ONTARIO POWER GENERATION

Internal Audit

DNR Unit 3 Turbine Generator Audit

September 18, 2020

Report Rating: **Requires Improvement**

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1.0 EXECUTIVE SUMMARY

1.1 Report Rating and Summary of Findings

Report Rating: **Requires Improvement**

No.	Finding	Risk Type	Risk Rating[1]		
			High	Moderate	Low
1	There was a delay in having an approved baseline schedule for the Unit 3 ("U3") Turbine Generator ("TG") project.	Operational	X		
2	The U3 TG Project Management Plan ("PMP") contains outdated information.	Operational		X	
3	The risk of a delay in the start of the TG project execution was not noted in the risk register.	Operational			X
	Total	**3**	**1**	**1**	**1**

1.2 Background

Approval for the refurbishment of U3 at Ontario Power Generation's ("OPG's") Darlington Nuclear Generating Station ("DNGS") was granted on February 19, 2018 by the Ontario Government. This is the second of the station's four CANDU units being refurbished, following Unit 2. The U3 Execution Estimate (EE), which was completed in March 2019, updated in November 2019 and again in August 2020, is the baseline schedule and cost performance of the U3 refurbishment program as a whole.

The TG project is a major project under the Darlington Nuclear Refurbishment ("DNR") Program. The TG project involves an outage for component upgrades, replacement of life-limiting components, as well as maintenance or replacement of other components, which can most effectively be executed during the unit's refurbishment outage period. The comprehensive work packages for the TG project are divided into two categories: modification and maintenance. The TG project is a large and complex turbine upgrade consisting of 61 new First of a Kind ("FOAK") modifications including turbine controls and excitation controls upgrades.

There are two primary approaches to contracting for the TG project:

1. Engineering Services and Equipment Supply ("ESES"):
   OPG has awarded an ESES contract for the TG project to the Original Equipment Manufacturer - Alstom Power Canada Inc., acquired by General Electric ("GE") Power in 2015.

2. Engineering, Procurement and Construction ("EPC"):
   This portion was initially entirely awarded to CanAtom, a joint venture between SNC Lavalin and Aecon. However, following a change in OPG's execution strategy which occurred in early 2020, certain construction scope of work for the TG project, including the generator stator in-situ rewind as well as centerline maintenance scopes, were transferred to GE.

OPG is accountable for oversight of all contractors involved in refurbishing and integrating all work packages throughout the project lifecycle. Plans for project management processes such as scope management, integration management, phase-gate management, quality management, risk management, and communication and stakeholder management are summarized in the OPG Project Management Plan ("PMP"), which outlines basic expectations for each process. CanAtom is responsible for developing and maintaining the overall master schedule for the U3 Refurbishment Program.

[1] Please refer to Appendix C for risk rating definitions

1.3 Objective & Scope

The objective of this audit was to review the readiness of U3 TG activities. To achieve the audit objectives, Internal Audit ("IA") reviewed the processes and tested, on a sample basis, whether:

A. Scope, Change and Integration Management
• Compliance with OPG Project Management ("PM") standards was established for scope validation and control; • Packages meet milestone requirements and phase gating approvals were in place; • Project deliverables were identified and tracked; • New scope items were integrated with the rest of the package; • Stakeholders' input and alignment, and identification of roles and key responsibilities, on new project scope were in place; and • Lessons learned were incorporated into scope, schedule, risk, human resource, integration, and quality management where appropriate.
B. Schedule Management
• Work package schedules had sufficient detail to facilitate accurate resource estimation, activity sequencing and duration estimation, and monitoring of those activities; • Dependencies between activities were adequately understood and documented; • Vendor schedules (including interdependencies between vendors) were integrated with the DNR master program and met quality standards; and • 'Rules of credit' were established in sufficient detail to measure earned value at optimal timeframes.
C. Risk Management
• Risks (including risks associated with commissioning FOAK packages) and risk ownership were identified, understood, documented and quantified; and • Risk mitigation approach was adequately planned and documented.
D. Human Resource Management
• Roles, responsibilities, and staffing levels (i.e., skillset and credentials) were defined among OPG and vendor teams; • Resource qualifications were identified, communicated to vendors, and monitored for compliance; • Appropriate training was in place for OPG and vendor teams; and • Resource mobilization and demobilization timing was clearly articulated and communicated.
E. Reporting
• Reporting requirements for regulatory review were being captured; • Information and data (including cost trending and variances) was reported and reviewed in a timely and efficient manner; and • Changes to milestones and baseline schedules were transparent in management reporting and were approved and explained.
F. Quality Management
• There were well-defined quality management plans from suppliers, complying with OPG standards; and • There was compliance with quality management plans.
G. Fraud considerations
Intentional misrepresentation or inconsistencies were made in levels of reporting.
H. Opportunities for Improvement
There were potential opportunities for cost efficiency related to optimization of processes and documentation (e.g. automation, duplication of activities).

