PROJECT AND PORTFOLIO MANAGEMENT - NUCLEAR

1.0 PURPOSE

This evidence provides an overview of the nuclear operations project portfolio and other related project work. The project portfolio includes project OM&A, which forms part of the overall OM&A amounts in the revenue requirement, and project capital, which is included in rate base when projects are completed and placed into service. This evidence discusses:

- Section 2.0: The nuclear operations project portfolio including the forecast level of nuclear capital and project OM&A expenditures (excluding the Darlington Refurbishment Program ("DRP")) in the test period.
- Section 3.0: The process for managing this project portfolio including enhancements to the asset management and investment planning process, establishment of an Enterprise Project Management Office, and associated project management initiatives.
- Section 4.0: The results of the Project and Modifications audit directed by the OEB in the EB-2016-0152 Decision and Order and OPG's response.

2.0 NUCLEAR OPERATIONS PROJECT PORTFOLIO

OPG employs a portfolio management approach to assess, prioritize and deliver all nuclear operations projects (both project OM&A and capital). OPG seeks to continuously improve its portfolio management approach and has made significant changes since EB-2016-0152. Details of the processes are discussed in Section 3.0.

OPG nuclear projects within the portfolio are developed to meet regulatory commitments (e.g., from the Canadian Nuclear Safety Commission), increase system or unit reliability, address system obsolescence, or optimize station generation. Expenditures on major capital spares are also considered part of the capital project portfolio, due to their role in supporting system or unit reliability.[1]

[1] A capital spare is a spare part that exceeds $200K per item, must consist of a complete assembly or major subassembly (i.e., cannot be a single part), and must be repairable. If not classified as a capital spare, the spare part would be included within the materials and supplies inventory (Ex. B1-1-1, Section 3.2.4).

The OPG Board of Directors approves the annual nuclear projects portfolio budget as part of OPG's corporate business plan. The actual and forecast nuclear operations project portfolio spending (i.e., annual capital expenditures and project OM&A) and key drivers of the changes in the nuclear operations project portfolio expenditures over the 2016-2026 period are addressed in Ex. D2-1-2 and Ex. F2-3-1.

In addition to the nuclear project portfolio, there are some additional capital and project-related OM&A expenditures in some years of the IR term:

- Capital expenditures on Minor Fixed Assets (Ex. D2-1-2);
- Capital and project-related OM&A expenditures on special, non-recurring projects outside of the project portfolio, referred to as "Non-portfolio projects" (Ex. D2-1-2 and Ex. F2-3-1); and,
- Capitalization of Darlington new fuel for refurbished units (Ex. F2-5-1).

3.0 NUCLEAR PROJECT PORTFOLIO MANAGEMENT PROCESSES

3.1 Overview

The nuclear project portfolio management processes consist of three main components: Project Identification and Prioritization (Section 3.2); Portfolio and Project Management (Section 3.3); and Commercial (Vendor) Management (Section 3.4).

As part of continuous improvement, OPG has strengthened its project portfolio management process. Prior to 2018, OPG's management of the nuclear project portfolio budget was administered by the Asset Investment Steering Committee ("AISC"). The AISC was responsible for both the process of reviewing newly identified projects, determining project prioritization and allocating portfolio funding to specific projects as well as the process of managing projects through the project's lifecycle.

In early 2018, OPG divided AISC's accountabilities into two separate oversight committees:

- Asset Management Oversight Committees ("AMOC"), focused on planning and prioritizing new investments; and,

- Project Management Oversight Committees ("PMOC"), focused on project execution and portfolio management.

This change was implemented to further define accountabilities and provide better focus and expertise within the respective committees, thereby facilitating more efficient and effective asset management, investment planning and project management.

