# Appendix B
# OPG's Response to Modus Observations

## Introduction

The purpose of this report is to provide an update on the actions taken by Management in response to the Modus/Burns and McDonnell ("Modus") report provided to the Nuclear Oversight Committee in May 2014, as well as an overview of the Darlington Refurbishment Program ("DRP") Management System as it relates to continuous improvement and assurance.

## Management Response to "MODUS" Observations

In the May 2014 oversight report, Modus provided key observations noting that OPG's Projects & Modifications ("P&M") organization, in executing pre-requisite projects on behalf of the DRP, incorrectly applied an "oversight" approach for its Engineer Procure Construct ("EPC") contracting strategy that ultimately allowed for poor scope definition, poor quality cost estimates, unrealistic and incorrect schedules and inability to manage risks, all resulting in increased costs and delays.

Many of the issues reported are with respect to the P&M experience in implementing an EPC contracting model with the Engineering Services-Master Services Agreement ("ES-MSA") vendors. The Nuclear Projects organization has employed a strategy that has had the DRP team focus on the planning and preparations for the DRP Execution Phase commencing in 2016, while the P&M organization, based on experience executing projects at both Pickering and Darlington, and piloting the EPC contracting approach, has been focused on managing the DRP pre-requisite projects. Lessons learned and experience gained in managing the pre-requisite projects are applied to the DRP Execution Phase projects in order to ensure a successful refurbishment.

The following is a summary of the key observations found in the Modus report with Management's response including corrective actions:

### Insufficient Front End Planning

- Management has implemented a collaborative front end planning process, and a process for direct awarding scopes of work to a single ES-MSA vendor based on their level of experience executing similar scopes of work. The ES-MSA vendor and OPG work collaboratively to ensure that ambiguities in design requirements are resolved, scopes of work are clearly defined, methodologies for the delivery of work are agreed to by both parties, and reliable schedules and cost estimates are developed.
- Prior to the formal implementation of the collaborative front end planning process, the DRP Balance of Plant project had implemented a number of front-end reviews, including a review of the Statement of Work against the conceptual design report and modification design requirements report, alignment of work breakdown structure and schedule coding with estimating templates, key milestones, and a review of schedule do-ability and constructability. Once bid packages are received, a cost comparison is completed for each scope of work and approved prior to submission to the DRP Gate Review Board for funding approval. This increases the level of understanding of the cost elements by the project team and provides opportunities to challenge estimates and obtain certainty that the work can be completed in accordance with the estimate basis.

### Inadequate oversight of the engineering phase deliverables resulting in cost increases and schedule delays in completing engineering deliverables

- P&M project managers did not apply appropriate oversight for the type of contracts put in place for pre-requisite projects and tended to take a "hands-off" approach.
- For DRP Execution Phase projects, such as the R&FR project, resident OPG engineers are assigned to the vendor's site to perform daily oversight of engineering work for both in-station modifications and R&FR tooling.

- Similar to the approach used in managing the R&FR project, a more direct and intrusive management approach is being taken with the ES-MSA vendors. Resident OPG engineers have been assigned to each of the ES-MSA vendors. These resident engineers work daily with the ES-MSA vendor to resolve engineering issues in real time, ensuring scope containment and a reduction in unnecessary hand-offs and reviews. This is shortening the overall engineering schedule.
- An Options Review Board has been instituted providing Management with an opportunity to direct the project early in the engineering process and in-between planned funding gates. The Barriers (physical fencing between refurbishment and operating units within the power-house) project provides an example of the value of this review board. A review by the Options Review Board resulted in a streamlining of the required engineering deliverables, which resulted in cost and schedule savings.
- Management has initiated an independent review to assess what the root causes that are leading to increased project engineering costs and ultimately project estimates.

