CONTINGENCY

1.0 OVERVIEW

Risk management is a systematic approach for proactively identifying, analyzing, managing and responding to project risks. OPG has implemented a comprehensive and robust risk management system for the Darlington Refurbishment Program "(DRP"), a key product of which is the contingency that is included in the Release Quality Estimate ("RQE"). Contingency is an important tool for managing uncertainty and risk throughout the life of a project. The process that OPG has used to develop the DRP contingency is set out in this Ex. D2-2-7. The process that OPG will use to manage contingency during the Execution Phase is described in Ex. D2-2-9.

2.0 CONTINGENCY

Determining the amount of contingency for a particular project or program is integral to the estimating, scheduling and risk management processes.

Importantly, contingency refers to amounts that are *expected* to be expended because there are risk items and uncertainties that will occur and cannot be entirely mitigated or avoided. Contingency is included as a component of a project estimate just like any other component of a project. It is not an extra amount that will not be spent if the project goes as planned, nor is it a tool to compensate for an underdeveloped project plan. It is a necessary, legitimate and thoughtfully developed part of the estimated project cost based on residual (post-mitigated) risk and uncertainty.

Association for the Advancement of Cost Engineering ("AACE") , a leading authority in the area of cost engineering, management and estimation, defines "contingency" as an amount that is added to an estimate to allow for items, conditions or events, for which the state, occurrence or effect is uncertain and that experience shows will likely result, in aggregate, in additional costs. In addition, the AACE definition states that "contingency is generally included in most estimates, and is expected to be expended."[1] Contingency is typically estimated using statistical analysis informed by judgment based on past experience and considers only residual (post-mitigated) risk exposures. Similarly, the Project Management Institute, a leading professional membership association for the project, program and portfolio management profession, explains that contingency allowances are part of the funding requirements for a project, necessary to account for cost uncertainty.[2]

OPG developed the DRP estimate in accordance with AACE's recommended practices for estimate classification. As part of this approach, OPG identified and classified risks and developed the contingency component of the DRP estimate based on industry best practices (including AACE guidelines). OPG retained KPMG to provide an independent review of the risk management and contingency development process used by OPG to develop the RQE for the DRP. Based on its review, KPMG found OPG's governance, methodology and approach to be in alignment with AACE guidelines and industry best practices in terms of identifying and classifying risks and using an integrated Monte Carlo-based risk analysis, as described below. A copy of KPMG's report on contingency is provided in Attachment 1 (the "KPMG Contingency Report").

3.0 CONTINGENCY DEVELOPMENT

OPG established a risk management team within the DRP organizational structure and equipped them with the necessary tools to identify, develop, manage and monitor risks associated with the DRP. The contingency estimate was developed through a detailed evaluation of (1) the uncertainties in estimating cost and schedule, (2) discrete risks relating to cost and schedule, and (3) contingent work across each project and the entire Program. This process relied upon the use of both qualitative and quantitative methods, including performance of an integrated cost and schedule Monte Carlo simulation. OPG retained a modelling expert to assist with the architecture and robustness of the model and oversee the simulation.

[1] "Cost Engineering Terminology", Recommended Practice 10S-90, AACE International, WV, rev. 2007.

[2] Project Management Institute, *Guide to the Project Management Body of Knowledge (PMBOK Guide)*, 4th ed., 2008, Section 7.1.2.6 at p. 173.