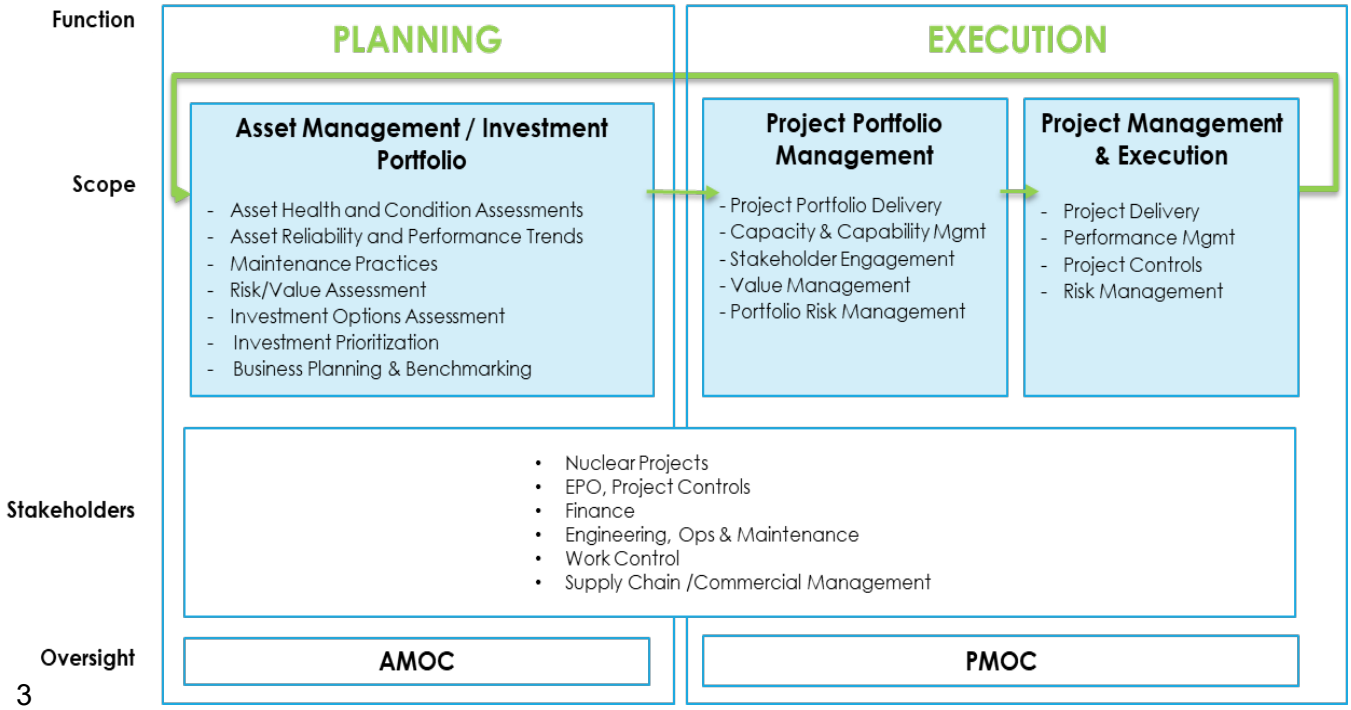
There are site AMOCs and one Nuclear AMOC with the overall accountability for oversight of the entire Nuclear fleet. The site AMOCs are for: Darlington, Pickering, and Inspection & Reactor Innovation. The AMOCs' role is to review and evaluate asset investment options during project identification and prioritization, as described in Section 3.2 below.

There are also site PMOCs and one Nuclear PMOC with overall accountability for providing oversight of the delivery of the Nuclear Operations project portfolio. The PMOCs are for: Darlington, Pickering, and Inspection and Reactor Innovation. The PMOCs' role is to provide oversight for each project through the project's lifecycle, as described in Section 3.3.

The function, scope, stakeholders, and interrelationship between AMOC and PMOC during the investment lifecycle are further outlined in Figure 1 below.

