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1   **BUSINESS PLANNING AND BENCHMARKING - NUCLEAR**

2

3   **1.0   PURPOSE**

4   This evidence presents the business planning and benchmarking results for OPG's Nuclear

5   Operations and provides a summary of the nuclear operating costs from the 2025-2031

6   Business Plan in support of the Application.

7

8   As used in this evidence, OPG's Nuclear Operations includes Darlington, Pickering and

9   Darlington New Nuclear Program ("DNNP") facilities. As discussed in Ex. A1-4-4, DNNP LP is

10 entering into a lease for the DNNP facilities with OPG. DNNP LP will undertake the

11 development, construction, and operation of the DNNP facilities, with OPG contracted to act

12 as the project manager and operator of the facilities. The Application assumes that DNNP LP

13 enters into the lease and associated arrangements at the end of 2025. DNNP LP will not have

14 its own workforce and will contract for all applicable services with OPG, who will in turn

15 leverage its workforce and organizational infrastructure to provide such services. DNNP LP

16 will reimburse OPG for its fully allocated costs of providing the services. As such, the evidence

17 regarding OPG's Nuclear Operations supports both OPG and DNNP LP's proposed revenue

18 requirements in this Application.

19

20 In accordance with the rate-setting proposal for the regulated nuclear facilities, as described

21 in Ex. A1-3-2, forecast information for the IR term (2027-2031) is provided for all operating cost

22 exhibits and capital-related exhibits.

23

24 **2.0   OVERVIEW**

25 This Application is based on OPG's 2025-2031 Business Plan, which in respect of the

26 regulated nuclear operations was prepared reflecting the business planning process outlined

27 in Ex. A2-2-1 and Section 3.1 below. The methodology employed as part of that process is

28 unchanged from OPG's previous payment amounts application. This Application reflects

29 significant changes in OPG's Nuclear Operations, which pose unique challenges and

30 opportunities in terms of business planning and benchmarking. Highlights of OPG's 2025-2031

31 Business Plan as it pertains to Nuclear Operations include the following:

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1 • Ensuring the success of the extension of Pickering Units 5-8 to 2026, which will continue
2 to provide Ontario with a clean and reliable source of baseload power while supporting
3 summer capacity needs through to 2026 (Section 4.0).

4 • Ensuring an effective transition of OPG nuclear operations from ten-unit on-line operations
5 to four unit on-line operations (at Darlington) post-2026, until the first Pickering unit returns
6 to service in May 2031.

7 • Ensuring transition following Pickering Refurbishment Program ("PRP") to first unit coming
8 on-line on May 2031. Executing initiatives impacting "our people, our plant and our future"
9 to drive station operational performance improvements over the IR term (Section 3.4).

10 • Maintaining high standards of safety and environmental stewardship by targeting best
11 quartile performance and/or maximum Nuclear Performance Index ("NPI") points at both
12 Pickering and Darlington relative to the Company's Safety Cornerstone (Section 3.3).

13 • Improving the identification and execution of project portfolio investments to enhance
14 performance, reliability and overall value of the nuclear assets through a strengthened
15 asset management program and Enterprise Project Management Office (Ex. D2-1-1).

16 • Continue with planning and execution work in support of DNNP's facilities generating
17 station with first unit available for commercial operations in October 2030.

18 • Investing in life cycle management and other sustaining infrastructure investments at
19 Darlington and Pickering that will help to prepare stations for their second life safely and
20 reliably (Ex. D2-1-3).

21

22 Achieving success on the business plan priorities will require building and continuing on the
23 success of major programs undertaken within OPG over the past several years, which include;
24 a) The final Darlington Unit refurbishment completed and back in-service, b) safely extending
25 the life of Pickering Units 5-8 beyond its previously planned end of commercial operations date,
26 c) progressing the PRP execution including returning Unit 5 to service, applying lessons
27 learned from Darlington Refurbishment, d) best practices of the Enterprise Project
28 Management Office, which further enhance the competency and process of managing and
29 executing large project refurbishments (i.e., Darlington and Pickering), Nuclear Operations'
30 capital and OM&A projects, e) DNNP Unit 1 coming online, and f) implementing initiatives that

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1 will improve Nuclear operational performance. These completed gap closure initiatives, and

2 their results are described in Attachment 1 to this exhibit.

3

4 A summary of actual and planned operating costs over the 2020-2031 period are presented in

5 Ex. F2-1-1, Table 1a and 1b.

6

7 **3.0   NUCLEAR BUSINESS PLANNING AND BENCHMARKING**

8 **3.1   Gap-Based Business Planning Process**

9 The business planning cycle for OPG's Nuclear Operations is undertaken as part of the overall

10 OPG business planning process (Ex. A2-2-1). This cycle is focused on establishing strategic

11 and performance targets for the nuclear business, in alignment with OPG's corporate-wide

12 objectives, and identifying the initiatives and resources required to achieve these targets.

13

14 OPG Nuclear continues to use a gap-based business planning process which consists of the

15 following steps:

16 • **Performance Review**: Process of comparing nuclear performance to the previous

17   approved business plan and industry benchmarks in order to identify areas for

18   improvement.

19 • **Setting Strategic Direction**: Process of goal alignment by establishing the level of

20   performance and targets that are expected to be achieved within the business planning

21   period.

22 • **Gap Closure Planning**: Process of planning gap closure initiatives as required to achieve

23   targeted performance.

24 • **Developing Detailed Business Plan:** Process where generation, financial and staff plans

25   are developed based on the approved corporate strategic direction, performance targets,

26   priorities and resources ensuring integration with corporate business planning processes.

27 • **Performance Reporting**: Process for robust performance management reporting by

28   effectively monitoring the execution of the first year of the approved business plan with

29   careful consideration of risks, costs and execution.

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1 Once the detailed business plan is developed and approved, OPG uses operational and
2 financial measures to track its performance against target.

3

4 **3.2   Gap-Based Business Planning – Benchmarking**

5 The 2024 Nuclear Benchmarking Report (Attachment 2) shows OPG's benchmarking
6 performance against industry peers based on 2023 data and uses various indicators aligned
7 with the cornerstone values of Safety, Reliability, Value for Money and Human Performance.

8

9 The 2024 Nuclear Benchmarking Report uses the same methodology and format as the
10 previous nuclear benchmarking reports filed with the OEB based on a benchmarking initiative
11 undertaken by OPG in 2009 with the assistance of ScottMadden, Inc. ("ScottMadden"), a
12 consulting firm. OPG has, from time to time, advised the OEB of updates to its benchmarking
13 metrics that were required to reflect changes in industry reporting or other factors (e.g.,
14 amalgamation of Pickering A and Pickering B). In 2024, OPG engaged ScottMadden to
15 conduct an independent review of the 2024 Nuclear Benchmarking Report to highlight areas
16 of opportunity for better alignment with leading practices. ScottMadden has found the
17 modifications made to the 2024 report to have increased the clarity and the efficiency of the
18 report's production. The improvements to the 2024 Nuclear Benchmarking Report relative to
19 the 2020 Nuclear Benchmarking Report filed in EB-2020-0290 are as follows:

20

21 • Discontinued the "Major Operator Summary" section of the Report to support
22   ScottMadden's earlier recommendation (EB-2020-0290, Ex. F2-1-1, Attachment 3) that
23   OPG focus on site-level comparisons of performance for Pickering and Darlington rather
24   than operator-level comparisons in the future as site-to-site comparisons provide a larger
25   and more comparable data set resulting in a more robust and accurate view of OPG
26   performance relative to the industry which better informs the target-setting process.
27 • Various improvements to clarity and conciseness of the report (e.g., Executive summary in
28   the 2024 Report addresses performance cornerstones, like Reliability, rather than each
29   individual metric and discontinued unit-level analysis and plant and unit-level bar charts)
30 • Enhanced online deficient and corrective maintenance backlog reporting by including
31   current performance year and the prior five years of performance with benchmarking,

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1   creating a visual representation of the trend. The 2020 Nuclear Benchmarking Report only

2   had the current performance year.

3

4   In addition, OPG engaged ScottMadden in 2024 to ensure continued accuracy of reporting and

5   consistency with industry best practices. ScottMadden's assessment found that OPG's current

6   benchmarking methods align with previous guidance and current leading practices in the

7   industry. The evaluation found no issues with benchmarking report calculations or

8   presentations of data and the review noted that OPG's Nuclear business planning processes

9   remain consistent with established OPG governance and industry leading practice.

10   ScottMadden's assessment is filed as Attachment 3.

11

12   3.2.1   Benchmarking – Supporting Studies

13   In the EB-2016-0152 Decision and Order,[1] the OEB agreed that OPG's benchmarking

14   methodology was appropriate, with the exception of OPG's provided methodology for

15   normalizing Total Generating Cost per MWh ("TGC/MWh") for the effects of Darlington

16   Refurbishment Program ("DRP"). The OEB noted that ScottMadden had suggested that there

17   were alternative approaches to account for the impact of refurbishment on TGC/MWh and

18   indicated an expectation that OPG would file a review from ScottMadden regarding OPG's

19   nuclear benchmarking methodologies.

20

21   In prior studies, ScottMadden has identified various differences between CANDU reactors and

22   Pressurized Water Reactors and Boiling Water Reactors as well as age-related differences

23   that impact value for money performance comparisons with peers. OPG has consistently

24   identified these factors in its Benchmarking Reports as contributing to the benchmarking gap,

25   but, prior to EB-2020-0290, was unable to quantify their impact.[2] While OPG's gap-based

26   business planning process relies upon benchmarking to compare OPG's nuclear performance

27   against industry leaders in order to identify areas with the greatest potential for improvement,

---

[1] Decision and Order, EB-2016-0152, December 28, 2017, p. 49.
[2] EB-2016-0152, Ex. F2-1-1, Attachment 1, 2015 Benchmarking Report, p. 72.

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1   OPG understands that there are limitations in assessing benchmarking results. The OEB has

2   also recognized the limitations of benchmarking.[3]

3

4   In EB-2020-0290, OPG engaged ScottMadden to conduct an independent review of Nuclear's

5   2019 Benchmarking Report and process to ensure continued accuracy of reporting and

6   consistency with industry best practices. The 2020 Benchmarking Report included four

7   material updates relative to the 2015 Nuclear Benchmarking Report filed in EB-2016-0152,

8   which are the inclusion of the following metrics Total Recordable Injury Frequency ("TRIF"), 1-

9   year On-Line Deficient Critical Backlogs and 1-year On-Line Corrective Critical Backlogs and

10   the normalization of several value for money metrics (Normalized 3-Year Total Generating

11   Cost per MWh; Normalized 3-year Non-Fuel Operating Costs per MWh; Normalized 3-Year

12   Capital Cost per MW Design Electrical Rating ("DER")). In the EB-2020-0290 OEB-approved

13   settlement proposal,[4] the parties accepted the nuclear benchmarking methodology, results and

14   targets as reasonable.

15

16   Based on the OEB's expectations and in an effort to improve the usefulness of benchmarking

17   results and address the benchmarking limitations described above, for this Application, OPG

18   engaged ScottMadden to undertake an independent study to revisit the normalization

19   methodology of OPG's value for money metrics to enable closer comparisons with peers (OPG

20   Nuclear Cost Performance Benchmarking – A Study of Factors Impacting TGC/MWh

21   Performance with Normalizing Adjustments to Facilitate Closer Comparison – Attachment 4).

22

23   In addition, the EB-2016-0152 Decision and Order[5] and the EB-2020-0290 OEB-approved

24   settlement proposal[6] require OPG to file a staffing benchmarking study following the Goodnight

25   Consulting ("Goodnight") methodology. OPG engaged Indeavor Inc. ("Indeavor") to undertake

26   this Nuclear Staffing Benchmarking Study (Attachment 5).

27

28   Each of the three supporting studies referenced above are discussed in greater detail below.

---

[3] Decision and Order, EB-2016-0152, December 28, 2017, p. 49.
[4] Decision and Order, EB-2020-0290, November 15, 2021, p. 99.
[5] Decision and Order, EB-2016-0152, December 28, 2017, p. 84.
[6] Decision and Order, EB-2020-0290, November 15, 2021, p. 118.

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1   3.2.1.1 <u>OPG Nuclear Cost Performance Benchmarking - Methodology to Adjust for</u>
2   <u>Refurbishment and Validation of Implementation</u>

3   As noted in EB-2020-0290 evidence, the purpose of ScottMadden's Methodology to Adjust for
4   Refurbishment and Validation of Implementation study was to facilitate useful comparisons to
5   past performance and industry peers for the operating plant at Darlington during the extended
6   time periods in which certain units would be offline due to the DRP.

7

8   ScottMadden's views on adjusting TGC/MWh for DRP are summarized below:
9   • DRP is a unique "mega-program" and there is no established practice for normalizing cost
10   metrics for this unique program.
11   • Normalization is necessary to facilitate benchmark comparisons to past performance and
12   industry peers.
13   • OPG should continue to report unadjusted (i.e., not normalized) version of the cost metrics
14   along with any normalized version.
15   • A more strongly supported and conventional approach to normalization of cost metrics is
16   to adjust actual costs in the numerator while using unadjusted actual MWhs generated in
17   the denominator.

18

19   ScottMadden examined various OPG cost items and OPG's corporate and nuclear support
20   cost attributions in order to identify costs that should be adjusted to create a normalized
21   TGC/MWh, Non-Fuel Operating Cost per MWh ("NFOC/MWh"), and Capital Cost per MW
22   Design Electrical Rating while maintaining generation. ScottMadden's methodology indicated
23   how each type of Darlington Station, Nuclear Support (now Operations and Project Support),
24   allocated corporate support OM&A (i.e., Support Services) costs and sustaining capital
25   expenditures could be removed for the purpose of normalizing TGC/MWh and its applicable
26   sub-components for refurbishment. The study ultimately established a methodology to allow
27   OPG to adjust the distribution of OM&A and capital costs while using actual generation to
28   estimate what TGC/MWh, NFOC/MWh, and Capital Cost per MW Design Electrical Rating
29   would be if Darlington was operating fewer than four units.

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1   OPG independently applied ScottMadden's methodology to normalize TGC/MWh and its sub-

2   components based on 2017 data. ScottMadden then reviewed OPG's work on the 2017 data

3   (Attachment 3, Section 4) and validated that the approach OPG followed was in accordance

4   with ScottMadden's guidance and that OPG accurately performed the calculations.

5   ScottMadden found that OPG correctly interpreted and implemented the guidance provided.

6

7   OPG continued to apply ScottMadden's normalization methodology in deriving Darlington's

8   Value for Money metrics in subsequent years. The 2023 results are shown in Chart 1 below.

9

10 3.2.1.2 OPG Nuclear Cost Performance Benchmarking – A Study of Factors Impacting

11   TGC/MWh Performance with Normalizing Adjustments to Facilitate Closer Comparison

12 As noted in the EB-2020-0290 evidence, OPG engaged ScottMadden in 2018 with the

13 objective of ScottMadden's Study of Factors Impacting TGC/MWh Performance with

14 Normalizing Adjustments to Facilitate Closer Comparison in determining whether and to what

15 extent certain site characteristics of OPG's CANDU units influence TGC/MWh performance

16 relative to industry peers, and if possible quantify and adjust these characteristics to produce

17 normalized TGC/MWh values. ScottMadden's CANDU and age-related normalization

18 methodology included:

19 •   An econometric analysis of Electric Utility Cost Group ("EUCG") data; and

20 •   A custom nuclear outage benchmarking study that sought to determine and normalize

21   expected impacts on generation between CANDU and non-CANDU plants.

22

23 In its econometric analysis, ScottMadden analyzed nine years of EUCG data (from 2009 to

24 2017) for OPG and its industry peers to understand which site characteristics most influenced

25 TGC over a sustained period and to what extent. ScottMadden's analysis indicated that

26 CANDU technology increases predicted TGC by over $250M per year relative to non-CANDU

27 plants, and each month of average unit age increases predicted TGC by $346,000 per year.

28 ScottMadden then adjusted the EUCG data to normalize for these factors.[7]

---

[7] In addition, the ScottMadden analysis found that site capacity was a driver of TGC variability. However, ScottMadden did not adjust for site capacity to be conservative and to ensure that adjustments were easy to understand as such an adjustment would also have required a complex adjustment to generation.

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1   In the case of Darlington, ScottMadden's econometric analysis included Refurbishment costs.

2   Since 2017, OPG has calculated an adjustment for Refurbishment costs based on the

3   previously established methodology that continues to be applied until the DRP is completed.

4

5   ScottMadden also undertook a custom nuclear outage benchmarking study, including a

6   confidential direct survey of nuclear operators representing 47 nuclear plants. The custom

7   nuclear outage benchmarking study methodology quantified and adjusted for the impact of

8   regularly recurring, planned maintenance outages on power generation, taking steps to arrive

9   at an average annual value for days offline due to these planned outages.

10

11   In 2024, OPG reengaged ScottMadden to refresh the study performed in 2018 (Ex. F2-1-1,

12   Attachment 4). The objective of ScottMadden's Study of Factors Impacting TGC/MWh

13   Performance with Normalizing Adjustments to Facilitate Closer Comparison remained

14   unchanged: to assess whether, and to what extent, specific site characteristics of OPG's

15   CANDU units influence TGC/MWh performance relative to industry peers, and if possible,

16   quantify and adjust for these characteristics to produce normalized TGC/MWh values.

17   ScottMadden's CANDU and age-related normalization methodology included:

18   • An econometric analysis of Electric Utility Cost Group ("EUCG") data; and

19   • A nuclear planned outage analysis of EUCG data.

20

21   In its econometric analysis, ScottMadden analyzed eighteen years of EUCG data (from 2006-

22   2023) for OPG and its industry peers to understand which site characteristics most influence

23   TGC over a sustained period and to what extent. ScottMadden's analysis indicated that

24   CANDU technology increases predicted TGC by over $539M per year relative to non-CANDU

25   plants and each month of average unit age increases predicted TGC by $77,000 per year.

26   ScottMadden then adjusted the EUCG data to normalize for these factors.[8]

---

[8] In addition, the ScottMadden analysis found that site capacity was a driver of TGC variability. However, ScottMadden did not adjust for site capacity to be conservative and to ensure that adjustments were easy to understand as such an adjustment would also have required a complex adjustment to generation.

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1   The econometric analysis relied on unadjusted (other than for inflation) TGC data. In the case

2   of Darlington, this analysis included costs associated with units in Refurbishment. Since 2017,

3   OPG has calculated an adjustment for Refurbishment costs based on the previously

4   established methodology that continues to be applied until DRP is completed. To avoid the

5   possibility of making an adjustment for Darlington that is overly influenced by Refurbishment

6   costs, Darlington adjustments were reduced associated with the econometric model.

7   Specifically, the refurbishment adjustment was applied on a year-by-year basis and

8   proportionally reduced the econometric model adjustments for Darlington by the corresponding

9   annual factors for CANDU and age-related factors.

10

11   In its nuclear outage analysis, ScottMadden analyzed eighteen years of EUCG data (from

12   2006-2023) for OPG and its industry peers to identify the plant with the lowest average

13   percentage of planned outages. Utilizing the lowest average planned outage percentage as

14   the benchmark, MWh was adjusted for each plant/year to match the benchmark rate, adding

15   MWh when outages are longer and subtracting when outages are shorter.

16

17   Chart 1 below summarizes the application of normalization methodologies for refurbishment

18   (described in Section 3.2.1.1), and CANDU and age-related factors from the 2018 and 2025

19   ScottMadden study (described in Section 3.2.1.2), to the main 2023 Value for Money metrics.

20

21   OPG does not apply CANDU and age-related normalization, consistent with ScottMadden's

22   methodology, to the sub-components of TGC/MWh (i.e., Non-fuel Operating Cost per MWh or

23   Capital Cost per MW DER). OPG accepts ScottMadden's normalization methodologies as

24   described above as this achieves a closer comparison of OPG's TGC/MWh performance to

25   peers.

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1   **Chart 1 - Summary of Normalization Methodology Adjustments**

2   **Value for Money Metrics (2023)**

Indicator	Non-Normalized	Refurbishment Normalization	Original Methodology (2018)		Updated Methodology (2025)	
			CANDU, Age-related, Outage Duration Normalization	CANDU, Age-related, Outage Duration, & Refurbishment Normalization	CANDU, Age-Related, Outage Duration Normalization	CANDU, Age-related, Outage Duration, & Refurbishment Normalization
3-year Total Generation Cost per MWh	PN: $64.93 DN: $95.04	PN: N/A DN: $62.11	PN: $44.12 DN: $70.08	PN: $44.12 DN: $39.29	PN: $33.62 DN: $58.17	PN: $33.62 DN: $38.11
3- year Total Generating Cost per Unit	PN: $230.73 DN: $627.40	PN: N/A DN: $409.98	PN: $168.77 DN: $494.92	PN: $168.77 DN: $277.51	PN: $138.50 DN: $398.79	PN: $138.50 DN: $261.26
3- Year Non-Fuel Operating Cost per MWh	PN: $58.31 DN: $62.76	PN: N/A DN: $43.89	N/A	N/A	N/A	N/A
3-year Capital Cost per MW DER	PN: $19.54 DN: $212.29	PN: N/A DN: $106.57	N/A	N/A	N/A	N/A

3

4   3.2.1.3 Nuclear Staffing Benchmarking Study

5   As required by the EB-2016-0152 Decision and Order[9] and the EB-2020-0290 OEB-approved

6   settlement proposal,[10] a Nuclear Staffing Benchmarking Study was undertaken by Indeavor

7   and is included as Attachment 5. Indeavor is a company with workforce analytics expertise in

8   the energy sector, and the study was led by a consultant who supported similar studies in the

9   past, performed for OPG by Goodnight, which is a company no longer in business.

10

11   The main conclusions of the 2025 Indeavor Nuclear Staffing Study are as follows:

12   • Indeavor compared OPG Nuclear staffing levels to other North American nuclear operators

13   using an approach similar[11] to the methodology used by Goodnight to evaluate OPG in

14   2011, 2013, 2014, and 2019.

---

[9] Decision and Order, EB-2016-0152, December 28, 2017, p. 88.
[10] Decision and Order, EB-2020-0290, November 15, 2021, p. 118.
[11] The previous staff benchmarking studies included external purchased services (managed tasks), which are excluded from the current study due to the self-reported nature and data visibility from benchmarked peers.

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1 • The analysis showed that OPG, as of December 2024, is 455 Full-Time Equivalents

2 ("FTEs") (9.3%) better than (below) the total North America nuclear operator benchmark of

3 4,913 FTEs.

4 • 4,458 OPG Nuclear staff were benchmarked; 2,386 OPG Nuclear personnel were excluded

5 from benchmarking consistent with the methodology applied in prior studies.

6 • OPG is above benchmark staffing in 16 job functions, and below benchmark staffing in 25

7 functions.

8

9 OPG benchmarked staffing levels have continued to show significant improvement by closing

10 the gap identified initially by Goodnight in 2011 then continuing to improve even after the gap

11 was eliminated in 2016.[12] The latest study completed by Indeavor in 2025 confirms that actions

12 taken by OPG have been effective in achieving favourable performance compared to

13 benchmarked nuclear operators. Refer to Figure 1 below for historical trend analysis on OPG

14 benchmarked staffing levels, including Oncore hourly contractors, but excluding external

15 purchased services.

---

[12] In 2011, Goodnight indicated that OPG Nuclear was 17% above its industry peers, with a later update by Goodnight demonstrating that OPG Nuclear had narrowed the gap to 7.6% per EB-2013-0321, Ex. JT1.13. The Goodnight Nuclear Staffing Benchmarking Analysis published in December 2014 (EB-2016-0152, Ex. F2-1-1 Attachment 2) showed that staff reductions had further narrowed the gap to 4.1%, and as stated in EB-2016-0152, Ex. F2-1-1, OPG had eliminated the gap in 2016.

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1   **Figure 1 – OPG Nuclear Staff Benchmarking Headcount**

OPG Nuclear Staff Benchmarking Headcount (including Oncore Hourly, excluding other Purchased Services)
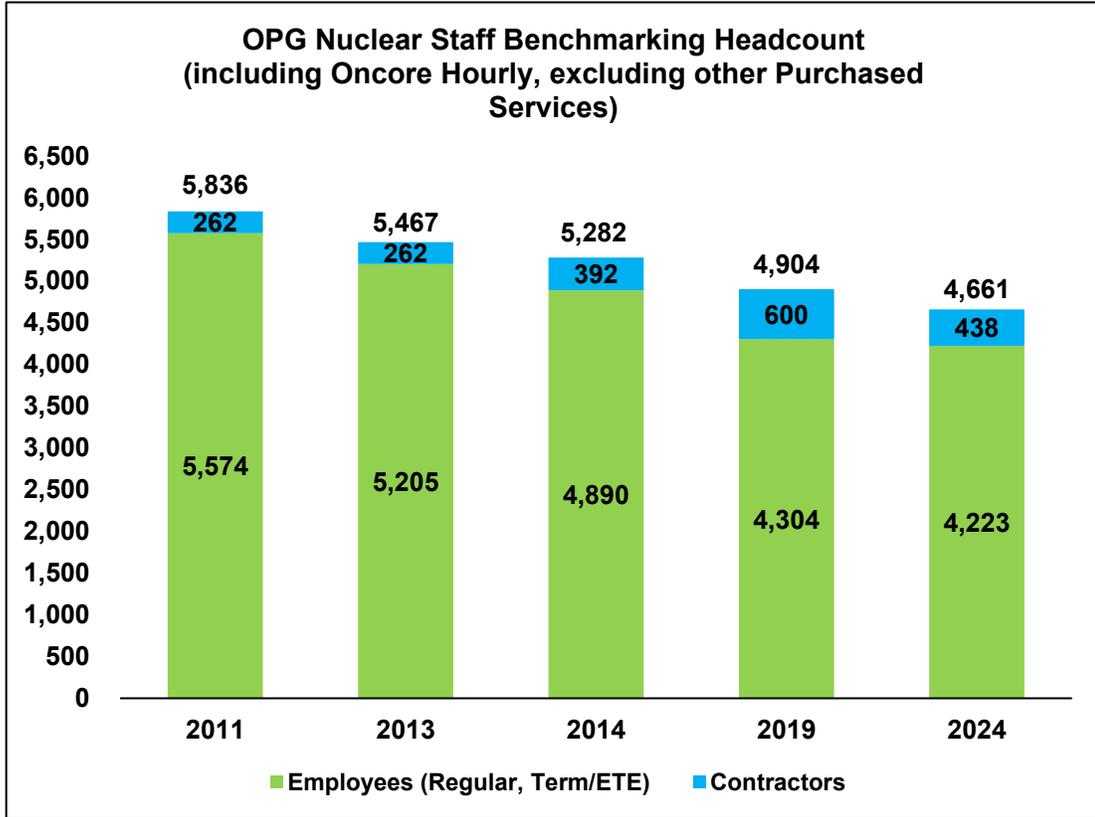
	2011	2013	2014	2019	2024
Total OPG Benchmarked	5,956	5,587	5,421	5,016	4,458
Contractors: Purchased Services	(120)	(120)	(139)	(112)	0
Contractors: Oncore Hourly					203
	5,836	5,467	5,282	4,904	4,661

2

3   3.2.2   Benchmarking Results

4   Chart 2 is a reproduction of Table 1 from OPG's 2024 Nuclear Benchmarking Report

5   (Attachment 2) and provides a summary of OPG's 2023 plant-level performance for each of

6   the key performance indicators benchmarked.

