Recruitment → Selection → Onboarding → **Welcome and Cultural Integration** → Training & Testing → Reporting to work and delivering value

**4**
- Individuals using their skills on the job
- Contributing to the performance of OPG

**3**
- Ensure we are ready to welcome new employees – employee ID, set up on payroll, computer, email set up, CBTs, Training

**2**
- Clarify selection criteria
- Educate leaders on selection
- Key messaging to market and value proposition of OPG as an employer

**1**
- Critical early area of focus
- Important to get the numbers and the mix right
- Streamline and communicate Recruitment policy and processes

**AREA OF OPPORTUNITY**
- Welcome schedule
- Information on OPG
- Mentors
- Peer partners

# Process enabling the right Outcome

Identification of hiring needs → Recruitment → Selection → On-boarding → Welcome and Cultural Integration → Training → Reporting to work and delivering value

## Done Right – People delivering value for OPG in a shorter timeframe


Save Time
+ Money

Increase Productivity
+ Engagement

- ✓ The right people working for OPG
- ✓ Seamless positive experience from application, through selection, on-boarding and training
- ✓ People feeling valued and welcomed
- ✓ People understanding how their job matters
- ✓ Increased bench strength
- ✓ Reduced time to hire
- ✓ Reduced cost to hire

# Success?... Metrics Driven

ONTARIO POWER GENERATION

## Nuclear Resourcing Program - March 2016

Version: Mar 21/16

| Program Status | G | Headlines | Communication & Change Management | Check & Adjust |
|---|---|---|---|---|
| | | | | |

| Hiring Need | Recruitment | Onboarding | Training |
|---|---|---|---|
| | | | |

| Approved 2016 Hiring Need | Req Temp | Term | Total |
|---|---|---|---|
| Nuclear Engineering | | | |
| Maintenance - Pick & IMS | | | |
| Maintenance - Darlington | | | |
| Operations | | | |
| Refurbishment | | | |
| Projects & Mods | | | |
| Rad Protection | | | |
| Emergency Svcs | | | |
| Work Management | | | |
| IMS | | | |
| Nuclear Training | | | |
| Aug Staff | | | |
| Other | | | |
| PC&C | | | |
| Total | | | |

| Postec | Int'l Fwr | Filled | % of Hiring Plan Actual | Target |
|---|---|---|---|---|
| | | | | |

| Recruitment Metrics | |
|---|---|
| Avg Time to Hire | XX days |
| External Hire Rate | XX% |
| Applicant Ratio | XX |
| Recruitment Cost/ | $XXX |
| Rehire Rate | XX% |

| Total Onboarded | YTD |
|---|---|
| Nuclear Engineering | XX |
| Maintenance - Pick & IMS | XX |
| Maintenance - Darlington | |
| Operations | XX |
| Refurbishment | XX |
| Projects & Modifications | XX |
| Rad Protection | XX |
| Emergency Svcs | XX |
| Work Management | XX |
| IMS | XX |
| Nuclear Training | XX |
| Aug Staff | XX |
| Other | XX |
| | XXX |

| Onboarding Metrics | |
|---|---|
| Avg Time to Onboard | XX days |
| Avg Trainee Days[1] | XX days |
| Avg Trainee Days In[2] | XX days |

Notes:
1.Average onboarding days on training
2.Training days between hire date and site start date.

| Training Readiness[3] |
|---|
| |

| Training Metrics | |
|---|---|
| Success Rate - Operators | XX% |
| Total Remediations | XX |

### Roadmap By Quarter

| Q1 | Q2 | Q3 | Q4 |
|---|---|---|---|
| Eng posted → | Eng IM Target Hire May → | Eng XXX trained Q3 | |
| Mtce posted → | Mtce XX Target Hire Jun | | |
| → | Ops XX Target Hire May | | |
| Refurb posted → | Refurb XX Target Hire Jun | | |

# The Impact

***MANY new people*** introduced into OPG in the same timeframe

***A LOT for line leadership*** and the organization at large to absorb

With new people come ***NEW ideas, challenges, and opportunities*** to re-look at how we do things

This ***DIVERSITY*** will be our OPPORTUNITY to ensure our success

The work is about ***MUCH MORE THAN HIRING***

We are ***impacting OUR CULTURE*****.....**

# Culture

Culture is...

- a reflection of how work gets done.
- creates a set of norms based on knowledge, symbols and beliefs shared by a group which attaches meaning to learned behaviors, attitudes and assumptions.
- culture shapes what people believe they need to do to:
  - fit in -- who we are
  - get work done - how things are done around here
  - be successful - what we value
- leadership is the core of culture; it shapes experiences, beliefs, decisions and action.

> *"Culture is not a thing. It's not something an organization has or doesn't have. Culture is something an organization is."*
> – Lizz Pellett, Author of *Cultural Fit Factor*

# Resourcing Program....
# What are we solving for?

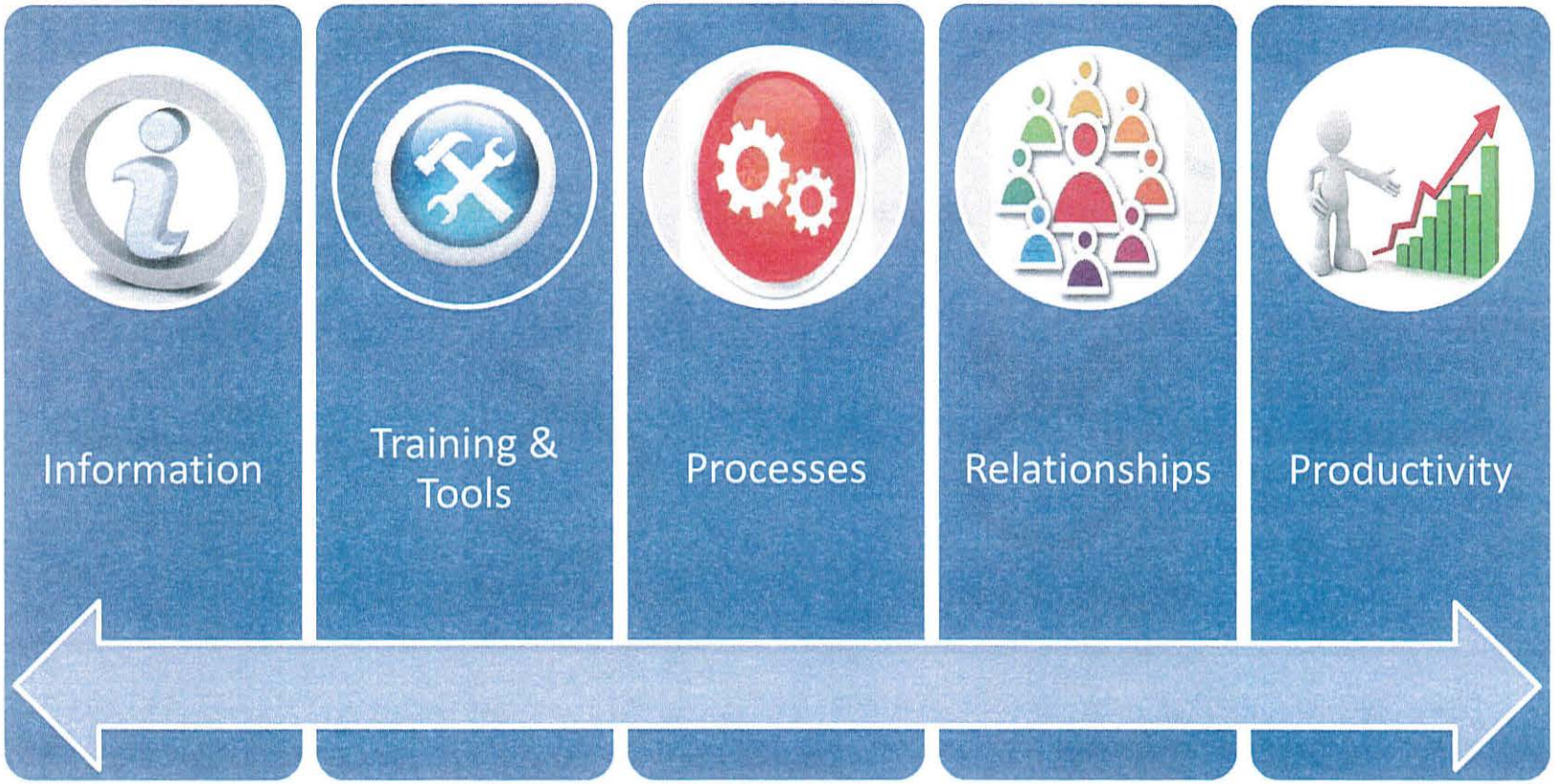
**HIRE!** ... then what?

New hires want to feel **welcomed** and **needed** which translates to:

- ✓ Being ready for them
- ✓ Managers making an effort to make them feel welcome
- ✓ Genuine and sincere interest from Senior Leaders
- ✓ Seeing their path i.e. within existing role and potentially beyond
- ✓ Understanding how their job matters in connection with the broader company
- ✓ Being supported through mentors, leaders, training and OPG in general
- ✓ Being productive

# Accelerating awareness and connectivity to OPG

A consistent 'One Company' experience that connects new hires roles to the broader organization, creating an integrated and welcoming experience that differentiates OPG through information sharing; training & tools; processes; relationships and productivity



# New Employee welcome and integration through ***LEADERSHIP in PARTNERSHIP***

## Recruitment

Accountable for the candidate experience in partnership with the Line Leader

## Line Leadership

Key role with the Employee Experience by ensuring they are set up for success by communicating culture and expectations, business context, direction and insight for the new employee

## Nuclear On-Boarding Centre (NOBC)

Accountable for the tools requested within established timelines to support success.
Key role with Pre-Boarding & New Hire Experience

## New Employee

Actively participates in the candidate, new hire and employee experience by partnering and building relationships

## Senior Leadership

Welcomes and contribute to the Employee experience by providing the company's strategy, reinforcement of company culture and connection between their role and the Strategic Imperatives ( SVP+)

