

OUTAGE OM&A – NUCLEAR

1.0 PURPOSE

This evidence presents nuclear outage OM&A costs for the period 2010 - 2015.

2.0 OVERVIEW

Outage OM&A costs vary year over year depending on the number and scope of outages in a given year and therefore cannot be trended over time, as shown in Table 1 below. The test period outage OM&A expense of \$262.7M in 2014 and \$330.7M in 2015 forms part of the OM&A expense in the nuclear revenue requirement.

Actual and forecast outage OM&A costs over the period 2010 - 2015 primarily reflect:

- Preparatory work in 2013 and 2014 for a planned 2015 Darlington Vacuum Building Outage ("VBO") followed by the 4 unit VBO outage in 2015.
- The completion of Pickering Units 5-8 Continued Operations at the end of 2014.
- The addition of mid-cycle outages for Pickering Units 1 and 4 over the period 2012 - 2014 to accelerate reliability work execution.

Table 1 below shows outage OM&A costs over the period 2010 - 2015, along with the number of planned outages

Table 1
Outage Costs and Frequency

	2010	2011	2012	2013	2014	2015
Outage Costs (\$ millions)	278.2	215.0	214.3	311.0	262.7	330.7
Darlington Unit Outages	2 Units	1 Unit	1 Units	2 Units	1 Unit	1 Unit
Darlington Station Outages				VBO Preparation	VBO Preparation	4 Units VBO Execution
Pickering Unit Outages	3 Units	3 Units	3 Units	3 Units	3 Units	3 Units
Pickering Station Outages	6 Units VBO Execution					
Pickering Mid-Cycle Outages			Unit 1	Unit 4	Unit 1	

OPG is continuing with its Outage Improvement Initiative (Ex.F2-1-1) to increase the efficiency of planned outage work as part of a program to achieve the production and value for money targets in the business plan. Some notable successes in reducing length and cost of outages include improved outage production effectiveness and improved outage scope control are 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 plans and outage schedule for each station as part of the Nuclear Generation and Outage Plan ('Generation Plan'), which is discussed in detail at 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 by year necessary to ensure the continued safe, reliable, long-term operation of the plant and in compliance with 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 planned outage scheduled under the Generation Plan.

Work activities are planned at a detailed level; 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 under with the best planning, unforeseen equipment conditions discovered during outages may result in additional scope and cost.

The completion of specific outages requires both base resources and incremental resources. The cost of these incremental resources in support of outage execution is captured in outage OM&A as is the cost of Inspection and Maintenance Services (IMS) regular staff labour. This is because the primary function of IMS is to support outage execution. OM&A base resources (i.e., regular staff labour) in the stations or in the Nuclear support divisions that work in outages are captured in base OM&A.

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 resource types associated with these incremental resources are as follows:

- Non-Regular Labour: additional non-regular staff directly supervised by OPG staff (typically construction labour or trade workers such as electricians).

- 1 • Overtime: the costs for regular and non-regular staff working on overtime in support
- 2 of outage execution.
- 3 • Augmented Staff: contractors directly supervised by OPG staff (typically, engineers,
- 4 assessors).
- 5 • Materials: the materials and supplies installed or consumed in outage execution.
- 6 • Other Purchased Services: the cost of contractors performing specialized inspection
- 7 and maintenance work or conducting major component refurbishments.

8
9 For 2010 and 2011, the Nuclear Stations' Other Purchased Services included the cost for
10 work performed by OPG's Inspection and Maintenance Services ("IMS") division in support of
11 outage execution. For 2012 and thereafter, IMS costs are separately identified as part of
12 outage services provided by the Nuclear Support divisions.

13
14 A major component in outage OM&A costs is incremental labour. The key consideration in
15 assessing incremental resources during an outage is the ability to optimize all available base
16 work resources and skills. Planning and executing outages is a balance of regular, temporary
17 and contractor resources. Regular staff is utilized to the greatest extent possible in order to
18 execute complex work assignments while maintaining the outage schedule. However, the
19 availability of regular maintenance staff for outage work has to be assessed relative to:

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

24
25 OPG uses incremental staffing resources such as overtime or other purchased services (e.g.
26 contractors) during outages because it is more cost effective than maintaining permanent
27 outage staff in its base organization. Overtime is particularly useful during planned outages
28 when base resources are insufficient to meet all of the scheduled work. The selection of
29 which incremental labour resource option to employ is an ongoing resource optimization and
30 balancing process and will depend on the specific circumstances driving the need for labour
31 resources at the time. Use of contractors or other temporary staff instead of overtime during

an outage can be constrained by collective agreements in certain areas. However, the nature of the maintenance activity may mandate the use of external, highly specialized contractors or original equipment manufacturer expertise.