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1   **Chart 2 - Comparison of OPG Nuclear Performance to Industry Benchmarks**

Metric	2023 Actuals					
	NPI Max	Best Quartile	Median	Third Quartile	PN	DN
Safety						
Total Recordable Injury Frequency (#/200k hours worked)		0.95	1.48	2.21	0.20	0.00
Rolling Average[2] Industrial Safety Accident Rate (#/200k hours worked)[1]	0.20	0.00	0.00	0.05	0.00	0.00
Rolling Average[2] Collective Radiation Exposure (Person-rem per unit)[1]	80.00	46.00	72.13	94.67	67.33	20.61
Airborne Tritium Emissions (Curies) per Unit[3]		3,131	6,068	6,845	2,164	1,027
Fuel Reliability (microcuries per gram)[1]	0.000500	0.000001	0.000094	0.000239	0.000239	0.000106
2-Year Reactor Trip Rate (# per 7,000 hours)[1]	0.500	0.000	0.215	0.430	0.247	0.430
3-Year Auxiliary Feedwater System Unavailability (#)[1]	0.0200	0.0000	0.0006	0.0021	0.0019	0.0000
3-Year Emergency AC Power Unavailability (#)[1]	0.0250	0.0002	0.0004	0.0030	0.0000	0.0000
3-Year High Pressure Safety Injection Unavailability (#)[1]	0.0200	0.00000	0.00000	0.00000	0.0000	0.0002
Reliability						
Rolling Average[2] WANO NPI (Index)[1]		89.44	87.02	82.78	82.78	89.44
Rolling Average[2] Forced Loss Rate (%)[1]	1.00	1.05	1.41	2.29	2.29	5.03
Rolling Average[2] Unit Capability Factor (%)[1]	92.00	90.46	87.43	86.59	80.34	90.46
Rolling Average[2] Chemistry Performance Indicator (Index)[1]	1.01	1.00	1.01	1.01	1.20	1.01
1-Year Online Deficient Critical Backlog (work orders per unit) [1]		0.00	0.00	0.50	0.67	0.00
1-Year Online Deficient Non-Critical Backlog (work orders per unit) [3]		1.33	7.66	22.00	29.50	29.00
1-Year Online Corrective Critical Backlog (work orders per unit) [1]		0.00	0.00	0.00	0.00	0.00
1-Year Online Corrective Non-Critical Backlog (work orders per unit) [3]		0.00	0.33	1.00	0.83	0.00
Value for Money						
3-Year Total Generating Costs per MWh ($ per Net MWh)[1]		33.44	39.66	49.23	64.93	95.04
Normalized 3-Year Total Generating Cost per MWh ($ per Net MWh)[4]		27.95	33.51	42.57	44.12	39.29
3-Year Total Generating Cost per Unit (M $ per Unit)		283.01	313.31	358.44	230.73	627.40
Normalized 3-Year Total Generating Cost per Unit (M $ per Unit)[4]		236.12	276.78	320.69	168.77	277.51
3-Year Non-Fuel Operating Costs per MWh ($ per Net MWh)[1]		19.64	24.64	32.22	58.31	62.76
3-Year Normalized Non-Fuel Operating Cost per Net MWh ($/MWh)		19.64	24.64	32.22	--	43.89
3-Year Fuel Costs per MWh ($ per Net MWh)[1]		6.11	6.68	7.44	3.79	4.05
3-Year Capital Costs per MW DER ($ per MW)[1]		33.87	60.01	107.30	19.54	212.29
Normalized 3-Year Capital Cost per MW DER ($ per MW)		33.87	60.01	107.30	--	106.57
Human Performance						
18-Month Human Performance Error Rate (# per 200k ISAR and contractor hours) [1]		0.0000	0.0000	0.0410	0.0600	0.0000

2   [1] Best Quartile, Median and Third Quartile are from Q4 2023 best available information.
3   [2] Indicates a 2-Year Rolling Average for Pickering and a 3-Year Rolling Average for Darlington.

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1 [3] Best Quartile, Median, Third Quartile are from Q4 2022 which is the most current available benchmark for these
2 metrics.
3 [4] Reflects original technology, age-related, and outage duration normalization methodology, as described in Ex. F2-
4 1-1, Section 3.2.1.2

5 **Legend**

6

4th Quartile Performance	3rd Quartile Performance	2nd Quartile Performance	Maximum NPI points achieved or Best Quartile

7

8 Detailed discussion of the 2023 performance trends and drivers by cornerstone is provided in

9 the OPG 2024 Nuclear Benchmarking Report (Attachment 2), and is summarized as follows:

10 - **Safety**

11 Overall, OPG's nuclear generating stations continue to demonstrate strong safety

12 performance, achieving green ratings for all safety metrics in 2023. Darlington and

13 Pickering continued to demonstrate first quartile performance in Total Recordable Injury

14 Frequency ("TRIF"), with OPG achieving its best TRIF performance in the history of the

15 company in 2023 since the company's inception in 1999 and having the best TRIF

16 performance in 2023 compared to its peer group.

17

18 Darlington and Pickering generating stations achieved maximum NPI results or best

19 quartile performance for all seven NPI safety sub-metrics.

20

21 The Collective Radiation Exposure ("CRE") remained in the top quartile for Pickering and

22 Darlington resulting in maximum NPI points. Continued performance reflects

23 implementation of specialized source term agents, source term controls and improved

24 shielding to reduce does rates.

25

26 The Airborne Tritium Emissions remained in first quartile for Darlington while Pickering has

27 improved from second to first quartile. Improved performance reflects emission reduction

28 initiatives driven by a High Impact Team, enhancing focus on tritium sources identification

29 and enhanced management oversight. In addition, collaboration between both sites to

30 exchange operating experience, innovation activities on tritium mitigation, and benchmark

31 performance.

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1 The Fuel Reliability Index remained in the first quartile at both Darlington and Pickering

2 achieving maximum NPI points due to continual efforts to enhance performance at both sites

3 including completing the fuel design manual and drawing update which strictly controls the

4 manufacturing process as well as the fuel operating, fuel handling and fuel performance limits.

5

6 • **Reliability**

7   Several key reliability indicators at both stations noted sustained or improved quartile

8   performance in 2023.

9

10   Significant improvements were recorded for On-line Deficient Maintenance Backlogs, and

11   On-line Corrective Maintenance Backlogs for both stations in 2023. Darlington's On-line

12   Deficient Non-Critical Backlogs registered a 52% reduction compared to the previous year,

13   while Pickering improved by 26%. Both stations continue to work down the backlog

14   priorities through Fix It Now and Work Management process.

15

16   The Unit Capability Factor ("UCF") improved to achieve first quartile at Darlington which is

17   attributable to reduced planned outage days in 2023, partially offset by forced outage

18   events impacting post-refurbishment Unit 2. Pickering remained in fourth quartile with

19   improved performance attributable to improved FLR due to 2021's elevated FLR no longer

20   included in the rolling average window, partially offset by increased planned outage days

21   in 2023.

22

23   The Chemistry Performance Indicator sustained first quartile performance at Darlington

24   achieving maximum NPI points. Pickering's Chemistry Performance Indicator remained in

25   the fourth quartile in 2023, attributable to condenser tube leaks on Unit 4 and Unit 8 and

26   boiler level transient. Both stations continue to have a Chemistry Outage Single Point of

27   contact to provide improved coordination and planning.

28

29   The Forced Loss Rate ("FLR") decreased from the third to fourth quartile at Darlington in

30   2023 due to forced outage events impacting post-refurbishment Unit 2 on Turbines and

31   Main Power Output (2022) and Primary Heat Transport (2023). As this metric is a rolling

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1   average, in 2023, only Unit 2 results are included (Units 1, 3, and 4 were in refurbishment).

2   Pickering remained in the fourth quartile with improved performance due to 2021's elevated

3   FLR no longer included in the rolling average window. Fuel Handling contribution reduced

4   in 2023 and remains a focus area to build sustainability.

5

6   • **Value for Money**

7   Darlington's TGC/MWh performance was in the third quartile in 2023 after normalizing for

8   refurbishment costs, CANDU technology, age-related and outage duration factors (as

9   described in Section 3.2.1.1 and Section 3.2.1.2). Darlington's TGC/MWh performance

10   (non-normalized) was in the fourth quartile. These non-normalized results were driven

11   largely by significant capital expenditures, which are necessary for reliable post-

12   refurbishment operation, and reduced generation during the DRP. Darlington achieved top

13   quartile performance in Fuel Cost per MWh.

14

15   Pickering's normalized TGC/MWh was in fourth quartile (normalized and non-normalized).

16   Pickering's performance reflects reduced capital investment while maintaining reliable

17   operations leading up to the end of commercial operations. Pickering maintained best

18   quartile performance in Fuel Cost per MWh and Capital Cost per MW DER. Pickering units

19   are the smallest in the peer group, with a capacity of 540 MW per unit compared to the

20   peer group average of 1,026 MW.

21

22   • **Human Performance**

23   OPG Nuclear's human performance strategy focuses on and reinforces the correct

24   behaviors during all phases of station operations and maintenance. Darlington maintained

25   top quartile performance in its Human Performance Error Rate in 2023. Pickering Human

26   Performance Error Rate was in the fourth quartile in 2023. OPG is targeting building

27   industry-leading Human Performance practices through it being a focus across the fleet

28   with actions taken to further improve performance by continuously improving the

29   Observations & Coaching program as well as integration of Fail-Safe strategies and

30   trending processes to strengthen values and behaviours of Nuclear Professionals.

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1 OPG has made improvements in many areas and continues to identify and implement
2 opportunities for further improvement as discussed in Section 3.4 below.
3
4 **3.3   Gap-Based Business Planning – Target Setting**
5 OPG's operating and financial targets are designed to drive continuous improvement in OPG
6 Nuclear Operations' performance. Targets are set for each year of the business plan and are
7 monitored each year to assess performance for the given year.
8
9 **2025-2031 Targets**
10 OPG's Chief Nuclear Officer, in consultation with OPG's Nuclear leadership team, provided
11 direction on the operating and financial performance targets for each nuclear station for the
12 2025-2031 business planning period, based on the applicable corporate targets. The operating
13 and financial targets for this business plan recognize the following drivers of operating costs
14 and generation, including:
15 a) The need for capital expenditures within the Nuclear Operations' project portfolio and,
16   where appropriate, for non-portfolio projects to position Darlington and Pickering for strong
17   performance post refurbishment, including addressing emergent reliability risks at
18   Darlington (as discussed at Ex. D2-1-2).
19 b) Pickering Units 5-8 investments and resources that are being optimized and planned
20   outages are being undertaken to ensure the station safely operates towards its planned
21   pre-refurbishment shutdown on September 30, 2026 and is prepared for an effective
22   transition into the four-unit refurbishment outage and subsequent post-refurbishment
23   operations.
24
25 The operating and financial targets for OPG's facilities are also informed by historical
26 performance, targets set in prior years and the latest benchmarking results. Charts 3
27 (Pickering) and Chart 4 (Darlington) set out OPG's nuclear operational and financial targets
28 for 27 benchmark performance indicators for the 2027-2031 period. OPG views these targets
29 as challenging but achievable. Performance measures and targets for the DNNP facilities will
30 be developed as Unit 1 approaches commercial operation.

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1 **Chart 3 - Annual Operational and Financial Targets for Pickering**

Benchmarking Indicators	WANO Max NPI	Best Quartile[1]	Median Quartile[1]	Third Quartile[1]	Pickering Annual Targets						
					2025	2026	2027	2028	2029	2030	2031
					Targets Only						
Safety											
Total Recordable Injury Frequency (#/200k hours worked)		0.95	1.48	2.21	0.20	0.20	N/A	N/A	N/A	N/A	0.20
Total Industrial Safety Accident Rate (#/200k hours worked)[2]	0.20	0.00	0.00	0.05	0.00	0.00	N/A	N/A	N/A	N/A	0.00
Collective Radiation Exposure (person-rem per unit)	80.00	46.00	72.13	94.67	59.30	41.82	N/A	N/A	N/A	N/A	45.30
Airborne Tritium Emissions (Curies) per Unit		3,131	6,068	6,845	2,000	1,870	N/A	N/A	N/A	N/A	1,336
Fuel Reliability (microcuries per gram)	0.0005	0.000001	0.000094	0.000239	0.0005	0.0005	N/A	N/A	N/A	N/A	0.0005
Reactor Automatic and Manual Trip Rate (# per 7,000 hours)[3]	0.500	0.000	0.215	0.430	0.5000	0.5000	N/A	N/A	N/A	N/A	0.5000
Auxiliary Feedwater System Unavailability (#)	0.0200	0.0000	0.0006	0.0021	0.0000	0.0000	N/A	N/A	N/A	N/A	0.0000
Emergency AC Power Unavailability (#)	0.0250	0.0002	0.0004	0.0030	0.0250	0.0250	N/A	N/A	N/A	N/A	0.0250
High Pressure Safety Injection Unavailability (#)	0.0200	0.0000	0.0000	0.0000	0.0200	0.0200	N/A	N/A	N/A	N/A	0.0200
Reliability											
Rolling Average WANO NPI (Index)[4]		89.44	87.02	82.78	78.4	81.8	N/A	N/A	N/A	N/A	N/A
Forced Loss Rate (%)	1.00	1.05	1.41	2.29	3.50	3.50	N/A	N/A	N/A	N/A	12.00

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Benchmarking Indicators	WANO Max NPI	Best Quartile[1]	Median Quartile[1]	Third Quartile[1]	Pickering Annual Targets						
					2025	2026	2027	2028	2029	2030	2031
					Targets Only						
Unit Capability Factor (%)[5]	92.0	90.46	87.43	86.59	89.14	87.06	N/A	N/A	N/A	N/A	68.16
Unit Capability Rate (%)[5]	98.0	98.68	98.17	97.35	98.71	96.07	N/A	N/A	N/A	N/A	87.52
Chemistry Performance Indicator (Index)	1.01	1.00	1.01	1.01	1.07	1.01	N/A	N/A	N/A	N/A	1.00
On-line Deficient Non-Critical Backlog (work orders/unit)		1.33	7.66	22.00	14.00	14.00	N/A	N/A	N/A	N/A	10.00
On-line Deficient Critical Backlog (work orders/unit)		0.00	0.00	0.50	0.00	0.00	N/A	N/A	N/A	N/A	0.00
On-Line Corrective Non-Critical Backlog (work orders/unit)		0.00	0.33	1.00	0.00	0.00	N/A	N/A	N/A	N/A	1.00
On-Line Corrective Critical Backlog (work orders/unit)		0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	N/A	0.00
Value for Money											
Normalized Total Generating Cost per MWh – Updated Methodology ($/MWh)**[6]		29.51	34.09	41.78	31.72	38.95	N/A	N/A	N/A	N/A	N/A
Normalized Total Generating Cost per MWh – Original Methodology ($/MWh) **[6]		27.95	33.51	42.57	41.99	54.19	N/A	N/A	N/A	N/A	N/A
Total Generating Cost per MWh ($/MWh)**		33.44	39.66	49.23	71.57	97.94	N/A	N/A	N/A	N/A	N/A
Normalized Total Generating Cost per Unit –		257.91	284.30	328.93	141.60	143.88	N/A	N/A	N/A	N/A	N/A

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Benchmarking Indicators	WANO Max NPI	Best Quartile[1]	Median Quartile[1]	Third Quartile[1]	Pickering Annual Targets						
					2025	2026	2027	2028	2029	2030	2031
					Targets Only						
Updated Methodology (M$ per Unit)**[6]											
Normalized Total Generating Cost per Unit – Original Methodology (M$ per Unit)**[6]		236.12	276.78	320.69	178.44	168.83	N/A	N/A	N/A	N/A	N/A
Total Generating Cost per Unit (M$ per Unit)**		283.01	313.31	358.44	284.63	278.48	N/A	N/A	N/A	N/A	N/A
Normalized Non-Fuel Operating Cost per MWh ($/MWh) **(6)		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Non-Fuel Operating Cost per MWh ($/MWh) **		19.64	24.64	32.22	59.67	78.05	N/A	N/A	N/A	N/A	N/A
Fuel Cost per MWh ($/ MWh)		6.11	6.68	7.44	5.15	5.75	N/A	N/A	N/A	N/A	N/A
Normalized Capital Cost per MW DER (k$/MW) ***[6]		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Capital Cost per MW DER (k$/MW) ***		33.87	60.01	107.30	34.71	77.90	N/A	N/A	N/A	N/A	N/A
Human Performance											
Human Performance Error Rate (# per 200k ISAR hours)		0.0000	0.0000	0.0410	0.0000	0.0000	N/A	N/A	N/A	N/A	0.0000

1

2 ** TGC/MWh and Non-Fuel Operating Cost per MWh exclude OPEB, Pension and Asset Service Fees to align with the industry

3 standard.

4 *** Design Electrical Rating (DER)

5 Note 1: Indicates a 2-Year Rolling Average for Pickering and a 3-Year Rolling Average for Darlington.

6 Note 2: Industrial Safety Accident Rate (ISAR2) has been replaced by Total Industrial Safety Accident Rate (TISA2) in Q1 2024

7 to align with NPI methodology transition from Method 4 to Method 10. ISAR included only permanent employees when counting

8 industrial safety accidents, while the new indicator TISA includes both contractors and permanent employees.

9 Note 3: Reactor Trip Rate was replaced by Reactor Automatic & Manual Trip Rate following the NPI Method 10 transition in 2024.

10 The indicator change includes the change from Unplanned Automatic Scrams (UA7) to Unplanned Total Scrams (US7). Method

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1 4 utilized UA7 metric which only included the automatic scram data. The new indicator, US7, which includes both automatic and

2 manual scrams.

3 Note 4: The Nuclear Performance Index Method 10 is a WANO sponsored performance measure and is a weighted composite of

4 ten WANO Performance Indicators related to safety and production performance reliability. In Q1 of 2024, Method 10 replaced

5 Method 4: Unit Capability Factor (UCF) was replaced by Unit Capability Rate (UCR), Automatic Reactor Scrams (UA7) was

6 replaced by Automatic and Manual Scrams (US7) and Industrial Safety Accident Rate (ISAR2) – replaced by Total Industrial

7 Safety Accident Rate (TISA2). NPI is calculated using a 2-year rolling average for PN and a 3-year rolling average for DN.

8 Note 5: UCR replaced UCF due to NPI methodology change from Method 4 to Method 10 in Q1 of 2024. UCF will continue to be

9 reported as UCF incorporates additional factors that impact production (i.e. Unbudgeted Planned Outages).

10 Note 6: Value for Money targets are indicative and will be updated for final cost allocations reflected in this Application.

11 Normalization methodologies are applied as described in Ex. F2-1-1, Section 3.2.1.

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1 **Chart 4 - Annual Operational and Financial Targets for Darlington**

Benchmarking Indicators	WANO Max NPI	Best Quartile[1]	Median Quartile[1]	Third Quartile[1]	Darlington Annual Targets						
					2025	2026	2027	2028	2029	2030	2031
					Targets Only						
Safety											
Total Recordable Injury Frequency (#/200k hours worked)		0.95	1.48	2.21	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Total Industrial Safety Accident Rate (#/200k hours worked)[2]	0.20	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Collective Radiation Exposure (person-rem per unit)	80.00	46.00	72.13	94.67	25.57	66.78	67.28	47.95	73.35	44.05	45.80
Airborne Tritium Emissions (Curies) per Unit		3,131	6,068	6,845	1,215	1,049	1,017	1,008	1,002	1,040	1,008
Fuel Reliability (microcuries per gram)	0.0005	0.000001	0.000094	0.000239	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Reactor Automatic and Manual Trip Rate (# per 7,000 hours)[3]	0.50	0.000	0.215	0.430	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Auxiliary Feedwater System Unavailability (#)	0.020	0.0000	0.0006	0.0021	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Emergency AC Power Unavailability (#)	0.025	0.0002	0.0004	0.0030	0.000	0.000	0.000	0.000	0.000	0.000	0.000
High Pressure Safety Injection Unavailability (#)	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Reliability											
Rolling Average WANO NPI (Index)[4]		89.44	87.02	82.78	87.8	82.1	92.2	92.3	91.6	93.1	93.6
Forced Loss Rate (%)	1.00	1.05	1.41	2.29	3.6	3.5	2.9	2.2	2.0	2.0	2.0

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Benchmarking Indicators	WANO Max NPI	Best Quartile[1]	Median Quartile[1]	Third Quartile[1]	Darlington Annual Targets						
					2025	2026	2027	2028	2029	2030	2031
					Targets Only						
Unit Capability Factor (%)[5]	92.0	90.46	87.43	86.59	94.2	76.0	62.9	88.6	83.5	88.6	88.7
Unit Capability Rate (%)[5]	98.0	98.68	98.17	97.35	95.3	95.3	95.8	96.6	96.8	96.9	96.8
Chemistry Performance Indicator (Index)	1.01	1.00	1.01	1.01	1.1	1.1	1.00	1.00	1.00	1.00	1.00
On-line Deficient Non-Critical Backlog (work orders/unit)		1.33	7.66	22.00	14.0	3.0	3	3	3	2	2
On-line Deficient Critical Backlog (work orders/unit)		0.00	0.00	0.50	0	0	0	0	0	0	0
On-Line Corrective Non-Critical Backlog (work orders/unit)		0.00	0.33	1.00	0	0	0	0	0	0	0
On-Line Corrective Critical Backlog (work orders/unit)		0.00	0.00	0.00	0	0	0	0	0	0	0
Value for Money											
Normalized Total Generating Cost per MWh – Updated Methodology ($/MWh)**[6]		29.51	34.09	41.78	34.72	42.26	51.58	41.14	42.21	39.14	34.68
Normalized Total Generating Cost per MWh – Original Methodology ($/MWh) **[6]		27.95	33.51	42.57	37.48	59.44	81.36	50.70	55.08	48.74	44.08
Total Generating Cost per MWh ($/MWh)**		33.44	39.66	49.23	72.18	84.90	106.86	67.80	74.02	66.71	62.23
Normalized Total Generating Cost per Unit –		257.91	284.30	328.93	240.44	299.75	342.47	292.13	300.11	280.07	250.36

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Benchmarking Indicators	WANO Max NPI	Best Quartile[1]	Median Quartile[1]	Third Quartile[1]	Darlington Annual Targets						
					2025	2026	2027	2028	2029	2030	2031
					Targets Only						
Updated Methodology (M$ per Unit)**[6]											
Normalized Total Generating Cost per Unit – Original Methodology (M$ per Unit)**[6]		236.12	276.78	320.69	277.24	355.46	402.50	352.23	360.25	340.23	310.51
Total Generating Cost per Unit (M$ per Unit)**		283.01	313.31	358.44	507.52	482.67	499.36	452.42	463.87	447.38	421.28
Normalized Non-Fuel Operating Cost per MWh ($/MWh) **(6)		N/A	N/A	N/A	37.78	49.26	N/A	N/A	N/A	N/A	N/A
Non-Fuel Operating Cost per MWh ($/MWh) **		19.64	24.64	32.22	48.35	51.86	66.61	42.33	50.82	44.35	44.46
Fuel Cost per MWh ($/ MWh)		6.11	6.68	7.44	5.02	6.05	6.49	6.80	7.33	7.80	8.19
Normalized Capital Cost per MW DER (k$/MW) ***[6]		N/A	N/A	N/A	110.40	161.75	N/A	N/A	N/A	N/A	N/A
Capital Cost per MW DER (k$/MW) ***		33.87	60.01	107.30	150.71	174.73	179.72	141.84	113.24	111.21	73.84
Human Performance											
Human Performance Error Rate (# per 200k ISAR hours)		0.0000	0.0000	0.0410	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

1   ** TGC/MWh and Non-Fuel Operating Cost per MWh exclude OPEB, Pension and Corporate Asset Service Fees to align with the

2   industry standard.

3   *** Design Electrical Rating (DER)

4   Note 1: Indicates a 2-Year Rolling Average for Pickering and a 3-Year Rolling Average for Darlington.

5   Note 2: Industrial Safety Accident Rate (ISAR2) has been replaced by Total Industrial Safety Accident Rate (TISA2) in Q1 2024

6   to align with NPI methodology transition from Method 4 to Method 10. ISAR included only permanent employees when counting

7   industrial safety accidents, while the new indicator TISA includes both contractors and permanent employees.

8   Note 3: Reactor Trip Rate was replaced by Reactor Automatic & Manual Trip Rate following the NPI Method 10 transition in 2024.

9   The indicator change includes the change from Unplanned Automatic Scrams (UA7) to Unplanned Total Scrams (US7). Method

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1 4 utilized UA7 metric which only included the automatic scram data. The new indicator, US7, which includes both automatic and
2 manual scrams.

3 Note 4: The Nuclear Performance Index Method 10 is a WANO sponsored performance measure and is a weighted composite of
4 ten WANO Performance Indicators related to safety and production performance reliability. In Q1 of 2024, Method 10 replaced
5 Method 4: Unit Capability Factor (UCF) was replaced by Unit Capability Rate (UCR), Automatic Reactor Scrams (UA7) was
6 replaced by Automatic and Manual Scrams (US7,) and Industrial Safety Accident Rate (ISAR2) – replaced by Total Industrial
7 Safety Accident Rate (TISA2). NPI is calculated using a 2-year rolling average for PN and a 3-year rolling average for DN.