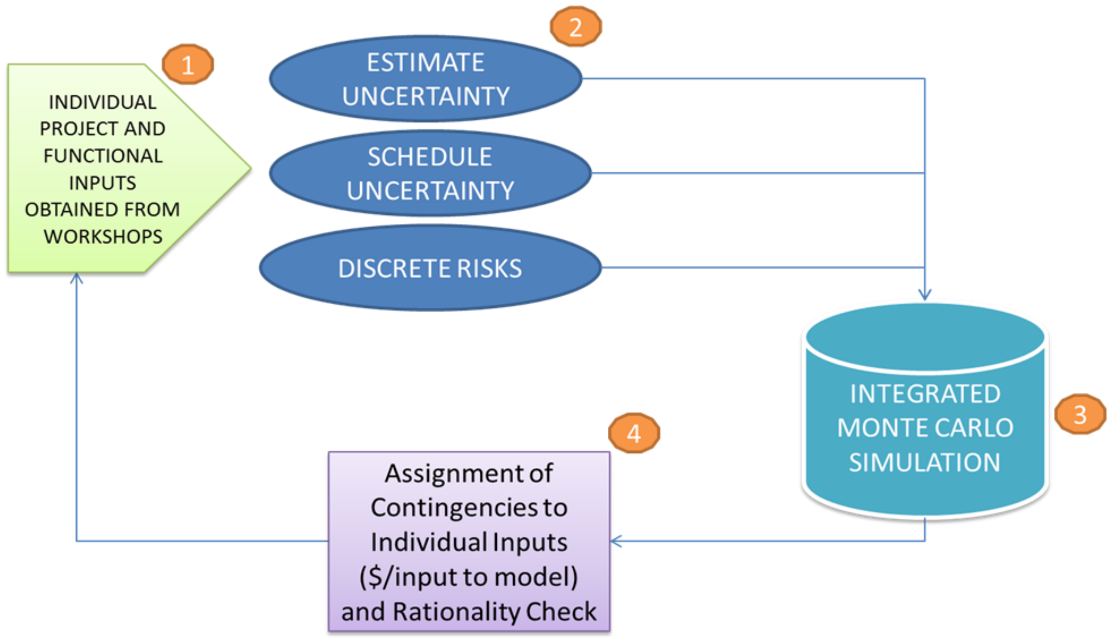
OPG's contingency estimate is based on three key contributors to contingency, namely cost uncertainty, schedule uncertainty and discrete risks.

- *Cost estimating uncertainty* is the possibility that the costs of the projects are more or less than the applicable estimates, taking into consideration the estimate classification of the base project cost (excluding discrete risk events).
- *Schedule estimating uncertainty* is the possibility that the actual schedule durations for the projects are more or less than the estimated durations (excluding discrete risk events).
- *Discrete risks* are the incremental cost and schedule impacts to the project baselines if risk events were to occur. These include risks that are specific and applied to individual project bundles, such as delays to procurement of a specific component for a specific project, as well as global Program risks that could impact the DRP in an overarching manner, such as with respect to the availability of sufficient skilled trades resources to execute the refurbishment work program.

A general illustration of the iterative process to gather, process, and refine the contingency inputs is shown in Figure 1 below.

Figure 1

Iterative Process for Gathering, Processing, and Refining Contingency Inputs



A comprehensive risk register including AACE estimate classifications for each project and detailed schedule logic was used to develop the contingency estimate. The risk register was initially developed by subject matter experts from each project team and was then vetted through a series of challenge sessions led by panels of independent subject matter experts to ensure reasonability and that the risks input to the process are legitimate and being effectively managed. Contract staff supported the contingency development process by developing the base cost and schedule estimates to approved AACE estimate classifications and by identifying risks that were incorporated in the risk registers.

The “cost uncertainty” and “schedule uncertainty” components of contingency were reviewed by the project management teams in collaboration with individual subject matter experts in a workshop environment and with reference to the AACE estimate classification and schedule durations. This practice of identifying and modeling the integrated effects of risk and uncertainty on schedule is an approach which KPMG considers to be best practice.

OPG used @Risk, a leading risk analysis software tool from Palisade Corporation, an internationally recognized leader in this field. As noted above, OPG also retained a risk modelling subject matter expert from Palisade to assist in the architecture and robustness of the model and oversee the simulation. KPMG found that such use of a risk modelling subject matter expert is considered a best practice for infrastructure projects of a similar nature and scale.

An integrated Monte Carlo simulation representing execution of the entire Program on a four-unit basis was conducted. Monte Carlo simulation is a computerized mathematical technique that replicates execution of the project thousands of times, accounting for potential realization of risk events and uncertainties, which allows quantitative analysis and decision making. It provides decision makers with a range of possible outcomes and the probabilities that those outcomes will occur to certain confidence levels. This technique builds models of possible results by substituting a range of values for any factor that has inherent uncertainty. The model is then used to calculate the results in an iterative manner, involving thousands of iterations, each using a different set of random values from the probability functions.[3] The intent is to simulate the outcome of DRP risk and uncertainty variables thousands of times and integrate these results to determine the confidence levels of contingency sufficiency. The RQE contingency estimate was a high confidence estimate based on the risk and uncertainty profile.

