

OUTAGE OM&A – NUCLEAR

1.0 PURPOSE

This evidence presents nuclear operations outage OM&A costs for the period 2013 - 2021.

2.0 OVERVIEW

Outage OM&A costs vary year over year depending on the number and scope of outages and therefore cannot be trended over time. Chart 1 below shows the cost, frequency and nature of nuclear outages during the 2013 to 2021 period. The test period outage OM&A expense is \$394.6M in 2017, \$393.8M in 2018, \$415.3M in 2019, \$394.4M in 2020 and \$308.5M in 2021, and forms part of the OM&A expense in the nuclear revenue requirement.

Outage OM&A costs over the test period primarily reflect the following:

- Outage OM&A costs to complete Darlington unit outages for the three year planned outage schedule for routine inspection and maintenance. This includes outage costs for units laid up during refurbishment (e.g., Unit 2 during 2016-2020), which will be subject to inspection and maintenance activities over the period 2017-2019 associated with a planned outage in accordance with OPG's aging and life cycle management programs, in addition to and separate from the refurbishment of the units. The outage work in 2017-2019 effectively replaces two scheduled planned outages for Unit 2 in 2016 and 2019 which would otherwise have been undertaken absent Unit 2 refurbishment.
- Darlington Unit 2 is scheduled to return to service in February 2020 following refurbishment. OPG has scheduled two post refurbishment mini planned outages to address any issues expected to arise after the major refurbishment is complete and the unit has resumed operations.
- Outage OM&A costs to complete Pickering unit outages for the two year planned outage schedule for routine inspection and maintenance. The cost for each of the planned outages for the period 2017-2020 also includes the additional scope added for Pickering Extended Operations which is required to enable Pickering's operation to 2022/2024. In addition, the Unit 7 outage in 2020 is being undertaken solely for

Pickering Extended Operations. The outage OM&A costs for Pickering Extended Operations are set out in Chart 2 below.

Chart 1

Outage Frequency and Outage Costs 2013-2021

DESCRIPTION	2013 Actual	2014 Actual	2015 Actual	2016 Budget	2017 Plan	2018 Plan	2019 Plan	2020 Plan	2021 Plan
Darlington Unit Outages [1]	Unit 2; Unit 4	Unit 1	Unit 3 & Unbudgeted Unit 1	Unit 4	Unit 1	Unit 3	Unit 4	Unit 1	None
Darlington Station Outages	VBO Preparation	VBO Preparation	Units 1-4 VBO Execution	None	None	None	None	None	None
Darlington Refurbishment Outages	None	None	None	Unit 2	Unit 2	Unit 2	Unit 2	Unit 2; Unit 3	Unit 3; Unit 1
Darlington PHT Pump Replacement Mini Outages				Unit 3	Unit 3; Unit 4	Unit 1; Unit 4	Unit 1	Unit 4	Unit 4
Darlington Post Refurbishment Outages	None	None	None	None	None	None	None	Unit 2	Unit 2
Pickering Unit Outages	Unit 1 (extended from 2012 [2]) Unit 5, 6	Unit 4,7,8	Unit 1, 5, 6 & Unbudgeted Unit 1, 8	Unit 4,7,8	Unit 1,5,6	Unit 4,7,8	Unit 1,5,6	Unit 4,7,8 [3]	Unit 1,5,6
Pickering Station Outages	None	None	None	None	None	None	None	VBO Preparation	Units 1-6 VBO
Pickering Mid-cycle Outages	Unit 4	None	None	Unit 1	Unit 4	Unit 1	Unit 4	Unit 1	None
Outage Costs (\$Millions)	277.5	221.3	313.7	321.2	394.6	393.8	415.3	394.4	308.5

[1] Unit 2 will be subject to inspection and maintenance activities over the period 2017-2019 associated with a planned outage in accordance with OPG's aging and life cycle management programs, in addition to and separate from the refurbishment of the units.

[2] The Unit 1 outage was extended from 2012 into 2013 due to a fire in the Lube Oil Purifier system, resulting in the 2013 scheduled Unit 4 outage being shifted into 2014.

[3] The scope for the Unit 7 outage in 2020 is limited as it is solely for Pickering Extended Operations and therefore excludes "typical" planned outage.

Chart 2

Pickering Extended Operations Outage OM&A 2017-2020

Line No.	Cost Item	2017	2018	2019	2020	Total	Reference
		(a)	(b)	(c)	(d)	(e)	(f)
1	Pickering Station	12.2	11.6	20.8	22.8		Ex. F2-4-1 Table 1
2	Nuclear Support Divisions	9.9	25.7	67.9	62.8		Ex. F2-4-1 Table 1
3	Total Outage OM&A	22.1	37.3	88.7	85.6	233.7	

1 Additional details describing the drivers for the schedule provided in Chart 2 are provided in
2 section 4.1 below.

3
4 OPG continues to pursue Outage Improvement Initiatives (see Ex. F2-1-1 Section 3.5) to
5 increase the efficiency of planned outage work as part of a program to achieve the
6 production and value for money targets in the business plan.