8 Note 5: UCR replaced UCF due to NPI methodology change from Method 4 to Method 10 in Q1 of 2024. UCF will continue to be
9 reported as UCF incorporates additional factors that impact production (i.e. Unbudgeted Planned Outages).

10 Note 6: Value for Money targets are indicative and will be updated for final cost allocations reflected in this Application.
11 Normalization methodologies are applied as described in Ex. F2-1-1, Section 3.2.1

12

13 The following summarizes the rationale for the targets set for each of the four cornerstones
14 for the period 2027-2031, specifically:

15 • **Safety Cornerstone:** For the safety cornerstone, OPG is targeting either best quartile
16 performance or maximum NPI points at both stations.

17 • **Reliability Cornerstone:** For the reliability cornerstone, OPG is targeting a post-
18 refurbishment FLR of 12.0% at Pickering for the first year following return to service of Unit
19 5 in 2031. This is based on industry operating experience and is also impacted by the
20 extended offline period of Pickering's units. Darlington's UCF fluctuate over the IR term.
21 The higher FLR in earlier years reflects the expected initial increase after the units return
22 to service post-refurbishment, with all units expected to transition to post-refurbishment
23 normal operations by 2028 (Ex. E2-1-1, Section 3.3). The 2.0% FLR target for Darlington
24 has been set to drive improvement from the recent performance. Online Deficient and
25 Corrective Maintenance backlogs will remain a focus for continued improvements at both
26 Pickering and Darlington. The online corrective non-critical maintenance backlog is
27 expected to be in the top quartile throughout 2027-2031, with continuous improvement
28 efforts being made for the on-line deficient non-critical backlogs.

29 • **Value for money:** As Pickering progresses toward the end of "first life" operation, the
30 station is expected to improve to second quartile normalized TGC/MWh performance by
31 2026, reflecting improved reliability and reduced capital investment requirements. For
32 Darlington, the TGC/MWh over the period 2027-2031 is expected to continue to be
33 temporarily affected by higher project-related investments supporting continued
34 preparation for Darlington second life operations and reduced generation resulting from

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1   refurbishment outages up to 2026, and subsequently from the VBO in 2027, as well as

2   emergent work associated with the Primary Moisture Separator Replacements and Turbine

3   Rotors Replacement. Toward the end of the IR term, Darlington is expected to achieve

4   second quartile normalized TGC/MWh performance.

5   • **Human Performance:** For the human performance cornerstone, OPG is targeting top

6   quartile performance at both Darlington and Pickering stations due to continuous

7   improvement efforts.

8

9   **3.4   Gap Based Business Planning - Gap Closure and Resource Plan**

10   The operational and financial targets established by the target setting process are the basis

11   for site and support group business planning. As part of that process, fleetwide and site

12   improvement initiatives are established to close performance gaps to targets over the business

13   planning period. The fleetwide improvement initiatives, which are described in Section 3.4.2,

14   are intended to improve efficiency, operational performance and cost effectiveness.

15

16   3.4.1   Prior Gap Closure Initiatives

17   In its EB-2020-0290 submission, OPG identified three Nuclear gap closure initiatives: (i) Right

18   Work, Right Time, Right Value, (ii) Leaders Driving Business Results, and (iii) People Powering

19   the Future. Attachment 1 provides details about these prior initiatives and benefits realized.

20

21   3.4.2   Current Fleetwide Improvement Initiatives

22   OPG's 2025-2031 Business Plan (Ex. A2-2-1, Attachment 1) sets out the resource

23   requirements for Nuclear. OPG's operating cost profile in the 2025-2031 Business Plan is

24   based on challenging but achievable OM&A targets necessary to position Darlington towards

25   improving TGC performance during the IR term. Darlington's TGC is expected to achieve

26   second quartile performance toward the end of the IR term.

27

28   In addition to managing improvements, OPG will make greater use of innovation, leveraging

29   proven technologies in the nuclear industry to change how work programs are executed. This

30   will be enabled by OPG's Digital Strategy (see Ex. D3-1-1). In order to maximize the value of

31   these initiatives, OPG will focus on empowering leaders, progress projects that enable

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1   effective monitoring of plant equipment, strengthening how work is planned and executed with

2   an overall innovation mindset to help drive business efficiencies.

3

4   Consistent with the above, the key nuclear initiatives discussed below are designed to bring

5   improvements across a range of areas broadly characterized as "our people, our plant and our

6   future". The initiatives will strengthen operational performance and cost effectiveness of the

7   nuclear fleet, helping drive improvements needed to meet the 2025-2031 Business Plan

8   commitments. The initiatives are also designed to mitigate risks to future performance and

9   ensure a successful transition from a ten-unit, two station fleet to a four-unit, one station fleet

10   until the first Pickering unit returns to service. Following successful execution of the DNNP,

11   with Unit 1 becoming commercially available in 2030 (see Ex. D2-4-1), and the PRP, with the

12   first unit becoming commercially available in 2031 (see Ex. D2-3-1), these initiatives would

13   also mitigate risks and ensure those units' successful transition to commercial operations.

14

15   3.4.2.1 Nuclear Specific Initiatives

16   Investments are integrated to ensure improvements are executed and sequenced

17   appropriately. Initiatives focus on strengthening how OPG executes work programs by

18   leveraging proven technology that is used in the nuclear industry.

19

20   The initiatives discussed below will help OPG to successfully transition to the PRP in 2026 and

21   support other areas of planned growth opportunities to achieve the Nuclear business plan

22   targets.

23

24   **Improving Safety as a Core Value**

25   Improving safety as a core value initiative focuses on developing a workforce that is committed

26   to continuous improvement and Excellence standards as well as focused on maintaining a fail-

27   safe mindset and elimination of at-risk behaviours. Key improvements and anticipated results

28   for this initiative are:

29   • Workforce committed to own safe execution of work and ensure that people, plant,

30   community and the environment are protected and shielded from hazards.

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1   • Fail Safe initiative includes identifying and strengthening the defenses so that when an
2   event does occur, the defenses in place ensure the event occurs safely. This involves a
3   shift in focus on measuring defenses, not events, to build capacity with strong defenses.

4   • High levels of proficiency are essential to achieving consistent, sustainable, high
5   performance and outcomes in individuals, teams and organizations. This is being achieved
6   through assessing the proficiency of teams and developing improvement plans that cover
7   the following elements:

8   o Foundations – Ensure workers have the knowledge, skills, familiarity, understanding in
9   executing work.

10   o Challenges – awareness of plant status, environment, organizational and human
11   performance.

12   o Mitigation – understanding risk strategies, oversight and implementing Enterprise,
13   Industry operating experience and lessons learned.

14

15   These initiatives support cost efficiencies as well as improved operational performance in
16   areas of conventional safety, maintenance, outage performance, and equipment reliability.
17   Anticipated results from Improving Safety as a core value initiative would be shown by
18   sustaining performance in work protection, minimize or eliminate human performance
19   consequential events (i.e., Event Free Day Resets), and industry best performance associated
20   with conventional safety (i.e., Serious Injury Incident Rates).

21

22   **Building Talent for Today & Tomorrow**
23   The Building Talent for Today & Tomorrow initiative focuses on building and proactively
24   maintaining a talent and leadership pipeline for the future through effective staff planning,
25   succession planning, knowledge management and transition planning. Key improvements and
26   anticipated results include:

27   • Leadership field presence, recognizing and engaging workforce in solutions for sustainable
28   performance improvements. Fostering leadership intrusiveness, with a focus on enhancing
29   team proficiency and providing feedback.

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1 • Ensuring work programs are resourced appropriately in accordance with the 2025-2031
2   Business Plan while minimizing the organizational and operational impacts associated with
3   transition to the PRP and Pickering and Darlington post-refurbishment operations.
4 • Drive continuous improvement and increased cross-functional effectiveness through peer
5   challenge and behavioral shaping actions.
6 • Cultivate a high-performance culture that strives for excellence through industry learnings
7   and benchmarking.
8 • Operations leading the station by demonstrating and enforcing excellence standards.
9
10 These initiatives are expected to result in enhanced employee engagement, strong succession
11 planning and improving processes used to proactively address early signs of performance
12 decline.
13
14 **Leading Reliability of Plant Equipment**
15 The Leading Reliability of Plant Equipment initiative focuses on the prevention and detection
16 of vulnerabilities so actions can be taken to eliminate or mitigate events. Key improvement
17 actions and anticipated results for this initiative include:
18 • Preventative Maintenance ("PM") reductions through sensor installations, optimizing
19   maintenance strategies and plant reliability processes with a focus on sustainability,
20   efficiency and cost-effectiveness.
21 • Simplify and optimize PM processes by implementing technology and data-driven
22   solutions, improve equipment health monitoring and develop innovative equipment
23   reliability tools while maintaining high standards of quality and performance and inform
24   decision making.
25 • Empower system health teams to identify the key issues of focus to improve overall system
26   health. Team members take ownership and accountability by creating innovative, practical
27   solutions and implement improvement plans that drive Excellence in equipment reliability,
28   raise awareness of issues and follow through to full resolution.

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1 These initiatives are expected to result in improving and sustaining Forced Loss Rates,

2 Equipment Reliability Consequential Events, Fuel Handling Equipment Reliability Index

3 performance, Online Critical Preventive Maintenance Open 2nd Half of Grace and Online critical

4 PM deferrals.

5

6 **Strengthening How Work is Planned and Executed**

7 The Strengthening How Work is Planned and Executed initiative focuses on excellence in

8 maintenance, outage and project planning and ensure work programs are executed with a

9 strong operational focus. Key improvement actions and anticipated results for this initiative

10 include:

11 • Leverage lessons learned and Industry best practices to improve advanced planning and

12   execution of maintenance, projects and major outages.

13 • Improve integrated technology to maximize effective maintenance tool time and PM

14   strategies through use of high-performance diagnostic tools to avoid operations and

15   maintenance costs and improve plant performance.

16 • Integrate resource balancing across project and maintenance functions to enable efficient

17   online, outage and project planning and execution.

18

19 These initiatives are expected to result in improving or meeting online Maintenance backlogs,

20 Work Management Index performance, planned outage durations and meeting planned

21 targets.

22

23 **Advancing Continuous Improvements to Support Growth**

24 The Advancing Continuous Improvements to Support Growth initiative focuses on Excellence

25 in Operations supporting future opportunities. Key improvement actions and anticipated results

26 for this initiative include:

27 • Leading Operations and strengthening Indigenous relations and business partnership to

28   develop new growth.

29 • Having a "Fit for Purpose" innovative mindset to drive efficiencies and plant reliability

30   perspectives into our processes and core culture.

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1 • Leadership and talent development through succession/transition planning, knowledge

2 retention and industry benchmarking with focus on training programs that promote an

3 organizational culture of continuous improvement.

4 • Strengthening external relationships with local communities and industry organizations in

5 developing plans for future ready teams that support Pickering Units 1 and 4 safe store,

6 the PRP and the DNNP.

7

8 These initiatives are expected to result in improving performance, enhance transition planning,

9 succession planning and ready now leaders.

10

11 **4.0   PICKERING OPTIMIZED SHUTDOWN**

12 **4.1   Overview**

13 On August 14, 2020, the Province of Ontario issued a press release announcing its support of

14 OPG's plan to pursue Optimization. The IESO's Annual Planning Outlook published in

15 December 2020 also assumes Pickering shutdown in 2024/2025. Optimizing the shutdown of

16 Pickering mitigates capacity uncertainties during the refurbishments of the Darlington and

17 Bruce stations.

18

19 In EB-2020-0290, OPG provided an update on the Pickering Extended Operations[13] initiative

20 and Pickering Optimization Shutdown aimed to safely optimize the shutdown of Pickering by

21 operating all six units until September 2024, five of the six units through the end of 2024 and

22 the remaining four units (Pickering Units 5-8) to the end of 2025.

23

24 On September 29, 2022, the Province issued a press release to support Pickering B Extension

25 from December 2025 to September 30, 2026 that further mitigates capacity uncertainties to

26 Darlington Refurbishment project completion in April 2026 and meet 2026 summer peak

27 demand.

---

[13] The Pickering Extended Operations initiative was completed in 2023 within its budget of $307M, as detailed EB-2023-0336, Ex. H1-1-1, Section 5.6.2, pp. 20-22.

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1 The Pickering B Extension Variance Account (now Pickering B Variance Account) was

2 established pursuant to an amendment to O. Reg. 53/05 made in December 2022. The

3 variance account records the difference between the revenues generated from the output of

4 Pickering Units 5-8 during the period from January 1, 2026-September 30, 2026, and the sum

5 of any forgone revenue related to forgone output from these units arising from activities

6 undertaken in furtherance of their operation during the period from January 1, 2026-September

7 30, 2026 and the revenue requirement impact resulting from actual capital and non-capital

8 costs incurred for such extension activities. As discussed in Ex. D2-3-1, O. Reg. 53/05 was

9 further amended to allow OPG to record, in the now Pickering B Variance Account, costs that

10 OPG is incurring for preserving resources and supporting infrastructure to enable potential

11 refurbishment and subsequent operation of the units beyond September 30, 2026.

12

13 **4.2 Work and Costs Required for Optimization**

14 The work related to the Pickering Optimized Shutdown initiative demonstrated that it is feasible

15 for Pickering to safely operate to the optimized shutdown dates of 2024 (for Units 1/4) and

16 2025 (for Units 5-8). Subsequent decision through the current 2022-2026 IR term resulted in a

17 Pickering B (Units 5-8) extension to September 2026.

18

19 Optimization involves incremental activities to demonstrate to the CNSC the station's

20 continued fitness of service to safely and reliably operate to the planned shutdown dates, and

21 to make other necessary improvements in support of this plan. The estimated cost of this work,

22 which has been incremental to normal operating costs, is over 2020-2026 period ("Enabling

23 Costs"). The Picking Optimized Shutdown initiative has now been completed, under budget.

24 Further details on the Pickering Optimized Shutdown work and Enabling Costs are described

25 below.

26

27 4.2.1 <u>Pickering Optimized Shutdown Work</u>

28 In advance of recommending Optimization, OPG completed an initial technical assessment of

29 the Pickering units' continued ability to operate to the Optimization's proposed shutdown dates.

30 The initial technical assessments serve as the basis for the detailed scope for the Enabling

31 Costs. The main elements of this scope of work were for: 1) the Periodic Safety Review ("PSR")

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1   revision; 2) the Fuel Channel Life Cycle Management Plan ("FC-LCMP"), and 3) Component

2   Condition Assessments.

3

4   ***Periodic Safety Review Revision***

5   Between 2019 and 2023, OPG's plan to extend commercial operation of Pickering Units 5-8

6   to the end of 2026 required an update to the most recent comprehensive Pickering Periodic

7   Safety Review (named PSR2) PSR2 assessment. The most recent comprehensive Pickering

8   Periodic Safety Review had been completed in support of Pickering commercial life extension

9   to 2024, as part of the Pickering 2018-2028 licence. OPG conducted an incremental review of

10   the PSR2, named the PSR2-B, and reassessed the time-dependent elements of the PSR2.

11   This addendum to the PSR assessed the period of 2024-2026 commercial operation for

12   Pickering Units 5-8. The PSR2-B IIP was accepted by the CNSC in July 2023. By December

13   2024, the last PSR2-B IIP Assignments and Resolution Actions were completed and accepted

14   as closed by the CNSC. OPG informed the CNSC in February 2025 that all PSR2-B

15   commitments are closed and no further reporting was required.

16

17   ***Fuel Channel Life Cycle Management Plan*** ("FC-LCMP")

18   The major limiting component for operations is the life expectancy of the fuel channels.

19   Technical assessments on the fuel channels' fitness-for-service continue through the FC-

20   LCMP and ongoing inspections and include incremental fuel channel scope required to

21   address known degradation to enable operation to the planned shutdown dates through to

22   September 2026. The ongoing work program consists of analysis and work activities to assess

23   fuel channel fitness-for-service for the planned operating durations and to develop methods

24   for assuring that each Pickering unit can meet its extended service life target. This work

25   program is being conducted under the Fuel Channel Life Management Phase V Project (Ex.

26   F2-3-3) and builds on the Fuel Channel Life Management and Fuel Channel Life Extension

27   projects.

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1 *Component Condition Assessments*

2 While the technical fitness-for-service of other major components, separate from the fuel

3 channels, is not considered life limiting, Component Condition Assessments were completed

4 to validate their fitness-for-service to the planned shutdown dates in 2024 and 2026.

5

6 4.2.2 Enabling Costs

7 The costs associated with completing the above work are included within OPG's Nuclear Base,

8 Outage and Project OM&A exhibits and associated tables, as summarized in Chart 5 below.

9 The budgets established in EB-2020-0290[14] for the enabling costs were $50M.

10

11 **Chart 5 – Optimization of Pickering Shutdown Costs ($M)***

Line No.	Cost Item	2020 Actual	2021 Actual	2022 Actual	2023 Actual	2024 Actual	2025 YTD[1]	Total Actual
1	Base OM&A	0.5	0.9	1.7	1.4	3.0	0.2	7.7
2	Project OM&A	0.3	1.7	4.9	3.0	0.2	0.0	10.1
3	Outage OM&A	0.1	1.9	1.8	7.2	11.8	1.1	23.9
4	Total Pickering Optimization	0.9	4.5	8.4	11.6	14.9	1.3	41.7

12 **Numbers may not add due to rounding*

13 [1]Year-to-date costs incurred as of September 30, 2025

14

15 Differences between forecast and actual Enabling Costs incurred to achieve Optimization have

16 been recorded in the Capacity Refurbishment Variance Account. The variance account is

17 discussed in Ex. H1-1-1, Section 5.6.

18

19 **5.0   NEW NUCLEAR INITATIVES**

20 **5.1   Darlington New Nuclear and New Nuclear Development**

21 In EB-2020-0290, OPG identified forecasted non-capital preliminary planning and preparation

22 costs in 2020 and 2021 for a new on-grid small modular reactor facility at the Darlington new

23 nuclear site (the Darlington New Nuclear Program ("DNNP")) to be recorded in the Nuclear

24 Development Variance Account. This included costs for technology developer selection with

---

[14] EB-2020-0290, Ex. F2-1-1, Section 4.2.2.

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1   the objective of arriving at the selection decision by the end of 2021. In the EB-2020-0290

2   Decision and Order, the OEB found that these costs were appropriate to be recorded in the

3   Nuclear Development Variance Account. In the EB-2023-0336 Decision and Order,[15] the OEB

4   agreed to the recovery of $108.3M for the amounts requested over 2020-2022 period. The

5   actual costs incurred in 2020 ($13.1M), 2021 ($95.4M), and 2022 ($2.4M) are presented in Ex.

6   F2-1-1, Table 1a, Line 7. These costs are not part of the DNNP. Further details about the

7   DNNP are discussed at Ex. D2-4-1.

8

9   As highlighted in the Ontario government announcement in November 2024,[16] OPG continues

10 to work with local communities to explore opportunities for new nuclear generation at the

11 Wesleyville site. Historical and bridge year amounts, identified in Ex. F2-1-1, Table 1a, Line 9,

12 primarily relate to preparation for potential new nuclear generation at OPG sites (Wesleyville,

13 Nanticoke and Lambton). These costs are being recorded in the Nuclear Development

14 Variance Account. No amounts related to potential new nuclear generation projects are

15 included in the revenue requirement for OPG's nuclear facilities over the IR term.

16

17 **5.2   Pickering Refurbishment Feasibility Study**

18 As described in Ex. D2-3-4, Section 2.1.1, following the Province of Ontario's request for OPG

19 to update its feasibility assessment for refurbishing Pickering Units 5-8 in 2022, OPG officially

20 began the Feasibility Phase of the refurbishment. The Feasibility Phase was the initial step in

21 assessing whether refurbishment of the Pickering Nuclear Generating Station is technically,

22 economically, and operationally viable. During this phase, a comprehensive feasibility study

23 was conducted, evaluating a range of options and identifying the most promising path forward.

24 The project team undertook high-level technical assessments, examined the condition of key

25 station components, and developed preliminary strategies for refurbishment.

26

27 As discussed in Ex. D2-3-4, key outputs that were driven by the feasibility report included a

28 preliminary project scope, an order-of-magnitude cost estimate, and a high-level schedule.

---

[15] Decision and Order, EB-2023-0336, June 13, 2024, pp. 39-41.

[16] Province of Ontario, News Release: Ontario Generating More Energy to Meet Soaring Demand, November 27, 2024. <https://news.ontario.ca/en/release/1005403/ontario-generating-more-energy-to-meet-soaring-demand>

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1   OPG conducted early engagement with stakeholders, including regulators, government, and

2   Indigenous communities, to understand expectations and concerns. A preliminary risk

3   assessment was also completed, identifying major technical and delivery risks, along with

4   potential mitigation strategies. The actual costs incurred to support this study, 2022 ($0.2M),

5   and 2023 ($17.8M), as presented in Ex. F2-1-1, Table 1a. The completion of this study, and

6   its subsequent approvals, led to the Pickering Refurbishment Program, as discussed in Ex.

7   D2-3-1. These costs are not part of the PRP.

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1 **LIST OF ATTACHMENTS**

2

3 Attachment 1: Prior Gap Closure Initiatives

4

5 Attachment 2: OPG 2024 Nuclear Benchmarking Report

6

7 Attachment 3: ScottMadden Evaluation of OPG Nuclear Benchmarking

8

9 Attachment 4: OPG Nuclear Cost Performance Benchmarking – A Study of Factors
10 Impacting TGC/MWH Performance with Normalizing Adjustments to
11 Facilitate Closer Comparison (ScottMadden)

12

13 Attachment 5: 2025 Indeavor Nuclear Staffing Benchmarking Analysis

14

15 Attachment 6: ScottMadden Evaluation of OPG Nuclear Benchmarking Retainer Letter

16

17 Attachment 7: ScottMadden OPG Nuclear Cost Performance Benchmarking Retainer
18 Letter

19

20 Attachment 8: Indeavor Nuclear Staffing Benchmarking Analysis Retainer Letter

21

22 Note: Attachments may be marked "Confidential", however, OPG has determined all
23 Attachments to be non-confidential in their entirety.

1   **ATTACHMENT 1**

2   **Prior Initiatives**

3

4   Nuclear Operations continues to leverage industry working groups, benchmarking industry

5   peers and utilizing next level industry tools to enable us to adopt industry best practices.

6   Operating stations and supporting business units have established targets that reflect strong

7   industry performance while leveraging Corporate Functional Area Manager accountability and

8   intrusive oversight.

9

10 The following provides an update of the objectives, description of activities undertaken and

11 benefits achieved of the three key fleet wide initiatives as identified in EB-2020-0290, Ex. F2-

12 1-1, Section 3.4: (i) Right Work, Right Time, Right Value, (ii) Leaders Driving Business results,

13 and (iii) People Powering the Future.

14

15   **Right Work, Right Time, Right Value**

16 **Objective**

17 The Right Work, Right Time, Right Value initiative focusses on improving plant reliability by

18 improving maintenance productivity. Another key area of focus is on improving work

19 management performance by transitioning to the use of digital work management tools and

20 artificial intelligence in work management and outage planning processes.

21

22 **Description**

23 Key improvement actions for this initiative are:

24 • Expanding the "Fix it Now" maintenance team and optimizing assessment of minor

25   maintenance. The benefit of the Fix it Now team is increased agility in executing priority

26   work. This team is empowered with cross-functional members to tackle urgent issues more

27   efficiently. Similarly, minor maintenance work is being optimized to ensure assessment is

28   based on a graded approach, which improves efficiency and reduces the comprehensive

29   requirements that are applied to complex work.

30 • Utilizing the Monitoring and Diagnostic Center ("M&D Center") to develop predictive failure

31   models and transitioning components of its time-based maintenance program to condition-

1 based maintenance. The objective of condition-based maintenance is to establish

2 continuous equipment condition monitoring using high performance diagnostic tools that

3 can combine the power of on-line process and equipment performance data acquisition

4 with advanced diagnostic methodologies, including advanced pattern recognition

5 technology (a form of artificial intelligence ("AI")), to avoid operations and maintenance

6 costs and improve plant performance.

7

8 **Benefits Realized**

9 Fix it Now Centre of Excellence at Pickering and Darlington have been established which are

10 industry best practices. The establishment of the Fix it Now Centre of Excellence has improved

11 minor maintenance execution and has driven reductions in both targeted critical and deficient

12 maintenance backlogs (see Figure 1).

13

14 As part of the continued evolution of the M&D Center, sensors and remote monitoring

15 technologies are being installed on plant equipment, which will provide real time data and

16 analysis to ensure maintenance is done promptly and resource utilization is maximized. This

17 enables the prioritization of maintenance activities and optimal use of resources to ensure high

18 plant reliability. OPG will continue to seek further opportunities to apply AI to support planning

19 outage scope and the efficient execution of outage work. The following performance

20 improvements have been realized:

21

22 • Corrective Critical backlogs at 0 for both stations. Corrective Non-critical and Deficient

23 Critical backlogs are 0 at Darlington while < 1 WO per unit at Pickering. Deficient Non-

24 critical backlogs show significant decline at both stations since 2020 (see Figure 1[1]);

25 • Critical PMs deferral at live 0 for both Pickering and Darlington;

26 • Reduction in number of PM's completed in 2nd half of grace;

27 • Maintenance and Work Management Index at industry best 100% for Pickering and

28 Darlington.

---

[1] Figure 1 combines On-Line Corrective Non-Critical, On-Line Corrective Critical, On-Line Deficient Non-Critical and On-Line Deficient Critical Backlogs for ease of reading.