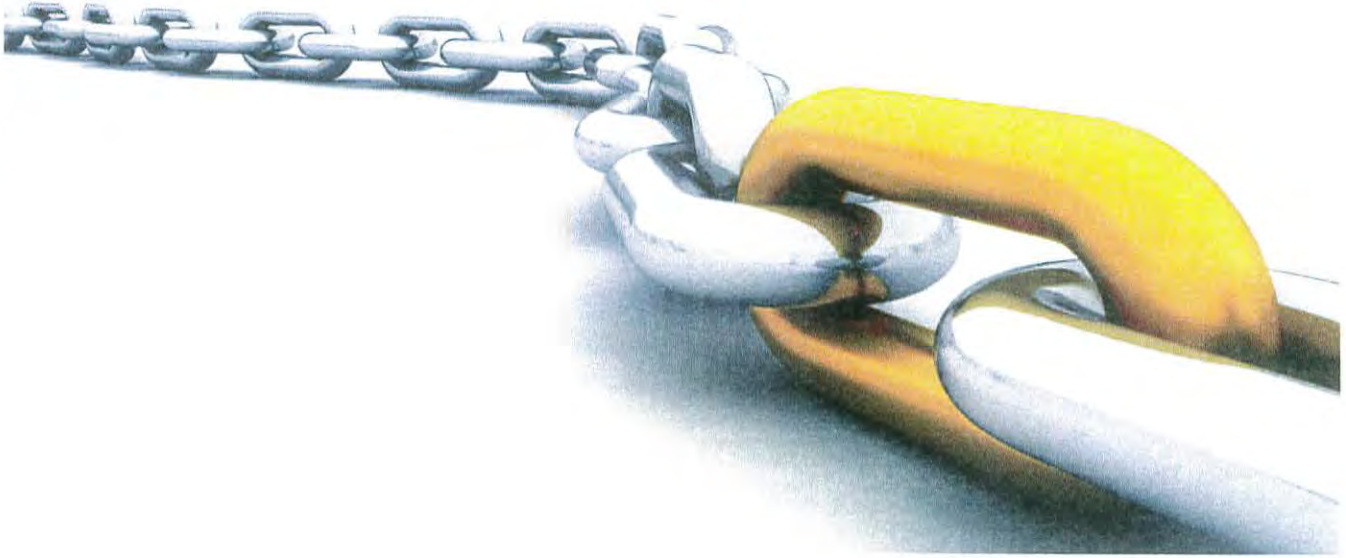
## Training

Key role with the Employee Experience by providing the right training at the right time to support success

## Peer Partner

Key role with the Employee Experience by acting as a resource, trusted guide and role model to the new employee

# Questions



# Trades Supervisor Development Initiative

EXECUTIVE SPONSOR
MIKE ALLEN

SPONSOR
KEN HOBBS

Lead : SILVIU IDITA

**Frontline**
"**Connects**" their crew to the Nuclear Safety Culture

# Trades Supervisor Development Initiative

- We are about to launch a 10+ year project that will have a demand for several hundreds of Trades Supervisors.
- With few exceptions, most of them may never have been working in a nuclear facility and many will be new to trades supervision.
- These supplemental supervisors may be unfamiliar with the Nuclear Safety Culture standards and expectations at Ontario Power Generation.
- We need to create consistency across all our Vendor Partners;
- This creates many challenges. Our past performance indicates a need for improvement.

# Vision

**Frontline Supervisor**
"**Connects**" their crew to the Nuclear Safety Culture

- The "Vision" for the initiative is to improve the safety and efficiency of supplemental workers through improved supplemental supervisors' performance;

- The overall goal is to increase safety and efficiency of the supplemental worker through improved supervisor selection, training and oversight.

- The initiative is focused on field work performed by supplemental workers no matter the leading organization within OPG Nuclear Projects, or Vendor Company.

**Frontline Supervisor**
"**Connects**" their crew to the Nuclear Safety Culture

- The **Nuclear Construction Supervisor Academy** (NCSA) training program strategically emphasizes why nuclear is different and that Supervisors are the most critical component of creating and maintaining a Nuclear Safety Culture.

- The course educates Vendor Supervisors on the basic nuclear fundamental elements and connecting the relevance to their job role and how they can impact Nuclear Power Plant performance

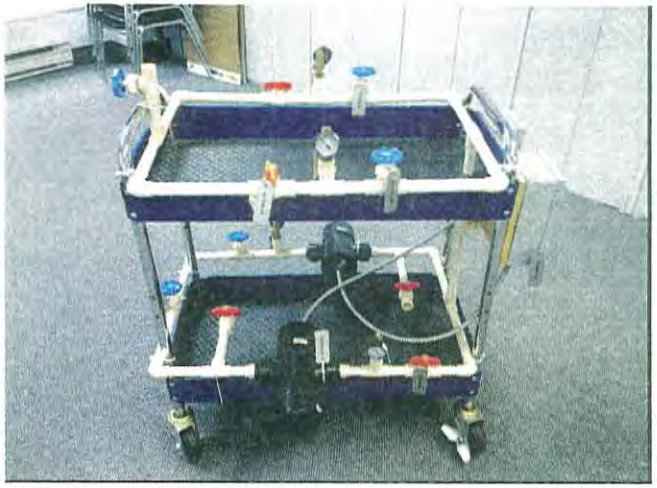
- This is done in the course by not only using practically the **Nuclear Operations & Maintenance Handbook** and **Principles for Excellence in Nuclear Project Construction** but in reviewing relevant OPEX and Case Study work to ensure that participants recognize how their role impacts Nuclear Safety and relevant tools that Nuclear Industry utilizes to assist them perform their job role

- Throughout the course there are consistent linkages to emphasize how the Supervisor controls and impacts Safety, Quality , Cost and Schedule. The (NCSA) training program was developed with the goal that "*Managers and Supervisors have the knowledge needed to reinforce the high standards and special requirements for nuclear project construction and to identify and correct quality and safety issues*" - **INP009-007**

**Frontline Supervisor**
"**Connects**" their crew to the Nuclear Safety Culture

# This initiative has the following five elements to be completed to obtain the desired goals:

- Planning and **Selection** of Trade Supervisors ;
- Trades Supervision **Training** and Qualification ;
- Trades Supervision Evaluation and **Feedback** ;
- Trade Supervisors **Oversight**;
- Contractor Organization **Safety Culture** Standards.



# KEY ELEMENTS

Consistent among Nuclear Vendors:

1. **NCSA** Deliveries (same 2-day classroom training, common Vendors deliveries);

2. Introduction of **DLA for Trades Supervisors**, where the supervisors (using a piping loop with valves and pressure gauge, equipment tags, work protection tags; Work package with procedure, PJB form and/or job aid) will:

   - Conduct a PJB using the SAFER dialogue;
   - Discuss OPEX ;
   - Observe task execution including: CCV demonstrated by workers; use of FME practices; Situational Awareness demonstrated with use of a 2-minute drill ;
   - Procedure Use and Adherence ;
   - Conduct Post Job Debrief ;
   - Observe and Coach throughout;

3. **Leadership Paired Observations;**

4. **Oral Review Boards** / Selection Procedures (Vendor) in place, accepted by OPG; developed ORB Common Q & A bank consistent among Nuclear Vendors

**Frontline Supervisor**
"**Connects**" their crew to the Nuclear Safety Culture

## What we expect to see differently in the field

- Trades Supervisors will be able to articulate why Nuclear is different and explain the role of the **3 Cs** (Control, Cool, Contain) in keeping the reactor safe;
- Trades Supervisors will identify attributes of how strong First-line Supervision is key to success in Nuclear Project Construction;
- Trades Supervisors will be able to explain how the behaviours of individuals, supervisors and the organization may positively or negatively influence nuclear safety culture;
- Pre-job Briefings ; Procedural Use and Adherence ; Self Check (STAR) ; 3way communication ; Question Attitude/Conservative Decision making ; 2 Minute Job Site Drill are consistently used;
- Trades Supervisors are able to describe significance and responsibility as a Supervisor relating to Hold Points, Seismic Routes, ECI, SATM;
- Trades Supervisors understand the Work Management Systems including accurate and timely reports, work reporting, schedule updates/compliance;
- Trades Supervisors Plan, Organize, Lead, and Control their area of responsibility; including emergent work and unintended consequences;

**Frontline Supervisor**
"**Connects**" their crew to the Nuclear Safety Culture

## What we expect to see differently in the field

- Trades Supervisors will coach workers on task conduct, implement the required work standards and processes, and address personnel performance issues;
- Trades Supervisors Demonstrate Quality and Safety balance with Cost/Schedule pressures;
- Trades Supervisors aggressively follow up and correct degraded conditions when standards are not met;
- Trades Supervisors use oversight and corrective action programs to analyze and aggressively resolve identified deficiencies;
- Trades Supervisors are conducting PJBs using the SAFER dialogue;
- Trades Supervisors are demonstrating Situational Awareness with use of a 2-minute drill;
- Post Job Debrief will be conducted;
- Observation and Coaching is applied as required.

## Nuclear Construction Supervisor Academy :

- **Module 1** - Setting The Foundation… Why Nuclear Is Different
- **Module 2** - Supervisors Are The "Linchpins" – POLC (Plan Organize Lead Control ) – essential attributes of a supervisor
- **Module 3** - Setting Expectations
- **Module 4** - Observation and Coaching
- **Module 5** - A Bias Toward Safety

DARLINGTON
REFURBISHMENT
Repowering Ontario

# Interface and Islanding Training

## DNGS Training Council

## 2016 Feb

Presenter: **Solly Solaiman** – Sr. Training Officer
Darlington Refurbishment Training

# Refurbishment Island (RI)

The Refurbishment Island (RI) Project will create a safe, precise work area that is separated from the operating plant through a system of physical barriers and controls.

Once separated, the RI goal will be to maximize the ability of OPG and contract staff to perform work safely and efficiently, and on the unit that is being refurbished while minimizing the impact on the operating units.