After initial contingency development workshops were completed and a preliminary contingency estimate was prepared, management reviews were held to validate the overall adequacy of the contingency estimate. This further ensured that the level of detail and the input of risks and uncertainties were reasonable and prudent. KPMG reviewed the inputs and simulation outputs and found that OPG developed a robust model by completing quality and data integrity checks after the contingency development workshops were held. KPMG also found that OPG's use of statistical correlations for the schedule analysis to simulate the interdependence of related activities is considered to be best practice.

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[3] Palisade Corporation, *Monte Carlo Simulation* <http://www.palisade.com/risk/monte_carlo_simulation.asp>.

4.0 CONTINGENCY AMOUNTS

4.1 DRP Contingency Amounts

The detailed evaluation of cost and schedule uncertainties and discrete risks, as well as contingent work across each project and the entire DRP, enabled OPG to determine the appropriate amount of contingency to include in the RQE. The outcome of this analysis yielded that, at a high confidence level, the RQE should include $1.7B (2015$) of contingency, which is comprised of project contingency and program contingency amounts. *Project contingency* is derived from the individual discrete risks and cost uncertainties managed by project directors. Project risks have a localized project impact if they occur. *Program contingency* is derived from overarching Program risks managed at the executive level that could influence the overall Program's objectives, may require Program-wide response and may have a global impact on the Program.

For a project of the size and duration of the DRP, there are a number of low probability high consequence events that could impact the Program and that are outside of the contingency determined for the Program. Due to the low probability, these items would not contribute sufficiently to a probabilistic assessment used in establishing contingency. Management has compiled a list of such events that could occur, and are beyond the ability of the project to manage or mitigate. Examples of events may include force majeure, a significant labour disruption, changes in the political environment, an international nuclear accident (Fukushima-type event) or incident, and unforeseen changes to financial and other economic factors beyond those assumed in the Program. If such an event were to occur, Management would evaluate the cost and schedule consequences of the event and provide a recommendation to the Board for approval on the appropriate response.

A breakdown of the DRP contingency amounts is set out below in Chart 1.

Chart 1

Unit Project and Program Contingency

Project	Estimate Class[4]	Project Contingency ($M)	Program Contingency ($M)	Total Contingency ($M)
RFR	2	236	381	617
Turbine Generator	2-3	195	23	218
Steam Generators	2	20	0	20
Fuel Handling and Defueling	3	25	38	63
Balance of Plant	3-5	230	0	230
F&IP and SIO	1-3	42	34	76
Project Execution and Operations and Maintenance	N/A	58	222	280
Unallocated Program Contingency	N/A	0	202	202
Total Contingency ($B)	**-**	**$0.8B**	**$0.9B**	**$1.7B**

Authorization of the use of contingency funds is strictly controlled through the Change Control Board ("CCB"), which requires an explanation of the risk or uncertainty element that has been realized and a robust approval model that requires escalation for use of any contingency funds. Additional information regarding the CCB is found under Ex. D2-2-9, Attachment 1.

4.2 Unit 2 Contingency Amounts

Of the total $1.7B of DRP contingency, $694.1M is attributed specifically to the Unit 2 refurbishment and forms part of the forecast cost of Unit 2 refurbishment. This includes $339.0M of project level contingency and $355.1M of Program level contingency, which together represent 14.4 per cent (7.0 per cent and 7.4 per cent respectively) of the total Unit 2 in-service additions for 2020.

Allocation of the total contingency across the four units was based on 'risk exposure windows', which refers to the anticipated timing for when the risks or uncertainties would be realized and associated contingency costs would be incurred. In allocating contingency to

[4] See section 2 of Ex. D2-2-8 for further information on estimate classification.

Unit 2, OPG assumed, based on industry experience, that the first unit will realize more risks than subsequent units and that lessons learned will be incorporated for subsequent units to avoid recurrence. Accordingly, approximately 40 per cent of the total DRP contingency amount was allocated to Unit 2, with the expectation that the amount of contingency required for each subsequent unit would be less than the one prior to it. A breakdown of the specific components of the $694.1M of contingency for Unit 2 is provided in Chart 2, below.