1   **Figure 1**

CORRECTIVE AND DEFICIENT BACKLOGS

Legend: Pickering Backlogs — Darlington Backlogs — Median — Best Quartile
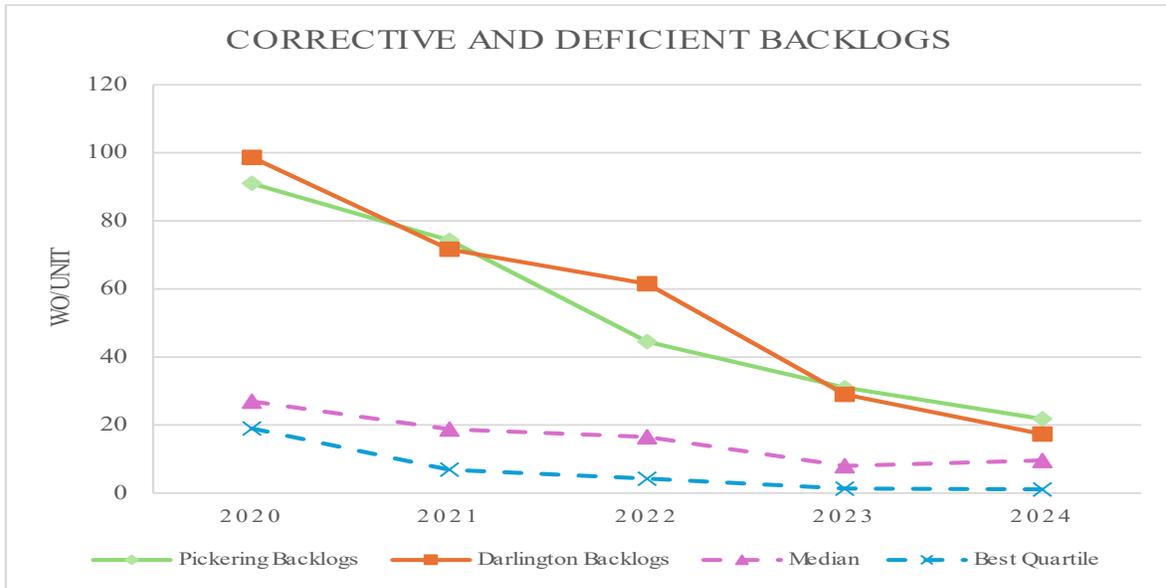
2
3
4   **Leaders Driving Business Results**

5   **Objective**

6   The Leaders Driving Business Results initiative focusses on managers driving business

7   efficiencies through innovation. The initiative provides managers with information, tools and

8   training to make sound risk based decisions that will improve the performance of their teams

9   and support improvement in Safety, Financial, Project, and Operational excellence through

10   readily available information.

11

12   **Description**

13   Key improvement actions for this initiative are:

14   • Established automated centralized business data and reports providing managers with

15   more efficient reporting and access to information to make better informed and more timely

16   decisions. As an example, OPG has implemented a suite of online reporting dashboards

17   providing managers with the ability to see up-to-date operational and cost information,

18   including Performance Improvement, Work Protection, Business Unit Risk Dashboards as

19   well as overtime trend data to better manage budgets. These dashboards also support

20   building broader awareness of business acumen.

1   • Training and workshops to ensure that all managers have the required knowledge and
2   skills to use these tools and manage their teams to drive and sustain innovation and
3   performance improvement.
4
5   **Benefits Realized**
6   OPG created reports, along with training to support their understanding, simplifies and enables
7   leaders to quickly grasp overall performance. These reports are used in station monthly Key
8   Performance Indicator review meetings, Business Unit Risk meetings and Organizational
9   Effectiveness Reflection sessions. Innovation and data analytics have shown significant gains
10   and progress with available Power BI dashboards that include both Operational and Financial
11   tools. Planned enhancements in OPG's safety culture are being achieved through improving
12   work protection, executing work error free and strengthening defenses. This is accomplished
13   through implementing industry defined excellence standards, use of employee advocates and
14   employee-led innovations to improve safety, maintenance and effectiveness.
15
16   **FIGURE 2**

WORK PROTECTION (WPPI)

17
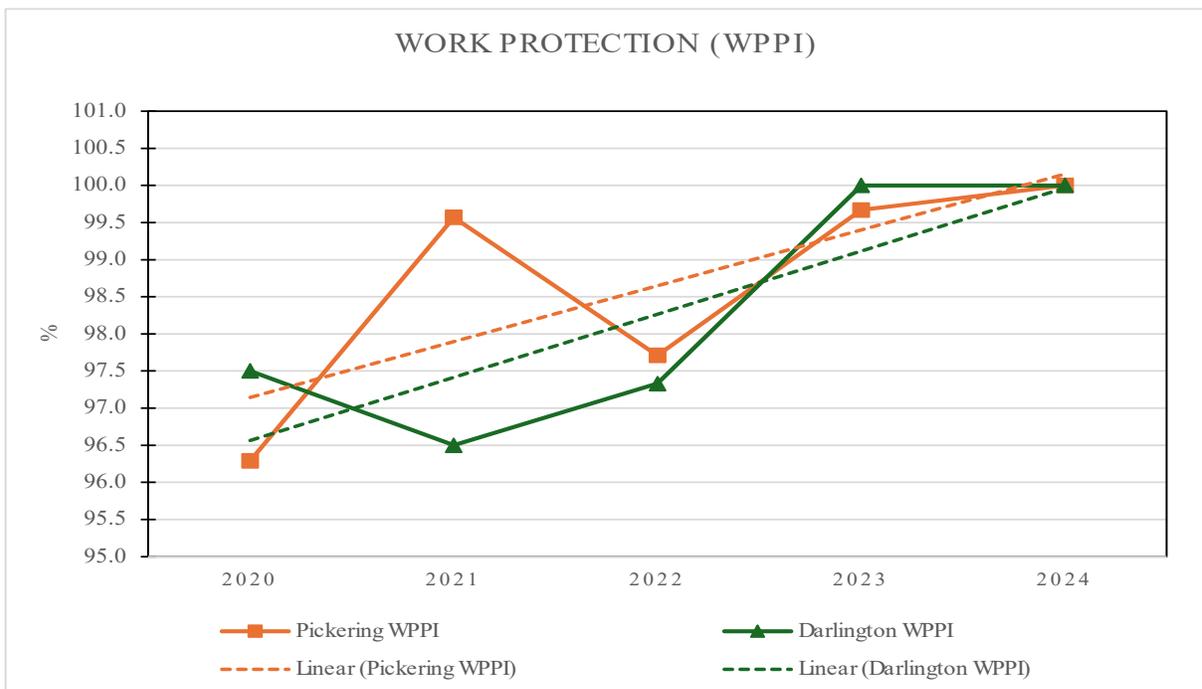
1   **People Powering the Future**

2   **Objective**

3   The People Powering the Future initiative focused on ensuring work programs were resourced

4   appropriately while minimizing the organizational and financial impacts associated with the

5   then planned Pickering commercial operations shutdown.

6

7   With the announcement in January 2024 where the government supported OPG to proceed

8   with the Project Initiation Phase of Pickering Refurbishment (see Ex. D2-3-1), OPG has been

9   working on its strategies to resource the business based on the work demands, transitioning

10   the organization from Pickering end of commercial operations to Pickering Refurbishment and

11   back to commercial operations within the upcoming IR term.

12

13   **Description**

14   In preparing for this transition, OPG has developed a workforce plan that redeploys skilled

15   labour during this transition period to meet the demands of operations and projects across the

16   business. As the organization makes these changes, it is important to ensure that the right

17   individuals and skills are available to meet project and operational demands while addressing

18   risks such as attrition and the retirement eligibility of OPG's workforce (discussed further in Ex.

19   F4-3-1, Section 5.1). The workforce strategies will ensure operational and project excellence

20   to maintain strong performance, while also securing the required resources to progress

21   Pickering Refurbishment and Darlington post-refurbishment operational life.

22

23   **Benefits Realized**

24   Nuclear Operations is improving as a business through strategies to continuously improve and

25   address emerging risks and opportunities. A focus on leadership development and behaviours,

26   employee engagement strategies and high levels of proficiency will help to ensure the

27   workforce can continue to meet demands of continued operational excellence and further, to

28   ensure a sustainable future throughout the IR term and its impending workforce transitions.

29   The focus on leadership development and workforce proficiency includes initiatives on

30   knowledge retention and mentoring programs to strengthen leaders and coaching, and

31   improved feedback to drive proficiency and maintain high safety standards. The continued

1   focus on workforce strategies also helps to secure a capable workforce that can adapt to

2   OPG's future needs.

2024 Nuclear Benchmarking Report

Safety • Reliability • Value for Money • Human Performance

ONTARIO**POWER** GENERATION | *Electrifying life*

Table of Contents

In 2023, Ontario Power Generation (OPG) demonstrated favorable results compared to its peer in number of key areas.

Safety

Total Recordable Injury Rate (TRIF)
Both Darlington Nuclear Generating Station (DNGS) and Pickering Nuclear Generating Station (PNGS) improved performance in 2023, contributing to OPG's best ever TRIF performance, and exceeding industry top quartile.

To further strengthen safety performance, OPG continues to build on its Fail-Safe strategy by building capacity & strengthening safety defences, implementing the Edison Electrical Institute Safety Classification & Learning (SCL) model to recognize and mitigate Serious Injuries & Fatalities (SIF) precursor conditions, as well as the integration of the Electronic Safe work Planning & Pre-Job Briefing (eSWP) platform to enhance sharing of safe work planning knowledge including the Energy Wheel to identify energy hazards.
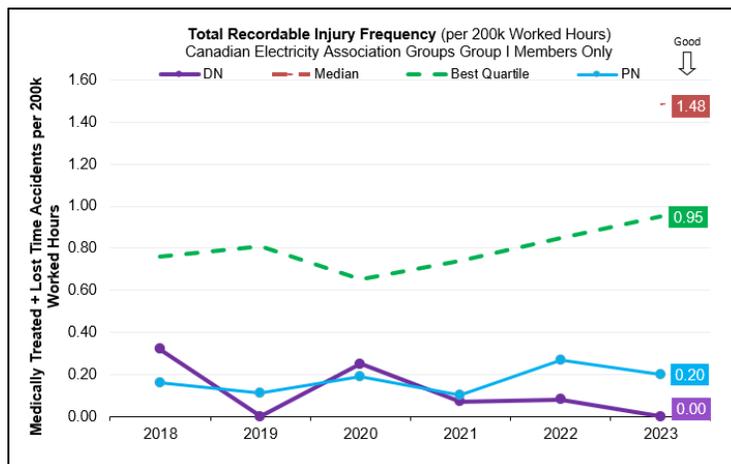
Collective Radiation Exposure (CRE)
DNGS and PNGS continued to achieve maximum Nuclear Performance Index (NPI) in 2023. DNGS improved performance is due to the planned outage schedule in 2023 of zero outages. PNGS CRE slightly increased as a result of planned and unplanned outage scope.

DNGS and PNGS have implemented source term controls including utilizing dose reducing Lanxess resin and improved shielding to reduce dose rates. PNGS is also continuing to focus on foreign material and chemistry heat transport purification management.
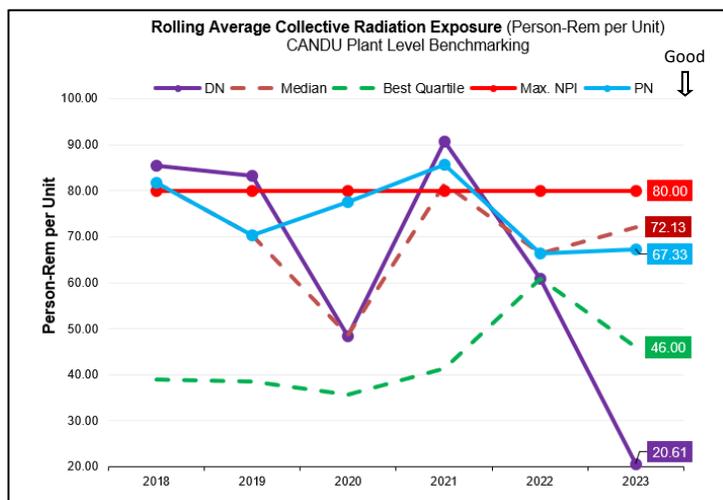
Airborne Tritium Emissions

PNGS and DNGS Airborne Tritium Emissions remain at a very small fraction of regulatory limits.

DNGS and PNGS achieved top quartile in 2023, largely driven by the increase of industry quartiles. This factor led to PNGS achieving top quartile in 2023 for the first time since 2005. DNGS continued best quartile performance is also attributable to tritium identification and reduction activities.

Both sites have continued tritium reduction activities driven by a High Impact Team (HIT), enhancing focus on tritium sources identification and enhanced management oversight. In addition, collaboration between both sites to exchange operating experience, innovation activities on tritium mitigation, and benchmark performance.
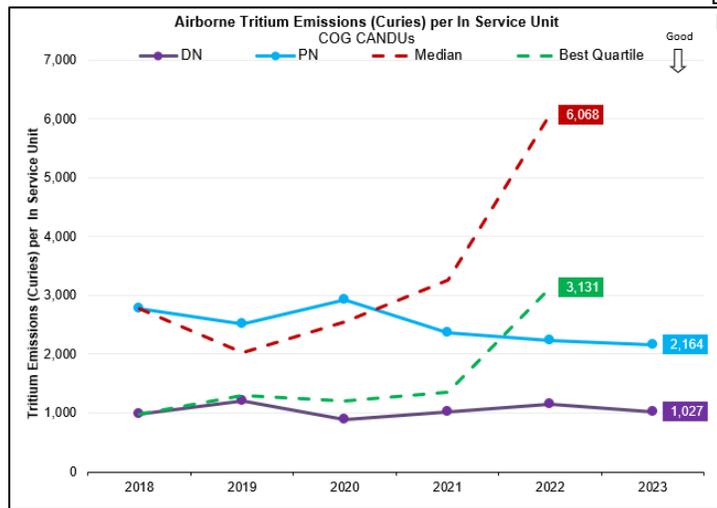
Fuel Reliability Index (FRI)

DNGS and PNGS continued to achieve maximum NPI points in 2023.

One fuel defect was observed for DNGS in 2023 in comparison to zero in 2022. Two fuel defects for PNGS were confirmed in 2023, similar to 2022.

Continual efforts to enhance performance at both sites includes completing the fuel design manual and drawing update which strictly controls the manufacturing process as well as the fuel operating, fuel

handling and fuel performance limits. PNGS is also improving surveillance methods and eliminating foreign materials from entering the Heat Transport System through improved Fuel Handling and Outage practices. DNGS continues to mitigate fuel debris failures by utilization of Foreign Material Exclusion practices.
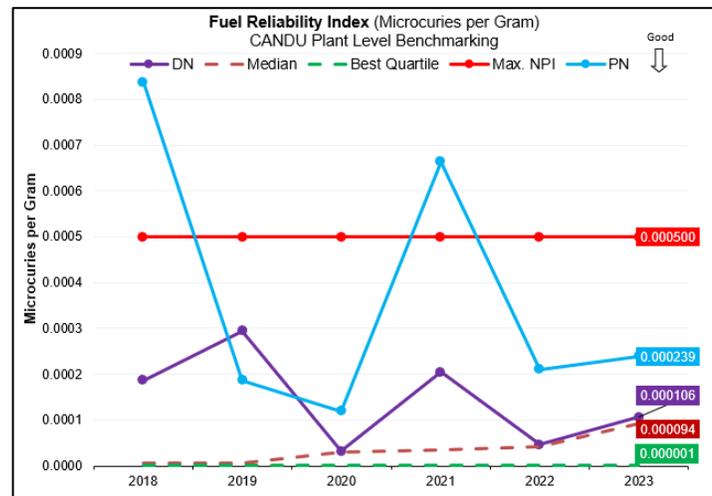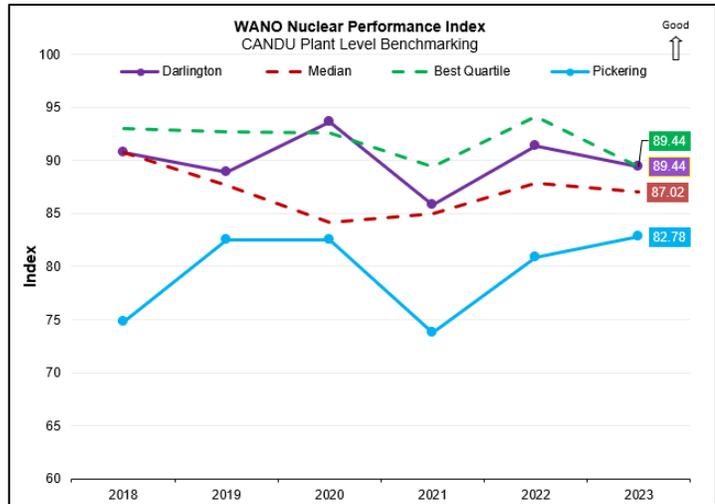
The five other safety-related metrics at DNGS and PNGS were favourable and achieved green ratings in 2023. Both DNGS and PNGS achieved maximum World Association of Nuclear Operators (WANO) NPI results and best quartile performance for all NPI Safety sub-metrics.

Reliability

Nuclear Performance Index (NPI)

In 2023, DNGS performance continues to achieve best quartile due to excellent performance for all seven of the safety metrics.

PNGS performance improved in 2023 due to Unit Capability Factor (UCF) and Forced Loss Rate (FLR) improving performance. PNGS' third quartile performance also reflects the need for extended outages to accommodate fuel channel inspection programs, unbudgeted planned outages for non-routine maintenance work and unplanned outages due to external causes which impact UCF, Collective Radiation Exposure (CRE) and Chemistry Performance Index (CPI) Metrics.

Chart: WANO Nuclear Performance Index – CANDU Plant Level Benchmarking. Series: Darlington, Median, Best Quartile, Pickering. 2023 values: 89.44 (Best Quartile), 89.44 (Darlington), 87.02 (Median), 82.78 (Pickering).
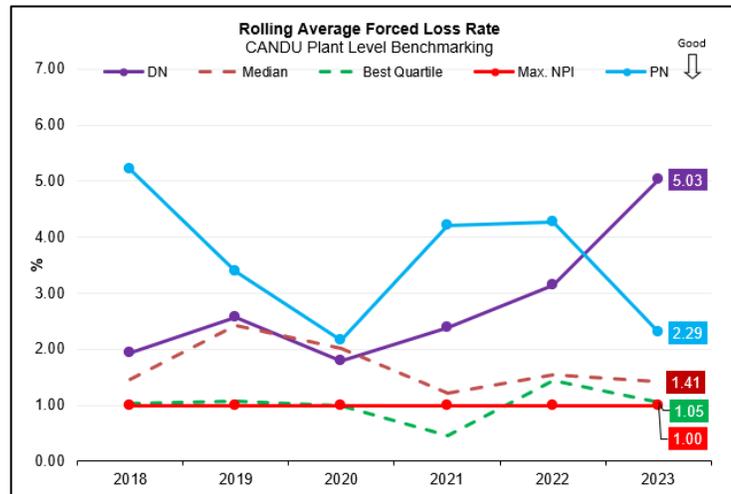
Forced Loss Rate (FLR)

In 2023, FLR performance declined at DNGS and improved at PNGS.

PNGS experienced six forced outages in 2023 compared to elevated FLR in 2021 which is no longer included in the rolling window. DNGS experienced one forced outage and was attributable to post refurbishment outage events on Unit 2.

Fuel handling contribution reduced in 2023 and remains a focus area to build sustainability. Focused initiatives including vulnerability identification and elimination, proficiency building and project execution at both stations to increase Turbine Generator Reliability, the highest fleet contributor. Fuel handling remains a fleet focus area to build sustainability.

Chart: Rolling Average Forced Loss Rate – CANDU Plant Level Benchmarking. Series: DN, Median, Best Quartile, Max. NPI, PN. 2023 values: 5.03 (DN), 2.29 (PN), 1.41 (Median), 1.05 (Best Quartile), 1.00 (Max. NPI).

## Unit Capability Factor (UCF)

In 2023, DNGS improved to achieve best quartile and PNGS remained in fourth quartile. PNGS improved performance is attributable to improved FLR performance in 2023 compared to elevated FLR in 2021 which is no longer included in the rolling average. This was partially offset by increased planned outage days in 2023 in comparison to 2021. DNGS best quartile performance in 2023 is attributable to reduced planned outage days in 2023 compared to 2021, partially offset by forced outage events impacting post refurbishment for Unit 2.
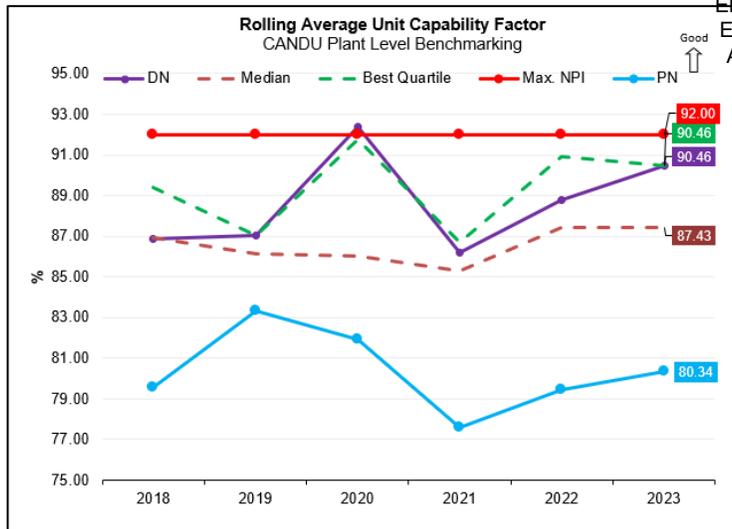
Focused initiatives including vulnerability identification and elimination, proficiency building and project execution at both stations to increase Turbine Generator Reliability, the highest fleet contributor. Fuel handling contribution reduced in 2023 and remains a focus area to build sustainability.

Chemistry Performance Index (CPI)

PNGS decline in 2023 performance is attributed to condenser tube leaks and boiler level transient. Declined performance in 2019-2022 was primarily caused by start-up boiler sulfates due to turbine maintenance activities during outage, and condenser tube leak resulted in elevated boiler ions.
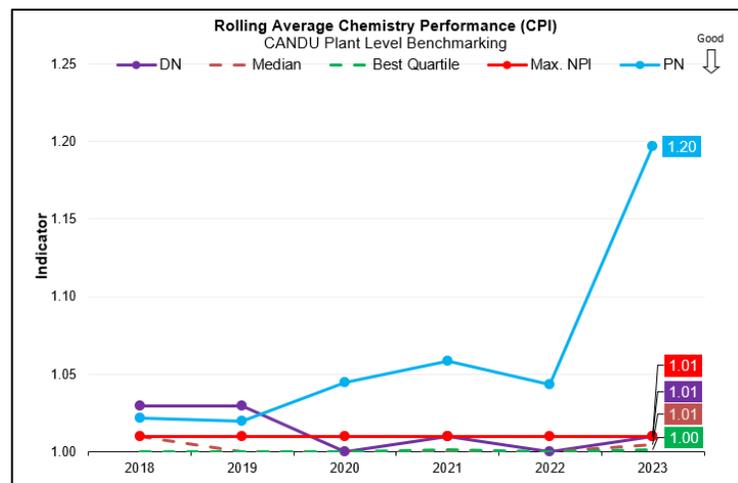
DNGS continues to achieve maximum Nuclear Performance Index (NPI). The slight decline in performance in 2023 compared to 2022 can be attributed to condenser tube leaks on Unit 2.

DNGS and PNGS continue to have a Chemistry Outage Single Point of Contact (SPOC) to provide improved coordination/planning such that system chemistry control is improved during outages/start-ups.

On-Line Deficient Non-Critical Backlog and Deficient Critical Backlog

The favourable trend for Backlog performance at PNGS continued into 2023, with significant improvements for On-line Deficient Non-Critical Backlogs (26% improvement) compared to 2022 results.

DNGS improved their On-line Deficient Non-Critical Backlog by 52% and Deficient Critical Backlog sustained a best quartile score of zero as a result of continued station focus, overall maintenance efficiency and improved schedule quality.

On-line Deficient Non-Critical Backlog
INPO AP-928 Workgroup

Legend: DN, Median, Best Quartile, PN

2023 values: 29.50, 29.00, 7.66, 1.33
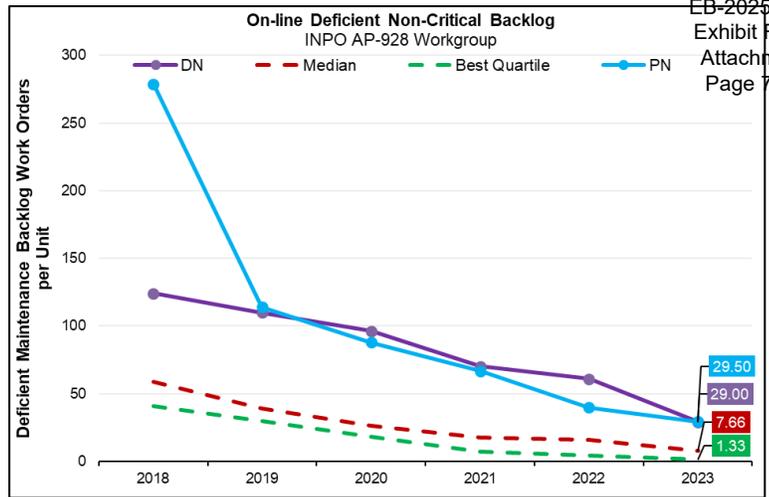
On-Line Corrective Non-Critical Backlog and Corrective Critical Backlog

PNGS On-line Corrective Non-Critical Backlog performance improved in 2023 due to decreases in the Corrective Non-Critical Backlogs.