**Project estimates were set prior to completing detailed design**

- For many pre-requisite projects, including the D2O Storage and Drum Handling Facility, the project estimate was set upon award of the EPC contract, as an outcome of the competitive bidding process. The estimate was incorrectly considered to be budget quality prior to completion of detailed engineering, resulting in an understatement of the required contingency for estimate uncertainty.
- All pre-requisite projects are now required to complete detailed engineering prior to setting the cost baseline for the project and prior to requesting full releases of funds to complete execution phase work, in alignment with the DRP's "Gated" process. All attributes of the "Gated" process will be applied to the pre-requisite projects, including assessment of discrete risks, determinations of required contingency, and requirements for high quality schedules.
- A review and strengthening of the "Gated" process is underway. A "black hat", or contrarian, role will be added to the Gate Review Board forum to challenge the team's readiness to proceed to the next gate. Management has recently rejected gates at the Gate Review Board resulting in increased quality standards and further detailed assessment of cost impacts, prior to acceptance.
- A full cost reforecast has been completed for many of the pre-requisite projects and have been reported in recent updates to the Nuclear Oversight Committee. A full cost reforecast for the D2O Storage and Drum Handling Facility project is currently pending completion of detailed engineering; the revised estimate will be presented to the Nuclear Oversight Committee in August 2014.

**Schedules for ES-MSA executed projects were inadequate**

- Many of the ES-MSA projects have come to the Gate Review Board without the required level of detail in their schedules for the phase of work that they were entering, and when these projects transition from the planning to the execution phase, schedules are not fully developed.
- The DRP has assigned a team to work with P&M and the ES-MSA vendors to establish schedule expectations and to develop appropriate resource loaded project schedules that can be integrated within the overall Refurbishment Program master schedule. Sixteen level 3 schedules are now populated and integrated into the DRP master schedule.
- As noted above, projects will not proceed through a gate without a fully developed level 3 schedule that conforms to OPG's standards and, and without validation by OPG's quality program using such tools as Acumen Fuse (tool that assess quality of schedules).
- P&M's project management procedures were not developed to manage multi-year projects of the size and scope of some of the pre-requisite refurbishment projects. P&M has now adopted the procedures that were developed by the DRP for implementation of large multi-year projects, including the Gating and Scheduling processes.
- The DRP is setting up a Schedule Control Centre where a scheduling representative from each vendor is assigned to control their schedule within the overall integrated DRP master schedule. This centre will be fully operational later in 2014 and will focus on ensuring a fully integrated schedule is available and operational for the DRP Execution Phase.

**P&M's risk management program requires improvement. Risks need to be monetized appropriately at funding gates.**

- The DRP is now providing risk management support for pre-requisite projects being executed by P&M. P&M has adopted the DRP risk management process for refurbishment funded projects, and all projects are required to present their risks and cost estimating uncertainty for the purposes of determining contingency.
- The resulting contingency is managed in accordance with the DRP's contingency allocation processes and drawdowns are subject to change control requirements.
- Recent P&M executed projects processed in this manner include the Auxiliary Heating System, R&FR Island Support Annex, Refurbishment Project Office, Operations Support Building, Water and Sewer, and D2O Storage and Drum Handling Facility projects.

**Reporting of project status, in terms of cost and schedule performance, is not timely; project reporting needs emphasis on forecasting the Estimate at Completion.**

- The DRP program has implemented life-cycle cost reporting within its Cost Management toolset (Proliance). Each Project Manager must report, on a monthly basis, the forecast estimate at completion for their project. This requirement is also being applied to DRP pre-requisite projects managed by P&M.
- The framework for Earned Value Management is in place for DRP projects, and is being implemented for P&M managed pre-requisite projects as schedules are developed. The target is to have this in place for the pre-requisite projects where schedules are in place, by end of June. The D2O Storage and Drum Handling Facility will be fully integrated by August month end following presentation to the Nuclear Oversight Committee of the revised project forecast.

**The performance of** [redacted]

- The P&M management team is now holding weekly [redacted] meetings with [redacted] Senior Nuclear Projects management and members of the DRP management team are also participating in these meetings. Management is reinforcing accountability at these meetings with both OPG staff and [redacted] and barriers are being successful removed.
- Senior executive level review meetings that include the respective CEOs will be implemented, similar to what is already in place for the DRP projects.
- [redacted]

In addition to responding to the above observations, Management is actively identifying and implementing corrective actions as a result of its Management System. This includes the following:

- The DRP team has conducted numerous evaluations of adverse conditions to quality that include engineering, procurement, construction and all other aspects of the DRP.
- The DRP team has also conducted a large number of self assessments. Self assessments are aimed at all areas of the DRP and some key findings and learning include:
  - Engineering staff not understanding their roles and responsibilities, and not having the proper qualifications.
  - Quality issues with the Component Condition Assessment process.
  - Cost management and reporting deficiencies that require improvement.
- Project oversight activity is ongoing and yields observations that are proactively addressed to ensure corrections are made. Some examples of observations include:
  - [redacted]