8 **3.0 OUTAGE OM&A PLANNING AND RESOURCING**

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

12
13 Planned outages also give OPG an opportunity to perform systems and equipment
14 upgrades, configuration changes, and other improvements and modifications.

16 **3.1 Outage Scope and Duration Planning**

17 The nuclear outage OM&A budget is derived in conjunction with the development of the
18 approved generation plan and outage schedule for each station as part of the Nuclear
19 Generation and Outage Plan ("Generation Plan"), which is discussed in Ex. E2-1-1. The
20 Generation Plan, by reference to the station's life cycle management plan, establishes the
21 number, frequency and duration of the outages for each year that are required to ensure the
22 continued safe, reliable, long-term operation of the plant and ensure that it is in compliance
23 with Canadian Nuclear Safety Commission ("CNSC") regulatory requirements.

25 **3.2 Outage Resource Planning**

26 The Nuclear outage resource plan is established and costed on the basis of the work
27 activities required to execute each planned outage scheduled under the Generation Plan.

28
29 Work activities are planned at a detailed level, and resource requirements are identified
30 using material requirements and resource productivity information from recently-completed
31 outages. These resource costs are aggregated to determine total outage OM&A

1 requirements. However, even with planning using best practices, unforeseen equipment
2 conditions discovered during outages may result in additional outage scope and cost.

3
4 The completion of specific outages requires both base resources and incremental resources.
5 OM&A base resources (i.e., regular staff labour) in the stations or in the Nuclear support
6 divisions that work on outages are captured in base OM&A. The cost of incremental
7 resources in support of outage execution, and the cost of Inspection and Maintenance
8 Services ("IMS") regular staff labour, is captured in outage OM&A. This is because the
9 primary function of IMS is to support outage execution.

10
11 The costs associated with the completion of projects undertaken during an outage are
12 captured in either project OM&A or project capital, as applicable to the specific project.

13
14 The resource types associated with resources utilized during outages are as follows:

- 15 • Non-Regular Labour: additional non-regular staff directly supervised by OPG staff
16 (typically construction labour or trade workers such as electricians).
- 17 • Overtime: regular and non-regular staff working on overtime in support of outage
18 execution.
- 19 • Augmented Staff: contractors directly supervised by OPG staff (typically engineers and
20 assessors).
- 21 • Materials: the materials and supplies installed or consumed in outage execution.
- 22 • Other Purchased Services: contractors performing specialized inspection and
23 maintenance work or conducting major component refurbishments.

24
25 Outage-related IMS costs are separately identified as part of outage services provided by the
26 Nuclear Support divisions.

27
28 Incremental labour is a major component in outage OM&A costs. The key consideration in
29 assessing the need for resources during an outage is the ability to optimize all available
30 base work resources and skills. Planning and executing outages is an exercise in balancing
31 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 the Outage Cost Forecast for 2017-2021

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

1 efficiency where possible. Similar outage activities (e.g., unit shut down and start up
2 windows) are benchmarked to ensure that the benefits of process improvements and
3 efficiencies are incorporated.

4
5 Since units do not necessarily age in a uniform way or at a uniform rate, it is highly unlikely
6 that the outage scope for a particular unit in a certain year of operation will precisely match
7 the outage scope for a different unit in the same year of its operation. While there are many
8 standard elements included in the outage scope, there can also be unique activities,
9 programs or major equipment campaigns that are unit-specific. For example, the need for a
10 single fuel channel replacement or station-specific initiatives such as the extra outage work
11 required in support of Pickering Extended Operations.

12
13 Other factors that drive outage scope include:

- 14 • The results from ongoing outage inspection and maintenance work, which could
15 influence the scope of work planned for future outages, even if the future outages
16 are at a different unit or station.
- 17 • New or evolving CNSC regulatory requirements which may influence outage scope
18 and cost.
- 19 • Operational information shared within the nuclear industry that provides OPG with
20 information about potential emerging issues, which necessitates additional
21 inspections in future outages to assess the the impact of the emergent issue on
22 OPG's nuclear units.

23
24 In addition to outage scope, outage OM&A cost is impacted by the number of unit outages.
25 Chart 2 above presents the unit outages in the 2013-2021 period, and the following provides
26 further background on the nature and timing of these outages.

27
28 Darlington units are on a three year outage cycle. As a result, outage OM&A expenditures
29 reflect two planned outages in 2013 but one planned outage in 2014, in 2015, and for each
30 year during refurbishment. In addition, the units laid up during refurbishment (e.g., Unit 2
31 during 2016-2020 and Unit 3 during 2020-2021) will be subject to inspections associated with

1 a planned outage (cyclical outages) in accordance with OPG's aging and life cycle
2 management programs. These work activities and associated outage OM&A expenditures
3 are in addition to and separate from the refurbishment of the units.