DNGS remained in the best quartile for the Corrective Critical Backlogs and improved to best quartile for On-line Corrective Non-Critical Backlog performance.
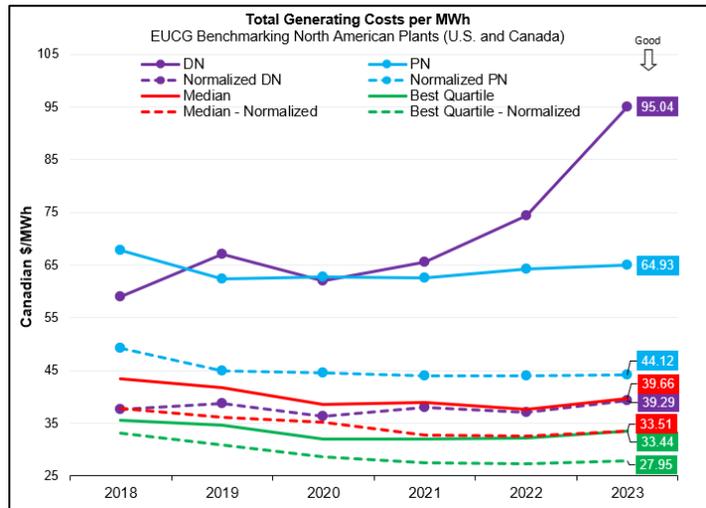

On-line Corrective Non-Critical Backlog
INPO AP-928 Workgroup

Legend: DN, Median, Best Quartile, PN

2023 values: 0.83, 0.33, 0.00, 0.00
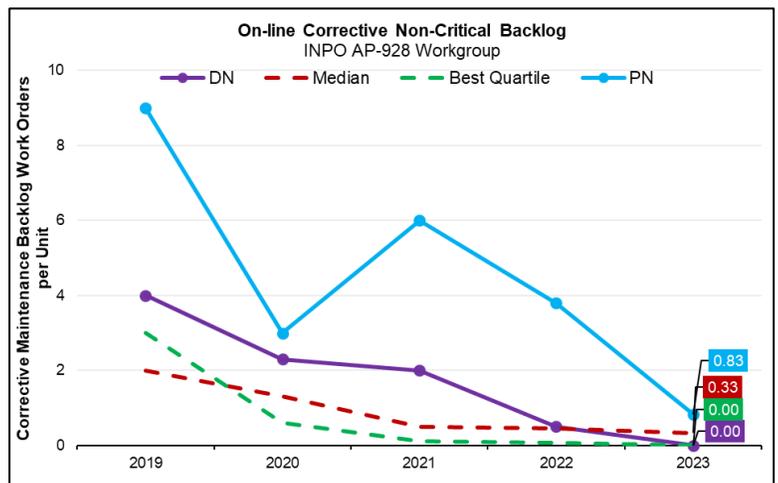
Value for Money

TGC/MWh

In 2023, normalized Total Generating Cost per Megawatt-hour (TGC/MWh) performance remained in the third quartile for DNGS and the fourth quartile for PNGS after normalizing[1] for refurbishment, technology including outage duration and age-related impacts.

DNGS normalized performance was impacted by capital investment requirements for life post-refurbishment and reduced 3-year generation related to the refurbishment schedule while PNGS normalized performance reflects continued reduction in capital investment as the station approaches the end of commercial operations in 2026.
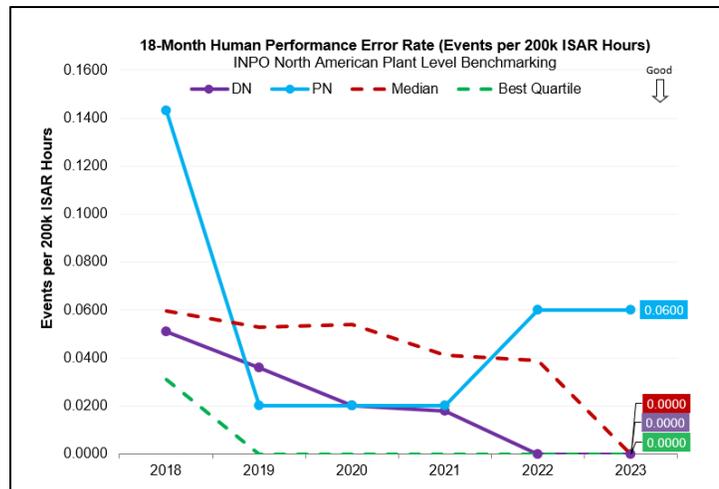
Total Generating Costs per MWh
EUCG Benchmarking North American Plants (U.S. and Canada)

Legend: DN, Normalized DN, Median, Median - Normalized, PN, Normalized PN, Best Quartile, Best Quartile - Normalized

Good ⇩

Y-axis: Canadian $/MWh
X-axis: 2018, 2019, 2020, 2021, 2022, 2023

2023 values: 95.04, 64.93, 44.12, 39.66, 39.29, 33.51, 33.44, 27.95

Human Performance

Human Performance Error Rate

DNGS maintained best quartile performance and did not experience any Site Event Free Day Reset (S-EFDR)'s in 2023.

PNGS experienced one S-EFDR which contributed to fourth quartile performance. The event causes were identified, and corrective actions implemented to address the gaps.

Human performance continues to be a focus across the fleet with actions taken to further improve performance by continuously improving the Observation & Coaching program as well as integration of Fail Safe strategies and trending processes to strengthen values and behaviours of Nuclear Professionals.

18-Month Human Performance Error Rate (Events per 200k ISAR Hours)
INPO North American Plant Level Benchmarking

Legend: DN, PN, Median, Best Quartile

Good ⇩

Y-axis: Events per 200k ISAR Hours
X-axis: 2018, 2019, 2020, 2021, 2022, 2023

2023 values: 0.0600, 0.0000, 0.0000, 0.0000

---

[1] See section 4.0 for more information about the TGC/MWh normalization methodology.

Benchmarking Results – Plant Level Summary

Table 1 provides a complete summary of 2023 performance compared to benchmark results.

Table 1: Plant Level Performance Summary

Metric	2023 Actuals					
	NPI Max	Best Quartile	Median	Third Quartile	Pickering	Darlington
Safety						
Total Recordable Injury Frequency (#/200k hours worked)		0.95	1.48	2.21	0.20	0.00
Rolling Average[2] Industrial Safety Accident Rate (#/200k hours worked)[1]	0.20	0.00	0.00	0.05	0.00	0.00
Rolling Average[2] Collective Radiation Exposure (Person-rem per unit)[1]	80.00	46.00	72.13	94.67	67.33	20.61
Airborne Tritium Emissions (Curies) per Unit [3]		3,131	6,068	6,845	2,164	1,027
Fuel Reliability (microcuries per gram)[1]	0.000500	0.000001	0.000094	0.000239	0.000239	0.000106
2-Year Reactor Trip Rate (# per 7,000 hours)[1]	0.500	0.000	0.215	0.430	0.247	0.430
3-Year Auxiliary Feedwater System Unavailability (#)[1]	0.0200	0.0000	0.0006	0.0021	0.0019	0.0000
3-Year Emergency AC Power Unavailability (#)[1]	0.0250	0.0002	0.0004	0.0030	0.0000	0.0000
3-Year High Pressure Safety Injection Unavailability (#)[1]	0.0200	0.00000	0.00000	0.00000	0.0000	0.0002
Reliability						
Rolling Average[2] WANO NPI (Index)[1]		89.44	87.02	82.78	82.78	89.44
Rolling Average[2] Forced Loss Rate (%)[1]	1.00	1.05	1.41	2.29	2.29	5.03
Rolling Average[2] Unit Capability Factor (%)[1]	92.00	90.46	87.43	86.59	80.34	90.46
Rolling Average[2] Chemistry Performance Indicator (Index)[1]	1.01	1.00	1.01	1.01	1.20	1.01
1-Year Online Deficient Critical Backlog (work orders per unit) [1]		0.00	0.00	0.50	0.67	0.00
1-Year Online Deficient Non-Critical Backlog (work orders per unit) [3]		1.33	7.66	22.00	29.50	29.00
1-Year Online Corrective Critical Backlog (work orders per unit) [1]		0.00	0.00	0.00	0.00	0.00
1-Year Online Corrective Non-Critical Backlog (work orders per unit) [3]		0.00	0.33	1.00	0.83	0.00
Value for Money						
3-Year Total Generating Costs per MWh ($ per Net MWh) [1]		33.44	39.66	49.23	64.93	95.04
Normalized 3-Year Total Generating Cost per MWh ($ per Net MWh)		27.95	33.51	42.57	44.12	39.29
3-Year Total Generating Cost per Unit (M $ per Unit)		283.01	313.31	358.44	230.73	627.40
Normalized 3-Year Total Generating Cost per Unit (M $ per Unit)		236.12	276.78	320.69	168.77	277.51
3-Year Non-Fuel Operating Costs per MWh ($ per Net MWh) [1]		19.64	24.64	32.22	58.31	62.76
3-Year Normalized Non-Fuel Operating Cost per Net MWh ($/MWh)		19.64	24.64	32.22	--	43.89
3-Year Fuel Costs per MWh ($ per Net MWh)[1]		6.11	6.68	7.44	3.79	4.05
3-Year Capital Costs per MW DER (k$ per MW)[1]		33.87	60.01	107.30	19.54	212.29
Normalized 3-Year Capital Cost per MW DER (k$ per MW)		33.87	60.01	107.30	--	106.57
Human Performance						
18-Month Human Performance Error Rate (# per 200k ISAR and contractor hours) [1]		0.0000	0.0000	0.0410	0.0600	0.0000

1. Best Quartile, Median and Third Quartile are from Q4 2023 best available information.

2. Indicates a 2-Year Rolling Average for Pickering and a 3-Year Rolling Average for Darlington.

3. Best Quartile, Median, Third Quartile are from the Q4 2022 which is the most current available benchmark for these metrics.

Legend

4th Quartile Performance	3rd Quartile Performance	2nd Quartile Performance	Maximum NPI points achieved or Best Quartile

Background

This report presents a comparison of OPG Nuclear's performance to that of nuclear industry peer groups. Benchmarking results are used during business planning to drive top-down target setting with business improvement as the objective.

Performance Indicators

Good performance indicators used for benchmarking are metrics with standard definitions, reliable data sources, and utilization across a representative portion of the industry. Good indicators allow for benchmarking to be repeated year after year in order to track performance and improvement. Additionally, when selecting an appropriate and relevant set of metrics, a balanced approach covering all key areas of the business is essential. In accordance with these criteria, key performance indicators have been selected for comparison to provide a balanced view of performance and for which consistent, comparable data is available. These indicators are defined in Section 6.0.

Each indicator reflects a particular duration of historical performance in accordance with peer group expectations. For example, Electric Utility Cost Group (EUCG) data for Value for Money metrics are based on three-year average performance, whereas WANO NPI safety and reliability metrics reflect multi-year rolling averages based on each station's outage cycle. For NPI metrics, Darlington and Pickering's results reflect a three-year and two-year outage cycle, respectively.[2]

Industry Peer Groups

Peer groups were selected based on performance indicators widely utilized within the nuclear industry. Overall, six different peer groups were used as illustrated in Table 2 of Section 6.0 and panel members are detailed in Tables 3 to 8 of Section 6.0.

Report Structure

Sections 2.0 to 5.0 of the report focus on safety, reliability, value for money and human performance areas.

The Major Operator Section (historically Section 6.0) was removed from this report, consistent with ScottMadden's recommendations with respect to streamlining the report and ensuring consistency with leading practices and value for stakeholders. The Major Operator section provided a fleet operator level summary across a few key metrics, primarily across North America, utilizing a simple average of the results (mean) from each of their units/plants. While the operator level summary can be informative, it is more appropriate to look at OPG's two nuclear facilities individually given that they are at different stages of their lifecycle, have different sized units and reflect different generations of CANDU technology. This view is aligned with ScottMadden's most recent evaluation OPG Nuclear Benchmarking. The detailed data in sections 2.0 to 5.0 of the report provides a more complete picture of OPG's performance.

Section 6.0 provides an appendix of supporting information, including common acronyms, definitions, peer group and panel composition details.

---

[2] The planned outage cycle for each unit at Pickering is transitioning from a 24-month to a 30-month outage cycle. Pickering continues to assume a 24-month rolling average for benchmarking to be consistent with WANO reporting expectations.

Methodology and Sources of Data

The majority of safety metrics were calculated using data from WANO. Data labelled as invalid by WANO were excluded from all calculations. Indicator values of zero are not plotted or included in calculations except in cases where zero is a valid result. Current data was obtained and consolidated with previous benchmarking data.

The WANO Nuclear Performance Index (NPI), a maximum score of 100 is possible. The WANO NPI is an operational performance indicator comprised of 10 metrics, 7 of which are analyzed in this section:

- Industrial Safety Accident Rate (ISAR) [Rolling Average]
- Collective Radiation Exposure (CRE) [Rolling Average]
- Fuel Reliability Index (FRI) [Annual]
- 2-Year Unplanned Automatic Reactor Trips
- 3-Year Auxiliary Feedwater Safety System Performance Unavailability
- 3-Year Emergency AC Power Safety System Performance Unavailability
- 3-Year High Pressure Safety Injection Unavailability

The remaining three WANO NPI metrics are included in the Reliability Section (Section 3.0).

Note: To benchmark performance, Max NPI is used to indicate best quartile performance for metrics that perform better than the Max NPI benchmark. If metric performance is not better than Max NPI, quartile benchmarks are used to benchmark performance.

In addition to the WANO NPI safety sub-indicators listed above, Total Recordable Injury Frequency and Airborne Tritium Emissions per In Service Unit are included in this section of the report.

Total Recordable Injury Frequency (TRIF) was calculated using data from the Electricity Canada (EC). The peer group are members of Electricity Canada (EC) (Section 6.0, Table 6).

- OPG benchmarks against EC Group 1 peers (a subset of all EC members), which incorporates organizations with more than 1,500 employees, including most provincial utilities, leveraging EC's Occupational Health & Safety Statistics 2023 Report.

Airborne Tritium Emissions per In Service Unit data was collected from the CANDU Owners Group (COG). The peer group for this metric is all CANDUs who are a member of COG. There is a one-year lag for the industry values associated with this metric.

Total Recordable Injury Frequency (TRIF)

Total Recordable Injury Frequency (per 200k Worked Hours)
Canadian Electricity Association Groups Group I Members Only
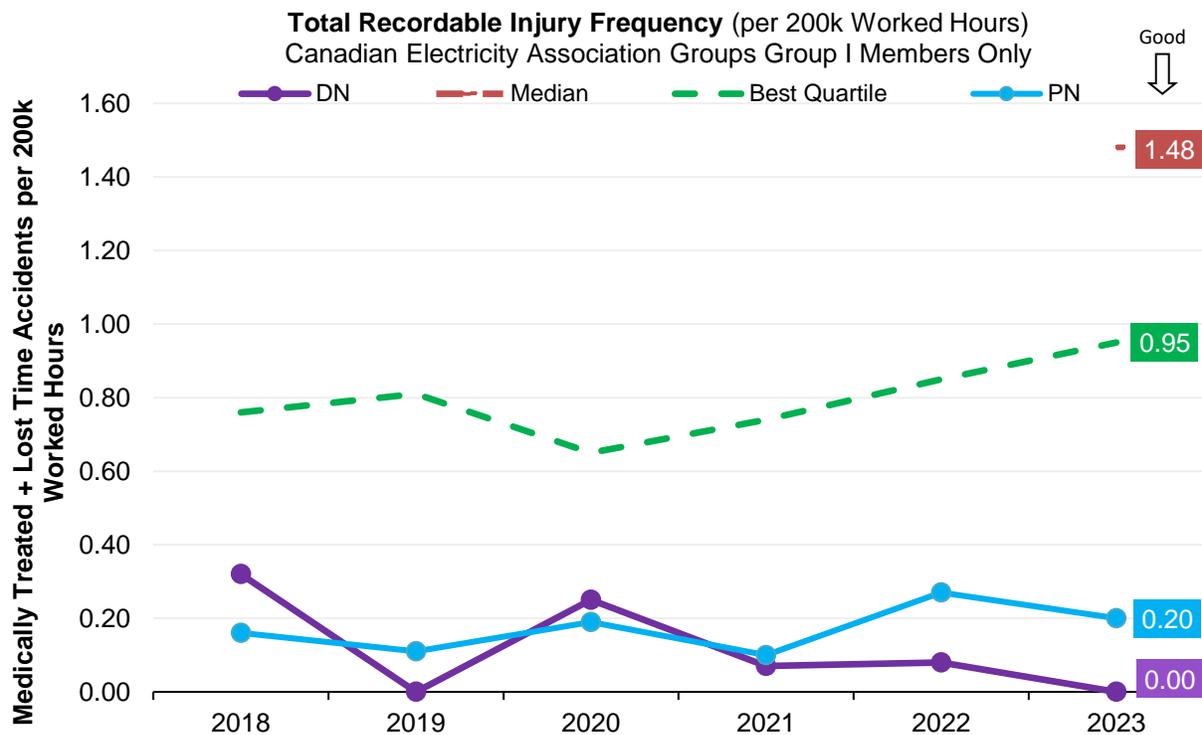
Note: Annual Value; median unavailable 2018-2022.

	2023 Value
DN	0.00
PN	0.20
Best Quartile	0.95
Median	1.48

Factors Contributing to Performance

- DNGS and PNGS improved performance in 2023 continued a long-standing pattern of excellent TRIF performance by exceeding the industry top quartile (top 25%) mark of 0.95 and top decile (top 10%) mark of 0.56, where DNGS reached 0.00 and PNGS achieved 0.20.
- Both DNGS and PNGS combined TRIF performance of 0.13 contributed to OPG's best TRIF performance of 0.16 in 2023 since the company's inception in 1999 and was the best performance in 2023 when compared to Electricity Canada's Group 1 companies with over 1,500 employees.
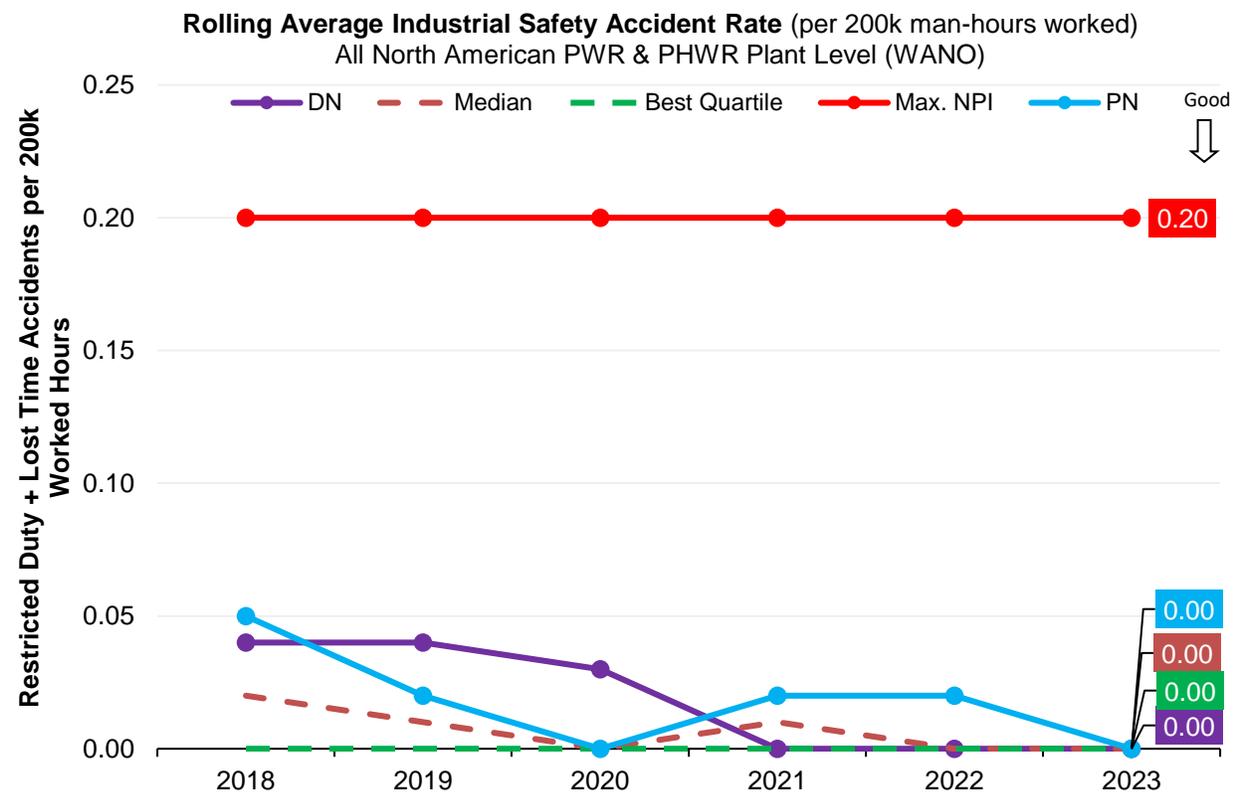
Initiatives to Improve and Sustain Favorable Performance Include:

Implementation of the following initiatives are aimed at leading OPG to world-class safety performance:

- OPG continues to build upon its Fail-Safe Strategy to reduce the frequency of employee injuries by building capacity and strengthening safety defences.

- As part of the Fail-Safe Strategy, OPG is modernizing how it classifies safety events - through the implementation of the Edison Electrical Institute Safety Classification and Learning (SCL) model. The SCL model helps enable early recognition and mitigation of Significant Injuries & Fatalities (SIF) precursor conditions to learn from safety events and prevent recurrences. In addition, the SCL model identifies if barriers/controls were in place when the event occurred, providing learnings and insights on where OPG can make improvements.

- OPG has an ongoing initiative to modernize Pre Job-Briefs (PJBs) and Safe Work Plannings (SWPs) into a single integrated digital platform, the Electronic Safe Work Planning & Pre-Job Briefing (eSWP) platform. The eSWP will strengthen Fail-Safe defences and enhance the sharing of safe work planning knowledge. The eSWP platform will also feature The "Energy Wheel" tool, to aid in the identification of energy hazards that are often overlooked, and to support workers in implementing additional safety precautions for high-energy tasks that pose significant risks in the event of human error or equipment failure.

- Updates have been made to data systems to integrate and facilitate trending of safety events as well as the early identification of emerging safety risks.

- OPG continues to incorporate and implement external benchmarking learnings to achieve industry best practice.

Rolling Average Industrial Safety Accident Rate (ISAR) * +

Rolling Average Industrial Safety Accident Rate (per 200k man-hours worked)
All North American PWR & PHWR Plant Level (WANO)

Legend: DN, Median, Best Quartile, Max. NPI, PN, Good

Max. NPI = 0.20 (constant 2018–2023)

2023 values: PN 0.00, Median 0.00, Best Quartile 0.00, DN 0.00

* Sub-indicator for WANO NPI

+ 2 Year Avg PNGS, 3 Year Avg DNGS – Unit 2 (U1 & U4 in Refurbishment. Unit 3 in-service Q2, not online for 3 years)

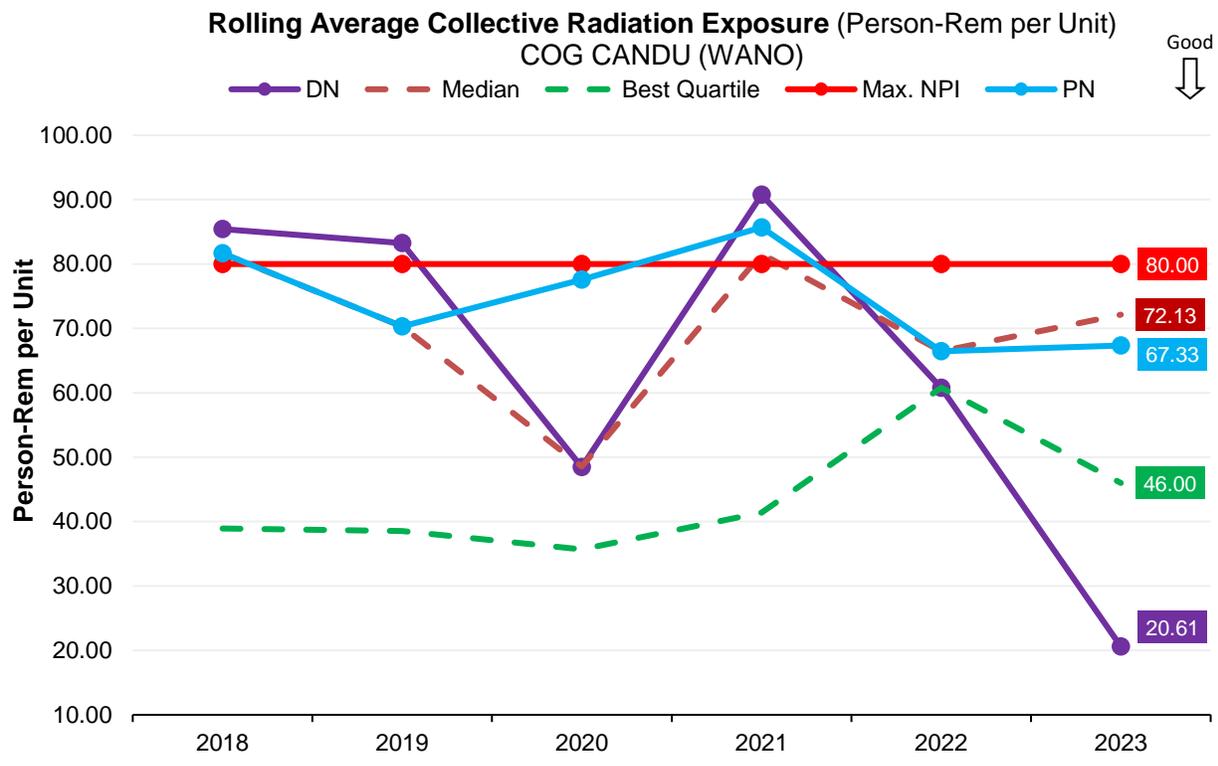|	**2023 Value**
DN	0.00
PN	0.00
Best Quartile	0.00
Median	0.00

Factors Contributing to Performance

- DNGS and PNGS continued to achieve maximum Nuclear Performance Index (NPI) points.
- DNGS achieved best quartile performance with zero ISAR events during the last 3-year rolling average reporting period.
- PNGS achieved best quartile performance with zero ISAR events during the last 2-year rolling average reporting period.

Initiatives to Improve and Sustain Favourable Performance Include:

- OPG continues to prioritize the implementation of the Fail-Safe health and safety program, which focuses on high-energy work, sequential control measures, event learning, and various strategies:
  - Modernization of safety metrics to incorporate leading indicators for early intervention includes the use of Quality of Safety Practices (QSP) which monitors high and low energy conventional safety risks to identify vulnerability and opportunities to increase capacity by implementing controls.
  - Implementation of Electronic Safe Work Planning (eSWP) which aims to assess the quality of direct controls addressing high-energy hazards within safe work plans.
  - Adoption of the Edison Electrical Institute Safety Classification and Learning (SCL) model to better identify more learning opportunities through safety classifications which will allow for better benchmarking within the industry.
  - Enhancing the oversight program with a graded approach that monitors performance for prevention and early intervention by increasing oversight to address behaviors and/or program deficiencies through Observation and Coaching (O&C's), metrics, audits/assessments, benchmarking, and events.