Scope Period: the scope included activities of the U3 TG project up to and including July 31, 2020 and lessons learned from Unit 2 TG.

1.4 Conclusion

The U3 Refurbishment Program achieved Gate 3 approval in August 2019. One of the objectives of Gate 3 is to refine the schedule and cost performance baselines. However, the TG project schedule and estimate were under development at the time of Gate 3, hence only a bounding cost estimate and schedule was provided for approval to the Board of Directors.

Since the Gate 3 approval in August 2019, the following combination of events have impacted the development of a schedule baseline:

1. In late 2019, the TG project was presented with an opportunity for the Original Equipment Manufacturer, GE, to execute an in-situ stator rewind, in place of the planned stator replacement by CanAtom;
2. In early 2020, the TG project was presented with an opportunity to have GE execute the centre line maintenance scope instead of CanAtom; and
3. In March 2020, the COVID-19 pandemic resulted in a 4-month suspension period, and a deferral of the start of the U3 Refurbishment Program including the TG project to September 2020 (the U3EE was further updated in August 2020 to reflect these changes and was approved by the OPG Board).

The transferring of scope from CanAtom to GE provided an opportunity to mitigate risks, and improve safety/quality/cost and schedule outcomes for the project. However, at the time of this audit, there was no formal baseline schedule for the TG project. The start date for pre-requisites execution for the TG project was at one point set for early July, but was delayed to August due to the absence of a baseline to measure against. IA notes that CanAtom finally competed the TG project construction baseline schedule on August 19, 2020.

OPG governance requires that the timeframe to complete schedule review, verification and acceptance is between 20 to 27 weeks before the start of execution. Considering the above noted events, the TG project team continued to develop the cost and schedule baseline within a significantly compressed timeframe, up to a few weeks prior to the start of pre-requisites execution. Although the TG project is currently not on the critical path of OPG's Unit 3 refurbishment outage schedule, the delay in finalizing the TG construction schedule poses the potential risk of undermining the level of quality and due diligence required for building a reliable and accurate cost and schedule baseline. Any sustained delays in starting pre-requisites execution for the TG project could potentially jeopardize the planned start of TG work for the remaining units within the DNR program.

IA also noted that the effectiveness of the TG project PMP is being undermined by having outdated information. Given the delays in finalizing the TG project baseline cost estimate and schedule and outdated information in U3 TG PMP, there are risks to the execution of the TG project that should be mitigated. The TG project team and senior DNR leadership are currently putting forth a significant effort to finalize and refine the TG project schedule baseline.

<u>Positive Observations</u>

- The overall oversight of the modification of the comprehensive work packages has been well planned, organized, and effective. The OPG Engineering Change Control ("ECC") process has been followed. For the FOAK scope, the interfacing groups have also been involved for risk identification, Constructability Operability Maintenance and Safety ("COMS") presentations, review of contract deliverables, risk management, and integration of lessons learned from Unit 2 during the different phases of the project from initiation to execution planning;

- IA noted that lessons learned and Operational Experience ("OPEX") from the Unit 2 TG project are being effectively leveraged for the U3 TG project. They are being addressed and logged in documents such as, "Engineering Advice re Minutes of Meeting 20200409." There is evidence of discussions related to lessons learned from Unit 2 and their application to U3 TG project delivery where the lessons learned are discussed and analyzed with stakeholders to mitigate potential risks; and

- The Basis of Estimate for the TG project, dated July 6, 2020, is a comprehensive document detailing key information such as the purpose of the estimate, the project scope, pricing basis, allowances, key milestones, critical path, trades calendars and assumptions/exclusions. The Basis of Estimate provides background information for the development of a baseline and could be an essential source to rely upon in the event of a dispute, and it contains information typically expected in leading practice.