4
5 Darlington's Unit 2 is also scheduled for two abbreviated post refurbishment planned outages
6 in 2020 and 2021 following return to service. These post refurbishment outages will address
7 any issues that arise after the major refurbishment is complete and the unit has resumed
8 operations (e.g., address regulatory requirements for baseline inspections, warranty work)
9 (see Ex. E2-1-1 section 2.0). In addition, Darlington has scheduled eight mini outages during
10 2016-2021 for the purpose of Primary Heat Transport pump replacement. There were no
11 budgeted outage costs for these mini outages, as the work activities will be funded through
12 capital expenditures (Project #73566/80144 as described in Ex. D2-1-3).

13
14 Pickering units are on a two year planned outage cycle, such that there are generally three
15 units in outage each year. In addition, mid-cycle outages were added for Pickering Units 1
16 and 4 in each year from 2013 to 2021 to increase reliability. OPG does not budget outage
17 costs for mid-cycle outages, as the work activities can be undertaken by resources funded
18 within base OM&A.

19
20 Outage OM&A costs are significantly impacted by scheduled outages to inspect the station
21 negative pressure containment systems, or Vacuum Building Outages ("VBO"). For
22 Pickering, a station-wide VBO is required every 11 years, with the most recent occurring in
23 2010 and the next scheduled for 2021. Pickering's outage OM&A expenditures in 2020
24 include costs for preparatory work for the 2021 VBO and the outage OM&A forecast in 2021
25 includes expenditures associated with a six unit VBO.

26
27 For Darlington, prior to 2015 a station-wide four unit VBO was required every 12 years and a
28 Station Containment Outage ("SCO") every six years. A SCO also requires that all four units
29 be shut down, but for a shorter duration. However, OPG was successful in obtaining CNSC
30 consent to implement a 12 year VBO/SCO cycle versus continuing with a 12 year VBO/6
31 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 test period or refurbishment period. In addition to the positive payback by adopting a 12 year VBO/SCO cycle, the elimination of the VBO in 2021 has an additional benefit when Darlington is scheduled to have two units in refurbishment by reducing complexity and resource demands. The elimination of the 2021 Darlington VBO also minimizes potential conflicts and complications with the Pickering VBO scheduled in 2021.

Pickering will be undertaking incremental outage days and work activities in 2017-2020 to enable Pickering Extended Operations and ensure Pickering units are fit for service until 2022/2024 (see Chart 2). Outage OM&A includes expenditures for incremental planned outage scope including maintenance and inspection of pressure tubes, steam generators, feeders, 'balance of plant' components, Inspection and Maintenance Services tooling, and fuel channel work (including fueling machine maintenance). Outage OM&A will also include expenditures for work performed on spacer location and relocation work, additional steam generator water-lancing and feeder replacements

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. F2-1-1 section 3.5). Key areas targeted for improvement are outage preparedness through improved planning and execution of outage work, including the following:

- Improve outage scheduling, operations performance and resource planning
- Preliminary review of outage cycle at Pickering
- Implement execution improvements within IMS
- Life Cycle Management plan development improvements
- Implement outage model template
- Develop and implement a long term purchased services and vendor quality strategy

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, 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 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. 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 3 below.

Chart 3
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

Numbers may not add due to rounding.

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Exhibit F2
Tab 4
Schedule 1
Table 1

Table 1
Outage OM&A - Nuclear (\$M)

Line No.	Division	2013 Actual	2014 Actual	2015 Actual	2016 Budget	2017 Plan	2018 Plan	2019 Plan	2020 Plan	2021 Plan
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
	Nuclear Stations									
1	Darlington NGS	95.7	56.4	123.8	89.3	131.1	120.7	113.4	145.4	53.1
2	Pickering NGS	77.6	83.0	97.4	116.2	121.3	125.6	120.6	90.5	158.7
3	Pickering Continued Operations	10.2	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	Pickering Extended Operations	0.0	0.0	0.0	0.0	12.2	11.6	20.8	22.8	0.0
5	Total Stations	183.5	143.1	221.2	205.5	264.6	257.9	254.8	258.7	211.8
6	Nuclear Support Divisions^{1,2}	94.0	78.2	92.5	115.7	129.9	135.8	160.5	135.7	96.7
7	Total Outage OM&A	277.5	221.3	313.7	321.2	394.6	393.8	415.3	394.4	308.5

Notes:

1 Nuclear Support Divisions includes Outage OM&A expenditures for Pickering Continued Operations of \$10.5M in 2013 and \$10.7M in 2014.

2 Nuclear Support Divisions includes Outage OM&A expenditures for Pickering Extended Operations of \$9.9M in 2017, \$25.7M in 2018, \$67.9M in 2019 and \$62.8M in 2020.