Figure 1

Investment Lifecycle



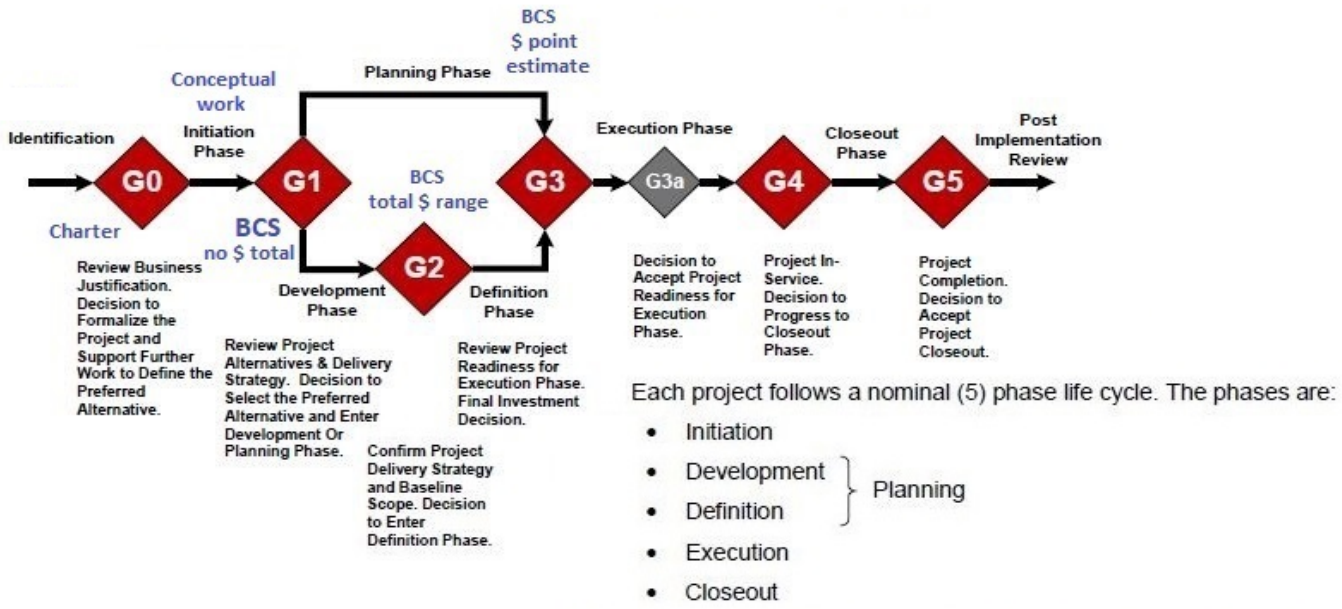
The asset management and investment planning process has been strengthened to assess and prioritize potential investments in a systematic manner, and oversight accountability has been aligned between the site AMOCs and the Nuclear AMOC depending on the level of the investment required. OPG's updated asset management and investment planning process is designed to enable reliable operation, maintenance, and investment in assets efficiently and with an appropriate balance among cost and risk, as described in Section 3.2.2.

The Nuclear project portfolio management and execution process, as updated, manages projects through various phases. Following the Project Identification and Prioritization process (Section 3.2) there are fives phases in the life cycle of a nuclear project: Initiation, Development, Definition, Execution, and Closeout. An overview of the project lifecycle phases is shown in Figure 2, which illustrates the interrelationship among the five phases, the phase gating process and the Business Case Summary ("BCS") approval process. Descriptions of the various project phases in a project's lifecycle are provided in Attachment 1.

Under the updated Nuclear project portfolio management and execution process, all active projects moving through these five phases are monitored and controlled by the PMOC to ensure that periodic and systematic reviews are conducted before proceeding to the next phase. This control of a project's progression through project phases is termed "phase-gating." Based on the amount of assessment and engineering work that is completed at each phase of a project life cycle, the PMOC seeks to ensure that project scope, cost and schedule are defined, reviewed and approved prior to proceeding to the next project phase.

Figure 2

Project Life Cycle Phases and Gates



Details on the main components of OPG's investment lifecycle process are discussed below.

3.2 Project Identification and Prioritization

In the identification stage, the objective is to identify and prioritize potential nuclear projects through an asset management and investment planning process. OPG's current asset management and investment planning process overseen by AMOC consists of the following three steps:

1. Identification of Investment Need – gather a list of asset investment options, which includes potential projects with start dates well into the future.
2. Investment Options Assessment – analyze each asset investment option taking into consideration the balancing of risk and cost as well as the identification of preferred options.
3. Project Selection and Prioritization – produce a prioritized list of candidate projects for inclusion in the business plan within unallocated capital and project OM&A, subject to the business planning approval process (see Ex. D2-1-3, Tables 5a and 5b for current list).

3.2.1 Identification of Investment Need

Technical assessments of asset performance, health, obsolescence and current condition are performed on a periodic basis, including the development of system health reports, component condition assessments, plant inspections, life cycle management plans and periodic safety reviews. Based on these assessments, recommendations to adjust maintenance strategies and requests for capital/OM&A project funding needs are prepared. The technical assessments include reviews of overall asset reliability, current maintenance practices (e.g., preventive and corrective) and asset performance trends. For example, a technical assessment will consider an asset replacement relative to the base case of maintaining the asset through preventive and/or corrective maintenance alone. From these assessments, a need for an asset replacement may be identified for an investment option assessment.