Key Finding & Recommendations

- At the time of this review, the formal baseline schedule for the TG project had yet to be completed. The June 9, 2020 version of the Level 3 schedule reviewed by IA had significant gaps, 3 weeks prior to the original pre-requisites execution start date of July 1, 2020. The pre-requisites start date was eventually delayed by a month to early August 2020 due to the absence of a schedule baseline to measure and report against. The timeframe for schedule review, verification and acceptance to be completed 20-27 weeks before start of execution (as per OPG governance) was being compressed for completion in a few weeks prior to the start of execution. This poses the potential risk of undermining the level of quality and due diligence required for building a reliable and accurate schedule baseline for the project. Management should continue to actively monitor changes to the TG schedule with the vendor, and consider deploying additional resources if required, to build short-term capacity for proper schedule review, verification and acceptance.

- The effectiveness of the TG project PMP is being undermined by having outdated information. Review of the latest version of the TG PMP, dated November 26, 2019 indicated that:
    - A detailed work breakdown structure ("WBS") for U3 TG was missing from the PMP;
    - The gate structure, definitions, and the project gate strategy in the PMP did not reflect the approach taken for the U3 TG project; and
    - The PMP did not reflect the revised execution strategy and changes to project items such as scope, assumptions, resources and risks caused by the transfer of scope to GE.

  Management should update the PMP in a timely manner to keep it current for the reference of existing and new team members to facilitate effective project oversight and delivery of gating/milestone requirements.

The findings noted in this report have been reviewed with management and they have committed to specific action plans. Please refer to Section 2.0 for specific details of the findings, along with the associated risk impact, audit recommendations and management action plans.

Opportunities for Improvement

- IA noted that the processing time for TG project change directives ("PCDs") and change control forms ("CCFs") was greater than turn-time targets. The median processing times from entitlement date up to vendor (i.e. CanAtom) PCD sign-off was 156 days, 50% more than the target turn-time set in the joint OPG/CanAtom process map. Also, the median processing time of CCFs between initiation (create date) and sign-off (approval date) is 38.5 days, 80% more than OPG's target turn-time of 21 days. Delays in processing PCDs can potentially cause cost and schedule exposure as well as inaccuracy in the reporting of progress. Management should consider formalizing the already developed joint OPG/CanAtom PCD workflow into the integrated change control governance document and the U3 TG PMP, and increase the TG project team's visibility into aging PCDs to improve accountability for timely processing.

- At the time of this audit, within the T-10 ("T= project execution", and "-10" represents 10 weeks before the start of project execution) window and just prior to the finalization of the baseline schedule, IA noted that the rules of credit for measuring physical progress were not yet established by CanAtom. The TG project team informed IA that CanAtom would submit its rules of credit documentation along with its baseline schedule submission. It is a good practice to establish rules of credit early in the development of a schedule and not wait until a baseline schedule is close to being finalized. Setting early expectations with the contractor for the level and frequency of progress measurements, informs the level of detail required in the schedule to accurately measure and report earned value at the expected time intervals.

2.0 DETAILED AUDIT FINDINGS

IA identified the following detailed findings which have been risk rated based on the definitions outlined in Appendix C.

1. There was a delay in having an approved baseline schedule for the U3 TG project.	**High**

According to OPG-GUID-00120-0001 *Project Schedule Guide*, 'when developing a Level 2 or Level 3 Schedule, the Defense Contract Management Agency ("DCMA") 14-Point Assessment Criteria should be used to check the schedule quality and all issues should be resolved or understood.

At the time of this internal audit, there was no formal baseline schedule. Significant changes in TG project contracting and execution strategy due to the transfer of scope from CanAtom to GE in early 2020 and the four month suspension of work related to COVID-19 in March 2020 resulted in the need to reassess the project schedule. As well, the TG project Team delayed mobilization for execution of pre-requisite work due to the absence of a schedule baseline to measure and report against.

Deficiencies noted regarding the schedule:

- IA conducted a schedule integrity check of the June 9th, 2020 Primavera 6 ("P6") schedule against the DCMA 14-point assessment criteria (please see Appendix A for details of the 14-Point Assessment Criteria and IA's test results). It was noted that the following six checks (out of 11 applicable checks) failed to meet DCMA's requirements:

    1. Approximately 10% of activities were missing a predecessor and/or a successor;
    2. There were 4 leads in the schedule;
    3. Approximately 50% of activities had high floats (> 44 working days);
    4. There were 3,045 activities that had negative float;
    5. There were 3 activities with "Actual Dates" > "Data Date"; and
    6. Critical path was not accurate due to incomplete logic and negative floats.