Chart 2

Breakdown of Unit 2 Contingency Amounts

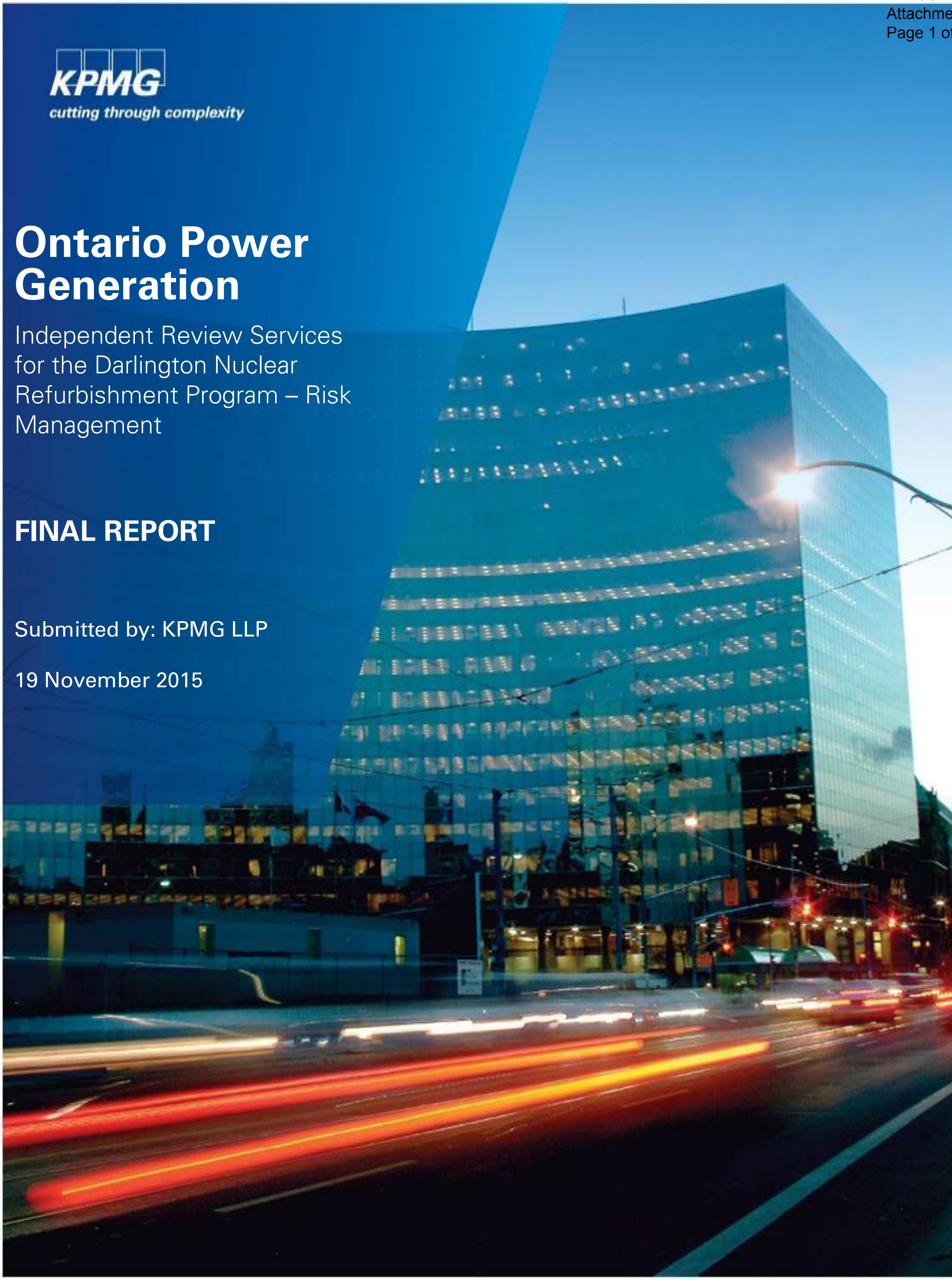
Program Element	Contingency ($M)
RFR	117.9
Turbine Generator	81.7
Fuel Handling/Defueling	10.5
Steam Generator	8.2
Balance of Plant	96.6
Subtotal Major Work Bundles	**314.9**
Project Execution	3.6
Contract Management	0.6
Engineering	2.7
Managed System Oversight	0.4
Planning and Controls	0.8
Nuclear Safety	-
Program Fees and Other Supports	6.1
Supply Chain	0.9
Work Control	1.0
Operations and Maintenance	7.9
Subtotal Functions	**24.1**
Subtotal Project Contingency	**339.0**
Program Contingency	355.1
Total Contingency	**694.1**