Island Training

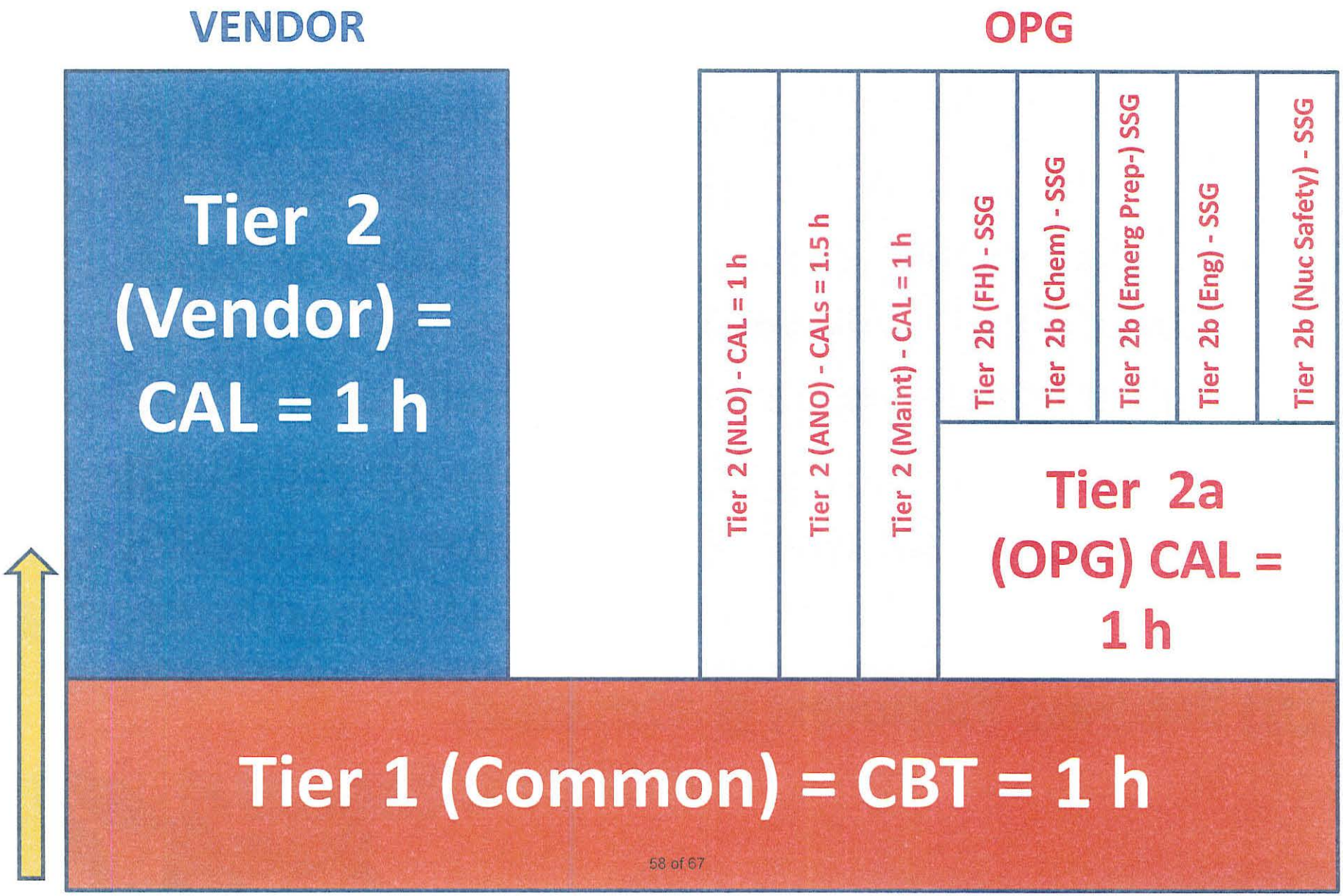
# Rationale

## Interface & Islanding Training (IIT)

Educating OPG & Vendors on:

- Refurbishment Island (RI) - definition, physical barriers and administrative controls.
- Interface (& protocols) between NR and Station.
- Changes to Systems, Structures and Components (SSCs) and their operation, requirements and restrictions due to islanding.
- Facilities locations in the station.
- Pathways.

# IIT Qualification Structure



# IIT Status

- Tier 1 CBT developed and on Test Server;

  Video recorded 2016 Feb 9 starring Brian Duncan and Mike Allen ;

- Tier 2 CALs: Drafts Developed / TCD for Production Apr 01, 2016

# IIT: Frequently Asked Questions

1 ) Who must do the IIT Tier 1 CBT?

Everybody who has access to refurb/operating island within the protected area.

2 ) Is IIT Tier 1 CBT part of NGET?

No, because NGET is a Fleet Course (must be taken by PNGS, DNGS, Waste Management).

Therefore, it must be a stand alone PEL.

3 ) How are people linked to IIT Tier 1 CBT?

TIMS Admin to implement a nightly script to automatically link IIT Qual to individuals who hold valid DNGS Orange 1/ Orange 2/ Yellow/ Green qual, i.e., the ONLY folks who have unescorted access on the refurb/operating island within the protected area.

# New to Nuclear?

Nuclear is a unique operational environment. To ensure everyone's safety, employees new to working in Nuclear will be protected by:

- Not being assigned to work alone
- Not be expected to make risk based decisions
- Only work after having a PJB
- Being mentored by experienced workers

# Nuclear Work Environment Supports

Workers new to nuclear will be identified with a distinguishable sticker on their Hard Hat.

They will also receive support from the following experienced nuclear staff:

- Field Supervisors & Field Superintendent
- Co-workers in the field
- Support staff (Radiation Protection, Safety, etc.)

**Speaking notes for New to Nuclear for Laura Clark to turn into something people will understand.**

Many petrochemical companies and some nuclear power plants have adopted Short Service Worker programs to ensure that any new staff entering the facility are identified and mentored by experienced co-workers and supervisors until they become familiar with plant layout and company safety rules and policies.

Inexperienced staff are more likely to make innocent errors because they haven't been shown what to do, or may be confused by our rules (radiation protection, steam doors, etc.). Our plants and rules may be different than anything people have experienced in other industries, even for seasoned trades.

OPGs program is called "New to Nuclear". A New to Nuclear worker is defined as:

*Any individual who has not previously worked inside the Protected Area of an OPG Nuclear facility for a total duration of six months. The six month requirement can be cumulative and may be with different employers, including OPG.*

Everyone working in our power plant was once new to nuclear. Many of us remember valuable advice and help received from coworkers when we first started working here. This program makes getting that help and advice more likely to happen because people will be able to see that you are new here.

To assist workers who are "new to nuclear", a safety awareness program is being implemented for all vendor and Appendix A employees who do not have at least six months experience working in OPG nuclear facilities. Contractor and subcontractor employees, and Appendix A staff will be screened for entry into the New to Nuclear program during onboarding. New to Nuclear workers will be identified with a hard hat sticker and will receive special attention from assigned mentors, co-workers and supervisors to help them comply with our standards and to keep them safe until they become experienced.

The program is being administered by our prime contractors, (B&M, ES Fox, JV) in partnership with OPG.

There is minimal bureaucracy involved in implementing this program.

It was recommended by WANO in the recent TSM on supplemental staff.

Once New to Nuclear workers have completed six months service, and their supervisor is satisfied that they understand the safety standards and expectations, they will graduate from the program by removing the sticker.

Contractor and subcontractor employees who will be continuously escorted will not be enrolled in the program.

August 31, 2015

**MEMORANDUM**

Contractor Site Managers
Darlington Nuclear

**Guidelines for New to Nuclear Program**

The nuclear work environment can be challenging for new employees until they become familiar with the physical layout of facilities, and OPG rules and expectations that may be different than working in other industries. To assist workers who are "new to nuclear", a safety awareness program is being implemented for all vendor and Appendix A employees working in OPG nuclear facilities.

New to Nuclear is defined as:

*Any individual who has not previously worked inside the Protected Area of an OPG Nuclear facility for a total duration of six months. The six month requirement can be cumulative and may be with different employers, including OPG.*

Effective Monday, August 31, 2015 all staff being onboarded including contractor and subcontractor employees, and Appendix A staff will be screened for entry into the New to Nuclear program by the onboarding centre. Individuals who have been recently hired for the VBO and were not screened by the onboarding coordinators should be asked by line management to provide details of their OPG Nuclear work experience. If the workers are deemed by General Foreman to be New to Nuclear, then issue them with a hard hat sticker, dated 6 months from the orientation date to fix to their hard hat. If the workers have some experience but do not meet the six month requirement, the date may be shortened to credit previous service. Once identified, it is expected that New to Nuclear workers will receive special attention from assigned mentors, co-workers and supervisors to help them comply with our standards and to keep them safe until they become experienced.

Contractor and subcontractor employees who will be on site less than 5 days or who will be continuously escorted do not require screening or identifying stickers on hard hats.

Grant M Howard P. Eng
Director Contract and Project Support
Projects and Modifications
OPG Darlington NGS

**This document titled "Darlington Nuclear Refurbishment: Project Controls Overview" was filed at L-4.3-15 SEC-022, Attachment 3, Tab 3.**