- Furthermore, IA also noted gaps in manpower loading. The manpower histogram from the P6 schedule did not follow an industry standard bell curve and manpower resources were not levelled. As an example, the schedule showed manpower peaks (~4 times more manpower than previous months) in the month of December 2023 (refer to Appendix B for the manpower curve). Manpower should not be increasing so significantly towards the end of the project and particularly during the month of December since it has fewer working days due to holidays. This indicates that the manpower resources were not levelled in this version of the schedule.

- OPG governance NK38-MAN-09701-10005_WIN Refurbishment Unit Planning Window Milestones, sets the expectation to have a Level 3 schedule accepted in the T-27 to T-20 window to provide sufficient time for review, verification and acceptance of a baseline and vendor lock-out-tag-out plans. The June 9, 2020 version of the Level 3 schedule had significant gaps 3 weeks prior to the pre-requisites execution start date of July 1, 2020. The Pre-requisites start date was eventually moved to early August.

The TG project Team and senior DNR leadership put forth a significant effort to finalize the TG project schedule baseline, which was finalized on August 19, 2020 (after the completion of audit fieldwork on July 31, 2020).

Potential Cause & Impact
Potential Causes: The August 2019 Gate 3 approval package for the TG project did not include a baseline schedule. Instead, a bounding schedule was submitted in the Gate 3 package. Since the Gate 3 approval in August 2019, the following events have resulted in reassessing the plans for the TG project under a compressed timeline: • In late 2019, the TG project was presented with an opportunity for the Original Equipment Manufacturer, GE, to execute an in-situ stator rewind, in place of the planned stator replacement by CanAtom; • In early 2020, the TG project was presented with an opportunity to have GE execute the centre line maintenance scope instead of CanAtom; and • In March 2020, the COVID-19 pandemic resulted in a 4-month suspension period, and a deferral of the start of the U3 Refurbishment Program, including the TG project, to September 2020 (the U3EE was updated in August 2020 to reflect these changes and was approved by the OPG Board). Potential Impacts: • Per OPG governance, schedule review, verification and acceptance activities are to be completed 20-27 weeks before the start of execution. For the Unit 3 TG project, these activities are being compressed for completion to a few weeks prior to the start of execution. This poses a potential risk of undermining the level of quality and due diligence required for building a reliable and accurate baseline schedule for the project; • Further delays in mobilization to site and start of work may potentially jeopardize the planned completion of the TG project, which in turn could potentially impact TG work for the remaining Units within the DNR program. Unit 1 TG work is scheduled to start only 3 months after the completion of U3 TG work; • Delays in timely completion of the U3 TG project could lead to an impact on project cost; and • Improper manpower loading could decrease the effective use of available resources across the project to maximize their utility, which could result in an impact to critical path.
Recommendation
The TG project Team should consider: 1. Actively monitoring the development of the schedule with vendors to prevent further delays in establishing the baseline; and 2. Deploying additional resources if required, to build short-term capacity for proper schedule review, verification and acceptance in the compressed timeframe prior to mobilization on site.

Management Action Plan
Management has completed the following actions in order to get to both a baseline cost & schedule for the CanAtom TG construction work (removal & installation) for U3 refurbishment: a) CanAtom submitted a baseline TG project P6 schedule for quality checks – completed on Jul 31, 2020; b) Completion of TG project schedule cost loading including ecosys/earning rules for CanAtom baseline schedule – completed on Aug 7, 2020; c) OPG Work Management performed detailed quality checks (i.e. Acumen Fuse) with CanAtom to update the schedule based on findings – checks completed on Aug 19, 2020; and d) Finalization of CanAtom TG project construction baseline schedule – completed on Aug 19, 2020. Management will also: e) Finalize baseline cost & schedule for the static commissioning window (W248) – December 20, 2020 Action Owner: Brad Dennis Target Completion Date: December 20, 2020

2. The U3 TG project Management Plan ("PMP") contains outdated information.	**Moderate**

The PMP is a living document that defines how the project will be planned, executed, monitored, controlled, and closed out. The PMP provides the TG project Team, and interfacing organizations, a common understanding of the project's scope, assumptions, constraints, risks, and resources.