Rolling Average Collective Radiation Exposure (CRE) * +

Rolling Average Collective Radiation Exposure (Person-Rem per Unit)
COG CANDU (WANO)

Good ⇩

Legend: DN — Median — Best Quartile — Max. NPI — PN

Chart values labeled at right: 80.00, 72.13, 67.33, 46.00, 20.61

* *Sub-indicator for WANO NPI*

+ *2 Year Avg PNGS, 3 Year Avg DNGS – Unit 2 (U1 & U4 in Refurbishment. Unit 3 in-service Q2, not online for 3 years)*

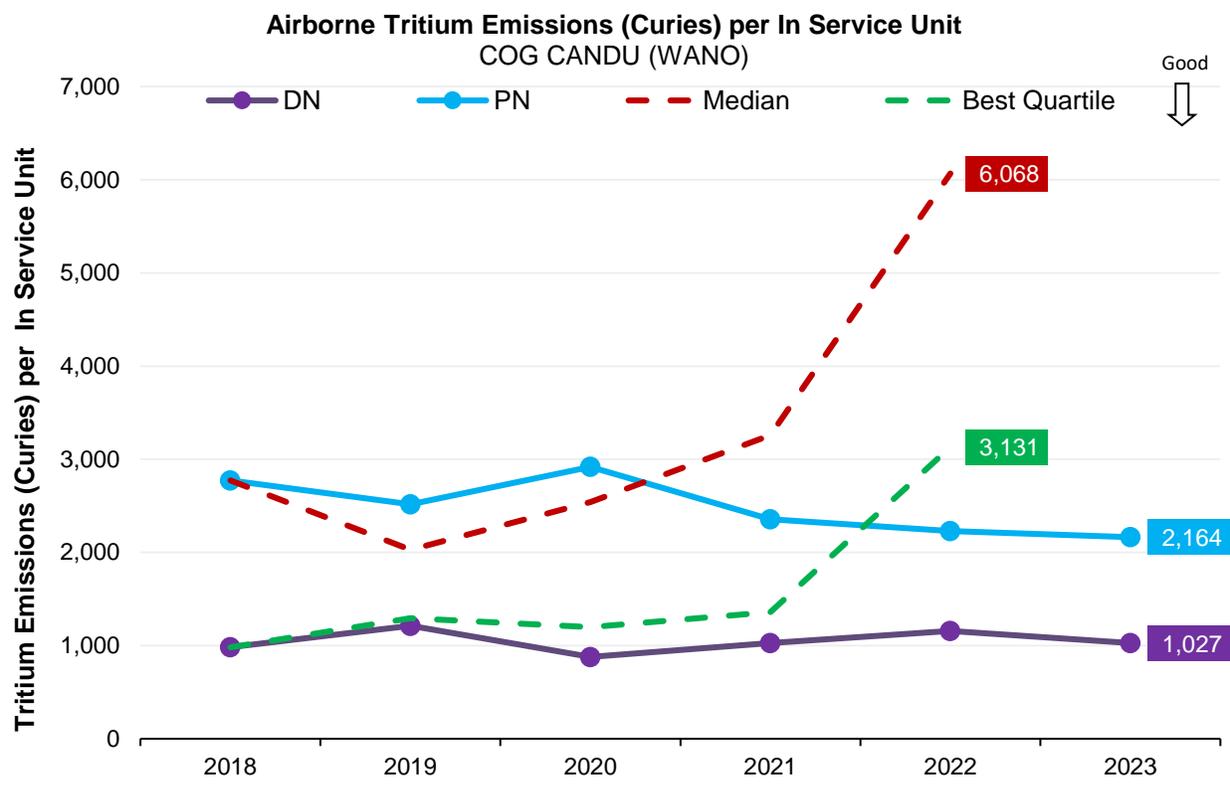|	2023 Value
DN	20.61
PN	67.33
Best Quartile	46.00
Median	72.13

Factors Contributing to Performance
- DNGS and PNGS continued to achieve maximum Nuclear Performance Index (NPI) points.
- DNGS performance improved in 2023, as a result of:
    - Zero planned outages scheduled in 2023.
    - 2022 CRE calculated for Unit 4 prior to refurbishment (Unit 1 & 3 were in refurbishment and Unit 2 was only online for 2 years) and 2023 CRE calculated for Unit 2 post-refurbishment (Units 1, 3 and 4 were in refurbishment) as this metric is a rolling average.
    - Two forced unit outages occurred but did not have significant impact to collective dose. Outage scope involved repairs on a primary heat transport pressurizer valve, moderator cover gas system repairs, tritium immobilization system glovebox repair, and a rupture disk repair.
    - Online and major project dose remained consistent compared to previous years.

- PNGS performance in 2023 was slightly higher compared to 2022. This was a result of additional planned unbudgeted and forced outages.
  - In 2023 there were three planned outages, two planned unbudgeted outages and six forced outages compared to three planned outages, one planned unbudgeted outage and five forced outages in 2022.
  - Work programs for the planned maintenance outages which contributed to dose included fuel channel components periodic inspection program, boiler inspection programs and a first in a while evolution of Boiler Secondary Side Chemical Clean which was performed on Unit 8.
  - The two planned unbudgeted outages were taken to address fueling machine vault air conditioner unit repairs and the six forced outages were taken to address emergent conditions.

Initiatives to Improve and Sustain Favourable Performance Include:

- DNGS has placed emphasis on these initiatives and practices to reduce exposures**:**
  - Implementation of source term controls such as post-refurbishment source term monitoring and characterization program, dose reducing Lanxess resin in purification systems, permanent isolation of containment equipment D_2O circulation supply lines, development and testing of ultrasonic technology for hot spot and crud removals.
  - Upcoming deployment of the Rapid Delivery Machine (RDM) for automated fuel channel inspections during unit outages to eliminate personnel on the reactor maintenance platform and minimize collective dose.
  - Modification of piping and lines containing build up of crud and hot spots to facilitate installation of magnetic shielding to reduce ambient dose rates inside containment during outages.

- PNGS continues to place concerted effort on improving performance by utilizing the following practices:
  - Reactor face dose rate surveys performed during 2023 Planned Outages showed that dose rates were slightly lower than the previous outages with between a 5 – 10% reduction.
  - Implementation of specialized source term reduction agents (i.e., Lanxess resin, fueling machine filter pore size reduction)
  - Continued focus on foreign material management and chemistry heat transport purification management.
  - ALARA (as low as reasonably achievable) initiatives, such as improved shielding, source term reduction initiatives and work methods improvements and efficiencies, contribute to improvements in dose performance.

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Airborne Tritium Emissions

Airborne Tritium Emissions (Curies) per In Service Unit
COG CANDU (WANO)

Notes:

- *Annual Value*
- *Median and Best Quartiles are plotted until 2022 as the 2023 results were unavailable at the time of benchmarking (one-year lag).*
- *Darlington values exclude Tritium Removal Facility (TRF) and associated West Annex emissions (consistent with COG benchmark results).*
- *Unit 1, Unit 3 and Unit 4 refurbishment periods, and the Retube Waste Processing Building (RWPB).*

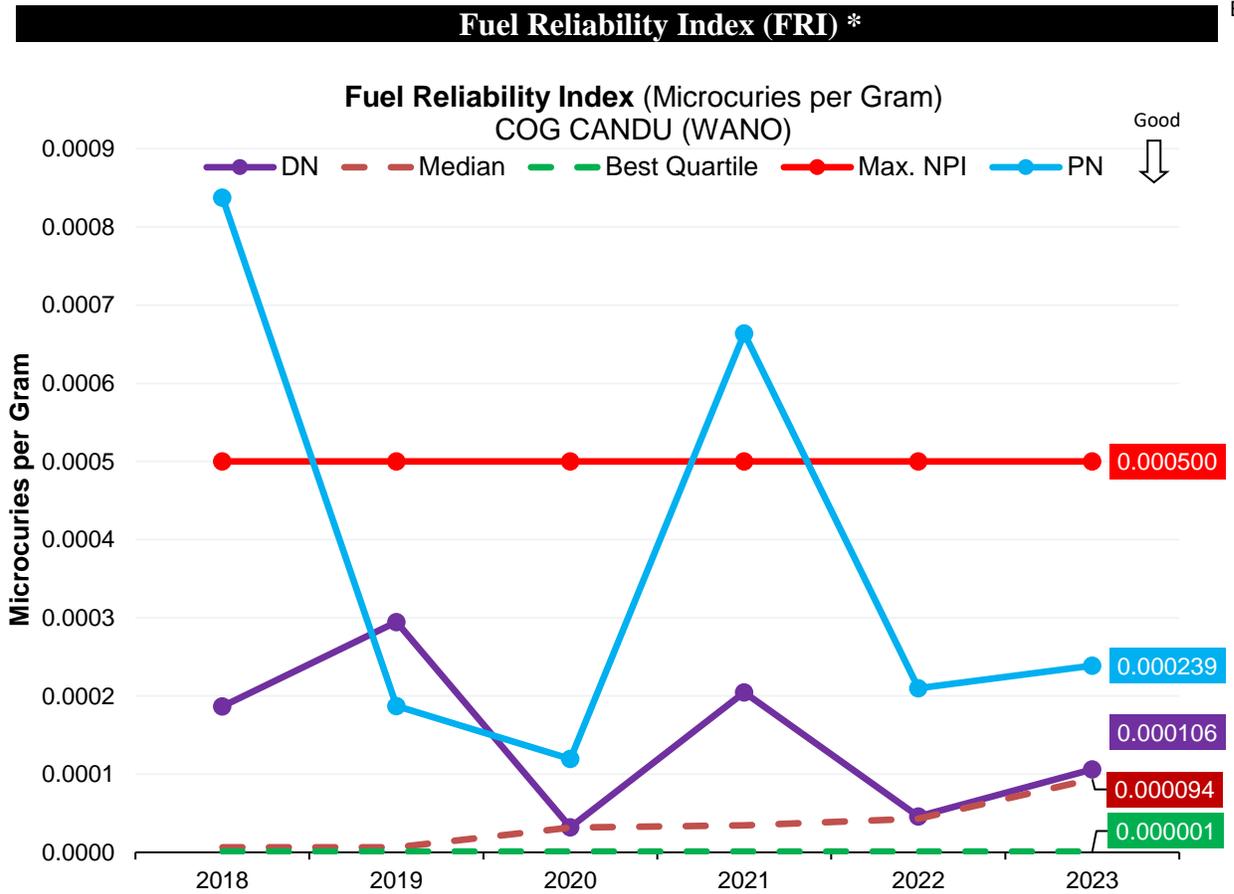|	2023 Value
DN	1,027
PN	2,164
Best Quartile	3,131
Median	6,068

Factors Contributing to Performance

- DNGS and PNGS Airbourne Tritium Emissions remain at a very small fraction of regulatory limits
- DNGS and PNGS achieved top quartile in 2023, largely driven by the increase of industry quartile which reflects an additional plant being included in the peer group.
- Both sites have continued tritium reduction activities driven by a High Impact Team (HIT) which focuses on day-to-day tritium reduction activities such as heavy water leaks and repairs, drier performance, continued management oversight and communication of priorities, utilized enhanced monitoring system station wide to provide real-time tritium monitoring capability.

- DNGS continues to achieve best quartile performance. This was mainly attributed to efforts by the station to focus on tritium identification and reduction activities such as prioritized repairs to leaking equipment and driers, utilized enhanced monitoring system station wide to provide real-time tritium monitoring capability and continued management oversight and communication of priorities.

- PNGS achieved industry top quartile performance in 2023 for the first time since 2005. This was mainly attributable to the declining industry performance in 2022. Improved performance can also be attributed to efforts by a High Impact Team in place to drive station tritium reduction activities such as a focused effort on reducing drier downtime, and prioritizing repairs and equipment leaks clean up, thus minimizing airborne impact.

Initiatives to Improve and Sustain Favourable Performance Include:

- Ongoing dedicated teams at both sites to enhance focus on tritium sources identification and elimination, including drier performance, heavy water leaks and repair.
- Enhanced management oversight and communication of priorities to focus tritium reduction activities daily at the Integrated Station Brief (ISB) meetings.
- Collaboration to exchange operating experience and innovation activities on tritium mitigation, and benchmark performance.
- Source term reduction on heat transport and moderator water.
- Tritium Oversight Committee in place at DNGS to develop longer term actions, provide oversight, and proactively schedule preventive maintenance activities.
- Tritium Prevention Procedure training for Operators to increase awareness on tritium reduction.
- Ongoing participation in COG environmental benchmarking of participating CANDU stations to determine best environmental practices.

Fuel Reliability Index (FRI) *

Fuel Reliability Index (Microcuries per Gram)
COG CANDU (WANO)

* *Sub-indicator for WANO NPI*
Note: 2023 Most Recent Operating Quarter
Note: DNGS – Unit 2 (U1 & U4 in Refurbishment. Unit 3 in-service Q2, not online for 3 years)

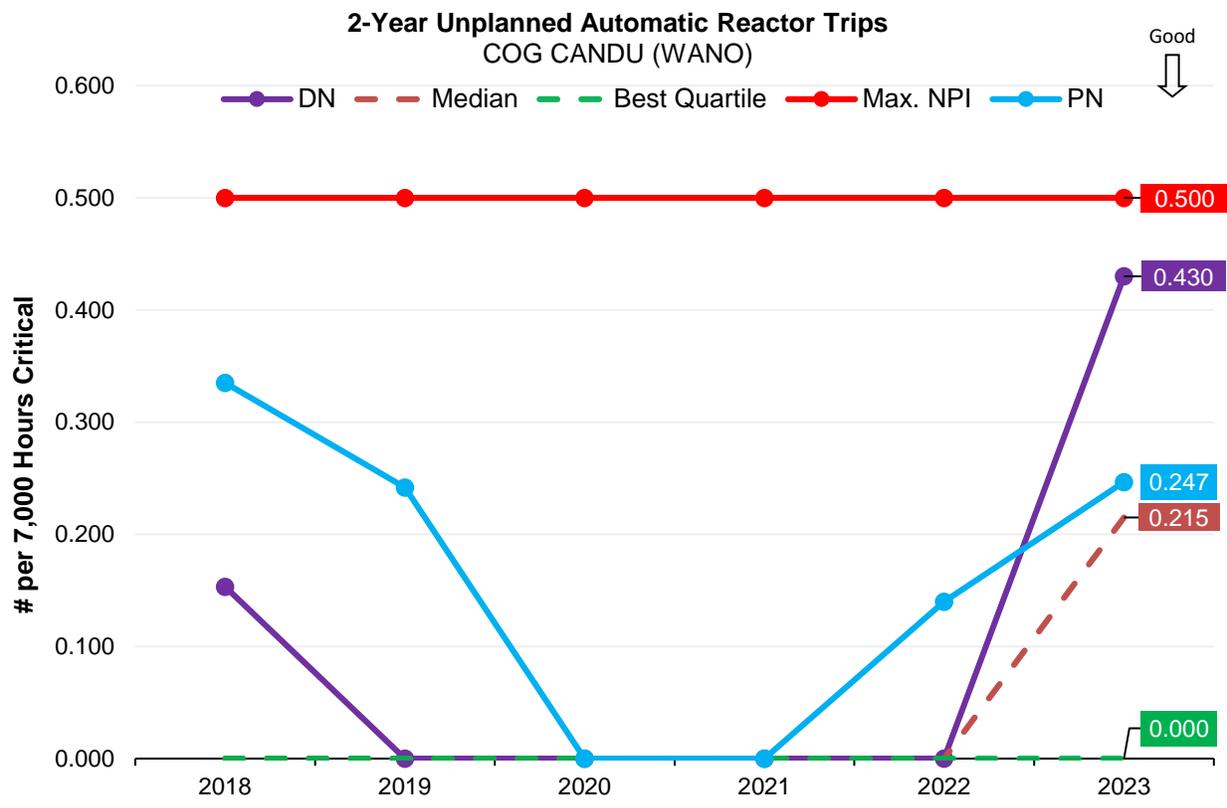|	2023 Value
DN	0.000106
PN	0.000239
Best Quartile	0.000001
Median	0.000094

Factors Contributing to Performance

- DNGS and PNGS continued to achieve maximum Nuclear Performance Index (NPI) points.
- One fuel defect was observed and discharged at DNGS in 2023, compared to zero in 2022.
- Two fuel defects were observed at PNGS in 2023, similar to 2022. One was discharged and the second remained in-core at the end of 2023. OPG is working to remove the remaining defect at the earliest possibility.

Initiatives to Improve and Sustain Favourable Performance Include:

- Both sites completed the fuel design manual and drawing update process. These documents strictly control the manufacturing process, fuel operating limits, fuel handling limits and the fuel performance limits. OPG continues to source fuel with tighter manufacturing tolerances at both sites, thereby eliminating certain modes of fuel defecting following fuelling runs.

- DNGS improvement initiatives include:
  - Foreign Material Exclusion practices continue to mitigate fuel debris fretting failures as shown by the low number of fuel defects following the DNGS reactor refurbishment activities.

- PNGS improvement initiatives include:
  - Increasing scope of Primary Heat Transport System (PHTS) grab sampling and analysis when defects are in-core, continues to assist in earlier detection.
  - Improving the methods of surveillance and elimination of the possibility of foreign materials entrance into the HTS due to Fuel Handling and Outage practices continues to mitigate entrance of micro-debris.
  - Improving and sustaining awareness of impact of foreign material in the PHTS on fuel performance.
  - Improving capability in Units 5 to 8 of detecting the defected fuel bundles during the discharge from the fuelling machines continues to assist in re-directing failed fuel to the inspection area.

2-Year Unplanned Automatic Reactor Trips *

2-Year Unplanned Automatic Reactor Trips
COG CANDU (WANO)

Good

Legend: ● DN ■ ─ Median ■ ─ Best Quartile ● ─ Max. NPI ● ─ PN

Y-axis: **# per 7,000 Hours Critical** — 0.000, 0.100, 0.200, 0.300, 0.400, 0.500, 0.600

X-axis: 2018, 2019, 2020, 2021, 2022, 2023

Max. NPI: 0.500

DN: 0.430

PN: 0.247

Median: 0.215

Best Quartile: 0.000

* Sub-indicator for WANO NPI
Note: DNGS – Unit 2 (U1 & U4 in Refurbishment. Unit 3 in-service Q2, not online for 3 years)

	2023 Value
DN	0.430
PN	0.247
Best Quartile	0.000
Median	0.215

Factors Contributing to Performance
- DNGS and PNGS continue to achieve maximum Nuclear Performance Index (NPI) points.
- DNGS performance was impacted by the following unplanned automatic reactor trip:
  - Unit 2: Shutdown System (SDS) 1 trip occurred due to failure of a hand controller causing a control valve to open and resulting in pressurizer steam loss. The cause of failure of the hand controller was a lack of maintenance, and less than adequate risk perception of the potential failure.
- PNGS performance was impacted by the following unplanned automatic reactor trip:
  - Unit 8: An automatic reactor trip on SDS1 and SDS2 occurred. SDS1 tripped on Heat Transport High Temperature (HTHT) trip parameter, while SDS2 tripped on the same trip parameter on channel G, followed by O (LBL) trip parameter on channel J. The direct cause of this event is high output failure of a boiler level transmitter, although the internal mechanism that caused the level transmitter to fail is unknown.

Initiatives to Improve and Sustain Favourable Performance Include:

The following are being implemented in both PNGS and DNGS:

- On-going performance monitoring and improvement activities by Station Operations, Engineering, and Maintenance organizations.

- Operating Experience (OPEX) from each event has been shared at PNGS, DNGS and at external summits. To improve human performance, technical procedures have been revised. To improve equipment reliability, where possible, like-for-like parts replacement has taken place. System health teams are involved in obsolescence issues.

- OPEX and lessons learned from the continuous exchange of information among Canadian utilities are incorporated into the OPG governance and governance support documents.

- OPG methods and approaches in Operations, Engineering, and Maintenance are compared with other utility and the latest international standards through CANDU Owners Group (COG) projects. Under the COG sponsorship, OPG participates in the COG task teams for alignment of practices and staying current with best industry practices.

- Internal and external audits as well as inspections and self-assessments are performed to verify compliance and recommend future improvement opportunities.

- Training and qualification requirements are established and reviewed to be up-to-date to execute the job tasks at all levels of Operations, Maintenance and Engineering.
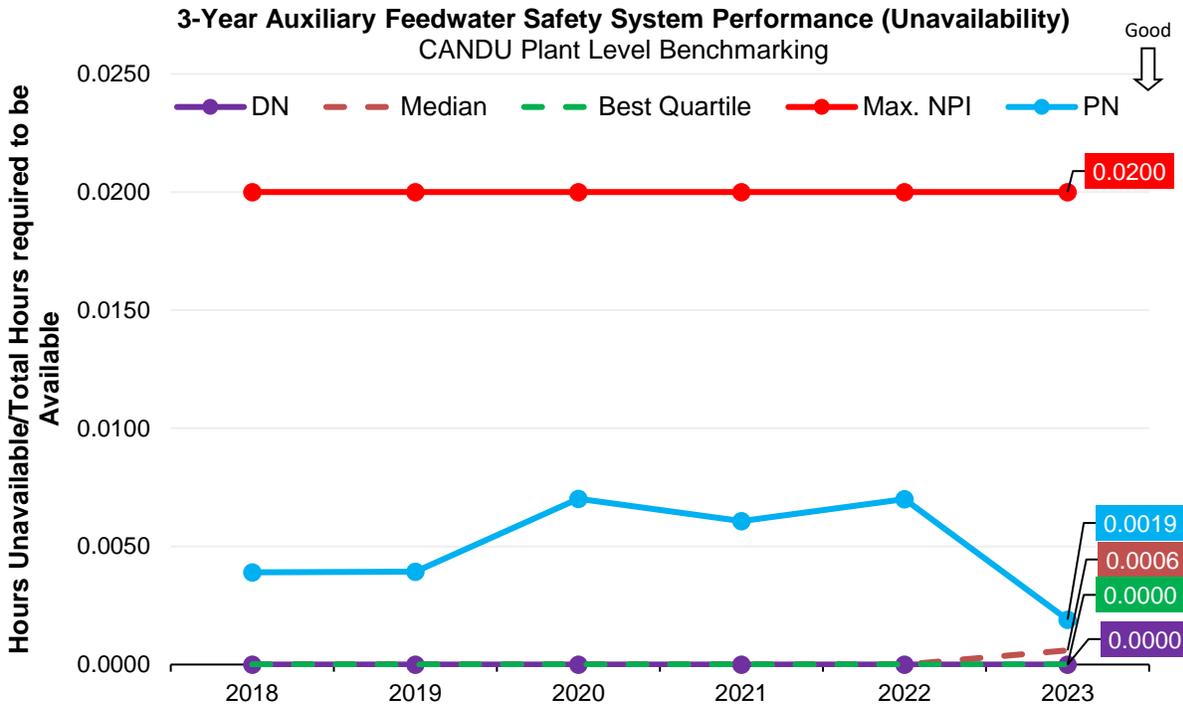
DNGS planned actions:

- Significant Issue Response (SIR) team was initiated with a mandate of determining the cause of control valve drifting fully open over a period of 6 minutes. Systematic Approach to Technical Problem Solving (SATPS) was initiated and a Troubleshooting plan was developed in attempts to replicate the scenario which caused the event. The cause was determined and the hand controller was replaced with new model.
- Continuous actions, such as, Engineering Technical Surveillance Program, are being implemented at DNGS to ensure the best performance through Safety Related System Tests.

The following actions were identified at PNGS:

- Track extent of condition review of this type of Rosemount transmitters and confirm maintenance strategy aligns with the consequence of failure.
- Review forensic analysis results and address any failure modes not already covered.
- Add risk associated with aged boiler level control (BLC) level and flow transmitters to the risk register.
- Propose BLC upgrade Engineering Change Request (ECR) to Site Screening committee.
- Revise BLC level transmitter criticality.
- Implement regular replacement Preventive Maintenance (PM) for BLC level and flow transmitters.

3-Year Auxiliary Feedwater Safety System Performance (Unavailability)*

3-Year Auxiliary Feedwater Safety System Performance (Unavailability)
CANDU Plant Level Benchmarking

* *Sub-indicator for WANO NPI*
Note: DNGS – Unit 2 (U1 & U4 in Refurbishment. Unit 3 in-service Q2, not online for 3 years)

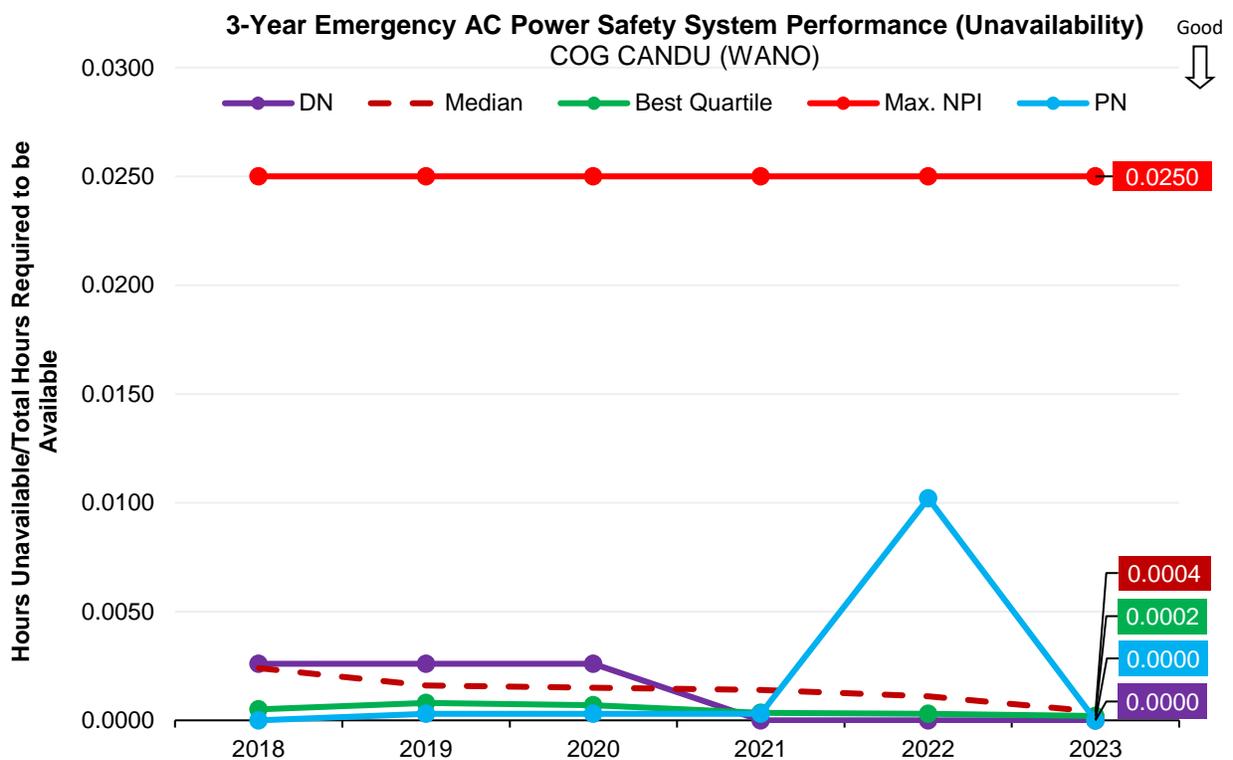|	**2023 Value**
DN	0.0000
PN	0.0019
Best Quartile	0.0000
Median	0.0006

Factors Contributing to Performance
- DNGS and PNGS continue to achieve maximum Nuclear Performance Index (NPI) points.
- Factors contributing to performance for DNGS include:
    - Identifying critical work on the plant reliability list.
    - Scheduling work using Integrated Planning Group and Cycle Plan processes.
    - Adhering to the cycle planning.
    - Following the System Performance Monitoring Plan.
    - Adhering to the Health Report 10-Year Improvement Plan.