As set out in section 5.6 of Ex. H1-1-1, OPG proposes that the variance between actual costs and firm financial commitments and those forecast costs and firm financial commitments underpinning the 2017-2021 annual nuclear revenue requirement approved by the OEB in this proceeding be recorded in the Capacity Refurbishment Variance Account ("CRVA"). The nuclear revenue requirement includes DRP in-service additions. In the event of any unallocated contingency at the point of in-service, the favourable revenue requirement amount will be recorded in the CRVA and returned to ratepayers in a future test period.

ATTACHMENTS

Attachment 1: KPMG Report on Contingency

KPMG
cutting through complexity



Ontario Power Generation

Independent Review Services for the Darlington Nuclear Refurbishment Program – Risk Management

FINAL REPORT

Submitted by: KPMG LLP

19 November 2015

Risk Management Program Review

Report Objectives and Methodology

KPMG LLP ("KPMG") was engaged by Ontario Power Generation ("OPG") to provide an independent review of the risk management and contingency development process for the Release Quality Estimate ("RQE") for the Darlington Nuclear Refurbishment Program ("DNRP" or the "Program").

KPMG's independent review of the DNRP risk management and contingency development process consisted of the following three primary focus areas:

- Comparison of OPG's current risk & contingency governance to AACE standards;
- Review of the output of the Monte Carlo Simulation and findings; and
- Risk and Contingency processes and reports as they relate to industry best practices.

It is worth noting that it is generally difficult to establish estimating benchmarks for contingency in the nuclear industry, and in particular for brownfield projects such as refurbishments. The primary reason for this is that very few recent nuclear projects have actually formally implemented schedule/cost risk contingency factors into their estimates. Another factor that limits direct comparison is that many of the refurbishments completed in North America have unique characteristics such as varying scope, different local factors (i.e., labour), tools and technologies (i.e., mock-up facilities) and often cannot be compared. In the absence of any meaningful refurbishment contingency benchmarks it is generally considered acceptable to follow AACE estimating guidelines to calculate the total estimated program contingency.

As a result the methodology used to perform the review is briefly summarized as follows:

- Review of the integrated contingency estimate and related documentation (see list of documents below). This included documents such as OPG's Contingency Development governance, OPG's Risk Management governance, and the Integrated Contingency Estimate – Snapshot 3 (Final).
- Conduct interviews with key OPG staff involved in the DNRP risk management and contingency development functional groups to clarify questions concerning the documentation reviewed, as well as better understand the estimate development and review process, and to understand the responsibilities of the various project team members.

The OPG documents that have been reviewed, in combination with the October 6th, 2015 interview of key OPG staff, include:

- RQE Contingency Development Plan, Dated 2015-06-04, NK38-Plan-09701-10006;
- RQE Contingency Development Report, Dated 2015-08-20, N-REP-09701-0556625;
- Nuclear Project Risk Management, Dated 2015-03-30, N-MAN-00120-10001;
- Nuclear Refurbishment Risk Management & Contingency Development Guide, Dated 2014-07-28, N-MAN-00120-1000;
- Nuclear Projects Risk Management and Oversight (RMO) TOOL, N-GUID-09701-10123;
- Presentation: "RQE Contingency Development", Dated 2015-06-24; and
- Integrated Contingency Estimate – Snapshot 3 (Final) dated September 30, 2015 – 'RQE Mgmt Summary – Contingency Snapshot 3.pdf'.

Summary of Findings

Overall, OPG's governance, methodology, and approach aligns with AACE guidelines and industry practice in terms of identifying and classifying risks and utilizing an integrated Monte Carlo based risk analysis.

OPG's integrated contingency estimate (Snapshot 3 – final) is based on a Monte Carlo analysis that consolidates the major contributors to contingency; namely: (a) cost uncertainty, (b) schedule uncertainty, and (c) discrete risks to determine the total contingency estimate for the DNRP.

The elements of contingency related to cost and schedule uncertainty are connected to the uncertain nature of the project work scope and depend on the following factors:

- Imperfect understanding of known work (e.g., estimator's interpretation of the contract documents, understanding of construction means and methods);
- Incomplete understanding of scope of work (e.g., quantity or type of materials); and
- Productivity factor / variability of factors applied (e.g., labour and equipment productivity).