The Turbine Generator Project Management Plan - NK38-PLAN-41000-10001-R005, (dated November 26, 2019), was the latest version of the PMP at the time of the audit. IA noted the following gaps in the TG PMP:

1. As per OPG-STD-0148 *Project Management*, ''the project work should be sub-divided into smaller more manageable components by establishing the WBS. The PMP should include the WBS structure and should be updated after completion of each phase of the project.'' When the TG PMP was last updated in November 2019 for the completion of Gate 3 (Execution for Pre-requisite Scope for Unit 3), the WBS structure for U3 had not been added to the PMP. The PMP lists the major components of U3 scope at a high level, and it currently only includes the WBS for Unit 2. The major components listed are: turbine and auxiliaries, generator and auxiliaries, moisture separator reheater steam turbine electronic controls, and generator and excitation controls. OPG's governance requirements of including the WBS in the PMP are aligned with leading industry practice and can be met by listing the WBS at the appropriate level to inform interfacing groups about the overall project structure; and

2. Per NK38-PLAN-41000-10001, 'the gated process for the project establishes the requirements and strategy for funding release to support the TG project. The intent of the gated process is to enable flexible management control of funding and gate progression approvals throughout the project life cycle.' Clear articulation of the gating process in the PMP provides direction to the TG project team on the overall governance process. TG's PMP Table 1 displays the following information:

Gate	Information
Gate U3G3a	Execution for Pre-requisite scope (stator pre-requisites and infrastructure development) [COMPLETE]
Gate U3G3b	Execution Phase – Mobilization and Installation scope of work for TG [IN PROGRESS]

   However, it was clarified by the TG project team that the project does not have gates U3G3a and U3G3b – there is only one Gate 3. The team also clarified that the absence of cost and schedule baseline indicates that the TG project is still in the definition phase and has not yet progressed into execution phase. As a result, the gate structure, definitions, and the project gate strategy in the PMP do not reflect the approach taken for the U3 TG project.

3. OPG's PMP document does not reflect the revised execution strategy and changes to project items such as scope, assumptions, resources and risks caused by the addition of new scope to GE's contract. This change in strategy has resulted in changing GE's status from an ESES vendor to both an ESES and construction (EPC) contractor. As a construction contractor, GE has new roles and responsibilities, which are not reflected in the current TG PMP. Similarly, there are no revisions to GE's Project Management Plan (TS-PLAN-PMT-0002) to capture these changes.

Potential Cause & Impact

Potential Causes:

- Major changes in the execution and contracting strategy occurred after the PMP was updated and submitted for approval in November 2019;
- Changes to the execution strategy occurred while the document was going through the approval process, which took almost three months; and
- Due to the COVID-19 related suspension of work in March 2020, the TG project team focused on other priorities and did not update the TG PMP.

Potential Impacts:

- The absence of a WBS in the PMP could make it difficult for interfacing groups to understand how the project is structured, and reporting may be not generated at the required level of detail to enable informed decisions. Lack of a detailed WBS can also undermine the TG project team's ability to:
  - Monitor and control development of intermediate and final deliverables;
  - Verify the baseline for cost and schedule; and
  - Manage cost, time, and resources across the project.
- Lack of clear articulation of the execution strategy in the PMP could impact the TG project team's ability to provide effective oversight; and
- Inaccurate reflection of the gating strategy in the PMP poses the risk of the project not understanding, and thereby not meeting, governance/milestone requirements.

Recommendation

IA recommends that the TG PMP be updated as follows:

1. Inclusion of a WBS at the appropriate level for managing and reporting on the project;
2. Revising the Phase Gate strategy in accordance with the selected approach; and
3. Revising the execution strategy including updates to the roles and responsibilities and scope for both the EPC and the ESES scopes of work.

Management Action Plan

Management will:

Update The Turbine Generator Project Management Plan - NK38-PLAN-41000-10001-R005. At a minimum, the update must include the following:

a) Update WBS structure (add the latest U3 WBS);
b) Update the details of the phase gating strategy by clarifying that there is no Gate 3a/b, just Gate 3; and
c) Update the execution strategy - stator swap scope replaced with stator in-situ rewind for U3, change in ownership of TG centerline work from CanAtom to GE, as well as any other changes since last revision of PMP.