# 90-Day Lookahead

April 28, 2016

Dietmar Reiner, SVP Nuclear Projects
Mike Allen, VP Execution

BEHAVIOURS

- Say It, Do It
- Simplify It
- Think Top and Bottom Lines

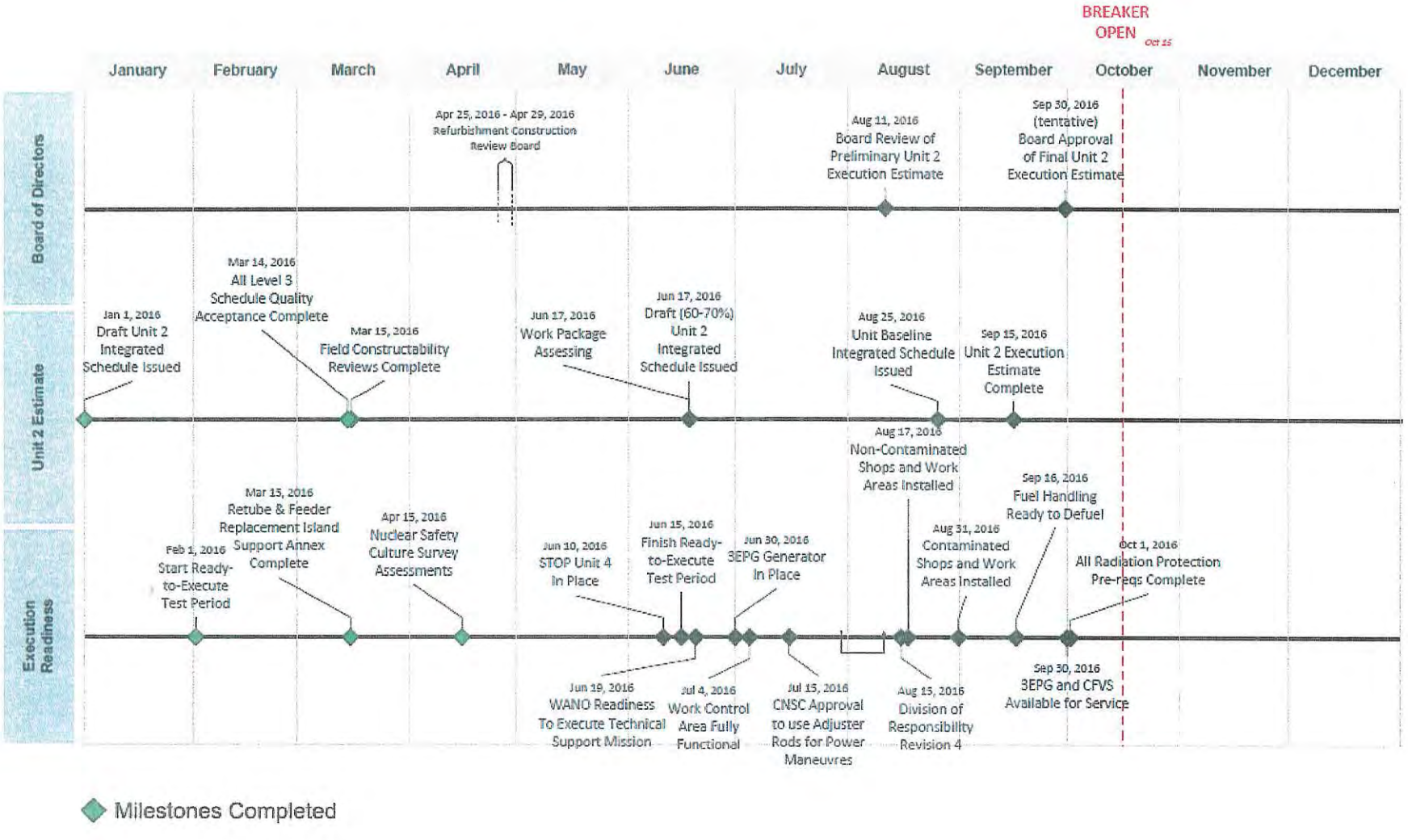





PEOPLE POWERING THE FUTURE
OPG NUCLEAR

ONTARIO POWER GENERATION

# Significant Milestones Leading to Breaker Open (90 Day Look Ahead)



# Closing Comments

ONTARIO POWER GENERATION



April 25, 2016

# DARLINGTON REFURBISHMENT PROGRAM

## REASON FOR REPORT

This report provides an update on the status of the Darlington Refurbishment Program (DRP) including a review of program performance as of March 31, 2016, and an update on OPG's readiness to commence Unit 2 refurbishment including a status of the pre-requisite Facilities & Infrastructure and Safety Improvement Opportunity (SIO) projects. An overview of the assurance program, a summary of key findings, and a six-month look ahead are also included.

## HIGHLIGHTS

### PROGRAM PERFORMANCE OVER THE PERIOD

**DARLINGTON REFURBISHMENT PROGRAM PERFORMANCE DASHBOARD**

| Cost Performance Index (CPI) | | Status | Trend | Safety (YTD) | | Status | Trend |
|---|---|---|---|---|---|---|---|
| Current | 1.02 | | ↓ | All Injury Rate (#/200k hrs worked) | 0.00 | | – |
| Previous Report | 1.03 | | | # High Max. Reasonable Potential for Harm | 1 | | |
| **Schedule Performance Index (CPI)** | | | | **Quality (YTD)** | | | |
| Current | 0.95 | | ↑ | # Event Free Day Resets | 0 | | – |
| Previous Report | 0.94 | | | # Regulatory Non- Compliance | 1 | | |

**FINANCIAL SUMMARY - CURRENT APPROVED RELEASE - UNIT 2 MOBILIZATION**

| Life-to-Date Cost (M$) | | | At Completion of Mobilization Phase (M$) | | | | |
|---|---|---|---|---|---|---|---|
| Actual | Plan | Variance | Forecast | Plan | Variance | | |
| **205** | **421** | **(216)** | **852** | **1,021** | **(169)** | | |

| Mobilization Phase Contingency (M$) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Budgeted | | Allocated | | Unallocated | | | |
| 69.5 | 100% | [redacted] | 25% | [redacted] | 75% | | – |

Legend: – No Change; ↑ Improvement; ↓ Decline

### *SAFETY*

There have been no significant safety incidents since the previous report. As a result, the year-to-date combined All Injury Rate for OPG and contractor employees is zero, and remains below the target of 0.24. A high Maximum Reasonable Potential for Harm incident occurred on the Turbine Generator project during maintenance work when a temporary handrail installed on the turbine hall crane struck and damaged a section of fluorescent light fixtures. At the time, the crane was being operated by an [redacted] The fluorescent light fixture fell and came to rest on top of the crane, and the fluorescent light tubes fell approximately 19 meters to the turbine hall floor. No injuries resulted from this event. An investigation is underway to identify causal factors and actions to prevent recurrence. Additional details on safety performance are provided in Appendix 7.

### *QUALITY*

[redacted] The Refurbishment Quality Management team is involved in the investigation and will ensure that any lessons learned are applied, and that the appropriate compensatory measures are in place within both vendor and OPG teams. Additional details on quality performance are provided in Appendix 8.

### *COST PERFORMANCE*

The life-to-date cost at the end of the Definition Phase (December 2015) was $2,184 Million. In November 2015, as part of the Release Quality Estimate, the OPG Board approved funding of $1,021 Million, including $69.5 Million in contingency, for Unit 2 mobilization activities for the period January 1, 2016 to October 15, 2016. All cost reporting in this report is against the release of funds for Unit 2 mobilization activities.

The Cost Performance Index has slightly declined since the last report but is still positive largely as a result of efficiencies within the vendor and OPG project management teams. However, year-to-date costs as of March 2016 month end are $205 Million, $216 Million below plan mainly due to delays in completing work. The forecast cumulative spend to October 2016 is $169 Million below the plan of $1,021 Million.

Drawn-down contingency is [redacted] against the released amount of $69.5 Million for 2016, including [redacted] related to Facilities & Infrastructure and SIO projects.

Details on cost and contingency performance are provided in Appendices 1 and 2 for the core projects and Appendix 3 for the pre-requisite projects. Additionally, details on OPG's project management and functional resources are provided in Appendix 5.

### *SCHEDULE PERFORMANCE*

Schedule performance has improved slightly since the last report; however, it remains behind plan largely due to delays experienced on the Heavy Water Storage & Drum Handling Facility and 3rd Emergency Power Generator projects, as well as some Unit 2 pre-requisite projects. OPG oversight and management of contractor performance continues in order to maintain the in-service dates. Currently, there are no significant risks to the commencement of the Unit 2 refurbishment nor the development of the Unit 2 Execution Estimate. Details regarding project performance are included in the Project Performance section below.

### *PROGRAM HIGHLIGHTS*

- Over 90% of tooling scope on the Re-tube & Feeder Replacement project is complete. Manufacturing of production tools is progressing and all tool sets are scheduled for delivery by May 2016. Rehearsals at the mock-up facility are in progress.
- 18 fuel channels were successfully defueled using flow defueling and the new Universal Carriers and Flow Restricting Outlet Bundles during the current Darlington Unit 4 planned outage. The results of these tests were positive and are being analyzed to validate the projected total duration to defuel the reactor.
- All field constructability reviews (>100) were completed on design modifications for Unit 2. The reviews are being performed to ensure all field conditions are known and issues fully addressed prior to execution.
- Approximately 30% of the concrete foundation slab has been poured on the Re-tube Waste Processing Building, with completion scheduled in June 2016.
- In April 2016, the Federal Court of Appeal dismissed a judicial review filed by interveners to the Environmental Assessment of the refurbishment and continued operations of Darlington. The court found that there were no gaps or errors in the 2013 Environmental Assessment. The court also found there was nothing unreasonable about the determinations made by the responsible authorities, and that the interveners' arguments were not borne out by the evidence.
- As part of the Ontario Energy Board (OEB) rate filing for the period 2017 to 2021, OPG will request approval to place nearly $5 Billion of Refurbishment related costs into the rate base with the planned completion of Unit 2 in early 2020. These costs include the DRP planning and Unit 2 execution costs. OPG's supporting evidence will put forth a strong case that the cost and schedule estimate, including contingency and contracting strategy, are reasonable, and that OPG has the processes in place for effective execution.

[redacted]

- OPG, in collaboration with vendor partners, has developed a Nuclear Construction Supervisor Academy for incoming trades supervisors. The academy addresses known areas of weakness including oversight, safe work behaviors and the use of human performance tools in a nuclear environment. To-date over 70 vendor supervisors have attended the two-day training program and provided positive feedback.
- OPG hosted representatives from potential insurance providers for the DRP. Site tours were conducted and a number of detailed presentations were delivered. Insurers' feedback at the end of the two-day visit was positive. OPG senior management will travel to Europe in June 2016 to meet with insurance company executives to finalize insurance plans for the DRP.
- Funding for the Refurbishment Project Office and the Re-tube & Feeder Replacement Island Support Annex was approved by the OPG Board under separate Business Case Summaries. These have been updated to align with the most current estimate-at-complete costs.

## PROJECT PERFORMANCE

The following table provides an overview of the current status and potential impact of the DRP pre-requisite projects and Unit 2 execution projects on the commencement of the Unit 2 refurbishment.

| PROJECT PERFORMANCE INDICATORS AND TRENDS | | | | | |
|---|---|---|---|---|---|
| **Pre-requisite Projects** | **Status*** | **Trend** | **Unit 2 Execution Projects** | **Status*** | **Trend** |
| Facilities & Infrastructure and Safety Improvement Projects | ◯ | – | Re-tube & Feeder Replacement | ◯ | – |
| Unit 2 Ready-to-Execute Plan | ◯ | – | Turbine Generators | ◯ | – |
| Pre-requisite Projects | ◯ | – | Fuel Handling & Defueling | ◯ | – |
| Unit 2 Execution Estimate | ◯ | ↓ | Steam Generator | ◯ | – |
| **Legend:** – No Change; ↑ Improvement; ↓ Decline | | | Balance of Plant | ◯ | – |

### *PRE-REQUISITE PROJECTS*

**Facilities & Infrastructure and Safety Improvement** projects indicator is yellow due to low schedule float in the Heavy Water Storage & Drum Handling Facility and 3rd Emergency Power Generator projects.

At OPG's request, the vendor for the Heavy Water Storage & Drum Handling Facility project has put a new project manager and additional resources in place. Construction activities for the facility have been re-sequenced to recover schedule and expedite the in-service date. Contingency plans to temporarily store Unit 2 heavy water in existing station storage, and to delay draining of Unit 2 heavy water are also being developed. These contingencies will mitigate the potential impact of a delayed in-service date on the Unit 2 refurbishment execution schedule.

A regulatory commitment was made to place the 3rd Emergency Power Generator in-service prior to the start of Unit 2 refurbishment; however, there is no physical requirement to have the generator in place prior to the commencement of the refurbishment. At OPG's request, the vendor is in the process of providing a new leadership team for the project. The team's focus will be to ensure that commissioning activities, which pose the highest risk to the in-service date, are understood and managed. There is no risk to Unit 2 refurbishment.