The elements of contingency related to risk (i.e., discrete risks) are specific 'known' risks that have been identified by the project teams in the risk register (i.e., the RMO tool discussed below) and the project teams have applied three point estimates to each risk's (a) probability and (b) cost or schedule impact (i.e., dollars or duration) depending on the nature of the risk.

The OPG RMT confirmed that the contingency estimate in 'Snapshot 3' is calculated at a 'P90' which means that from a statistical standpoint there is a 90% chance that the actual contingency will be less than the estimated amount. It is important to note that this value is calculated as the result of a Monte Carlo risk analysis using computer simulations. The Monte Carlo analysis essentially simulates the project taking place over thousands of iterations. As it runs, the Monte Carlo analysis activates risks randomly throughout the project. As a result the total contingency estimate will be slightly different each time the risk analysis simulation is run.

Similarly, the same Snapshot 3 document shows the total outage delay at a P90 for the first unit (i.e., Unit 2) broken down into days of delay attributed to risk (i.e., discrete risk events that impact activities on the critical path) and days of delay attributed to schedule uncertainty.

OPG Contingency Development Process: AACE, Monte Carlo and Industry Best Practice Review

Contingency funds are allocated to manage uncertainty and risk throughout the life of a project or a program. Contingency development is an integral part of the estimating, scheduling and risk management process. Contingent funds should be a function of variables such as project size, duration, complexity, risk exposure, tolerance, prior experience with the work, and confidence levels set by management. In all cases, contingency development is predicated on a high quality base plan and a high quality risk register

Without a high quality base plan, one cannot effectively identify risks. Without a high quality risk register, one cannot effectively identify contingency. It is the expectation that the base plan is reasonable, achievable and endorsed by necessary stakeholders in advance of requesting contingency calculations.

It is KPMG's view that the risk register implemented by OPG, in the "RMO" tool, is of quality and integrity, it is also in alignment with industry guidelines and best practices. The RMO risk register adequately encompasses the risks identified by the project managers, and the broader OPG team through ongoing risk workshops and team meetings conducted by the OPG DNRP team.

The completeness of the risk register has not been assessed by KPMG team, nor have the specific dollar amounts associated to each of the risks in the register. KPMG's review focused solely on the processes and governance applied by OPG to identify and quantify risk and to determine contingency for the DNRP.

According to AACE recommended practices 40R-08, 57R-09, 41R-08 a risk management and contingency development methodology should address (at a minimum) these general principles:

1. Clearly defined contingency governance, processes and tools;
2. Identification of the risk drivers with input from all appropriate parties;
3. Clear linkages between risk drivers and cost / schedule outcomes;
4. Probabilistic estimating results in a way that supports effective decision making and risk management;
5. Inclusion of the impact of schedule risk on cost risk; and
6. Range estimating techniques applied to critical risk items.

The following tables outlines the DNRP Contingency Development Process observations as they correlate to AACE recommended practices outlined above:

AACE RP 40R-08	Recommended Practices as compared to OPG's Risk Management and Contingency Development Program
1. Clearly defined contingency governance, processes and tools.	■ Overall, OPG's risk management and contingency development planning documentaion is considered to be in-line with AACE guidelines and industry practice in terms of defining the key elements of the risk/contingency development process and providing the roadmap for the DNRP's project teams to follow in the risk/contingency development process. For reference the following primary documentation (combined with the knowledge and experience of the RMT) provided guidance. • RQE Contingency Development Plan, Dated 2015-06-04, NK38-Plan-09701-10006; • RQE Contingency Development Report, Dated 2015-08-20, N-REP-09701-0556625; • Nuclear Project Risk Management, Dated 2015-03-30, N-MAN-00120-10001; • Nuclear Refurbishment Risk Management & Contingency Development Guide, Dated 2014-07-28, N-MAN-00120-10001; and • Nuclear Projects Risk Management and Oversight (RMO) TOOL, N-GUID-09701-10123. ■ The core risk management team ("RMT") is a centralized function within the DNRP that has developed standardized risk management processes and tools for the DNRP. In addition to an oversight role, the RMT provides ongoing guidance and support to the project managers of the various project bundles in applying and interpreting the risk management methodology. The centralized nature of the Risk Management function allows the team to provide standardized processes and tools across the various bundles of the DNRP which is considered to be in line with best practices (ref. Document review list for a sample standard documentation). ■ A key element of the contingency development process is the Risk Management and Oversight Tool (RMO) which KPMG considers to be leading practice. The