Action Owner: Brian Barclay

Target Completion Date: October 30, 2020

3. The risk of a delay in the start of the TG project execution was not noted in the risk register.	**Low**

As per OPG-STD-0148 *PROJECT MANAGEMENT*, **"**Risk management includes identifying, analyzing, planning for and responding to uncertain events that could affect project outcomes.

Risk Management should include:

- Identification, documentation, and analysis of project risks.
- Defining proper risk response strategy through mitigation, acceptance, transfer, avoidance, and monitoring of risks through preventive action planning and execution.
- Determining the cost and schedule contingency required for residual risks impact through contingency/ risk modeling and adequacy review.
- Developing risk contingency plans to deal with residual risks that may materialize.
- Monitoring and controlling risks, and contingency management throughout the Project Life Cycle and also in accordance with the Cost Management activities.

Risk management processes should be applied regularly in each phase of the project."

The Risk Register report ID 0707A for the TG project dated June 17, 2020, and July 7, 2020 were reviewed and it was noted that the risk of a delay in the execution of pre-requisite work due to the absence of approved budget and baseline schedule, was not identified in the risk register.

Potential Cause & Impact

Potential Cause:
Risks are being discussed in stakeholder meetings, and other communication channels. The TG project team is aware of emerging risks, but they are not always formally and consistently documented.

Potential Impact:
The risk of a delay in execution work can potentially impact the project through:

a. Inability to track schedule performance;
b. Risk on not finishing to schedule; and
c. Potential delay in costs.

Recommendation

We recommend that the TG project team should apply additional rigour to ensure all significant risks are identified and properly documented.

Management Action Plan

TG risks will be jointly reviewed by the Project Management Office risk specialist and the TG project team on a monthly basis as part of the quarterly quantitative risk analysis monte carlo run. The review will include identification of any new risks, identification of risks that can be closed, and updates to the active risk profile (three point assessments on probably and impact). In addition, the risk specialist will actively participate in key project meetings, including the TG Refurbishment Team Alignment Meeting and Tier3 – Project Management Review Meeting (PMRM) to help the project team identify any new risks or issues that are facing the project that need to be documented.

Action Owner: Brad Dennis
Target Completion Date: October 30, 2020

APPENDIX A – DCMA 14-Point Assessment result

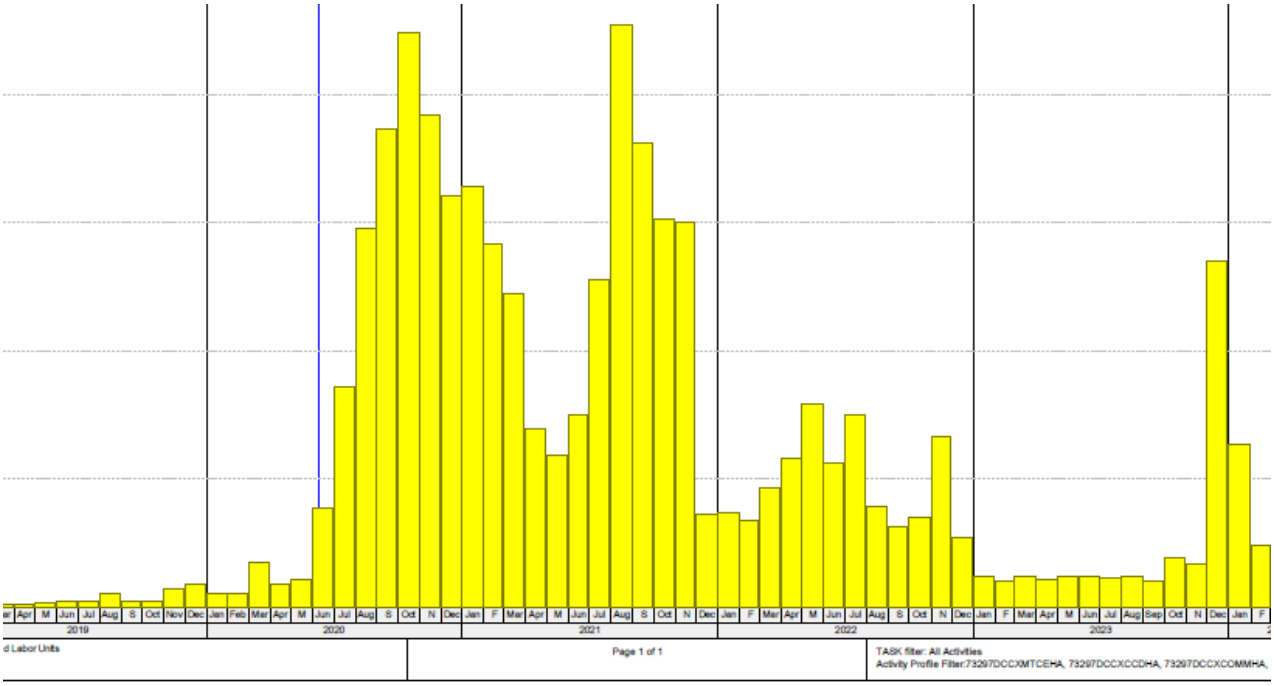
The following table shows the results of the DCMA 14-Point Assessment for the TG project schedule dated June 9, 2020.