Table 2
Outage OM&A by Resource Type - Nuclear (\$M)
Bridge Year and Test Period

Line No.	Division	Labour	Non-Regular Labour	Overtime	Augmented Staff	Materials	Other Purchased Services	Other	Total Outage OM&A
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
	Budget - Year Ending December 31, 2016								
	Nuclear Stations:								
1	Darlington NGS	0.0	11.1	14.6	3.8	19.3	40.0	0.6	89.3
2	Pickering NGS	0.0	6.6	18.7	0.0	20.6	70.3	0.0	116.2
3	Pickering Extended Operations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	Total Stations	0.0	17.7	33.3	3.8	39.9	110.3	0.6	205.5
5	Nuclear Support Divisions	29.2	19.4	17.3	20.6	9.9	19.0	0.3	115.7
6	Total Outage OM&A	29.2	37.1	50.5	24.4	49.8	129.2	0.9	321.2
	Plan - Year Ending December 31, 2017								
	Nuclear Stations:								
7	Darlington NGS	0.0	14.3	15.8	2.5	18.5	79.9	0.0	131.1
8	Pickering NGS	0.0	12.3	21.2	0.0	22.7	65.2	0.0	121.3
9	Pickering Extended Operations	0.0	0.0	0.0	0.0	0.0	12.2	0.0	12.2
10	Total Stations	0.0	26.6	36.9	2.5	41.2	157.3	0.0	264.6
11	Nuclear Support Divisions¹	28.9	16.3	17.6	20.4	7.7	38.8	0.3	129.9
12	Total Outage OM&A	28.9	42.9	54.5	22.9	48.9	196.1	0.3	394.6
	Plan - Year Ending December 31, 2018								
	Nuclear Stations:								
13	Darlington NGS	0.0	14.5	16.5	2.5	22.1	65.0	0.0	120.7
14	Pickering NGS	0.0	12.5	21.1	0.0	22.6	69.4	0.0	125.6
15	Pickering Extended Operations	0.0	0.0	0.0	0.0	0.0	11.6	0.0	11.6
16	Total Stations	0.0	27.0	37.6	2.5	44.7	146.1	0.0	257.9
17	Nuclear Support Divisions¹	27.6	16.9	15.1	17.3	6.3	52.4	0.2	135.8
18	Total Outage OM&A	27.6	43.9	52.8	19.8	51.0	198.5	0.3	393.8
	Plan - Year Ending December 31, 2019								
	Nuclear Stations:								
19	Darlington NGS	0.0	14.6	15.6	2.6	19.6	61.0	0.0	113.4
20	Pickering NGS	0.0	12.6	20.2	0.0	22.6	65.2	0.0	120.6
21	Pickering Extended Operations	0.0	0.0	0.0	0.0	0.0	20.8	0.0	20.8
22	Total Stations	0.0	27.3	35.8	2.6	42.2	147.0	0.0	254.8
23	Nuclear Support Divisions¹	21.0	17.5	19.8	11.5	4.7	85.5	0.5	160.5
24	Total Outage OM&A	21.0	44.8	55.6	14.1	46.9	232.5	0.5	415.3
	Plan - Year Ending December 31, 2020								
	Nuclear Stations:								
25	Darlington NGS	0.0	14.7	17.2	2.0	25.0	86.5	0.0	145.4
26	Pickering NGS	0.0	5.4	6.7	0.0	4.6	73.8	0.0	90.5
27	Pickering Extended Operations	0.0	0.0	0.0	0.0	0.0	22.8	0.0	22.8
28	Total Stations	0.0	20.1	23.9	2.0	29.6	183.0	0.0	258.7
29	Nuclear Support Divisions¹	15.7	14.0	14.9	9.3	2.1	79.6	0.2	135.7
30	Total Outage OM&A	15.7	34.1	38.8	11.3	31.7	262.6	0.2	394.4
	Plan - Year Ending December 31, 2021								
	Nuclear Stations:								
31	Darlington NGS	0.0	1.0	3.3	1.2	2.9	44.8	0.0	53.1
32	Pickering NGS	0.0	12.6	8.2	0.0	9.0	128.9	0.0	158.7
33	Pickering Extended Operations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	Total Stations	0.0	13.6	11.5	1.2	11.9	173.6	0.0	211.8
35	Nuclear Support Divisions	12.0	8.5	5.0	0.0	0.1	71.1	0.0	96.7
36	Total Outage OM&A	12.0	22.1	16.5	1.2	12.0	244.7	0.0	308.5

Notes:

- 1 Nuclear Support Divisions includes Outage OM&A expenditures for Pickering Extended Operations of \$9.9M in 2017, \$25.7M in 2018, \$67.9M in 2019 and \$62.8M in 2020.