AACE RP 40R-08	Recommended Practices as compared to OPG's Risk Management and Contingency Development Program
	RMO tool is more than just a risk register that forms the basis of the contingency calculation for discrete risks – it is an application project managers will use to perform risk management activities throughout the course of the DNRP. The risk management team owns and administrates the RMO tool and provides training, support, and guidance to the organization. ■ Another key element of the contingency development process is that the centralized risk management team has embedded local risk management team members within each project bundle (i.e., 'Single Point of Contact' or 'SPOC') to facilitate interpretation of the risk managment process and ongoing risk management. ■ The RMT confirmed that the RMO tool will be scalable such that additional risks can be input as they are identified throughout the course of the DNRP. In addition, the RMO tool enables risks to be tracked, monitored and adjusted as the program progresses to provide management with a clear real-time overview of project risks.
2. Identification of Risk Drivers	■ In accordance with OPG's risk breakdown structure, OPG's integrated contingency estimate (Snapshot 3 – final) contains three major contributors to contingency; namely: (a) cost uncertainty, (b) schedule uncertainty, and (c) discrete risks. **Discrete Risks** ■ OPG's RMO tool is the primary tool for identifying and managing the risk drivers on the DNRP (i.e., the discrete risk component of contingency). It is a centralized database that contains all the risk events (i.e., the known unknowns) which are then used as inputs to to the risk modeling program (i.e., Palisades' @RISK discussed below) to calculate the 'risk' based component of the contingency amount (the other component related to cost / schedule uncertainty is described below). ■ The risk register was initially developed by subject matter experts on each of the project teams (i.e., RFR, BOP, TG, etc.). The risk register was then vetted by a series of challenge sessions led by a panel of independent subject matter experts that interrogated the risks. **Cost & Schedule Uncertainty** ■ The second major component of contingency "cost / schedule uncertainty" was developed in collaboration with individual project subject matter experts (i.e., the project directors) and the DNRP's estimating and scheduling functional groups. ■ In terms of cost uncertainty, final estimates were approved and classified by the Estimating function and three point estimates (i.e., see estimating ranges discussed below) were provided by the project leads for each of the six major project cost elements: (1) Project Management, (2) Engineering, (3) Procurement, (4) Construction, (5) Commissioning and (6) Close-out (i.e., known as the 'PEPCC' elements). ■ In terms of schedule uncertainty, after the schedules were accepted and classified by OPG's scheduling and estimating functional groups, OPG's subject matter experts provided three point estimates for the activities on the critical path. In addition, 'discrete risks' that relate to activities on the critical path were mapped to such activities so that the composite effects of 'risk' and 'uncertainty' on schedule were considered in the Monte Carlo risk analysis. This approach is