- Factors contributing to performance for PNGS include:
    - System performance improvement due to preventative maintenance and test procedures
    - Unit 4: During execution of the safety related system, the Auxiliary Boiler Feedwater Pump (ABFP) control valve fails to maintain pump discharge pressure between 5.2 - 5.8 MPag, which leads to system impairment (System Does Not Meet Design Intent (SDNMDI)). Adjusted ABFP controller found setpoint to be higher to allow the control valve to control the pressure at 5.5 MPag.

Initiatives to Improve and Sustain Favourable Performance Include:

- DNGS design changes to the Auxiliary Boiler Feed (ABF) system include:
  - Installing gland injection cooling on pump seals to resolve mechanical seal O-ring failure.
  - Replacement of reverse rotation device for main and ABF pumps.

- The following was implemented at PNGS to improve the ABF system performance:
  - Performing an evaluation of repeat failures of Units 1 and 4 ABFP discharge pressure control valves.

3-Year Emergency AC Power Safety System Performance (Unavailability) *

3-Year Emergency AC Power Safety System Performance (Unavailability)
COG CANDU (WANO)

Legend: DN — Median — Best Quartile — Max. NPI — PN

Good ⬇

Y-axis: Hours Unavailable/Total Hours Required to be Available

Max. NPI: 0.0250
Median: 0.0004
Best Quartile: 0.0002
PN: 0.0000
DN: 0.0000

* *Sub-indicator for WANO NPI*
  Note: DNGS – Unit 2 (U1 & U4 in Refurbishment. Unit 3 in-service Q2, not online for 3 years)

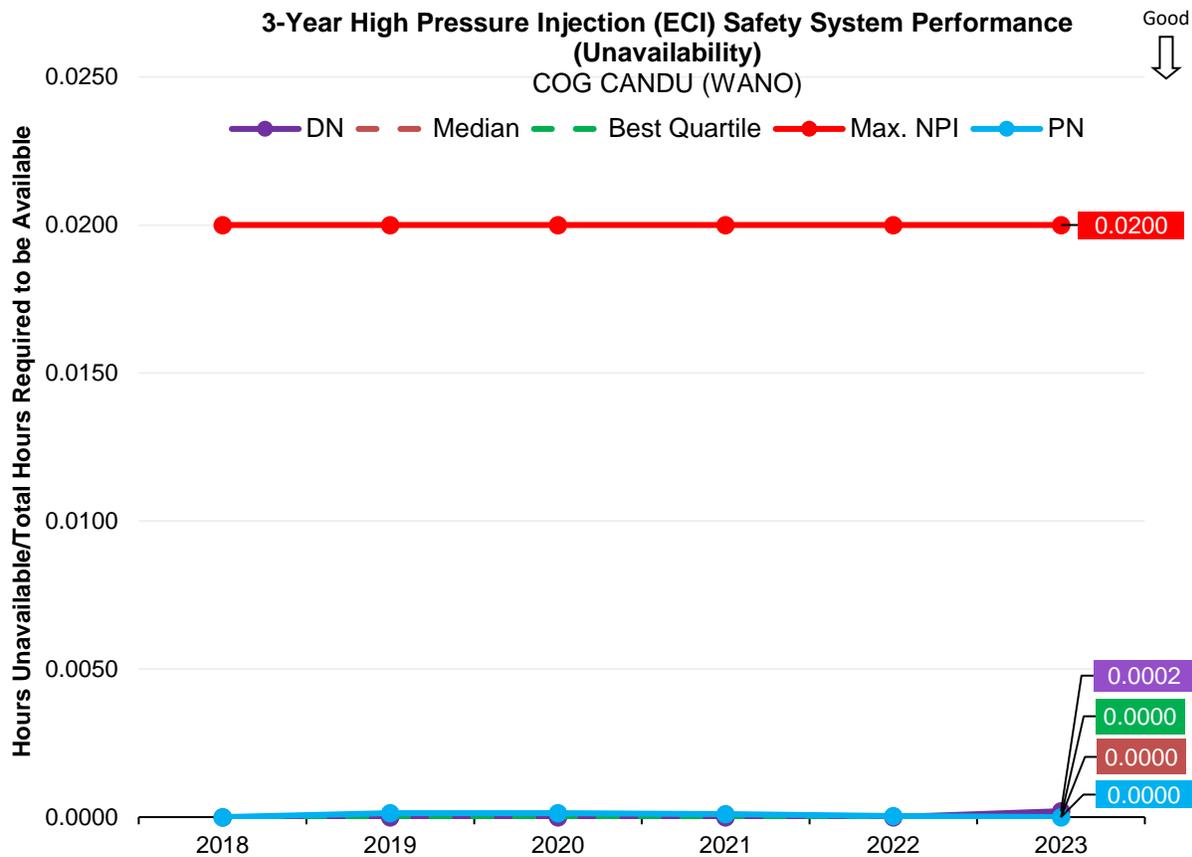|	2023 Value
DN	0.0000
PN	0.0000
Best Quartile	0.0002
Median	0.0004

Factors Contributing to Performance:

- DNGS and PNGS continue to achieve maximum Nuclear Performance Index (NPI) points.

- DNGS Emergency AC Power system achieved the best quartile performance of zero unavailability by performing the following:

    - Identifying critical work on the plant reliability list.

    - Scheduling work using Integrated Planning Group and Cycle Plan processes.

    - Adhering to the 10-year Outage Maintenance Strategy for the Standby Generators (SG) and Health Report Improvement Plan.

    - Following the System Performance Monitoring Plan.

    - Adhering to the Health Report 10-Year Improvement Plan.

- PNGS Emergency AC Power system achieved best quartile performance of by performing the following:

    - In Q1-2023, there was an overlapping of the failure of Gas Producer Lube Oil Low Pressure of one standby generator (SG), test performed on the second SG, and planned maintenance outage of the third SG. This resulted in unavailability of all three redundant standby generators (SGs) as it impacted quarterly and year-to-date performance despite overall SGs performance unavailability of zero.

    - Corrective and routine outage maintenance.

Initiatives to Improve and Sustain Favourable Performance Include:

- DNGS planned actions:

    - SGs Control System upgrades includes small updates to software and hardware to resolve aging/part obsolescence issue on the controls circuits.
    - A 10-year project is in progress on the SG protective relays to replace all the old electro-mechanical relays with modern digital versions.

- PNGS planned actions:

    - Performance Engineering will take actions to ensure timely review/implementation of the corrective and routine maintenance.
    - Cracked power turbine casings will be repaired or replaced.

3-Year High Pressure Injection (ECI) Safety System Performance (Unavailability) *

3-Year High Pressure Injection (ECI) Safety System Performance (Unavailability)
COG CANDU (WANO)

Good ⇩

Legend: DN — Median — Best Quartile — Max. NPI — PN

Y-axis: Hours Unavailable/Total Hours Required to be Available

- 0.0250
- 0.0200 (Max. NPI label: 0.0200)
- 0.0150
- 0.0100
- 0.0050 (DN 0.0002, Best Quartile 0.0000, Median 0.0000, PN 0.0000)
- 0.0000

X-axis: 2018, 2019, 2020, 2021, 2022, 2023

* *Sub-indicator for WANO NPI*
  Note: DNGS – Unit 2 (U1 & U4 in Refurbishment. Unit 3 in-service Q2, not online for 3 years)

	2023 Value
DN	0.0002
PN	0.0000
Best Quartile	0.0000
Median	0.0000

Factors Contributing to Performance:

- DNGS and PNGS continue to achieve maximum Nuclear Performance Index (NPI) points.
- DNGS High Pressure Safety Injection (HPSI) unavailability was 0.0002. The factor contributing to performance includes:
  - Unit 0: The loss of 4.16 kV Emergency Power Supply (EPS) buses leads to Level 2 impairment of Emergency Cooling Injection (ECI) system, which affected all units due to both Post-Accident Water Cooling System (PAWCS) heat exchanger flow paths being unavailable.

- PNGS continued with the best High Pressure Safety Injection (HPSI) quartile performance of zero unavailability.

Initiatives to Improve and Sustain Favourable Performance Include:

- DNGS HPSI related activities include the following:
  - o Review the relay logic and determine if closing circuit breaker 0-53290-101CB3 in the TEST mode with a ground fault trip signal present trip of EPS E0-53290-BU101 and BU103 buses supply breakers.
  - o Units 1-4 injection valve internals were overhauled.
  - o Completion of equipment reliability improvement work is driven via the 52-week cycle plan and Plant Reliability List (PRL) initiatives.
  - o Performing preventive maintenance on schedule to reduce component failures and unplanned unavailability hours.
  - o Scheduling maintenance work which could cause equipment unavailability as such that it maximizes system availability.
  - o Overhaul or replacement of critical components increases the equipment reliability (i.e., ECI Hydraulic Power Unit (HPU)/ECI Accumulator Control Module (AMCA)).

- PNGS HPSI related activities include the following:
  - o Placing an additional Calandria face cooling fan which returns ECI moderator level indications back in line with SDS2/process indications.
  - o H_2O injection valve diagnostic test.
  - o Ultrasonic flow measurements performed on the cooling water supply to the moderator room air conditioning units (ACUs).
  - o Ongoing voltage check and routine calibration of logic instrumentation.

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Methodology and Sources of Data

The majority of reliability metrics were calculated using data from WANO. Any data labelled as invalid by WANO was excluded from all calculations. Indicator values of zero are not plotted or included in calculations except in cases where zero is a valid result. Complete data for the review period was obtained and averages are as provided by WANO.
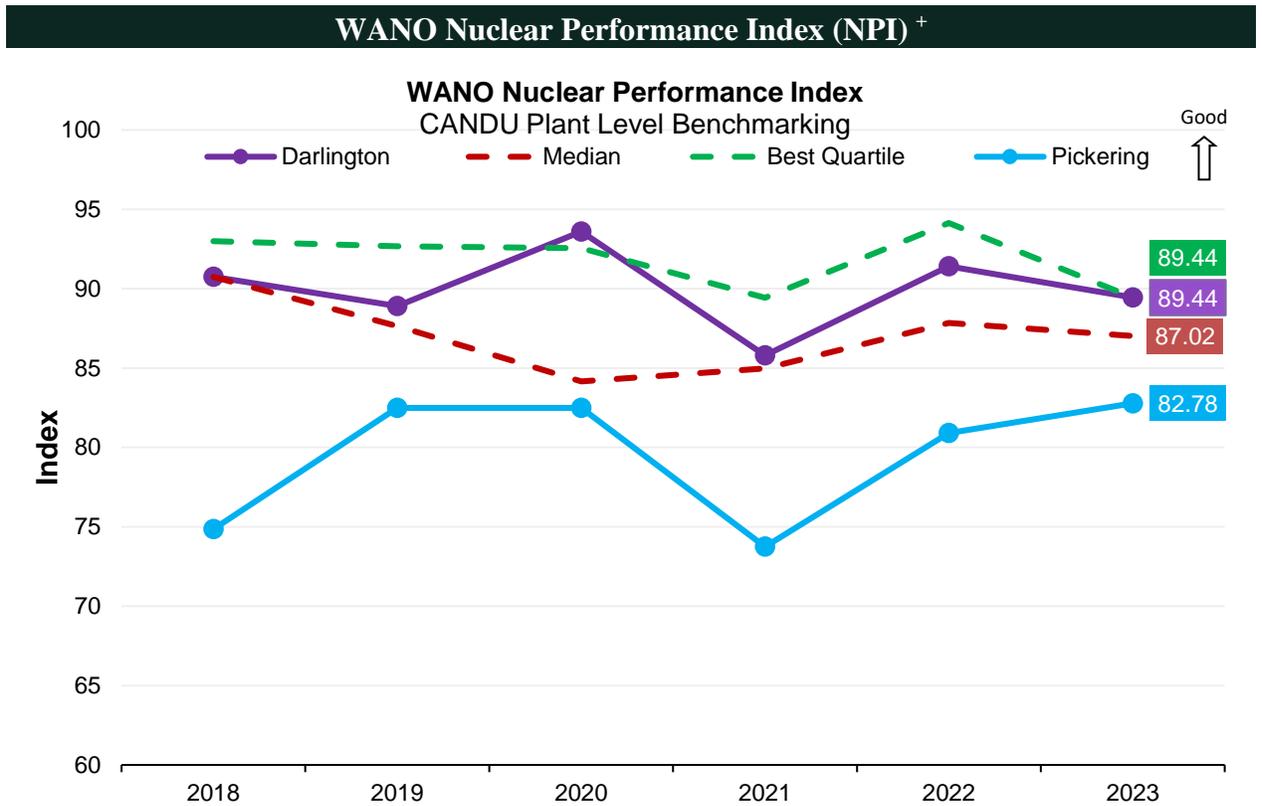
For the WANO Nuclear Performance Index (NPI), a maximum score of 100 is possible. The WANO NPI is an operational performance indicator comprised of 10 metrics, three of which are analyzed in this section:

- Forced Loss Rate (FLR) [Rolling Average]
- Unit Capability Factor (UCF) [Rolling Average]
- Chemistry Performance Indicator (CPI) [Rolling Average]

The other seven WANO NPI components are shown in the Safety Section (Section 2.0).

Note: To benchmark performance, Max NPI is used to indicate best quartile performance for metrics that perform better than the Max NPI benchmark. If metric performance is not better than Max NPI, benchmark quartiles are utilized to indicate quartile performance.

Backlog metrics for On-line Deficient and Corrective Maintenance are also included within this section and the data comes from an industry sponsored Institute of Nuclear Power Operators (INPO) AP-928 subcommittee. Data points benchmarked on backlogs are annual, not a rolling average. All data is self-reported.

WANO Nuclear Performance Index (NPI) +

WANO Nuclear Performance Index
CANDU Plant Level Benchmarking

Legend: Darlington | Median | Best Quartile | Pickering | Good ⇑

	2018	2019	2020	2021	2022	2023
Best Quartile						89.44
Darlington						89.44
Median						87.02
Pickering						82.78

+ 2 Year Avg PNGS, 3 Year Avg DNGS – Unit 2 (U1 & U4 in Refurbishment. Unit 3 in-service Q2, not online for 3 years)

	2023 Value
DN	89.44
PN	82.78
Best Quartile	89.44
Median	87.02

Factors Contributing to Performance:

- PNGS performance has improved by approximately two points primarily due to improved Unit Capability Factor (UCF) and Forced Loss Rate (FLR) performance with only brief forced outages in 2023, resulting in a sustained third quartile position from 2022.
  - o UCF and FLR have the most significant weighting within NPI calculation.
  - o Excellent performance for Reactor Trip Rate (RTR), High Pressure Safety Injection Unavailability (HPSI), Emergency AC Power Unavailability (EACP), Auxiliary Boiler Feedwater Unavailability (ABF), and Industrial Safety Accident Rate (ISAR) combined with good performance on Fuel Reliability Index (FRI), Collective Radiation Exposure (CRE), Chemistry Performance Indicator (CPI) was partially offset by the Unit Capability Factor (UCF) fourth quartile performance. Unit Capability Factor, Collective Radiation Exposure and Chemistry Performance Index metrics were impacted by the need for extended outages to accommodate fuel channel inspection programs, unbudgeted planned outages for non-routine maintenance work and unplanned outages due to external causes, which impacts Unit Capability Factor, Collective Radiation Exposure and Chemistry Performance Index metrics.

- DNGS achieved best quartile performance.
  - NPI slightly lower performance compared to previous years was attributed to continued excellent performance for all seven of the safety metrics offset by decline in FLR performance attributed to Unit 2 forced outage events compared to elevated FLR in 2021 which is no longer included in the rolling window.

Further details on factors contributing to performance and initiatives to improve and sustain favourable performance are discussed within each respective NPI sub-metric in this report.

Rolling Average Forced Loss Rate (FLR) * +
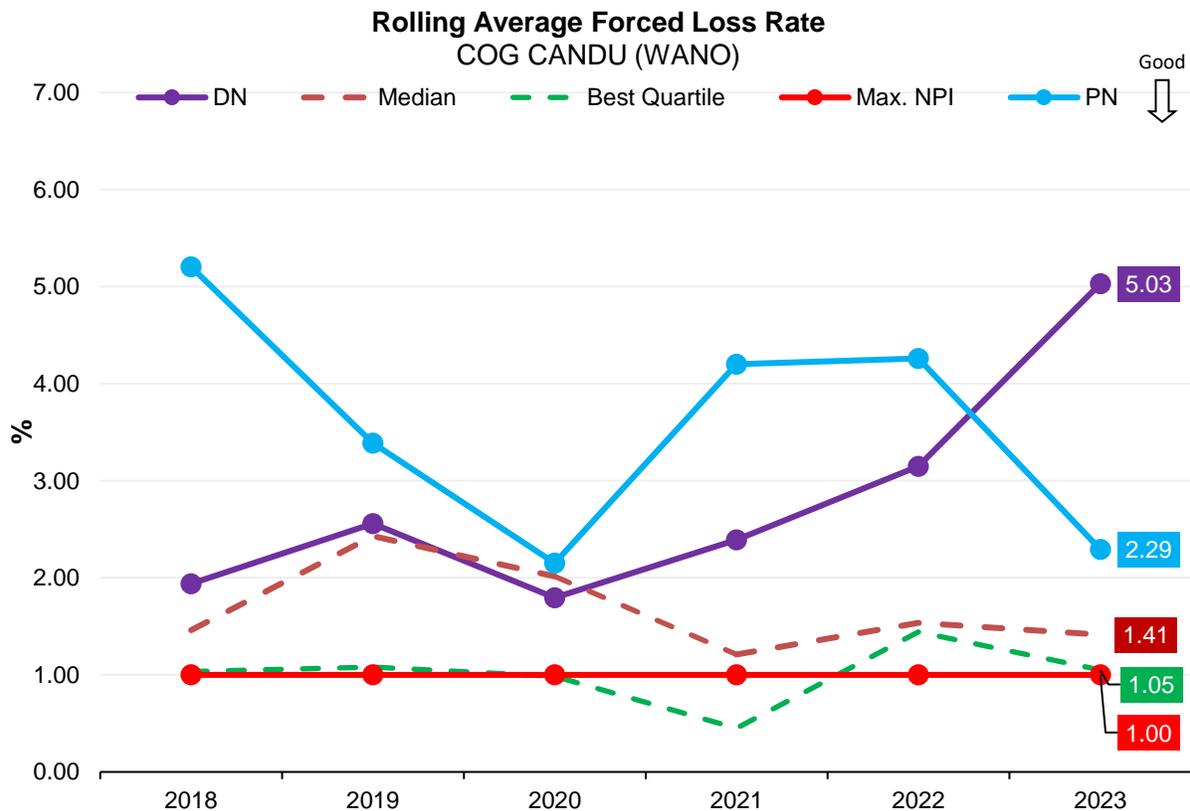
Rolling Average Forced Loss Rate
COG CANDU (WANO)

* *Sub-indicator for WANO NPI*

+ *2 Year Avg PNGS, 3 Year Avg DNGS – Unit 2 (U1 & U4 in Refurbishment. Unit 3 in-service Q2, not online for 3 years)*

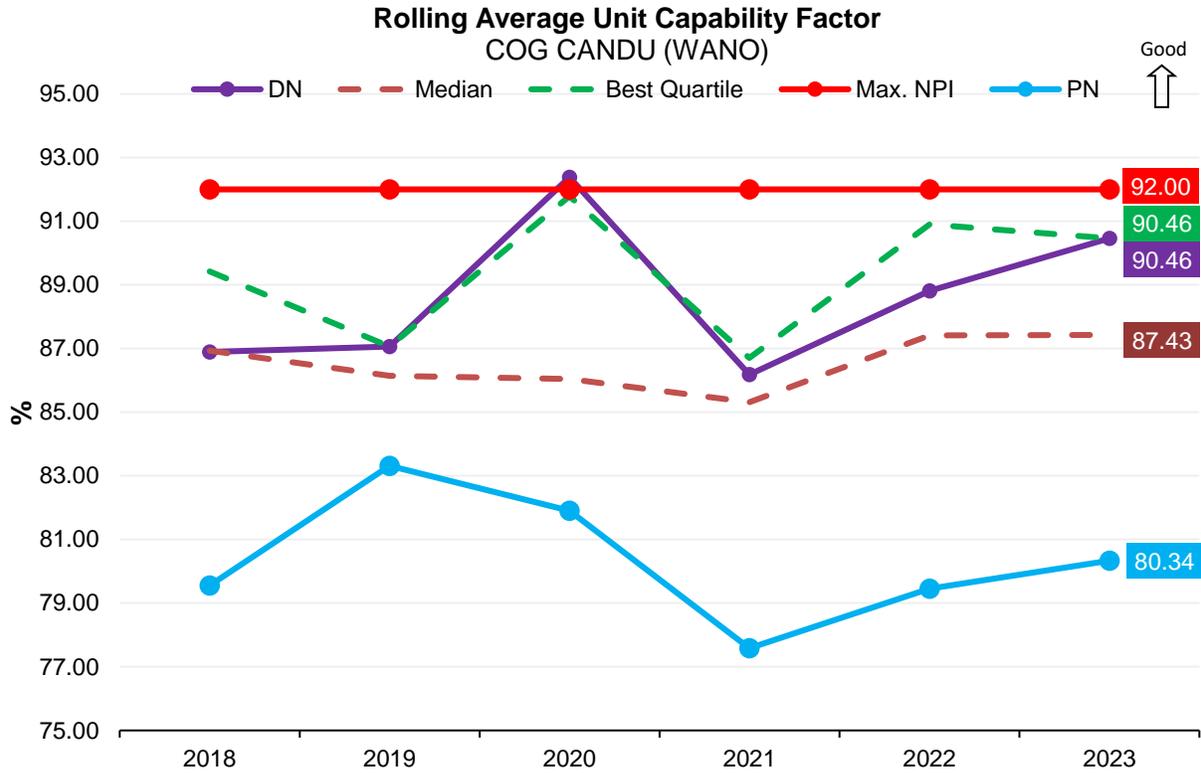|	2023 Value
DN	5.03
PN	2.29
Best Quartile	1.05
Median	1.41

Factors Contributing to Performance

- PNGS improved performance is attributable to improved FLR in 2023 compared to elevated FLR in 2021 which is no longer included in the rolling window. In 2023, there were six forced outages related to Turbine, Boiler Feedwater, Main Output, and Human Performance, and three forced outages related to Generator, Shutdown Systems and Human Performance in 2022.

- DNGS decline in performance is attributable to forced outage events impacting post-refurbishment Unit 2 on Turbines and Main Power Output (2022) and Primary Heat Transport (2023). As the metric is a rolling average, in 2023 only Unit 2 results are included (Units 1, 3 and 4 were in refurbishment). Similarly in 2022, only Unit 4 results were included (Unit 1 & 3 were in refurbishment and Unit 2 was only online for 2 years) Unit 2 FLR decreased in 2023 compared to 2022.

Initiatives to Improve and Sustain Favourable Performance Include:

- Focused actions, including vulnerability identification and elimination, project execution, and building proficiency at both the fleet and site level have been implemented for Turbine Generator Reliability, the highest fleet contributor.

- Fuel Handling contribution reduced in 2023 and remains a fleet focus area to build sustainability. Focused actions on proactive risk identification and elimination as well as work management are in place at both the fleet and site level.

- Internal peer teams, industry benchmarking, fleet assessments against industry best practice, enhanced participation in industry working groups are in place to manage this risk going forward.