3.2.2 Investment Options Assessment

Investment options are prepared along with the supporting reliability considerations, cost forecast, and a risk assessment according to an OPG-defined value framework, as described below.

The "Value Framework" provides a quantitative means to evaluate each asset investment option's benefits and costs with reference to the option's ability to mitigate key risks. In alignment with OPG's business imperatives, seven risk areas have been identified within the Value Framework:

- Safety Risks;
- Regulatory Risks;
- Lost Generation Risks;
- Social License and Reputation Impact;
- Environmental Risks;
- Security Risks;
- Financial Risk.

The Value Framework requires the quantification of the value of each asset investment option based on the summation of all benefits and costs in the seven risk areas. This model is used to select preferred project options that have the highest net benefit to address a project need.

3.2.3 Project Selection and Prioritization

The asset investment options are reviewed by the appropriate site AMOC to evaluate the recommended options and alternatives, feasibility of options and risk assessment. Once reviewed, a selected option may be approved as a candidate project for inclusion in the business plan by the AMOC. In addition, all selected options greater than $20M that have been endorsed by a site AMOC are required to be reviewed from a fleet perspective by the Nuclear AMOC prior to inclusion in the business plan.

All selected asset investment options that have been endorsed by the appropriate AMOC undergo an annual prioritization process during business planning. These investments are prioritized within funding, resource and scheduling constraints with the goal of maximizing overall value based on the Value Framework. Throughout this investment prioritization process, assumptions, including project cost forecasts, are reviewed and may be revised as necessary. This allows for adjustments in an iterative process to better refine the project prioritization and maximize portfolio value.

Following this process, a summary of prioritized candidate projects for inclusion in the business plan is reviewed for concurrence by the Nuclear AMOC. Upon Nuclear AMOC concurrence, a prioritized list of candidate projects is included in the business plan subject to the business planning approval process (see Ex. D2-1-3, Tables 5a and b for current list).

3.3 Portfolio and Project Management

Once a project has been approved through the AMOC and the business planning process, oversight of the project throughout its lifecycle is performed by the PMOC. This oversight includes: ensuring projects are executed within the approved timelines; overseeing project expenditures against plan to remain within funding constraints; and ensuring deviations from plan have documented lessons learned and corrective actions to prevent recurrence.

3.3.1 Project Management and Execution

As projects move through the Project Lifecycle, as shown in Figure 2, their planning, scope, engineering, procurement and execution strategies are further refined which advance the level of project definition; this process is referred to as phase-gating. The level of project definition determines the accuracy of project estimate. Each time a project moves forward into a subsequent phase, a BCS must be approved, with the last stage being an execution BCS. The PMOC, executing its accountability in phase-gating, reviews all BCSs as presented by the

project manager and, if the PMOC supports the proposal, the BCS is routed for funding approval per the Organizational Authority Register.[2]

For a project that is approved by PMOC to move from the definition phase to the execution phase requires substantial completion of detailed engineering, procurement and detailed construction/installation planning. This requirement ensures that total project cost estimates are based on the necessary level of definition and accuracy prior to execution. Generally, movement to the execution phase requires that a project have progressed to at least a Class 3 estimate (as defined in the Association for the Advancement of Cost Engineering ("AACE") International estimate class and accuracy ranges (see Attachment 1)) in order for a full release or partial release execution phase BCS to be approved. After an execution phase BCS has been approved, the project is considered to have a committed total project cost. Projects in the execution phase are still subject to known and unknown risks, which can result in cost and schedule variances.

Throughout the project lifecycle there continues to be an interface between AMOC and PMOC, as shown in Figure 1 above, at both Site and Nuclear portfolio levels.

After a project is complete, the new asset information is fed back to the Asset Management Program, described in section 3.2.1, which updates the asset attributes (e.g., asset reliability, risk). Subsequent system health reports, component condition assessments, life cycle management plans, and Investment Options Assessments will include new asset end-of-life targets and strategies based on this updated asset information.

3.4 Commercial (Vendor) Management

As presented in EB-2016-0152, OPG pursues various contracting strategies depending on the project. OPG's approach in determining contracting strategies considers factors such as project cost estimates, unique risks or risks that can be effectively transferred, contactor capability/specialization and project complexity.