Table 3
Outage OM&A by Resource Type - Nuclear (\$M)
Historic Years

Line No.	Division	Labour	Non-Regular Labour	Overtime	Augmented Staff	Materials	Other Purchased Services	Other	Total Outage OM&A
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
	Budget - Year Ending December 31, 2013								
	Nuclear Stations:								
1	Darlington NGS	0.0	13.3	25.8	0.6	21.1	35.8	0.2	96.9
2	Pickering NGS	0.0	10.2	27.3	0.0	20.9	31.3	0.1	89.7
3	Pickering Continued Operations	0.0	0.6	1.1	0.0	5.3	1.3	0.0	8.3
4	Total Stations	0.0	24.1	54.2	0.6	47.3	68.4	0.3	194.9
5	Nuclear Support Divisions	23.1	10.2	25.1	27.2	10.7	18.2	1.5	116.1
6	Total Outage OM&A	23.1	34.4	79.3	27.8	58.0	86.6	1.8	311.0
	Actual - Year Ending December 31, 2013								
	Nuclear Stations:								
7	Darlington NGS	0.0	12.4	30.3	0.0	23.5	28.4	1.0	95.7
8	Pickering NGS	0.0	5.1	25.2	0.0	21.6	25.2	0.6	77.6
9	Pickering Continued Operations	0.0	0.4	2.1	0.0	5.9	1.8	0.0	10.2
10	Total Stations	0.0	18.0	57.6	0.0	51.0	55.4	1.6	183.5
11	Nuclear Support Divisions¹	16.8	10.8	28.6	15.6	10.2	11.7	0.2	94.0
12	Total Outage OM&A	16.8	28.7	86.2	15.6	61.2	67.1	1.8	277.5
	OEB Approved² - Year Ending December 31, 2014								
	Nuclear Stations:								
13	Darlington NGS	0.0	10.5	14.0	2.0	14.0	25.4	0.0	65.9
14	Pickering NGS	0.0	11.0	29.4	0.0	22.1	37.6	0.0	100.1
15	Pickering Continued Operations	0.0	0.4	1.2	0.0	3.8	0.8	0.0	6.2
16	Total Stations	0.0	21.9	44.6	2.0	39.9	63.9	0.0	172.3
17	Nuclear Support Divisions	21.0	8.6	19.6	18.2	9.4	12.5	1.1	90.4
18	Total Outage OM&A	21.0	30.5	64.3	20.2	49.2	76.4	1.1	262.7
	Actual - Year Ending December 31, 2014								
	Nuclear Stations:								
19	Darlington NGS	0.0	7.7	13.8	0.4	13.0	20.9	0.6	56.4
20	Pickering NGS	0.0	8.7	20.5	0.1	19.1	33.9	0.8	83.0
21	Pickering Continued Operations	0.0	0.2	0.8	0.0	2.1	0.6	0.0	3.7
22	Total Stations	0.0	16.6	35.1	0.5	34.2	55.4	1.4	143.1
23	Nuclear Support Divisions¹	18.6	10.2	15.8	16.0	8.2	9.3	0.1	78.2
24	Total Outage OM&A	18.6	26.8	50.8	16.5	42.4	64.7	1.5	221.3
	OEB Approved³ - Year Ending December 31, 2015								
	Nuclear Stations:								
25	Darlington NGS	0.0	10.4	24.9	6.7	27.3	56.9	0.0	126.2
26	Pickering NGS	0.0	8.6	28.1	0.0	19.2	38.3	0.0	94.3
27	Pickering Continued Operations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	Total Stations	0.0	19.0	53.0	6.7	46.6	95.2	0.0	220.5
29	Nuclear Support Divisions	25.3	12.4	24.4	20.9	7.8	18.4	1.1	110.3
30	Total Outage OM&A	25.3	31.4	77.4	27.6	54.3	113.6	1.1	330.7
	Actual - Year Ending December 31, 2015								
	Nuclear Stations:								
31	Darlington NGS	0.0	10.5	18.2	0.7	27.0	65.9	1.6	123.8
32	Pickering NGS	0.0	6.4	19.6	0.2	23.7	46.4	1.1	97.4
33	Pickering Continued Operations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	Pickering Extended Operations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	Total Stations	0.0	16.8	37.8	0.8	50.8	112.3	2.6	221.2
36	Nuclear Support Divisions	20.0	13.7	15.8	25.0	6.9	11.0	0.1	92.5
37	Total Outage OM&A	20.0	30.5	53.7	25.8	57.6	123.3	2.7	313.7

Notes:

- 1 Nuclear Support Divisions includes Outage OM&A expenditures for Pickering Continued Operations of \$10.5M for 2013 Actual and \$10.7M for 2014 Actual.
- 2 As OEB Approved adjustments shown on Ex. F2-1-1 Table 2 were made at the aggregate Nuclear OM&A level, the figures presented here are 2014 Plan (from EB-2013-0321) rather than 2014 OEB Approved.
- 3 As OEB Approved adjustments shown on Ex. F2-1-1 Table 2 were made at the aggregate Nuclear OM&A level, the figures presented here are 2015 Plan (from EB-2013-0321) rather than 2015 OEB Approved.