Additional discussion on Facilities & Infrastructure and Safety Improvement projects is provided in Appendix 3. Appendix 9 provides photographs of construction activities for the remaining Facilities & Infrastructure and Safety Improvement projects.

Completion of the **Unit 2 Execution Estimate** has been delayed due to delays in completing the predecessor activities. The following table illustrates the key predecessors required to successfully complete the Unit 2 Execution Estimate.

| | Baseline | Forecast | Variance (Months) |
|---|---|---|---|
| Work Package Assessing Complete | Apr 15, 2016 | Jun 17, 2016 | 2 |
| Draft (60-70%) Unit 2 Integrated Schedule Issued | May 31, 2016 | Jun 17, 2016 | 0.5 |
| Unit 2 Baseline Integrated Schedule Issued | Jul 15, 2016 | Aug 25, 2016 | 1 |
| Unit 2 Execution Estimate Complete | Aug 15, 2016 | Sep 15, 2016 | 1 |

A key component in the development of the Unit 2 Execution Estimate is a detailed resource loaded schedule, or Unit 2 Baseline Integrated Schedule. This schedule is used to validate the cost estimates and cash flows over time.

The formation of the baseline integrated schedule is dependent on the completion of detailed work planning and Work Package Assessing activities. This includes the development of comprehensive work packages with instructions for each activity that outline the work execution methodology, OPG support tasks and vendor interdependencies.

[redacted] OPG has adopted a more collaborative approach and has provided the vendor with skilled resources to accelerate completion of the work packages, and metrics are in place to monitor progress.

This delay has impacted the issuance of the Baseline Integrated Schedule, and the Unit 2 Execution Estimate. As a result, OPG is re-sequencing its estimating activities and will present a preliminary Unit 2 estimate to the Darlington Refurbishment Committee in August, followed by a final Unit 2 estimate and cash flow in late September, in advance of the start of the Unit 2 refurbishment.

## KEY PROGRAM RISKS

Execution of first-of-a-kind and first-in-a-while work has been elevated as a key program risk. The project teams have been focused on identifying work that is first-of-a-kind and first-in-a-while, and ensuring appropriate reviews are conducted and mitigation plans are in place.

The risks associated with fuel handling reliability and regulatory approvals have been retired as key risks, and will continue to be managed within the project risk process. These reviews will be complete in advance of the commencement of Unit 2 refurbishment. Appendix 6 provides a summary of the key program risks that are being actively managed.

## PROJECT ASSURANCE

A Project Assurance function has identified the following major trends in the first quarter of 2016:

- **Low Level Reporting.** Contractors have not been adequately reporting low-level events, making identification and reversing of adverse trends difficult. To mitigate this, OPG has embedded staff at the contractor premises to assist with enhancing low level reporting and trending capability, and identifying corrective actions at an early stage. The contractors have recognized the importance of identifying and correcting low level trends in a nuclear environment and are support this change.
- **Documentation.** Some contractor documentation, including quality assurance documents, does not yet meet OPG's expectations and requirements. Oversight has concluded that there are instances where documentation is missing, incorrect, of poor quality, or lacks the required level of detail. Contractors lack some of the specialized resources and familiarity with the standards that are required for Nuclear work. To rectify these deficiencies, OPG is providing direct support to the contractors to ensure they meet expectations and requirements.

- **Field Initiated Changes (FIC).** There have been an increasing number of FICs to approved modification packages within the Balance of Plant projects. Most of these are minor in nature and relate to the final determination of equipment and finalization of comprehensive work packages. This is being managed through increased OPG engineering presence in the field to ensure timely incorporation of the changes. In addition, the FIC process is being reviewed for efficiency improvements, and actions are being formulated to address the root causes of the FICs.

With the mitigating actions currently underway on each of these findings and trends, no impact is anticipated on readiness for the Unit 2 refurbishment.

## KEY DELIVERABLES FOR NEXT PERIOD

The focus over the next six months is readiness for Unit 2 refurbishment including completion of the ready-to-execute test period, readiness to defuel and placing the 3rd Emergency Power Generator and Containment Filtered Venting System projects in service. An overview of key milestones is provided in Appendix 4.

## CONCLUSIONS

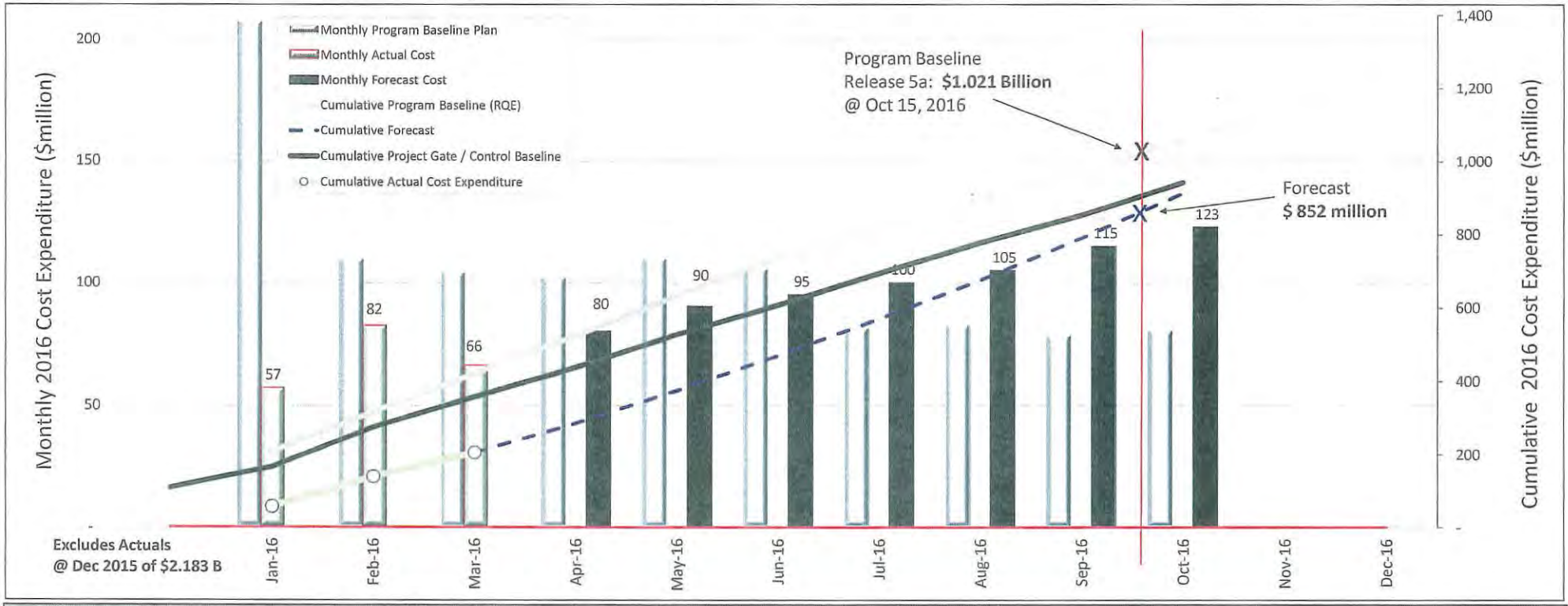
The program is on track to commence the execution and refurbishment of Unit 2 starting in October 2016.

## APPENDICES

1. Financial Performance
2. Contingency Management
3. Pre-requisite Projects – Cost and Schedule Performance
4. Key Deliverables for Next Period
5. OPG Project Management and Functional Resources
6. Key Program Risks
7. Safety Performance
8. Quality Performance
9. Photo Catalogue

# APPENDIX 1: FINANCIAL PERFORMANCE

Financial Performance of the Program for Funds Released till October 15, 2016 (Breaker Open)




## Executive Summary & Discussion:

| 2016 Cost Expenditure Summary | Life-to-Date Cost ($mil) | Variance from Plan ($mil) | % | @ Completion of Rel 5a : October 15, 2016 | Cost Expenditure ($mil) | % |
|---|---|---|---|---|---|---|
| Overall Program Release 5a Plan | 421 | (216) | -51% | Total Release 5a | 1,021 | |
| Project Gate Release Plan | 357 | (152) | -42% | Forecasted Expenditures through Oct 15th | 852 | -17% |
| Actual Cost Expenditure | **205** | - | - | **Variance from Plan** | (169) | |

*1 - Actual expenditure as of March 31 is $216 Million below plan largely due to timing changes in planned work. The largest contributors to the current under spend are Re-tube & Feeder Replacement ($96 Million), Facilities & Infrastructure and Safety Improvement Opportunities ($63 Million), Balance of Plant ($35 Million), and OPG Functional Teams ($16 Million).*

*2 - Forecasted Cost Expenditure through Oct 15th, 2016 (Rel 5a) of $1,021 Billion, is $169 Million below the Total Release 5a. Approximately $2 Million is permanent savings as a result of under staffing within the Functional OPG teams, and $10 Million of permanent cost savings resulting from the Re-tube Waste Processing Building cost estimate being less than the estimate within the Release Quality Estimate. The remaining $157 Million is related to the timing of work, and un-utilized contingency.*

ONTARIO POWER GENERATION

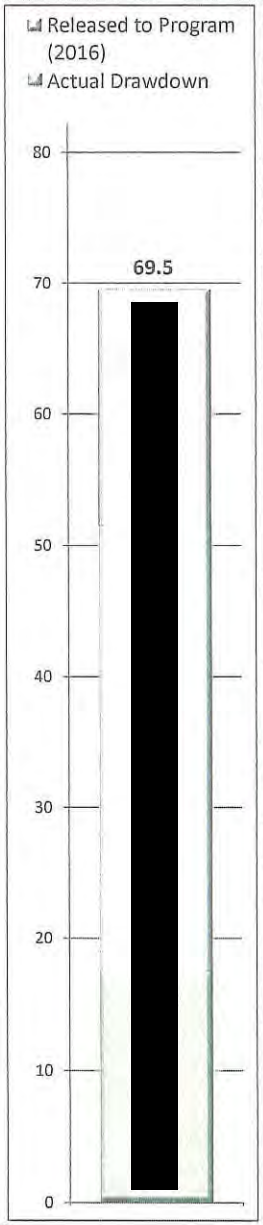
Darlington Nuclear Refurbishment Program

# APPENDIX 2: CONTINGENCY MANAGEMENT

Contingency Allocation for Funds Released till October 15, 2016 (Breaker Open)