[2] Ex. A2-2-1, Attachment 3 contains a description of OPG's approval process for BCSs and the Organizational Authority Register.

Engineering, Procurement and Construction: OPG uses an Engineering, Procurement and Construction ("EPC") contracting strategy. This model establishes a single point of accountability for the engineering, procurement and construction components of a designated portion of a project, while OPG maintains oversight. Consistent with implementing an EPC contracting strategy, OPG has Extended Services Master Services Agreements ("ESMSA") with three vendors. Prior to implementing the EPC model, OPG's project delivery organizations were the primary integrator, and relied upon different vendors or internal resources for each of the three components. Reliance upon a single vendor responsible for all three components generally results in increased predictability of cost and schedule by reducing delays or conflicts that may occur among vendors and/or OPG during handoffs along the three stages. An EPC contracting strategy also increases OPG's project execution capabilities by reducing any potential impact from OPG resource constraints.

Collaborative Front End Planning: OPG also employs a Collaborative Front End Planning ("CFEP") program that allows early planning and estimating with the vendor during the definition phase of a project. This allows OPG to work with the vendor on construction/installation planning and estimating, while ensuring in-depth and real time oversight by OPG. Collaborative Front End Planning between the vendor and OPG ensures there is a common understanding of the project requirements and the proposed solutions to meet them.

OPG will consider other contract strategies, which may separate the engineering, procurement and construction components. In some circumstances, OPG's optimal strategy is to rely solely upon in-house resources and expertise for one or more of these three components. For example, rather than rely on an EPC vendor for procurement, OPG may conduct procurement internally to pursue strategic sourcing arrangements for economies of scale. Use of project specific agreements allows OPG to select a contractor best suited for specialized projects, optimize risk transfer, and leverage specific performance incentives related to the cost and schedule expectations.

3.5 Initiatives to Improve Project Management within OPG

OPG continuously seeks to improve the performance of its project management function. These initiatives are categorized as either enterprise-wide (completed across all OPG businesses including Nuclear), or Nuclear portfolio initiatives.

3.5.1 Enterprise-Wide Project Excellence Initiative

The Enterprise-Wide Project Excellence Initiative expands upon OPG's Nuclear Project Excellence Initiative[3] to further enhance OPG's project management and controls, incorporate industry best practices, and facilitate continuous improvement across all OPG business units. The initiative has four main components:

1. Establishment of an Enterprise Projects Organization and further organizational realignment to facilitate greater cross functional collaboration;
2. Standardized processes and tools that leverage and incorporate industry best practices;
3. Enhanced project management proficiency; and
4. Improved project portfolio management.

Details on the improvement initiative are provided in the following sections.

3.5.1.1 Enterprise Projects Organization

In 2018, OPG established the Enterprise Projects Organization ("EPO") led by the Chief Project Officer. The EPO has four primary responsibilities:

1. Planning and executing large and complex strategic projects such as the DRP.
2. Providing specialized, common and consistent project planning and controls, and commercial management resources needed to support project delivery.
3. Supplying the processes, tools and project expertise necessary to consistently deliver successful projects throughout OPG.
4. Assessing industry best practices on a continuous basis and optimizing them for application across the company using a scaled project delivery model.

[3] OPG previously established a Project Excellence Initiative to implement consistent and streamlined project management practices for all projects executed in Nuclear (See EB-2016-0152, Ex. D2-1-1; Ex. L-4.4-15 SEC-043).

The EPO leverages project controls and industry best practices in project management developed through the DRP to projects being executed across the organization. Prior to transitioning to the EPO, these responsibilities were performed by OPG's Nuclear and Renewable Generation business units separately.[4] By creating the EPO and centralizing expertise and processes, OPG has enabled increased consistency and inter business-unit collaboration, strengthening staff proficiency, leveraging expertise, and implementing processes targeted at improving OPG's project performance.

In the second half of 2020, OPG implemented a major realignment of the organizational structure to facilitate greater cross-functional collaboration and synergies in preparation for post-Pickering operations. As part of that realignment, major project execution groups from across the Nuclear and Renewable Generation business units have now been integrated into the EPO, which will further align and leverage organizational expertise for improved project management and execution performance.