AACE RP 40R-08	Recommended Practices as compared to OPG's Risk Management and Contingency Development Program
	considered to be best practice – see Item 5 below – 'Inclusion of the impact of schedule risk on cost risk.'
3. Clear link between risk drivers and schedule / cost outcomes.	■ A solid Risk assessment process involves both qualitative and quantitative risk assessment to help identify priority risk items. ■ The qualitative risk assessment process assists the project teams (and Risk Management Team) to quickly determine the largest risks to the project and helps prioritize risks for risk response (i.e., developing strategic options and determining actions to reduce the threat). For the purpose of consistency the Risk Management team has developed a standard 'risk assessment scale' that enables each risk to be scored on the basis of probability and impact (financial or shedule). The qualitative risk assessment process is managed via the RMO tool, the risks themselves, initial risk scoring ('risk assessment scale' scoring), and risk response planning are tracked and monitored via the tool. This is aligned with best industry practices. ■ The quantitative risk analysis process is performed on items that have a significant qualitative risk that would require contingency fund allocation. For each identified risk the project team assign a three point estimate for probability and impact (i.e., dollar value) of the identified risk on overall project objectives. This activity provides a clear link between risk drivers and schedule / cost outcomes, and all this data feeds into the Monte Carlo risk simulation software (@Risk) to determine the 'discrete risk' component of contingency. This is aligned with best industry practices.
4. Probabilistic estimating results in a way that supports effective decision making and risk management.	■ OPG used a probabilistic Monte Carlo risk analysis (i.e., Palisades' @Risk software) to analyze the impact of risk and uncertainties using multiple simulations. The input for the probabilistic analysis was gathered from project leads and the estimating team. This involved obtaining three point estimates (Most Likely, Optimistic, and Pessimistic) for residual risk impacts and cost and schedule estimates. ■ To support the RQE contingency development process the output of the Monte Carlo simulation depicted the probability distribution of cost and schedule outcomes based on input assumptions. This type of information was used by OPG to understand the expected cost/duration and the range/dispersion of the projected cost and durations. ■ After the initial contingency development workshops were completed and a preliminary contingency estimate prepared, management reviews were held to validate the overall adequacy of the RQE contingency estimate. This ensured that the level of detail available for the estimate itself, and the input risks and uncertainties that comprise it, were reasonable and prudent. Reconciliation of the contingency estimate will be performed by the risk department in line with the RQE roadmap. ■ As additional support to the RQE contingency development process the results of the Monte Carlo simulation included a cumulative probability distribution of total cost / schedule, in the shape of an S-curve. The S-curve was derived from the contingency analysis process and represents the variability in the cost/schedule estimate for the project. For example, the S-curve for schedule duration is illustrated in OPG's 'Integrated Contingency Estimate – Snapshot 3 (Final)'.

AACE RP 40R-08	Recommended Practices as compared to OPG's Risk Management and Contingency Development Program
	■ Due to the size and complexity of the simulation that was required for the DNRP, the OPG Risk Management Team elected to bring onboard a Risk Modelling subject matter expert from Palisades (a recognized industry expert in risk modelling) which is considered best practice for infrastructure projects of this nature and scale. ■ The KPMG team reviewed OPG's Integrated Monte Carlo Simulation (IMCS). It was found that OPG had developed a robust IMCS model by completing quality and data integrity checks after the Contingency Development Workshops held in July 2015. ■ OPG utilized statistical correlations (also known as Markov chains) in the Monte Carlo simulation to simulate the interdependence of related activities which is considered to be best practice. Currently, OPG has applied a global correlation coefficient (i.e., ρ = 0.7 coefficient) to all its relationships. OPG ran multiple simulations and varied the correlation from weak to strong (see definition below) and it was shown that there was a relatively small impact on the overall contingency calculation. For reference, the correlations are described by the following coefficients: ▪ Weak Correlation (ρ = 0.15), ▪ Moderate (ρ=0.45), ▪ Strong (ρ=0.8 or higher)

AACE RP 57R-09	Recommended Practices as compared to OPG's Risk Management and Contingency Development Program
5. Inclusion of the impact of schedule risk on cost risk.	■ Based on the DNRP's resource loaded 'critical path method' (or "CPM") schedule, OPG calculated (using Monte Carlo simulation) the (4) unit overall schedule duration P90 (including uncertainty & risk). This includes OPG's assessment of Project, Program, and JV owned risks that could impact critical path. It uses the uncertainty ranges for optimistic, most likely, and pessimistic outage durations. The basis for a program level cost burn rate (per day) has been documented by the OPG Finance team and is incorporated in the analysis. ■ It is noted that a review of the inputs to this type of calculation were beyond the scope of this report. For reference these inputs generally include (a) a resource loaded schedule, (b) a contingency free cost estimate and (c) risk data with probability and impact parameter data. ■ The OPG RMT reviewed the RMO tool to ensure that Schedule uncertainty values did not overlap with "discrete risks for schedule" to ensure that there was no "double counting" of contingency. ■ The total integrated DNRP contingency estimate for the impact of schedule risk on cost risk for the (4) unit overall schedule comprises the largest overall percentage of contingency as illustrated in OPG's Integrated Contingency Estimate Snapshot 3 (Final).

AACE RP 41R-08	Recommended Practices as compared to OPG's Risk Management and Contingency Development Program
6. Range estimating techniques applied to critical risk items.	■ The OPG risk register adequately captures the data for the Monte Carlo probabilistic analysis including the three point estimates (Most Likely, Optimistic, and Pessimistic) for risk impacts, cost and schedule estimates.

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