Period Ending: 31-Mar-16

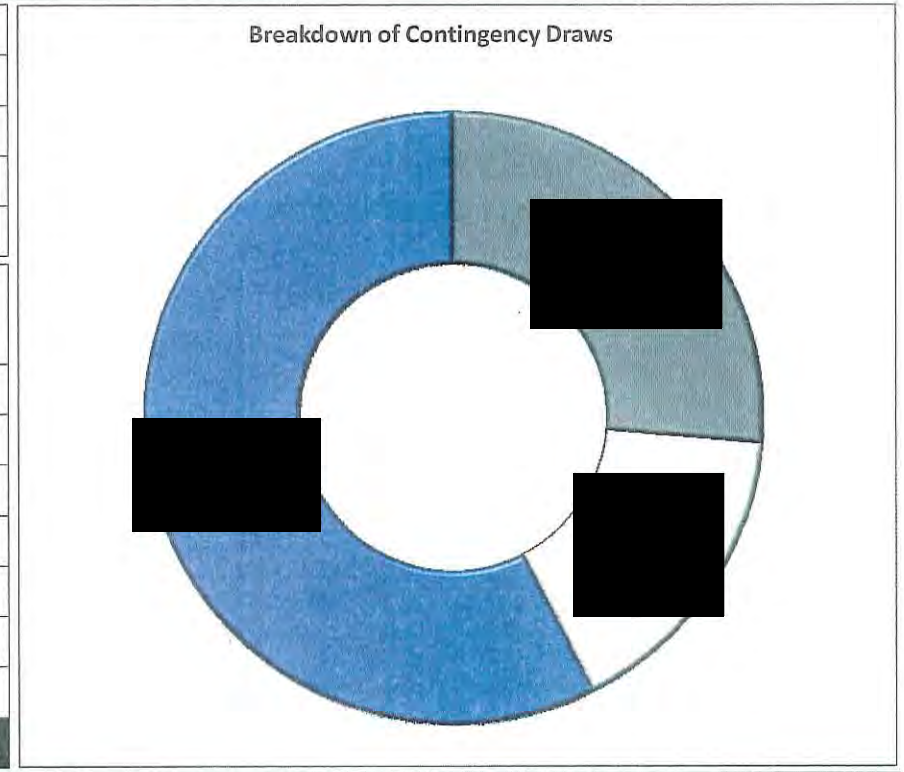
## STATUS OF U2




## CONTINGENCY USE & SUMMARY AGAINST PROGRAM RELEASE (5A)

| | | $ million | % |
|---|---|---|---|
| 1 | Total Contingency (Unit 2 + Campus Plan) | 722.0 | 100% |
| 2 | **Released to Program (Rel 5a*)** | 69.5 | 9.6% |
| 3 | Total Draws against Planned use in 2016 | [redacted] | |
| 4 | Drawdown's since last Period | | |

| Contingency Drawdown Category | | $ million | % |
|---|---|---|---|
| 1 | Project - Discrete Risks | [redacted] | |
| 2 | Project - Estimating Uncertainty | | |
| 3 | Project - Schedule (to P70) | | |
| 4 | Project - Schedule (to P90) | | |
| 5 | Program Level - Discrete Risks | | |
| 6 | Program Level - Estimating Uncertainty | | |
| 7 | Campus Plan Contingency | | |
| 8 | **Total Drawdown** | | |




## EXECUTIVE DISCUSSION

1 - *Release 5a Contingency includes $43.3 Million, plus a roll-over [redacted] Million of planned contingency unspent as of Dec 31,2015.*

2 - *Overall contingency allocation is below plan and trending positively.*

3 - *During November 2015, $69.5 Million was released to the Program (10% of the Total Unit 2 Contingency, including Campus Plan). As at March 31, [redacted] of contingency has been drawn down to support work within 2016.*

4 - *As previously communicated, contingency use has been classified into the following groupings: Discrete risks and Estimating Uncertainty at the Program and Project levels, Critical Path Schedule to Medium and High confidence, and contingency allocated for Facilities & Infrastructure and Safety Improvement Opportunity projects.*

5 - *The [redacted] of discrete risk is allocated as follows - [redacted] to Balance of Plant, $1.5 Million to Turbine Generator Project, [redacted] to Re-tube & Feeder Replacement, and the remaining to Steam Generators and Defueling.*

6 - *The [redacted] of estimating uncertainty is allocated to the Balance of Plant Project.*

7 - *The [redacted] of contingency was drawn down against Facilities & Infrastructure and Safety Improvement Opportunity projects*

8 - *Total Contingency of $722.0 Million includes $646.5 Million to Unit 2 Project & Program Level, $41.6 Million Campus Plan Project Level, $33.9 Million Campus Plan Program Level*

ONTARIO POWER GENERATION

Darlington Nuclear Refurbishment Program

Period Ending: 31-Mar-16

# APPENDIX 3: PRE-REQUISITE PROJECTS - COST & SCHEDULE PERFORMANCE

Facilities & Infrastructure and Safety Improvement Projects

## COST DETAIL ($ THOUSANDS)

| | | Cumulative (Life-to-Date) | | | | | At Completion of Project | | | | In-Service Date | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | a | b | c=b-a | d | e | f | g | h | j | k | m | n | o |
| Line | Project Title | Plan (PV) | Actual (AC) | Variance | CPI | SPI | Budget at Completion | EAC | Variance from BAC | Variance from Last Period | Need Date | Current Forecast | # Months Float | Variance from Last Period |
| 1 | Heavy Water Storage & Drum Handling Facility | 253.2 | 217.9 | (35.2) | 0.96 | 0.83 | 373.1 | 381.1 | 8.0 | 0.0 | Feb 2017 (PHT) May 2017 (Full) | Nov 2016 (PHT) May 2017 (Full) | 1 0 | 0 |
| 2 | 3rd Emergency Power Generator (EPG 3) | 87.7 | 85.1 | (2.6) | 0.97 | 0.82 | 88.2 | 128.8 | 40.6 | 3.8 | Oct 2016 | Sep 2016 | 1 | 2 1 |
| 3 | Containment Filtered Venting System | 62.7 | 66.3 | 3.6 | 0.91 | 1.01 | 80.6 | 84.6 | 4.0 | 0.0 | Oct 2016 | Sep 2016 | 1 | 0 |
| 4 | Shield Tank Over Pressure Protection | 10.4 | 11.9 | 1.5 | 0.90 | 0.92 | 14.0 | 3 14.1 | 0.1 | 0.0 | Mar 2017 | Feb 2017 | 1 | 0 |
| 5 | Balance of Pre-Requisite Projects In-Service | 324.8 | 323.8 | (1.0) | * | * | 4 321.7 | 333.7 | 12.0 | (0.5) | IN SERVICE | | | |
| 6 | Subtotal Campus Plan Before Contingency | 738.7 | 705.0 | (33.7) | 0.95 | 0.87 | 877.6 | 942.3 | 64.7 | 3.3 | | | | |
| | [redacted] | | | | | | | | | | | | | |
| | **Portion of the Re-Tube & Feeder Replacement Bundle** | | | | | | | | | | | | | |
| 9 | Re-tube Waste Processing Building | 65.9 | 52.4 | (13.5) | 5 Under Review | | 192.0 | 192.0 | 0 | 0 | Jul 2017 | Jun 2017 | 1 | 0 |

* Indicates n/a, not applicable

## Executive Discussion

1 - *The final in-service date for the facility has been maintained since the previous report. The schedule performance has been impacted due to delays in ordering bulk material, which has delayed pre-fabrication and material delivery to site. Addition of a second shift, and re-sequencing of structural steel erection to optimize space and resources is mitigating schedule slippage of the in-service dates. Re-sequencing of Unit 2 Refurbishment activities are under review to gain additional float.*

2 - *The in-service date for the 3rd Emergency Power Generator has been delayed due to inclement weather affecting construction activities, and constructability issues related to congestion. As a result, the estimate-to-complete has increased over the period. This increase can be accommodated with the available contingency.*

3 - *The forecast to complete is expected to increase as a result of the design changes required to rectify the pre-existing system condition. The installation of the STOP modification is on track to be completed during the current Unit 4 outage, while remaining installations on Unit 1 and Unit 3 are on track to support the need date of March for Unit 2 Bulkhead in-service milestone .*

4 - *Included in the Balance of Pre-Requisite Projects In-Service is the Refurbishment Project Office and Re-tube & Feeder Replacement Island Support Annex. Business Case Summaries for both have been updated to align with the most current estimate-at-complete costs and will be approved by the CEO. The Darlington Refurbishment Business Case Summary and 2016 Released Amount have been approved by Board and the estimate-at-complete for these projects falls within approved amounts. The final estimate-to-complete were included in the previous report and have not increased. Minor savings have been noted in the closeout of in-service projects, resulting in $0.5 Million of reductions over the period.*

5 - *The contract amendment for the Re-tube Waste Processing Building has been finalised, and is in alignment with the Release Quality Estimate. The project cost and schedule will be aligned with the amendment, and the revised cost and schedule performance index will be included in the next report.*

