OUTAGE OM&A – NUCLEAR

1.0 PURPOSE

This evidence presents nuclear operations outage OM&A costs for the period 2020-2026.

2.0 OVERVIEW

The IR term outage OM&A expense is $279.1M in 2022, $361.2M in 2023, $212.4M in 2024, $192.6M in 2025 and $61.3M in 2026, and forms part of the OM&A expense in the nuclear revenue requirement. Outage OM&A costs will vary year over year depending on the number and scope of outages and therefore cannot be trended over time.

Outage OM&A costs over the period 2020 to 2026 primarily reflect the following:

- Expenditures for routine inspection and maintenance activities undertaken during Darlington unit planned outages, consistent with Darlington's three year planned outage schedule. This includes non-refurbishment outage costs for those units laid up during refurbishment (i.e., Unit 2 during 2016-2020; Unit 3 during 2020-2023, Unit 1 during 2022-2025 and Unit 4 during 2023-2026). Non-refurbishment outage costs are costs for various inspection and maintenance activities associated with a planned outage in accordance with OPG's aging and life cycle management programs that are in addition to and separate from the refurbishment of the units ("Cyclical Outages"). For example, the non-refurbishment outage work for Unit 3 during its refurbishment outage (2020-2023) effectively replaces a Unit 3 scheduled planned outage in 2021 which would otherwise have been undertaken absent Unit 3 refurbishment. Similar non-refurbishment outage work will be undertaken for Units 1 and 4.
- Expenditures for routine inspection and maintenance activities undertaken during Pickering unit planned outages, consistent with Pickering's 30 month planned outage schedule. With the planned shutdown of Pickering at the end of 2025, there are no regular planned outages in 2025.
- Over the period 2020-2026, additional scope was added to Pickering planned outages for Pickering Extended Operations and Pickering Optimized Shutdown to enable Pickering's planned operation to 2024/2025. Outage OM&A costs also include ongoing costs associated with the Fuel Channel Life Extension project (Ex. F2-3-2). The outage OM&A

costs for Pickering Extended Operations, Pickering Optimized Shutdown and ongoing costs for the Fuel Channel Life Extension project are set out in Ex. F2-4-1, Table 1.

- Outage OM&A costs for a scheduled Vacuum Building Outage ("VBO") at Pickering in 2022, along with preparatory inspection work during 2020 and 2021.
- Outage OM&A preparatory VBO costs in 2025 and 2026 at Darlington for a scheduled VBO in 2027.
- OPG has scheduled six post refurbishment mini planned outages at Darlington to address any issues that could arise after the major refurbishment of a unit is complete and the unit has resumed operations. The outage OM&A forecast includes costs for work that may be undertaken during these mini planned outages.

OPG continues to pursue initiatives (Ex. F2-1-1, Section 3.4) to improve operational performance and cost effectiveness. This includes a continued focus on increasing the efficiency of planned outage work as part of a program to achieve the production and value for money targets in the business plan. OPG continuously seeks improvement in outage planning and execution to ensure that the required outage work is conducted at the lowest achievable cost as discussed in Section 4.2 below.

3.0 OUTAGE OM&A PLANNING AND RESOURCING

Nuclear planned outages are necessary to execute inspection and maintenance work related to asset management and regulatory requirements, or project work, on systems and equipment where access is not possible under normal operating conditions.

Planned outages also give OPG an opportunity to perform systems and equipment upgrades, configuration changes, and other improvements and modifications.

3.1 Outage Scope and Duration Planning

The nuclear outage OM&A budget is derived in conjunction with the development of the approved generation plan and outage schedule for each station, which is discussed in Ex. E2-1-1. The generation plan, by reference to the station's life cycle management plan, establishes the number, frequency and duration of the outages for each year that are

required to ensure the continued safe, reliable, long-term operation of the plant and that it is in compliance with Canadian Nuclear Safety Commission ("CNSC") regulatory requirements.

3.2 Outage Resource Planning

The Nuclear outage resource plan is established and costed on the basis of the work activities required to execute each regular planned outage scheduled under the generation plan.

Work activities are planned at a detailed level, and resource requirements are identified using material requirements and resource productivity information from recently completed outages. These resource costs are aggregated to determine total outage OM&A requirements. However, even with planning using best practices, unforeseen equipment conditions discovered during outages may result in additional outage scope and cost.