COMPARISON OF NUCLEAR OUTAGE OM&A

1.0 PURPOSE

This evidence presents period-over-period comparisons of outage OM&A by station for 2013-2021 in support of the approval of OPG's forecast outage OM&A for the test period.

2.0 OVERVIEW

Outage OM&A costs are impacted by the frequency, duration and scope of planned outages, as well as specific outage initiatives requiring support work.

Period-over-period variances are presented in Ex. F2-4-2 Table 1 and are explained below, along with the extent to which the above factors influence outage OM&A in the 2017-2021 test period.

3.0 PERIOD-OVER-PERIOD CHANGES – TEST YEARS

2017 Plan versus 2016 Budget

2017 Plan outage OM&A expenditures increase (+\$73.3M) versus 2016 Budget. The variances are largely due to Darlington (+\$41.8M), Nuclear Support Divisions (i.e., Inspection and Maintenance Services, and Fleet Operations and Maintenance) (+\$14.2M), and Pickering Extended Operations (+\$12.2M). Darlington planned outage costs in 2017 are higher primarily due to the routine station inspection and maintenance work required on Unit 2 during the Unit 2 refurbishment outage (+\$33.2M) and increased scope in relation to generator and transformer work and Single Fuel Channel Replacement (+\$8.6M). Increases in Nuclear Support Divisions are largely due to requirements to support Pickering Extended Operations, as described in Ex. F2-2-3.

2018 Plan versus 2017 Plan

2018 Plan outage OM&A expenditures decrease (-\$0.8M) versus 2017 Plan. The decrease is due to Darlington (-\$10.4M) and largely offset by Nuclear Support Divisions (i.e., Inspection and Maintenance Services) (+\$5.9M), and Pickering (+\$4.3M). Darlington planned outage

costs in 2018 are lower due to reduced scope during the Unit 2 routine inspection and maintenance activities (-\$11.5M). Inspection and Maintenance Services planned outage costs are higher due to Pickering Extended Operations, partially offset by no Single Fuel Channel Replacement at Darlington in 2018. Pickering planned outage costs in 2018 are higher due to additional scope changes.

2019 Plan versus 2018 Plan

2019 Plan outage OM&A expenditures increase (+\$21.5M) versus the 2018 Plan. The variances are largely due to Nuclear Support Divisions (i.e., Inspection and Maintenance Services) (+\$24.6) and work activities at Pickering related to Pickering Extended Operations (+\$9.2M), partially offset by Darlington (-\$7.3M) and Pickering's remaining outage work (-\$5.0M). Inspection and Maintenance Services costs in 2019 are significantly higher due to Pickering Extended Operations. Darlington planned outage costs in 2019 are lower due to the completion of routine inspection and maintenance work required on Unit 2 and due to a Low Pressure Service Water outage not required in 2019, partly offset by the start up of routine inspection and maintenance work required on Unit 3 (the next refurbishment unit after Unit 2) (-\$5.0M). Pickering costs for remaining outage work is lower due largely to reduced turbine scope in 2019.

2020 Plan versus 2019 Plan

2020 Plan outage OM&A expenditures decrease (-\$20.9M) versus the 2019 Plan. The variances are due to lower expenditures at Pickering (-\$30.1M) and Nuclear Support Divisions (i.e., Inspection and Maintenance Services) (-\$24.7M), partially offset by higher Darlington expenditures (+\$32.0M). Inspection and Maintenance Services is lower largely due to less Pickering outage support (-\$20.5M). The higher Darlington expenditures are primarily due to the ramp up of station maintenance work required on Unit 3 during the Unit 3 refurbishment outage (+\$11.3M), Feeder and Single Fuel Channel Replacement, additional Emergency Cooling Injection overhaul work on Unit 1, and a post refurbishment mini-outage on Unit 2 (+\$20.7M). Pickering costs are lower primarily due to two outages in 2020 versus three outages in 2019.

2021 Plan versus 2020 Plan

2021 Plan outage OM&A expenditures decrease (-\$85.9M) versus the 2020 Plan. The variances are largely due to Darlington (-\$92.3M), Nuclear Support Divisions (i.e., Inspection and Maintenance Services, and Fleet Operations and Maintenance) (-\$39.0M) and Pickering Extended Operations (-\$22.8M), partially offset by higher Pickering outage costs (+\$68.1M). Darlington planned outage costs in 2021 are lower as there are no scheduled planned outages except a short post-refurbishment outage for Unit 2 and the wind down of Unit 3 station maintenance work, slightly offset by higher start up of station maintenance work required on Unit 1 during the Unit 1 refurbishment outage. Inspection and Maintenance Services, and Fleet Operations and Maintenance are lower due to the completion of Pickering Extended Operations work. Pickering outage costs are higher primarily due to the station Vacuum Building Outage and a third outage in 2021.