ONTARIO POWER GENERATION

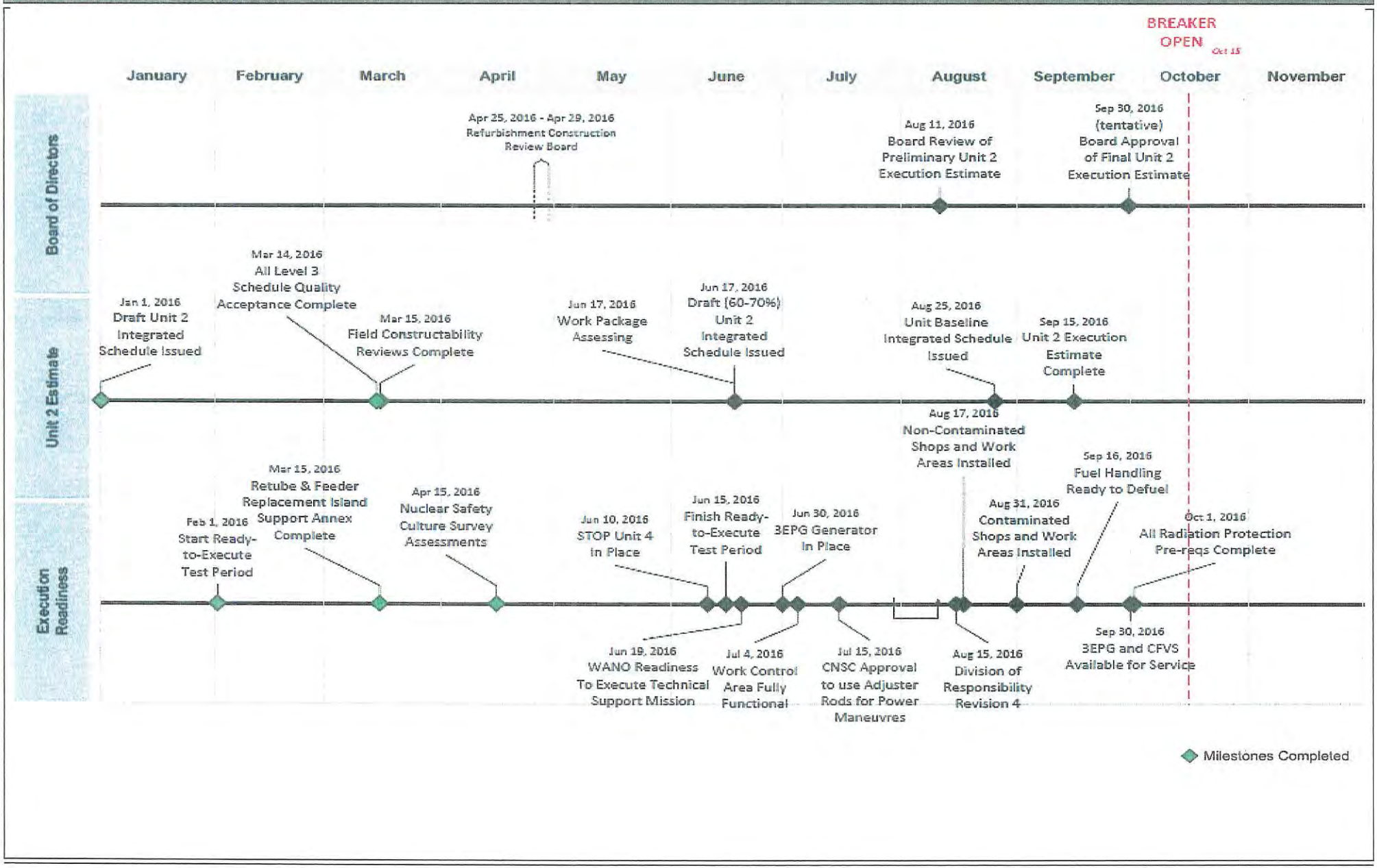
Darlington Nuclear Refurbishment Program

# APPENDIX 4: KEY DELIVERABLES FOR NEXT PERIOD

Significant Milestones Leading to October 15, 2016 (Breaker Open)



## KEY SCHEDULE MILESTONES

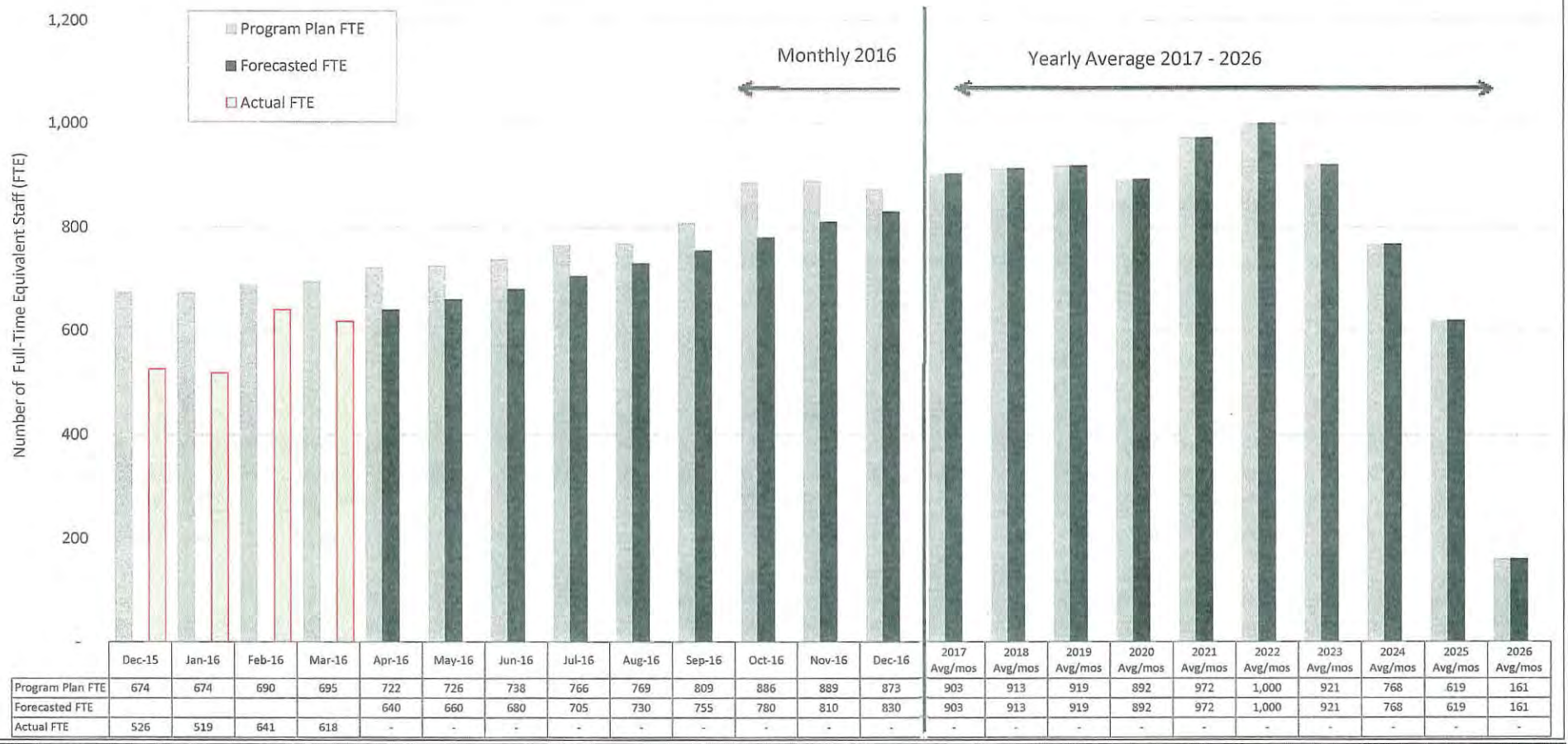


ONTARIO POWER GENERATION Darlington Nuclear Refurbishment Program

# APPENDIX 5: OPG PROJECT MANAGEMENT & FUNCTIONAL RESOURCES

Excluding Purchased Services / Contract Labour $






| | Dec-15 | Jan-16 | Feb-16 | Mar-16 | Apr-16 | May-16 | Jun-16 | Jul-16 | Aug-16 | Sep-16 | Oct-16 | Nov-16 | Dec-16 | 2017 Avg/mos | 2018 Avg/mos | 2019 Avg/mos | 2020 Avg/mos | 2021 Avg/mos | 2022 Avg/mos | 2023 Avg/mos | 2024 Avg/mos | 2025 Avg/mos | 2026 Avg/mos |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Program Plan FTE | 674 | 674 | 690 | 695 | 722 | 726 | 738 | 766 | 769 | 809 | 886 | 889 | 873 | 903 | 913 | 919 | 892 | 972 | 1,000 | 921 | 768 | 619 | 161 |
| Forecasted FTE | | | | | 640 | 660 | 680 | 705 | 730 | 755 | 780 | 810 | 830 | 903 | 913 | 919 | 892 | 972 | 1,000 | 921 | 768 | 619 | 161 |
| Actual FTE | 526 | 519 | 641 | 618 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

## Executive Discussion

1 - OPG Staffing includes Functions, Ops & Maintenance and Bundle Project Management/Oversight Teams and counts Regular Staff, Augmented Staff (Agency), EPSCA and Temporary

2 - OPG actual Staffing Levels are 11% below RQE plan (618 vs. 695) due to slower than expected hiring, however functions are (in most cases) being filled by purchased services.

3 - A Nuclear Projects Staffing and Hiring Plan has been developed to ensure that resource requirements and strategies are identified, and that they effectively utilize resources for the project while considering staffing strategies relating to Pickering End of Commercial Operation. As of March, over 100 Regular and almost 80 Augmented positions are currently in various stages of the recruitment process, which will support the resource need for the start of Unit 2 Refurbishment. The resource identification process is being reviewed for optimization.

4 - The availability and retention of staff continues to be a key program risk, and the mitigation plan is identified in the Key Program Risks section.

ONTARIO POWER GENERATION

Darlington Nuclear Refurbishment Program

# APPENDIX 6: KEY PROGRAM RISKS

Risks Being Actively Managed by the Program

## KEY PROGRAM RISK AND MITIGATION STATUS

| Line | Status | Risk Description | Mitigation Plan |
|---|---|---|---|
| 1 | ↓ | **Vendor Performance**<br>Poor vendor performance will negatively impact safety, quality, cost and/or schedule. | A Readiness to Execute oversight plan has been issued. This will support the detailed readiness assessment challenge process leading to the readiness milestone in June 2016. Plans to improve collaborative activities with the vendors for Engineering, Procurement and Construction have been developed. It includes active management and assisting vendors in removing barriers to work. A Nuclear Construction Supervisor Academy is operational, and is integral in improving vendor supervisory performance. The integrated field readiness walk downs at T-6 months and T-3 months with refurbishment and vendor teams will also promote better vendor performance overall in the field portion of the work. |
| 2 | - | **Availability/Retention of Staff**<br>Key project personnel with the required skill set will not be in place for the full refurbishment program resulting in impacts on performance. | Nuclear Projects People & Culture completed all but two actions from its comprehensive Mitigation Plan that addressed the risk in four key areas: 1. Strategic Direction; 2. Succession Plans/Process Improvements; 3. Building Project Depth/Emerging Talent ;4.PPR Health & Development Planning<br>The focus has been on establishing a strategic resourcing framework for the project under the RQE approved budget with the right organizational design and ensuring the right leadership pipeline is in place for future Unit Refurbishments (Units 3, 1, 4). Phase 2 of the Nuclear Fleet Bench strength Improvement Plan in progress. |
| 3 | - | **Availability of Skilled Craft Resources**<br>Key skilled craft resources may not be available when required for the Execution Phase. | OPG is participating in labour market information studies to gain insights into labour market issues, including the identification of skilled craft resource needs using tactics that include both short and long term approaches. The current plans and tactics are being evaluated to ensure integration with the Nuclear fleet to minimize the risks in all support areas. Provisions in trades union agreements also provide for resourcing flexibility. |
| 4 | ↑ | **First of A Kind/First in A While Work and Processes**<br>A lack of recognition of FOAK/FIAW work and processes during design and execution planning results in installations that do not meet requirements causing rework/delay or degraded production post Refurbishment. | Thorough and in-depth review was completed with Engineering, Project Teams and various execution and functional groups in Nuclear Refurbishment and Projects & Modifications organizations to flag FOAK/FIAW risks. A defined set of screening criteria align with WANO 2015 SOER report was developed and utilized. Specific mitigation actions are defined for FOAK/FIAW risks, and In-depth challenge/review of risks impact/events along with robust tracking of the mitigation actions are in progress. |