The completion of specific outages requires both base resources and incremental resources. OM&A base resources (i.e., Regular, Term and Extended Temporary Employee ("ETE") staff labour) in the stations or in Operations and Project Support that work on outages are captured in base OM&A. The cost of incremental resources in support of outage execution, and the cost of Inspection and Reactor Innovation ("IRI") Regular, Term and ETE staff labour, is captured in outage OM&A. This is because the primary function of IRI is to support outage execution.

The costs associated with the completion of projects undertaken during an outage are captured in either project OM&A or project capital, as applicable to the specific project.

The incremental resource types associated with resources utilized during outages are as follows:

- Non-Regular Labour: additional non-regular staff directly supervised by OPG staff (typically trade workers such as electricians).
- Overtime: regular and non-regular staff working on overtime in support of outage execution.

- Augmented Staff: contractors directly supervised by OPG staff (typically engineers and assessors).
- Materials: the materials and supplies installed or consumed in outage execution.
- Other Purchased Services: contractors performing specialized inspection and maintenance work or conducting major component refurbishments.

Incremental labour is a major component in outage OM&A costs. The key consideration in assessing the need for these resources during an outage is the ability to optimize all available base work resources and skills. Planning and executing outages is an exercise in balancing regular, temporary and contractor resources. Regular staff is utilized to the greatest extent possible in order to execute complex work assignments while maintaining the outage schedule. However, the availability of regular maintenance staff for outage work needs to be assessed relative to the following:

- the demand for regular maintenance staff to meet the ongoing maintenance requirements of the operating units; and,
- the demand and available skill set for peak staff resources to complete the outage scope within the outage schedule and budget.

OPG uses staffing resources such as overtime or other purchased services (e.g., contractors), where appropriate, during outages. Due to the peaking nature of outage work, it is more cost effective to use incremental staffing than to maintain permanent outage staff in the base organization. Overtime is particularly useful during planned outages when base resources are insufficient to meet all of the scheduled work. The selection of which labour resource option to employ is an ongoing resource optimization and balancing process of available fleet resources and depends on the specific circumstances driving the need for labour resources. Use of contractors or other temporary staff instead of overtime during an outage can be constrained by collective agreements. However, the nature of the activity may mandate the use of external, highly specialized contractors or original equipment manufacturer expertise.

OPG's use of staffing resources to complete outage work activities provides important resource flexibility and is consistent with industry best practices.

4.0 OUTAGE OM&A COST DRIVERS

4.1 Factors Driving Outage Costs

Outage OM&A is directly impacted by outage scope and the number of outages and related outage days.

The scope of outage work varies from year to year, reflecting station-specific inspection and maintenance activities as well as unit-specific requirements reflecting the operating life history or specific issues for a particular unit. The cost forecast and schedule are based on actual experience from previous outages and incorporation of improvements in execution efficiency where possible. Similar outage activities (e.g., unit shut down and start up windows) are benchmarked to ensure that the benefits of process improvements and efficiencies are incorporated.

Since units do not necessarily age in a uniform way or at a uniform rate, it is highly unlikely that the outage scope for a particular unit in a certain year of operation will precisely match the outage scope for a different unit in the same year of its operation. While there are many standard elements included in the outage scope, there can also be unique activities, programs or major equipment campaigns that are unit-specific. An example is the need for a single fuel channel replacement or station-specific initiatives such as the extra outage work required in support of Pickering Optimized Shutdown or the Fuel Channel Life Extension project.

Other factors that drive outage scope include:

- Results from ongoing outage inspection and maintenance work, which could influence the scope of work planned for future outages, even if the future outages are at a different unit or station.
- New or evolving CNSC regulatory requirements which may influence outage scope and cost.

- Operational information shared within the nuclear industry that provides OPG with information about potential emerging issues, which may require additional inspections in future outages to assess the impact of the emergent issue on OPG's nuclear units.

In addition to outage scope, outage OM&A cost is impacted by the number of units in outage. The following provides further background on the nature and timing of these outages.

Darlington units are on a three year outage cycle, but are currently impacted by the refurbishment schedule. As a result, outage OM&A expenditures reflect two regular planned outages in 2021,[1] one regular planned outage in each of 2023 and 2025, and no regular planned outages in 2020, 2022, 2024 and 2026. In addition, as noted above, the units laid up during refurbishment (e.g., Unit 3 during 2020-2023) will be subject to Cyclical Outages. The work activities and associated outage OM&A expenditures for Cyclical Outages are in addition to and separate from the refurbishment of the units.

Darlington's Unit 2, Unit 3 and Unit 1 are scheduled for a combined six short, post-refurbishment planned outages in 2021-2026 following return to service. These post refurbishment outages will address equipment issues that are expected to arise after the refurbishment is complete and the unit has resumed operations (Ex. E2-1-1, Section 2.0).