4.0 PERIOD-OVER-PERIOD CHANGES – BRIDGE YEAR

2016 Budget versus 2015 Actual

2016 Budget outage OM&A expenditures increase (+\$7.5M) versus 2015 Actual. The variances are for Nuclear Support Divisions (i.e., Inspection and Maintenance Services) (+\$23.2M) and Pickering (+\$18.8M), partially offset by a variance for Darlington (-\$34.5M). Inspection and Maintenance Services costs (+\$19.1M) are higher due to Single Fuel Channel Replacement at Pickering and increased support for Darlington outage work. Pickering costs are higher due to support for an increase in contractor resources working on outages. Darlington outage costs are lower as the Vacuum Building Outage was completed in 2015, partially offset by the routine station inspection and maintenance work required on Unit 2 during refurbishment.

5.0 PERIOD-OVER-PERIOD CHANGES – HISTORICAL YEARS

2015 Actual versus 2015 OEB Approved¹

¹ As OEB Approved adjustments shown on Ex. F2-1-1 Table 2 were made at the aggregate Nuclear OM&A level, the figures presented here are 2015 Plan (from EB-2013-0321) rather than 2015 OEB Approved.

2015 Actual outage OM&A decreased (-\$17.0M) versus 2015 OEB Approved. The variances were primarily in Nuclear Support Divisions (i.e., Inspection and Maintenance Services) (-\$17.7M). Inspection and Maintenance Services costs were lower as Single Fuel Channel Replacement work was re-scheduled to 2016. There was a partial offset due to higher Pickering costs (+\$3.1M) as a result of the Unit 1 planned outage shifted from 2014 into 2015 partially offset by the Unit 4 outage deferred to 2016.

2015 Actual versus 2014 Actual

Outage OM&A expenditures for 2015 Actual were higher (+\$92.4M) than 2014 Actual. The main driver of this increase was the Vacuum Building Outage at Darlington (+\$67.4M) and Vacuum Building Outage support costs incurred by Nuclear Support Divisions (i.e., Inspection and Maintenance Services, and Fleet Operations and Maintenance) (+\$14.4M). Pickering costs were also higher (+\$14.3M) partially offset by lower Pickering Continued Operations costs (-\$3.7M). Pickering costs were higher as a result of longer outage duration including additional rotor and spindle work, partially offset by the completion of all outage OM&A expenditures on Pickering Continued Operations in 2014.

2014 Actual versus 2014 OEB Approved²

2014 Actual outage OM&A expenditures were lower (-\$41.4M) than the 2014 OEB Approved amounts. The main drivers of this decrease were as follows:

- Pickering costs were lower (-\$17.1M) primarily as a result the Unit 8 outage being under spent due to scope reduction, lower overtime costs, and higher than planned efficiency gains by contract staff. In addition, outage costs were lower as the Unit 1 outage scheduled for 2014 was shifted into 2015 and replaced by a Unit 4 outage deferred from 2013. Darlington costs were lower (-\$9.5M) primarily as a result of lower than expected discovery work and use of lower cost temporary staff versus purchased services.
- Pickering Continued Operations costs were lower (-\$2.5M) primarily as a result of lower material spending.

² As OEB Approved adjustments shown on Ex. F2-1-1 Table 2 were made at the aggregate Nuclear OM&A level, the figures presented here are 2014 Plan (from EB-2013-0321) rather than 2014 OEB Approved.

- Nuclear Support Divisions costs were lower (-\$12.2M) primarily as a result of lower Inspection and Maintenance Services (-\$8.7M) due to the deferral of the Unit 1 Fall 2014 outage to first quarter 2015, and lower Projects and Modifications costs (-\$3.4M) due to lower outage requirements, where internal resources were used rather than the planned external support.

2014 Actual versus 2013 Actual

2014 Actual outage OM&A expenditures were lower (-\$56.2M) than 2013 Actual expenditures. The main drivers of this decrease were as follows:

- Darlington costs were lower (-\$39.3M) primarily as a result of one planned outage in 2014 versus two in 2013.
- Pickering Continued Operations costs were lower (-\$6.5M) primarily as a result of reduced work programs.
- Support Divisions (i.e., Inspection and Maintenance Services) costs were lower (-\$15.8M) primarily as a result of one planned outage in 2014 versus two in 2013. Demand for Inspection and Maintenance Services was lower in 2014 than 2013 (-\$14.2M). In 2013 Inspection and Maintenance Services performed a Single Fuel Channel Inspection at Darlington where none was required in 2014.
- Decreases were partially offset by Pickering (+\$5.4M) as a result of the deferral of the Pickering Unit 4 outage from fall 2013 to winter 2014.