3.5.1.2 Standardized Processes and Tools

The EPO issued an updated suite of nuclear project management processes and tools that came into effect in the first quarter of 2018. These updated processes and tools leverage and incorporate recognized industry best practices (e.g., those endorsed by the Project Management Institute, Construction Industry Institute, and AACE International) as well as the lessons from the planning and execution of the DRP in order to improve project management and controls across OPG. They also promote a consistent and streamlined application of project management, controls, and other project-related functions across the enterprise.

[4] In 2017, OPG had established a Project Management Center of Excellence within Nuclear.

As part of the above changes, the phase-gating process was significantly enhanced and is now a central component of OPG's project management processes throughout a project's lifecycle. The introduction of thorough control check points (or gates) provides the PMOC with the opportunity to challenge project readiness before the project progresses to the next phase, or determine if a project should continue to be endorsed. Project readiness involves an assessment of project progress, risk and risk mitigation, and confirmation that the proposed scope, cost estimate and schedule for the project's next phase are adequately planned and that the requested resources are reasonable. Phase-gating is managed through the PMOC process as discussed above in Section 3.3.

Additionally, the EPO's estimating of nuclear project cost and schedules was enhanced in 2018 through the establishment of industry recommended estimating practices, including a dedicated estimating department, standardized estimating techniques, templates, checklists for preparation of project estimates, and by incorporating lessons learned from previous projects within and outside of OPG. Specialized estimating resources within the EPO perform and validate estimates for projects of high value and complexity. These estimating resources are engaged throughout the lifecycle of a project including in the project's front-end identification and planning process and during project phase-gate reviews.

Further enhancements were achieved in the first quarter of 2020 when a suite of enterprise project management processes and tools centered on the scaled project delivery model came into use. The purpose of a scaled project delivery model is to characterize all projects using a common project evaluation method, thus enabling an appropriate level of project management rigor and planning, commensurate with the value and complexity of the project. This approach ensures high cost and complex projects are given appropriate oversight, while avoiding the cost of excessive oversight being applied to simpler, lower complexity projects. These enhancements build on the existing process improvements that had been made previously within the Nuclear Projects organization (formerly Nuclear Projects and Modifications).

3.5.1.3 Project Management Proficiency

OPG introduced a comprehensive project management training and development program in 2017. The program's scope covers project management, project controls, and contractor oversight and it provides training, experiential based learning and mentorship. One of the skills the program emphasizes is the ability to collaborate with and provide direction to vendors so that they deliver projects on budget and schedule. The program was established to ensure OPG has a proficient workforce capable of delivering projects over the near and long term.

3.5.1.4 Project Portfolio Management

Project portfolio management within the Project Excellence Initiative is focused on improving the delivery of the portfolio on budget and schedule by enhancing consideration of project interdependencies, and site and fleet priorities.

Through the application of consistent project management processes and tools, OPG is enhancing the visibility of project and project portfolio performance. Standard enterprise project portfolio measures and reporting were established to address cost, schedule and risk management. This enhanced insight into the project portfolio is intended to enable OPG to consistently evaluate performance, identify common risks and lessons, and apply early corrective actions as required.

3.5.2 Nuclear Portfolio Initiatives - Work Allocation

In addition to the above enterprise-wide initiative, OPG has also undertaken initiatives to improve the performance of its Nuclear project management function.

As first discussed in EB-2016-0152, Ex. D2-1-1, Section 3.2, OPG has entered into ESMSAs with three vendors for nuclear project work. By using an established set of terms and conditions, an ESMA eliminates the need to renegotiate standard terms and conditions each time a new work activity is to be undertaken. An ESMSA also shortens the procurement cycle for executing new EPCs or any combination of engineering, procurement or construction work. OPG continues to work collaboratively with its ESMSA vendors to optimize vendor capacity, capability and performance.

In 2018, following the OEB's Decision and Order in EB-2016-0152, OPG refined its approach in awarding new work. This refined approach ("Work Allocation") is a strategic programmatic method of awarding work to vendors based on capability, capacity and performance while considering efficiency gains based on similar/repetitive work and work location. The Work Allocation approach has allowed for early vendor engagement, enabling constructability reviews as part of the CFEP phase of a project. Cost management has also benefited from this approach through the use of collaborative estimating and risk management.