  - [redacted]
  - Plans for temporary power to build the Re-tube Waste Processing Building were not workable.
  - Oversight confirmed that qualified staff is performing design activities for the Turbine Generator Project, that Alstom has a strong Human Factors Engineering Program in their Engineering Change Control Process, and that Alstom has an adequate resource plan to meet the obligations of its contract with OPG.
- DRP leadership conducted a visit to TVA in June to review their successes in executing a re-baselined schedule after project cost and schedule targets were re-established. This is a follow-up to a benchmarking trip previously conducted that will allow Management to close the loop on the lessons learned from the first visit, and identify and implement the major contributors to the success of the recovery schedule.
- The P&M organization realigned its resources to ensure it is structured in an optimal way to support the execution of DRP projects. Where P&M project staff had been supporting the work of both the DRP and the Nuclear Operations portfolios, they have been re-organized to ensure entire departments are solely dedicated to DRP projects.

**DRP Management System**

The DRP has established a Management System that incorporates a corrective action program, actively assesses Operating Experience ("OPEX"), and performs self assessments, peer reviews and benchmarking. A "lessons learned" program is in place as well as a multi-tiered oversight and assurance model which includes internal and external independent oversight.

The program incorporates the following key elements:

1) Corrective Action Program – The DRP has implemented the OPG Nuclear corrective action program which includes use of Station Condition Records ("SCR") to record events for trending and to understand the extent of condition for management action, a self assessment, peer review, and benchmarking program, and an OPEX process. A Corrective Action Review Board ("CARB") made up of the Refurbishment Project Executive Team ("RPET") meets monthly to review results from SCRs, self assessments, and OPEX, and ensures appropriate corrective actions are implemented.

2) Lessons Learned Program – As part of the continuous improvement program, the DRP proactively seeks out opportunities to assess, understand, and apply key lessons from projects executed within OPG and external to OPG. Once lessons learned are identified, a senior manager is assigned to ensure that the lessons learned, where applicable, are applied to the DRP program, and if not applicable, documentation to support that determination is required. Key lessons learned, and the status of the implementation of each, are shared quarterly in a Key Lesson Learned Report and discussed at the CARB.

3) Program Assurance Plan – The DRP has a documented Program Assurance Plan that lists the roles and responsibilities of a multi-tiered oversight and assurance model which includes internal and external independent oversight. The plan includes five separate elements: Organizational Accountabilities, Internal Process Controls, Program Oversight, Audit, and Self Assessments. The assurance model seeks to ensure that assessments are done on a continuous basis on the performance of the DRP. All observations from each element of the plan are documented and assigned to a member of the management team to evaluate and implement appropriate corrective actions. Each is tracked on a regular basis to ensure they are dispositioned and closed. Feedback is provided to both Audit and External Oversight to ensure alignment of Management's action with the initial observations.

Each of these elements interact together to ensure that issues are reported, corrective actions are implemented, and that the performance of the DRP continues to improve.

The DRP and P&M organizations operate under a common Management System. However, a combination of previous leadership, utilization of metrics and controls that were developed for much smaller and shorter term project work, and a less rigorous implementation of key elements in the

Management System, have resulted in less effective corrective action and continuous improvement capability in the P&M organization. This is being corrected through process improvements and organizational changes being implemented across the Nuclear Projects organization.

**Conclusion and Summary**

Considering the early implementation of the EPC model with the ES-MSA contractors was on large and complex projects, and through Management's understanding of the underlying issues and implementation of process changes and corrective actions, Management believes that the cost growth is limited to the early pre-requisite projects.

The direct impact of the prerequisite project cost increases is expected to be in the range of $200 - $300 million (approximately 2% - 3% of the total program); however, further analysis of the impact will be performed leading up to the DRP Release 4D in November 2014. Considering the contingency and management reserve amounts included in the bounding estimate, Management remains confident that the cost of the DRP will remain less than $10 Billion ($2013), excluding capitalized interest and future escalation.

The approach being utilized by the DRP in planning and preparing for the October 2015 Release Quality Estimate ("RQE") considers all of the lessons learned documented within this report. The DRP remains focused on scope clarity, completion of detailed design in advance of the RQE date, and development of detailed level 3 schedules and Class 3 cost estimates for the Execution Phase projects prior to the RQE date.