2013 Actual versus 2013 Budget

2013 Actual outage OM&A expenditures were lower (-\$33.5M) than the 2013 Budget. The main drivers of this decrease were as follows:

- Pickering costs were lower (-\$12.1M) primarily as a result of the deferral of the Pickering Unit 4 outage from fall 2013 to winter 2014.
- Darlington costs were lower (-\$1.2M) primarily as a result of lower pre-requisite work associated with future year planned outages.
- Decreases were partially offset by Pickering Continued Operations (+\$1.9M) as a result of additional work orders completed during the outage windows, coupled with earlier staging of materials for the 2014 outage.

- 1 • Nuclear Support Divisions costs were lower (-\$22.1M) primarily as a result of lower
- 2 Inspection and Maintenance Services costs (-\$19.7M) due to the Pickering 1341
- 3 outage being executed in 2014 rather than 2013, and lower staff costs (-\$2.0M) due
- 4 to lower outage requirements where internal resources were used rather than the
- 5 planned external support.

Table 1
Comparison of Outage OM&A - Nuclear (\$M)

Line No.	Business Unit	2013 Budget	(c)-(a) Change	2013 Actual	(g)-(c) Change	2014 OEB Approved ¹	(g)-(e) Change	2014 Actual	(k)-(g) Change	2015 OEB Approved ¹	(k)-(i) Change	2015 Actual
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
	Nuclear Stations:											
1	Darlington NGS	96.9	(1.2)	95.7	(39.3)	65.9	(9.5)	56.4	67.4	126.2	(2.3)	123.8
2	Pickering NGS	89.7	(12.1)	77.6	5.4	100.1	(17.1)	83.0	14.3	94.3	3.1	97.4
3	Pickering Continued Operations	8.3	1.9	10.2	(6.5)	6.2	(2.5)	3.7	(3.7)	0.0	0.0	0.0
4	Pickering Extended Operations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	Total Stations	194.9	(11.4)	183.5	(40.4)	172.3	(29.1)	143.1	78.0	220.5	0.7	221.2
6	Nuclear Support Divisions²	116.1	(22.1)	94.0	(15.8)	90.4	(12.2)	78.2	14.4	110.3	(17.7)	92.5
7	Total Outage OM&A	311.0	(33.5)	277.5	(56.2)	262.7	(41.4)	221.3	92.4	330.7	(17.0)	313.7

Line No.	Business Unit	2015 Actual	(c)-(a) Change	2016 Budget	(e)-(c) Change	2017 Plan	(g)-(e) Change	2018 Plan	(i)-(g) Change	2019 Plan	(k)-(i) Change	2020 Plan
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
	Nuclear Stations:											
8	Darlington NGS	123.8	(34.5)	89.3	41.8	131.1	(10.4)	120.7	(7.3)	113.4	32.0	145.4
9	Pickering NGS	97.4	18.8	116.2	5.1	121.3	4.3	125.6	(5.0)	120.6	(30.1)	90.5
10	Pickering Continued Operations	0.0	(0.0)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	Pickering Extended Operations	0.0	0.0	0.0	12.2	12.2	(0.6)	11.6	9.2	20.8	2.0	22.8
12	Total Stations	221.2	(15.7)	205.5	59.2	264.6	(6.7)	257.9	(3.1)	254.8	3.9	258.7
13	Nuclear Support Divisions³	92.5	23.2	115.7	14.2	129.9	5.9	135.8	24.6	160.5	(24.7)	135.7
14	Total Outage OM&A	313.7	7.5	321.2	73.3	394.6	(0.8)	393.8	21.5	415.3	(20.9)	394.4

Line No.	Business Unit	2020 Plan	(c)-(a) Change	2021 Plan
		(a)	(b)	(c)
	Nuclear Stations:			
15	Darlington NGS	145.4	(92.3)	53.1
16	Pickering NGS	90.5	68.1	158.7
17	Pickering Extended Operations	22.8	(22.8)	0.0
18	Total Stations	258.7	(46.9)	211.8
19	Nuclear Support Divisions³	135.7	(39.0)	96.7
20	Total Outage OM&A	394.4	(85.9)	308.5

Notes:

- 1 As OEB Approved adjustments shown on Ex. F2-1-1 Table 2 were made at the aggregate Nuclear OM&A level, the figures presented here are 2014 Plan and 2015 Plan (from EB-2013-0321) rather than 2014 OEB Approved and 2015 OEB Approved, respectively.
- 2 Nuclear Support Divisions includes Outage OM&A expenditures for Pickering Continued Operations of \$10.5M for 2013 Actual and \$10.7M for 2014 Actual.
- 3 Nuclear Support Divisions includes Outage OM&A expenditures for Pickering Extended Operations of \$9.9M in 2017, \$25.7M in 2018, \$67.9M in 2019 and \$62.8M in 2020.