Table A-1: Schedule integrity analysis results for TG project schedule dated June 9, 2020

Index	DCMA Checks	Pass / Fail	Comments
1	**Logic:** Number of activities that are missing a predecessor, a successor or both should not exceed 5%.	Fail	10.4%% or 1,106 of the 10,631 activities have no predecessor, no successor or are missing both. - 284 of 10,631 have no predecessors (2.67%) - 1,008 of 10,631 have no successor (9.48%) - 186 of 10,631 have no successor or predecessors (1.75%)
2	**Leads:** There should be no leads (negative lags) in the schedule.	Fail	4 of the 10,631 activities have relationships lead (negative lag).
3	**Lags:** Number of lags in the schedule should be less than 5%.	Pass	0.73% or 78 of the 10,631 activities have relationships lags.
4	**Relationship:** Number of Finish to Start (FS) relationship should be more than 90%.	Pass	94.36% or 9,819 of the 10,631 activities have traditional FS relationships.
5	**Hard Constraints:** Number of activities with hard or two-way constraints should not exceed 5%.	Pass	0.19% or 20 of the 10,631 activities have hard or two-way constraints.
6	**High Floats:** Number of activities with total float greater than 2 months (44 work days) should not exceed 5%.	Fail	49.88% or 5,303 of the 10,631 activities have a total float of greater than 44 work days.
7	**Negative Floats**: Negative float is not allowed unless corrective actions are initiated and formally approved.	Fail	There are 3,045 activities with negative float.
8	**High Duration:** Total number of activities that have a duration longer than 2 months (44days). This number should not exceed 5%. Construction activities with duration over two weeks should not exceed 5%	Pass	1.68% or 179 of 10,631 activities have durations longer than 44 days.
9	**Invalid Forecast Dates and Invalid Actual Dates:** There should not be any invalid dates in the schedule.	Fail	According to the P6 schedule log, there are 3 activities with Actual Dates > Data Date (541180659, 7329756000, 7329756010)
10	**Resources:** Number of activities that do not have resources/costs assigned. All activities with duration more than zero shall have resource assignment (More than 95% for released work).	Pass	98% or 7,932 of the 8,070 of construction and commissioning activities that have a duration of more than 0 days are resource loaded.
11	**Missed Activities:** Number of activities missing from baseline to an update shall not exceed 5% for Level 3 activities (No deletes for L1, L2 and MS)	N/A	Cannot perform this test since no confirmed baseline schedule to date.
12	**Critical Path:** There shall be at least one path that leads activity sequence from start to finish of the project going through deliverable based activities (Longest/Critical/Near Critical path)	Fail	There is at least one path that leads activity sequence from start to finish of the project going through deliverable based activities. However: 1) critical path should be set at total float between 0-20h. It is currently set at total float equal to 0. 2) schedule currently showing "look error"
13	**Critical Path Length Index (CPLI)**: During schedule implementation, CPLI less than 0.95 should be considered a flag and requires further investigation.	N/A	Cannot perform this test since no confirmed baseline schedule to date.
14	**Baseline Execution Index (BEI)**: During schedule implementation, BEI less than 0.95 should be considered a flag and requires further investigation.	N/A	Cannot perform this test since no confirmed baseline schedule to date.

e

APPENDIX B – Manpower histogram from the TG project schedule dated June 9, 2020



The manpower histogram above from the TG project schedule dated June 9, 2020 does not follow the industry standard bell curve and manpower resources are not levelled. As an example, there are manpower peaks (~4 times more manpower than previous months) in the month of December 2023. Manpower should not be increasing so significantly towards the end of the project and especially during the month of December, since it has fewer working days due to the holidays. This indicates that the resources are not levelled in this version of the schedule.