Pickering units are transitioning to a 30 month planned outage cycle, such that there can be either two or three units in outage each year (Ex. E2-1-1, Section 3.2). Outage OM&A expenditures reflect two planned outages at Pickering in 2021, 2022 and 2024, and three planned outages in 2020 and 2023. With the planned shutdown of Pickering in 2024/2025, there are no regular planned outages in 2025.

Outage OM&A costs are significantly impacted by scheduled outages to inspect the station negative pressure containment systems or VBO. For Pickering, outage OM&A expenditures

[1] As a result of the deferred DRP schedule, OPG moved an outage from 2020 to 2021 and also added a regular planned outage in 2021 to support Unit 4 operation until its start of refurbishment. See Ex. E2-1-2 for further discussion.

reflect a station-wide VBO scheduled for 2022 as discussed at Ex. E2-1-1, including preliminary costs for preparatory work in 2020 and 2021.

For Darlington, prior to 2015, a station-wide four-unit VBO was required every 12 years and a Station Containment Outage ("SCO") every six years. A SCO also required that all four units be shut down, but for a shorter duration. However, OPG was successful in obtaining CNSC consent to implement a 12 year VBO/SCO cycle versus continuing with a 12 year VBO/6 year SCO cycle. In 2015, the Darlington VBO that was scheduled for 2021 was brought forward and combined with the SCO. The next VBO/SCO is scheduled in 2027, so there is no VBO or SCO scheduled at Darlington during the IR term or refurbishment period, although Darlington's outage OM&A expenditures in 2025 and 2026 include preliminary costs for preparatory work for the 2027 VBO/SCO.

Pickering will be undertaking incremental outage days and incurring outage costs to enable Pickering Extended Operations and the Pickering Optimized Shutdown to ensure Pickering units are fit for service until 2024/2025. There are also ongoing costs associated with the Fuel Channel Life Extension project, including for work activities to confirm that Darlington units can safely operate until the scheduled refurbishment start date for Darlington Unit 4. Outage OM&A includes expenditures for incremental planned outage scope including maintenance and inspection of pressure tubes, steam generators, feeders, balance of plant components, IRI tooling, and fuel channel work (including fueling machine maintenance). Outage OM&A will also include expenditures for work performed on spacer location and relocation, additional steam generator water-lancing and feeder replacements.

4.2 Outage Efficiency Improvements

Outage improvement has been the focus of OPG's prior gap closure initiatives (see Ex. F2-1-1, Attachment 1). Based on the results achieved, the outage improvement initiative was successfully closed out in 2019 with the outage shift schedule initiative item being incorporated into the Right Work, Right Time, Right Value initiative (Ex. F2-1-1).

OPG seeks continuous improvement in outage planning and execution to ensure that the required outage work is conducted at the lowest achievable cost. Key areas targeted for continuous improvement are outage preparedness through improved planning and execution of work, including improved outage scheduling, operations performance and resource planning.

5.0 MANAGEMENT OF OUTAGE COSTS

Treatment of outage costs varies with the nature of the costs and whether they are actual or forecast costs, as described below.

5.1 Forecast Outage OM&A (Bridge Year, IR Term)

The outage OM&A forecast does not include a budget for forced outages, planned derates or forced derates, as OPG typically does not use incremental non-regular labour or augmented staff for these events. When such situations arise, base work resources are re-prioritized to focus existing regular staff on returning the unit to full-power operation as quickly as possible.

5.2 Actual Outage OM&A (Historical Period)

Actual outage OM&A costs include the incremental costs of the planned outages and the cost of IRI staff. Actual outage OM&A costs also include costs due to forced extensions of planned outages, planned outage extensions, or unbudgeted planned outages.

Actual outage OM&A costs do not include costs incurred due to forced outages, planned derates or forced derates. These costs are recorded in base OM&A.

A summary of the treatment of actual and forecast outage costs is provided in Chart 1 below.

Chart 1

Treatment of Outage Forecasts and Actual Costs

	Forecast Cost	**Actual Cost**
Planned Outages	Outage OM&A	Outage OM&A
Unplanned Outage Costs		
Forced Extensions to Planned Outages	Not in Forecast	Outage OM&A
Planned Outage Extensions	Not in Forecast	Outage OM&A
Unbudgeted Planned Outages	Not in Forecast	Outage OM&A
Forced Outages	Not in Forecast	Base OM&A
Forced Derates	Not in Forecast	Base OM&A
Planned Derates	Not in Forecast	Base OM&A