4.0 PROJECT AND MODIFICATIONS AUDIT RESULTS AND OPG RESPONSE

In 2019, KPMG LLP ("KPMG") was engaged to conduct an independent audit of OPG's Nuclear Projects and Modifications ("P&M") organization ("KPMG Audit"). This was in response to OEB direction in EB-2016-0152 that OPG file an independent audit of its nuclear P&M organization, which would address adherence to best practices, measures and reporting regarding cost and schedule performance, and implementation of lessons learned.[5]

The following provides an overview of the objectives and methodology of the KPMG Audit and a summary of its findings (Attachment 2).

4.1 Objectives and Methodology of KPMG Audit

The KPMG Audit had three objectives:

1. To assess the alignment of P&M's project management procedures to industry recommended practices.[6]
2. To assess the implementation of P&M's project management procedures on a representative sample of projects.
3. To assess the effectiveness of P&M's project management function with respect to its projects, including any mitigating controls in place on a representative sample of projects.

[5] EB-2016-0152, OEB's Decision and Order, p.19

[6] KPMG defines "best practices" by reference to industry recommended practices from Project Management Institute ("PMI"), the Association for the Advancement of Cost Engineering ("AACE"), as well as its own internal and external subject matter expertise.

KPMG's methodology consisted of six steps: 1) establish an Audit Framework; 2) develop rating criteria for the objectives; 3) select a representative sample of projects; 4) obtain and review project management procedures; 5) obtain and review project-specific documents to assess the implementation of P&M's procedures; and 6) conduct interviews with P&M's project management teams to assess the effectiveness of P&M's project management function.

KPMG identified 11 project management areas to be assessed relative to the three audit objectives. Figure 3 below provides a summary of the 11 project management areas.

Figure 3

No.	Area	Brief description of the Objective of the Area
1	Governance	Lifecycle of the projects and the stage-gate process.
2	Scope management	Scope management plan and its definition, controlling and validation processes.
3	Cost and estimating management	Cost management plan and its estimating and controlling processes.
4	Schedule management	Schedule management plan and its development (including activity definition, relationship and duration) and controlling processes.
5	Change management	Change management plan and its identification, review, approval and implementation processes.
6	Contract management	Contract management plan and its award, administration and closure processes.
7	Procurement management	Procurement management execution and controlling processes.
8	Quality management	Quality management plan and its management and controlling.
9	Risk management	Risk management plan and its identification, assessment and monitoring processes, and how the response is planned and implemented.
10	Reporting	Reporting structure including the information and intended audience of the reports.
11	Lessons learned	Lessons learned plan and its collection, storage, and implementation processes.

A complete presentation of KPMG's six step methodology is set out in Section 2.0 of Attachment 2.

4.2 Summary of KPMG Audit Results

KPMG's Audit noted that, based on the projects sampled, P&M effectively managed the projects in all material respects in all 11 areas, and that, overall, P&M's project function effectiveness is consistent with industry recommended practice.

Figure 4.0 below presents a summary of the KPMG Audit results.

Figure 4.0

Results				
No.	Areas within the Audit Framework	Objective 1 – Procedures	Objective 2 – Implementation	Objective 3 – Effectiveness
1	Governance	Fully aligned	Fully Implemented	Effective
2	Scope management	Fully aligned	Fully Implemented	Effective
3	Cost and estimating management	Fully aligned	Fully Implemented	Effective
4	Schedule management	Aligned	Partially Implemented	Effective
5	Change management	Aligned	Fully Implemented	Effective
6	Contract management	Fully aligned	Fully Implemented	Effective
7	Procurement management	Fully aligned	Fully Implemented	Effective
8	Quality management	Fully aligned	Fully Implemented	Effective
9	Risk management	Fully aligned	Fully Implemented	Effective
10	Reporting	Fully aligned	Implemented	Effective
11	Lessons learned	Aligned	Fully Implemented	Effective

The KPMG Audit included a single audit finding relative to one component of Schedule Management that represented a low to moderate-level risk. As of January 2020, the issue raised in the audit finding has been fully addressed by OPG. KPMG also provided some observations for further enhancement of OPG project management. A number of these enhancements were previously identified and addressed by OPG during the roll-out of the Enterprise-Wide Project Excellence Initiative. OPG is considering the remaining observations as part of continuous improvement.

LIST OF ATTACHMENTS

Attachment 1: Project Lifecycle Phases and Gates

Attachment 2: KPMG Projects and Modifications Audit