APPENDIX C – RISK RATING DEFINITIONS FOR AUDIT FINDINGS

Finding: *Noted deficiency with potential impacts to the achievement of business unit/process area objectives, assessed using the following criteria:*

	High Risk	Moderate Risk	Low Risk
Financial	• Potential loss or financial impact =>5% of the sample population's value, or the department's OM&A budget if the former is unavailable.	• Potential loss or financial impact >=2% and <5% of the sample population's value, or department's OM&A budget if the former is unavailable.	• Potential loss or financial impact <2% of the sample population's value, or department's OM&A budget if the former is unavailable.
Operational Excellence	• Governance non-compliance or lack of/inadequate controls that may impact achievement of business or project objectives. • Errors in or insufficient internal reporting that drives senior management decision making. • Test results where =>25% of the sample had deficiencies in the execution of a key control.	• Governance non-compliance or lack of/inadequate controls with alternate controls in place to mitigate the impact to business or project objectives. • Errors in or insufficient internal reporting that could affect management decision. • Test results where >=10% and <25% of the sample had deficiencies in the execution of a key control.	• Governance compliance with procedural concerns or documentation issues which could impact OPG's ability to demonstrate appropriate due diligence. • Errors in or insufficient internal reporting that has minimal decision making impact. • Test results where <10% of the sample had deficiencies in the execution of a key control.
Safety & Social License	• Regulatory non-compliance. • Deficiencies that could result in: ○ Fatality, permanent disability, or lost time injury; ○ Data loss or unavailability of critical systems; ○ Security is compromised in sensitive / multiple areas; or ○ Fraud / theft.	• Insufficient evidence to support regulatory compliance. • Deficiencies that could result in: ○ Minor injury with no lost time; ○ Temporary data loss or unavailability of non-critical systems; ○ Security is compromised; or ○ Fraud / theft with some mitigating controls.	• Documentation improvements to support regulatory compliance. • Deficiencies that could result in incidents that do not require medical treatment.

Opportunity for improvement: *Observation with no risk impact that is provided to management for consideration to improve efficiency of processes and documentation (e.g. automation, duplication of activities).*

OVERALL REPORT RATING SCALE

An overall audit rating is assigned based on the number of observations identified for the audit and their assigned risk rating:

	Number of Findings			
Finding Risk Rating	**1**	**2**	**3 - 4**	**=> 5**
High	Requires Improvement	Not Effective	Not Effective	Not Effective
Moderate	Generally Effective	Generally Effective	Requires Improvement	Not Effective
Low	Effective	Effective	Generally Effective	Requires Improvement

APPENDIX D – PROCESS OWNER & DISTRIBUTION LIST

Distribution:

Michael Martelli
Chief Projects Officer

Dietmar Reiner
SVP Refurbishment Transition

Subo Sinnathamby
SVP Nuclear Refurbishment

William Owens
SVP Nuclear Refurbishment – Unit 3

cc:

Ken Hartwick	President & Chief Executive Officer
John Mauti	SVP Finance & Chief Financial Officer
Barb Kerr	VP Controllership
Zeina Elhami	VP Project Assurance & Contract Management
Karen Fritz	Chief Supply Officer
Jessica Polak	Senior Director, Projects
Adam Chiarandini	Director Enterprise Risk Management
Brad Dennis	Project Director Turbine Generators
Jos Diening	Project Director Turbine Generators
Janice Ding	Director Internal Audit
Paul Seguin	Director Nuclear Oversight
Jennifer Vulanovic	Director Project Assurance Commercial Strategy
Anthony Ling	Senior Manager Internal Audit
Audrey Lowry	Program Assurance Senior Planning & Reporting Specialist
Miranda Mastracci	Senior Law Clerk, Board Committees & Subsidiaries – Corporate Governance Group