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

4.0 OUTAGE OM&A COST DRIVERS

4.1 Factors Driving the Outage Cost Forecast

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

The scope of outage work varies year to year, reflecting station-specific inspection and maintenance activities as well as unit-specific requirements reflecting the operating life history or specific issues of a particular unit. The cost forecast is based on actual experience from previous outages and building in expected improvements in execution efficiency. Similar outage activities (e.g. unit shut down and start up windows) are benchmarked to ensure that 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; for example, the need for a single fuel channel replacement, or station-specific initiatives such as the extra outage work required in support of Pickering Continued Operations.

Some of the other factors that drive outage scope include:

- The 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 add to outage scope and cost.

- Operational information shared within the nuclear industry that provides OPG with information about potential emerging issues, that necessitates additional inspections in future outages to assess the extent with which the emergent issue impacts OPG's nuclear units.

In addition to outage scope, outage OM&A cost is impacted by the number of unit outages. Table 1 above presents the unit outages in the 2010 – 2015 period.

Darlington units are on a 3 year outage cycle. As a result, there are two unit outages in 2010, and again in 2013. Pickering units are on a 2 year planned outage cycle, such that there are generally three units in outage each year. In addition, to increase reliability for Units 1 and 4, mid-cycle outages were added from 2012 to 2014.

Finally, outage OM&A costs are significantly impacted by scheduled outages to inspect the station negative pressure containment systems. For Pickering, a station-wide Vacuum Building Outage (VBO) is required every 10 years, with the most recent occurring in 2010. For Darlington, a station-wide 4 unit VBO is required every 12 years and a Station Containment Outage (SCO) every 6 years. A SCO also requires that all 4 units be shut down, but for a shorter duration. A Darlington VBO was last conducted in 2009. The next planned Darlington VBO scheduled for 2021 has been moved forward to 2015, eliminating the need for a scheduled station containment outage in 2015. OPG is seeking CNSC regulatory approval to eliminate the need for SCO's going forward. This will change the requirement of a 4 unit station outage at Darlington from a 6 year cycle to a 12 year cycle. This change will result in savings in planned outage days in 2012 and beyond and will reduce complexity and resource demand during the Darlington Refurbishment project.

Preparatory work for the 2015 VBO outage is required in 2013 - 2014 and the costs of this preparatory work is a component of 2013 - 2014 outage OM&A.

4.2 Outage Improvement Initiatives

OPG continuously seeks improvement in outage planning and execution to ensure that the required outage work is conducted at the lowest achievable cost. Outage Improvement is

one of OPG's gap closure initiatives (see Ex. F2-2-1). Key areas targeted are: improving work execution efficiency (i.e., daily task rate); improving outage scope control and improving inspection tooling.

Some notable successes to-date have been:

- Work execution efficiency has improved by approximately 20 per cent (2009 - 2012) as measured by the daily average task rate.
- Scope control is a process that ensures rigorous and timely identification of outage scope ahead of a planned scope freeze date as well as formal control of outage scope following scope freeze. Maintaining effective scope control is essential to achieving a successful outage. Improving OPG's ability to pre-plan and to assess the level of work and resources required (including long lead time times for material) by the scope freeze milestone date reduces scope and planning churn thus reducing delays and higher potential costs in the outage. Outage scope variance (i.e., additions and deletions to planned work orders), from the scope freeze milestone date to the start of the outage has reduced from 42 per cent in 2009 to 15 per cent in 2012, resulting in reduced outage preparation costs.
- Inspection tool improvements under the direction of OPG's Inspection & Maintenance Services group have resulted in a savings of 3 to 4 days per outage.

5.0 MANAGEMENT OF OUTAGE COSTS

Treatment of outage costs varies with the nature of the costs.

5.1 Forecast Outage OM&A (Bridge Year, Test Period)

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 the situation arises, base work resources are re-prioritized in these circumstances 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.

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 Table 2 below:

Table 2
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