- No change over period
↑ Improvement
↓ Decline

HIGH RISK  LOW RISK

ONTARIO POWER GENERATION

Darlington Nuclear Refurbishment Program

# APPENDIX 7: SAFETY PERFORMANCE

Bundle and Vendor Performance Year-To-Date

31-Mar-16

## SAFETY PERFORMANCE - YEAR TO DATE (YTD)

| All Injury Rate (AIR) | Actual | Target | Status | Trend |
|---|---|---|---|---|
| **Nuclear Refurbishment Program** | | | | |
| Ontario Power Generation Refurbishment Staff | 0.00 | 0.24 | | - |

## EXPLANATORY NOTES

Feb: JV TG High MRPH: D-2016-5086 - Turbine Hall Lights Damage

Mar: OT SL First Aid: N-2016-07738 - WCT; Partition made contact with worker

## BUNDLE SAFETY PERFORMANCE - YEAR TO DATE (YTD)

| | | *All Injury Rate (AIR)* | *Accident Severity Rate (ASR)* | *Reportable Safety Incidents* | | | *Incidents* | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Line | Bundles | Actual | Actual | # Lost Time Injury | # Medical Injuries | # First Aid Injuries | # High MRPH | # Med. MRPH | # Level 1 Work Protection Events | Hours Worked |
| 1 | Re-tube Feeder Replacement | [redacted] | | | | | | | | 73,413 |
| 2 | Turbine Generator | | | | | | | | | 20,290 |
| 3 | Fuel Handling & Defueling | | | | | | | | | 1,232 |
| 4 | Steam Generator | | | | | | | | | - |
| 5 | Balance of Plant & Refurb. Support Facilities | | | | | | | | | 55,296 |
| 6 | Campus Plan - F&IP and SIO Projects | | | | | | | | | 83,445 |
| **7** | **Nuclear Refurbishment Performance** | **0.00** | **0.00** | **0** | **0** | **1** | **1** | **0** | **0** | **233,676** |

## VENDOR SAFETY PERFORMANCE - YEAR TO DATE (YTD)

| | | *All Injury Rate (AIR)* | *Accident Severity Rate (ASR)* | *Reported Safety Incidents* | | | *Incidents* | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Line | Bundles | Actual | Actual | # Lost Time Injury | # Medical Injuries | # First Aid Injuries | # High MRPH | # Med. MRPH | # Level 1 Work Protection Events | Hours Worked |
| 1 | SNC-Lavalin & Aecon | [redacted] | | | | | | | | 56,528 |
| 2 | E.S. Fox Ltd. | | | | | | | | | 161,237 |
| 3 | BWXT | | | | | | | | | - |
| 4 | GE-Alstom | | | | | | | | | - |
| 5 | GE Hitachi Nuclear | | | | | | | | | - |

## EXPLANATORY NOTES

ONTARIO POWER GENERATION

Darlington Nuclear Refurbishment Program

# APPENDIX 8: QUALITY PERFORMANCE

Bundle and Vendor Performance Year-To-Date

Period Ending: 31-Mar-16

## QUALITY PERFORMANCE - YEAR TO DATE (YTD)

| Overall Quality Performance | # Program Event Free Day Resets | # Regulatory Non-Compliance Events | Status | Trend |
|---|---|---|---|---|
| **Nuclear Refurbishment Program** | | | | |
| Significant Quality Events | 0 | 1 | | - |

## EXPLANATORY NOTES

The Regulatory non-compliance is related to quality issues with [redacted] Quality Assurance records on Projects & Modifications work **(non-Refurbishment project)**. An investigation is in progress, and Regulators are being kept informed and are satisfied with our oversight of the investigation. The extent of condition review will include documentation of Refurbishment projects, and vendors.

## BUNDLE QUALITY PERFORMANCE - YEAR TO DATE (YTD)

| Line | Bundles | # Program Event Free Day Resets | # Regulatory Non-Compliance Events | # NCAR Initiated in Period | # CAR Initiated in Period | Avg. # Field Initiated Changes | # ITP Non Compliance |
|---|---|---|---|---|---|---|---|
| 1 | Re-tube Feeder Replacement | [redacted] | | | | | |
| 2 | Turbine Generator | | | | | | |
| 3 | Fuel Handling & Defueling | | | | | | |
| 4 | Steam Generator | | | | | | |
| 5 | Balance of Plant & Refurb. Support Facilities | | | | | | |
| 6 | Campus Plan - F&IP and SIO Projects | | | | | | |
| **7** | **Nuclear Refurbishment Performance** | **0** | **0** | **1** | **-** | **0.99** | **1** |

## VENDOR QUALITY PERFORMANCE - YEAR TO DATE (YTD)

| Line | Vendors | # Program Event Free Day Resets | # Regulatory Non-Compliance Events | # NCAR Initiated in Period | # CAR Initiated in Period | Avg. # Field Initiated Changes | # ITP Non Compliance |
|---|---|---|---|---|---|---|---|
| 1 | SNC-Lavalin & Aecon | [redacted] | | | | | |
| 2 | E.S. Fox Ltd. | | | | | | |
| 3 | BWXT | | | | | | |
| 4 | GE-Alstom | | | | | | |
| 5 | GE Hitachi Nuclear | | | | | | |

## EXPLANATORY NOTES

[redacted]

*NCAR = Non-conformance Corrective Action Request; CAR= Corrective Action Request; ITP = Inspection and Test Plan

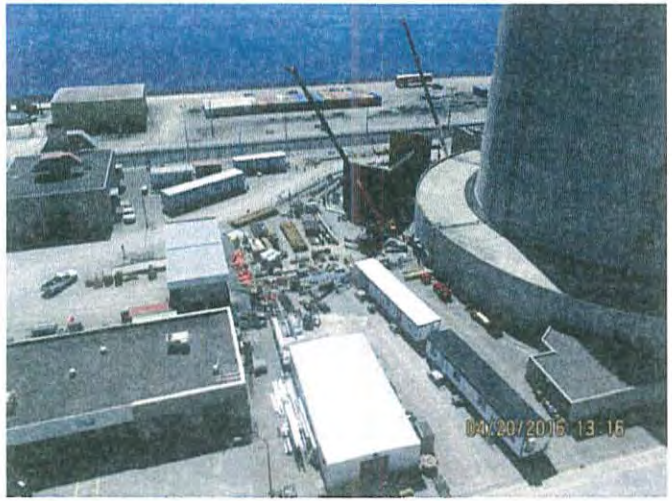
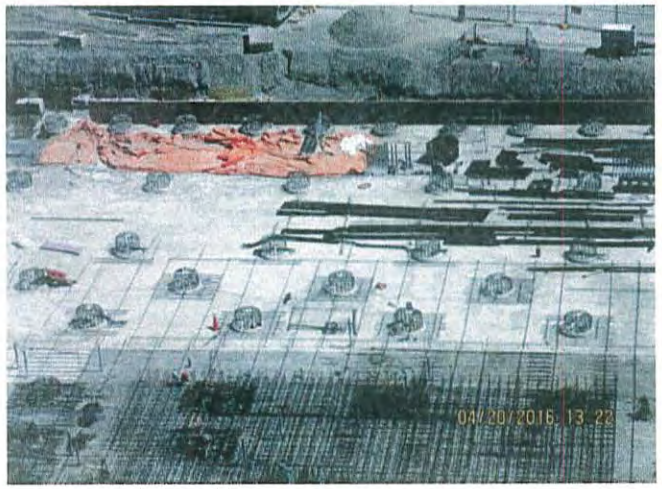
ONTARIO POWER GENERATION Darlington Nuclear Refurbishment Program

# APPENDIX 9: PHOTO CATALOGUE

| PROJECT | | |
|---|---|---|
| **Heavy Water Storage & Drum Handling Facility** |   |   |
| | Installation of a temporary roof | |
| **3rd Emergency Power Generator** |  |  |
| | Concrete pours and rebar construction | |

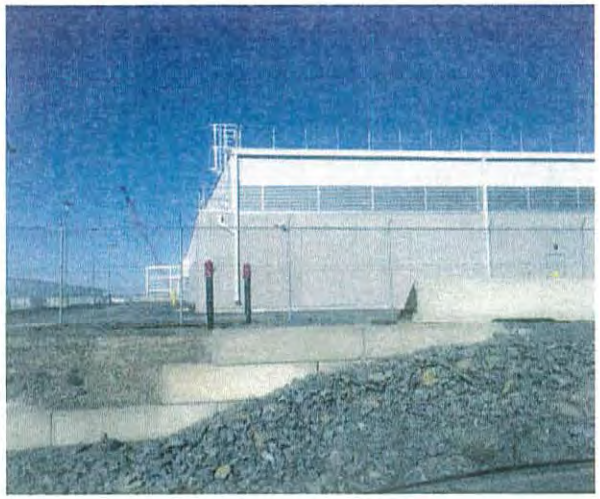
ONTARIO POWER GENERATION Darlington Nuclear Refurbishment Program

# APPENDIX 9: PHOTO CATALOGUE

| PROJECT | | |
|---|---|---|
| Containment Filtered Vented System |  |  |
| Re-tube Waste Processing Building |  |  |
| | Pilecap construction | |

ONTARIO POWER GENERATION Darlington Nuclear Refurbishment Program

# APPENDIX 9: PHOTO CATALOGUE

| PROJECT | | |
|---|---|---|
| Re-tube Waste Storage Building |  |  |
| | Erection of structural steel | |
| Used Fuel Dry Storage Building |  |  |

ONTARIO POWER GENERATION Darlington Nuclear Refurbishment Program

# APPENDIX 9: PHOTO CATALOGUE

| PROJECT | | |
|---|---|---|
| **Re-tube & Feeder Replacement Island Support Annex** |  |  Building completion |
| **Refurbishment Project Office** |  | Building completion |

| April 29 (DAY 5) | Presenter/Lead | Time |
|---|---|---|
| **Arrival/Coffee** | RCRB Members | 07:00-07:30 |
| **Exit Meeting** | RCRB Members | 07:30-09:30 |