Rolling Average Unit Capability Factor (UCF) * +

Rolling Average Unit Capability Factor
COG CANDU (WANO)

Good ⇧

Legend: DN ● (purple solid), Median (brown dashed), Best Quartile (green dashed), Max. NPI ● (red solid), PN ● (blue solid)

Callouts: 92.00, 90.46, 90.46, 87.43, 80.34

X-axis: 2018, 2019, 2020, 2021, 2022, 2023
Y-axis (%): 75.00 – 95.00

* *Sub-indicator for WANO NPI*

+ *2 Year Avg PNGS, 3 Year Avg DNGS – Unit 2 (U1 & U4 in Refurbishment. Unit 3 in-service Q2, not online for 3 years)*

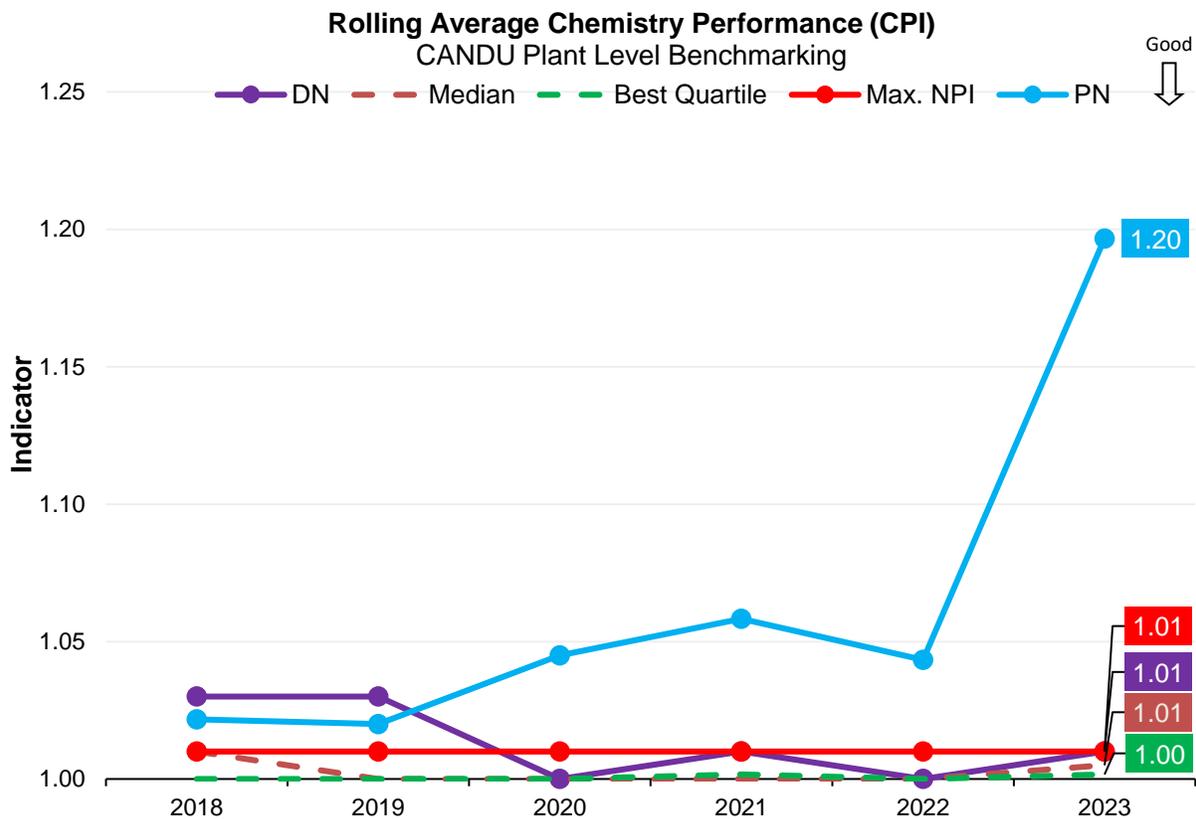|	**2023 Value**
DN	90.46
PN	80.34
Best Quartile	90.46
Median	87.43

Factors Contributing to Performance:

- PNGS improved performance is attributable to improved FLR in 2023 compared to elevated FLR in 2021 which is no longer included in the rolling window, partially offset by increased planned outage days in 2023 compared to 2021 and by increased FLR in 2023 compared to 2022. Unit 7 achieved Industry Best Quartile in 2023. Unit 4 and Unit 6 achieved Industry Best Quartile in 2022.

- DNGS improved and achieved Industry Best Quartile. As the metric is a rolling average, only Unit 2 results are included (Units 1, 3 and 4 were in refurbishment). DNGS improved performance is attributable to reduced planned outage days in 2023 partially offset by forced outage events impacting post-refurbishment Unit 2. 2022 results were measured against Unit 4 performance prior to entering refurbishment (Unit 1 & 3 were in refurbishment and Unit 2 was only online for 2 years).

Initiatives to Improve and Sustain Favourable Performance Include:

- Focused actions, including vulnerability identification and elimination, project execution, and building proficiency at both the fleet and site level have been implemented for Turbine Generator Reliability, the highest fleet contributor.

- Fuel Handling contribution reduced in 2023 and remains a fleet focus area to build sustainability. Focused actions proactive risk identification and elimination and work management implementations are in place at both the fleet and site level.

- Internal peer teams, industry benchmarking, fleet assessments against industry best practice, enhanced participation in industry working groups are in place to manage this risk going forward.

Rolling Average Chemistry Performance Indicator (CPI) *+

Rolling Average Chemistry Performance (CPI)
CANDU Plant Level Benchmarking

Good

Legend: DN — Median — Best Quartile — Max. NPI — PN

Endpoint labels (2023): 1.01 (Max. NPI), 1.01 (DN), 1.01 (Median), 1.00 (Best Quartile); PN = 1.20

* Sub-indicator for WANO NPI

+ 2 Year Avg PNGS, 3 Year Avg DNGS –U nit 2 (U1 & U4 in Refurbishment. Unit 3 in-service Q2, not online for 3 years)

	2023 Value
DN	1.01
PN	1.20
Best Quartile	1.00
Median	1.01

Factors Contributing to Performance

The decline in performance at PNGS from 2019 to 2023 can be attributed to the following:
- Post Unit 5 (2019) and Unit 7 (2021) start-up boiler sulfates due to turbine maintenance activities during their respective outages.
- Unit 4 condenser tube leak resulted in chronic elevated boiler ions for ~9 months (2021).
- Unit 8 condenser tube leak resulted in elevated boiler ions for ~2 weeks (2021).
- Unit 8 multiple condenser tube leaks resulted in elevated boiler ions (2023).
- Forced outage on Unit 8 resulting from condenser tube leak (2023).
- Forced outage on Unit 8 resulting from boiler level transient (2023).

DNGS continues to receive maximum Nuclear Performance Index (NPI) points. The decline in performance in 2023 from 2022 can be attributed to the following:
- Condenser tube leak on Unit 2 (2023).

Initiatives to Improve and Sustain Favourable Performance Include:

Both sites have an ongoing Chemistry Outage SPOC to provide improved coordination/planning such that system chemistry control has improved during outages/start-ups.

PNGS:
- Assess retubing plugged and stake tubes to regain thermal efficiency.
- Improve turbine vendor quality management program and oversight.
- Improve planning and execution of chemistry start-up activities through integration of Chemistry, Outage, and Operations.

DNGS:
- Improve integration into Outage meetings to optimize boiler chemistry (i.e. minimize duration where boilers are drained, improvements in Boiler Water Lancing activities etc.).
- Implemented a revised chemistry control strategy using continuous boiler blowdowns to manage secondary side chemistry control leading until Unit start-up to remove boiler ions.
- Revise the condenser tube leak response procedure and guidance to include previous operating experience and pre-decision-making logic during leak searching activities.
- Install permanent sodium hotwell analyzers for early detection of condenser tube leaks, to assist in isolating the correct Waterbox and minimize time out of specification.
- Improve reliability of condenser equipment including Condenser Tube Cleaning System (CTCS) through piping and valve replacements and increase inspections to assess condenser tube health to prevent and mitigation condenser tube leaks.

On-Line Deficient & Corrective Non-Critical Backlog
On-Line Deficient & Corrective Critical Backlog

On-line Deficient Non-Critical Backlog
INPO AP-928 Workgroup

On-line Corrective Non-Critical Backlog
INPO AP-928 Workgroup
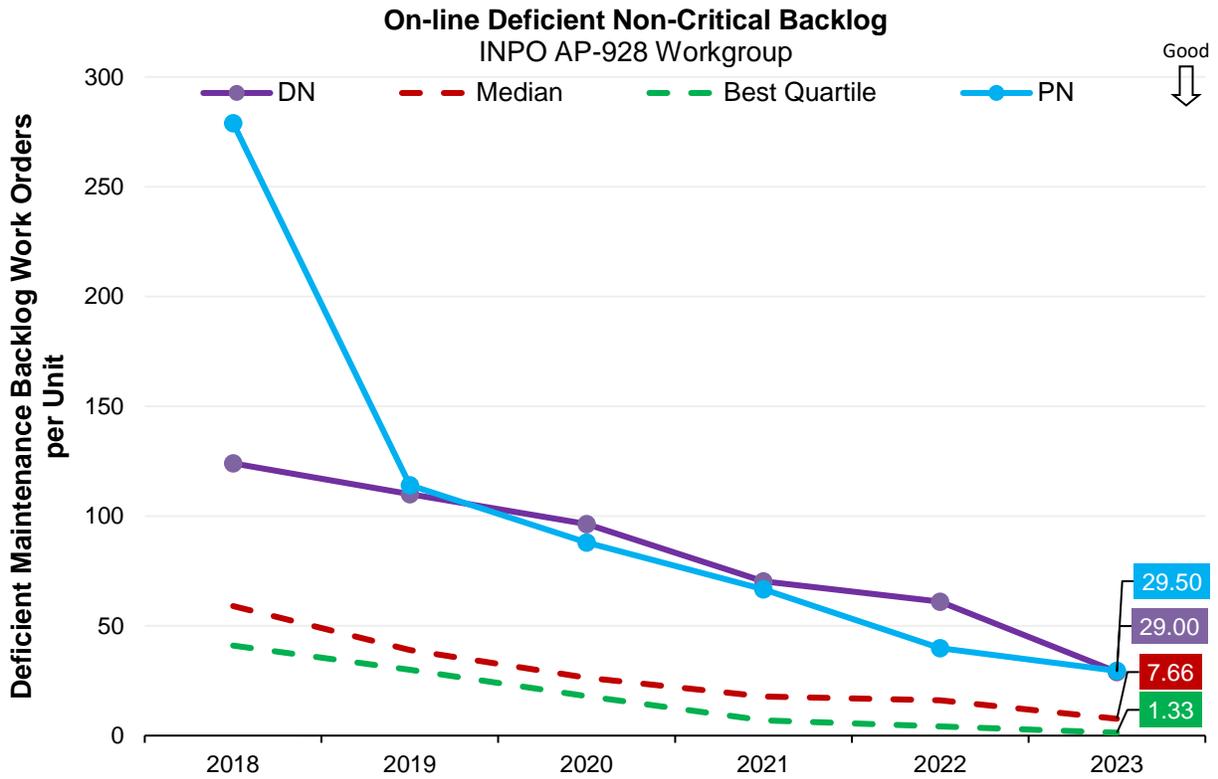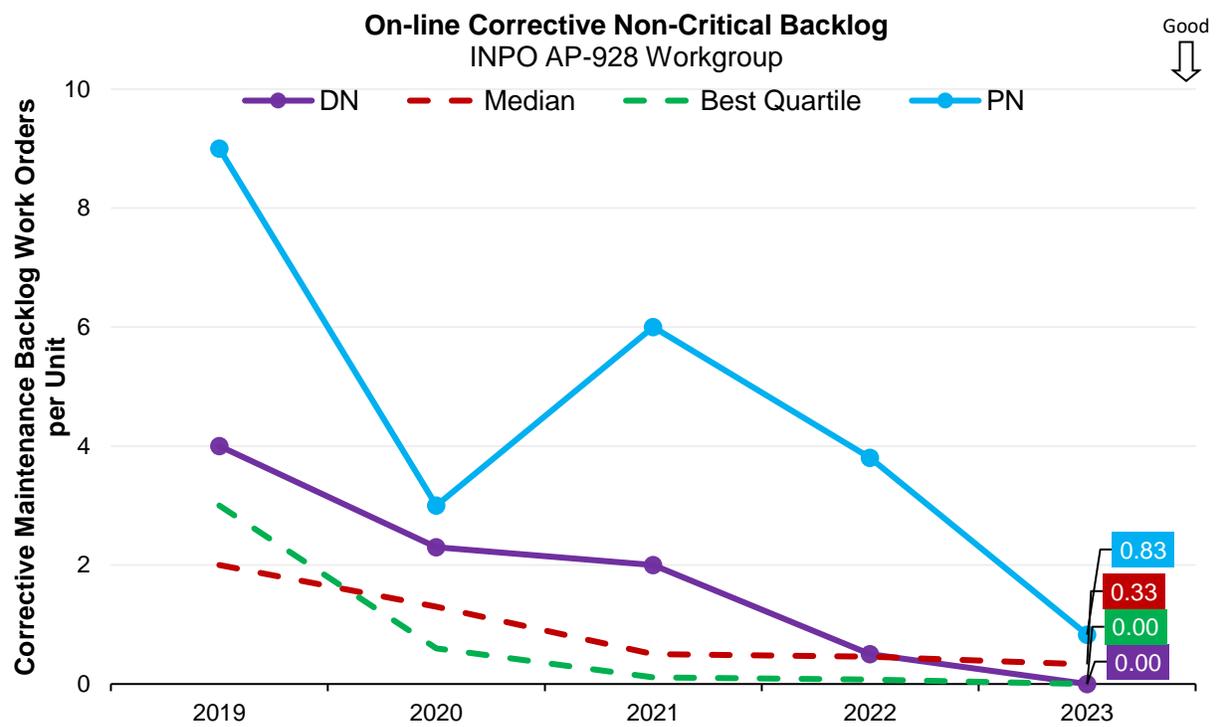
Note: Annual

	2023 On-Line Deficient Non-Critical Backlog	**2023 On-Line Deficient Critical Backlog**	**2023 On-Line Corrective Non-Critical Backlog**	**2023 On-Line Corrective Critical Backlog**
DN	29.00	0.00	0.00	0.00
PN	29.50	0.67	0.83	0.00
Best Quartile	1.33	0.00	0.00	0.00
Median	7.66	0.00	0.33	0.00

Factors Contributing to Performance

- PNGS and DNGS continue to meet industry best quartile for Corrective Critical Backlog.
- Both sites experienced performance improvement On-line Deficient Non-Critical Backlog, PNGS 26%, and DNGS 52%.
- PNGS performance improved for On-line Deficient Critical Backlog and On-line Corrective Non-Critical Backlog.
- Factors contributing to performance:
  - Continuing to work down the backlog priorities through Fix It Now (FIN) and Work Management (WM) process.
  - Action to implement sustainable FIN process for Live Zero backlog, long lead part and grace period enhancements.
  - Provide oversight/support on DNGS Refurb Backlog to ensure targets are met.
  - Frequently performed cross functional backlog review of all current Online Backlog work orders for quality of coding.

- Not all station backlog targets were set to industry best quartile for 2023.
- DNGS continues to leverage the Minor Maintenance Tool.
- PNGS initiated Cross Functional Backlog Recovery Team

Initiatives to Improve and Sustain Favourable Performance Include:

- Continued review of opportunities to execute online work during unit shutdowns and specific unit configurations.
- Continued scrutiny over work orders that are introduced into the backlog.
- Monitor and track actions as well as metrics via weekly Integrated Station Briefing meetings, bi-weekly Senior Work Management meetings, and monthly Station Excellence meetings.

Note: Factors Contributing to Performance and Initiatives to Improve and Sustain Favorable Performance are relevant to all backlogs.

Methodology and Sources of Data

The Electric Utility Cost Group (EUCG) database is the source for cost benchmarking data. Data was collected for three-year rolling averages for all financial metrics. All data submitted to and subsequently extracted from EUCG by OPG is presented in Canadian dollars.

EUCG automatically applies a purchasing power parity (PPP) factor to adjust all values across national borders. The primary function of the PPP value is to adjust for currency exchange rate fluctuations, but it also adjusts for additional cross-border factors, which may impact purchasing power of companies in different jurisdictions. As a result, cost variations between plants are limited, as much as possible, to real differences and not due to advantages of utilizing one currency over another.

The benchmarking panel utilized for value for money metrics is made up of all North American (U.S. & Canada) plants reporting to EUCG. Bruce Power is the only other CANDU technology plant reporting within that panel. The remaining plants are Boiling Water Reactors or Pressurized Water Reactors making it challenging to compare performance across plants with technology differences. As a result, beginning with 2017 results, both PNGS and DNGS TGC/MWh and TGC/Unit performance has been normalized for CANDU technology (including outage duration) and age-related impacts.
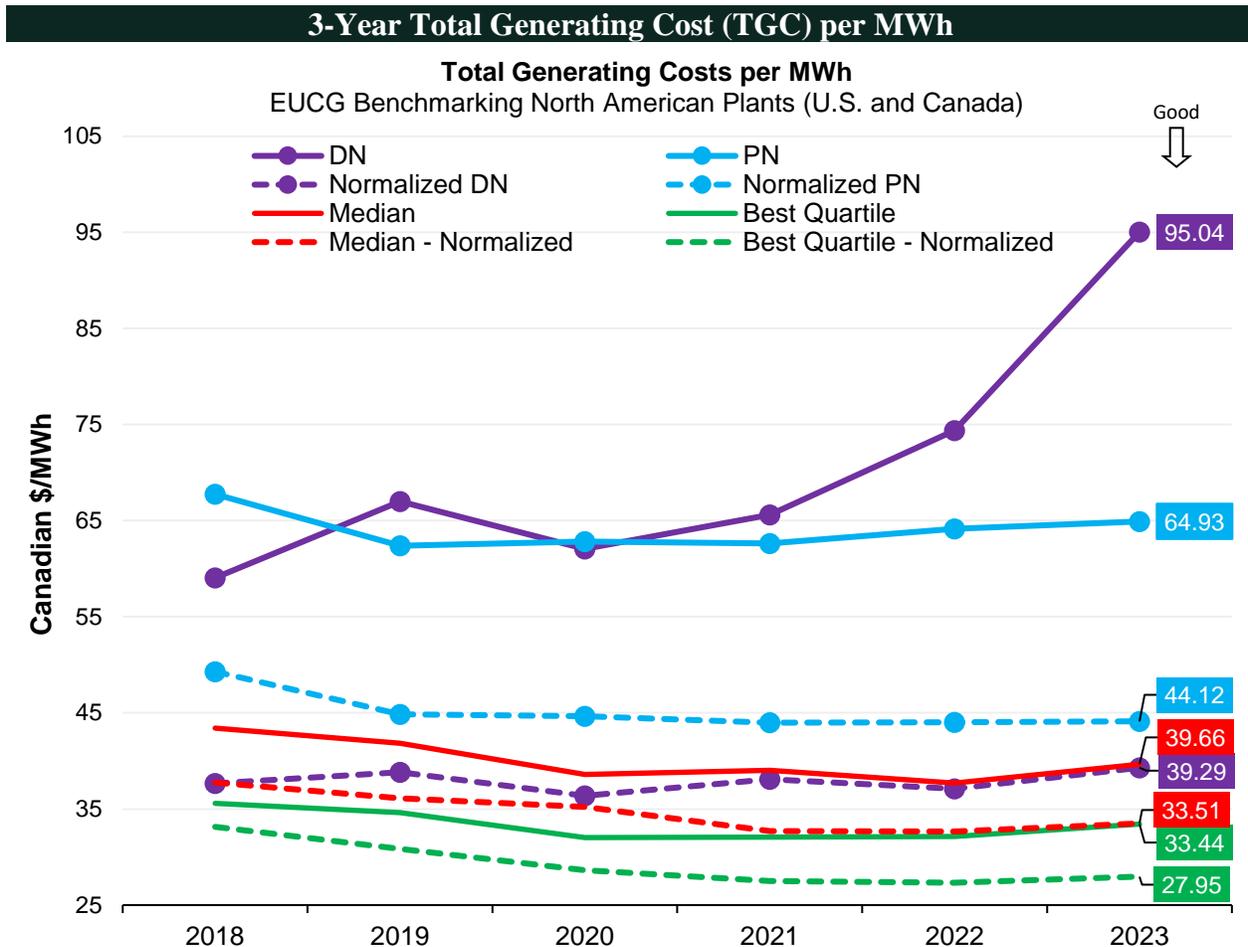
Darlington's TGC/MWh, TGC/Unit, Non-Fuel Operating Costs (NFOC)/MWh and Capital Cost/MW DER performance have also been normalized for refurbishment. The refurbishment normalization methodology allows OPG to adjust the distribution of actual operating and capital costs to reflect Darlington's number of operating units rather than a four-unit site. OPG is performing a mid-life refurbishment at Darlington, which involves bringing units offline for the replacement of certain life-limiting components. It is necessary to normalize these metrics during refurbishment to allow for comparisons to prior site performance and industry peers, given reduced generation and no corresponding decline in fixed costs.

OPG engaged ScottMadden Management Consultants (ScottMadden) to develop the normalization methodologies[3]. The combined normalization allows for a more comparable assessment of performance between peers.

Total Generating Cost per MWh is the sum of Non-Fuel Operating Cost (NFOC), Fuel Cost and Capital Cost measured on a per MWh basis for benchmarking purposes.
Given the differences between OPG's nuclear generating stations and most North American plants with respect to non-fuel operating costs, fuel and capital costs, it is difficult to compare plants using non-fuel operating cost, fuel cost or capital cost metrics separately.

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[3] Two ScottMadden normalization reports provide details on the normalization methodologies: 1) *OPG Nuclear Cost Performance Benchmarking A Study of Factors Impacting TGC/MWh Performance with Normalizing Adjustments to Facilitate Closer Comparison* and 2) *OPG Nuclear Cost Performance Benchmarking Methodology to Adjust for Refurbishment and Validation of Implementation*

3-Year Total Generating Cost (TGC) per MWh

Total Generating Costs per MWh
EUCG Benchmarking North American Plants (U.S. and Canada)

Good

Legend:
- DN
- PN
- Normalized DN
- Normalized PN
- Median
- Best Quartile
- Median - Normalized
- Best Quartile - Normalized

Y-axis: Canadian $/MWh (25 to 105)
X-axis: 2018, 2019, 2020, 2021, 2022, 2023

2023 labelled values: 95.04, 64.93, 44.12, 39.66, 39.29, 33.51, 33.44, 27.95

* DNGS – Unit 2, Unit 4 in Refurbishment until Q3 2024, Unit 3 in-service Q2 2024 (U1 in Refurbishment)

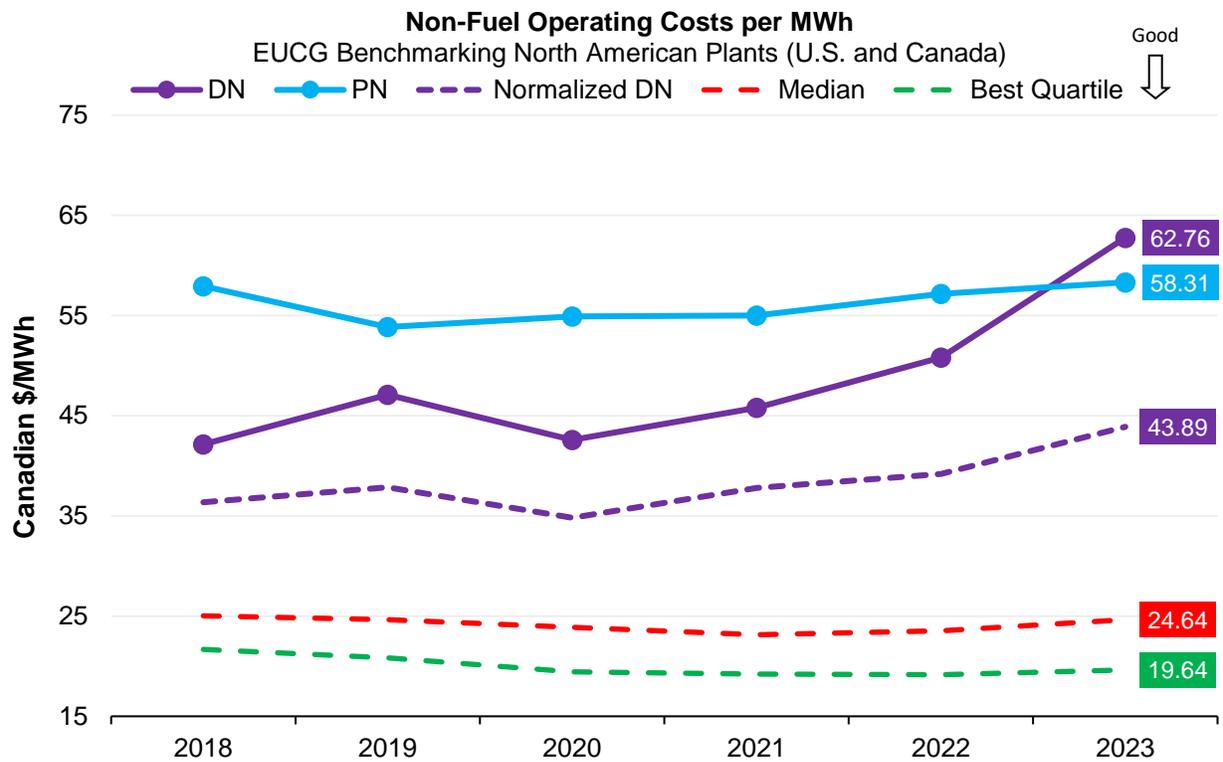|	**2023 Non-Normalized Value**	**2023 Normalized Value**
DN	95.04	39.29
PN	64.93	44.12
Best Quartile	33.44	27.95
Median	39.66	33.51

Factors Contributing to Performance

- DNGS normalized performance declined in 2023 compared to 2022 due to reduced 3-year generation related to the Refurbishment outage schedule with the equivalent of two units being in refurbishment outages the full year in 2023 (Unit 1 full year, Unit 4 offline in Q3 and Unit 3 in-service Q2) compared to one unit for 9 months in 2020 (Unit 2 in-service Q2 and Unit 3 offline in Q3) increasing spending on sustaining investments to ensure long term reliability, and higher OM&A costs in 2023 from increased unionized compensation as a result of the Ontario Superior court decision finding Bill 124 of limiting annual wage increases to one percent for a 3-year period unconstitutional, partially offset by lower fuel & OM&A costs due to refurbishment schedule.

- DNGS non-normalized performance declined in 2023 compared to 2022 due to reduced 3-year generation related to the Refurbishment outage schedule (as per above), higher OM&A costs in 2023 from increased unionized compensation as a result of the Bill 124 court ruling (as per above), and increased capital investment requirements for life post-refurbishment, partially offset by lower fuel costs due to refurbishment schedule.

- PNGS normalized and non-normalized performance is similar to 2022, reflecting reduced capital spending while maintaining reliable operations in the period leading up to the end of commercial operations, partially offset by higher OM&A costs from increased unionized compensation as a result of the Bill 124 court ruling (as per above).

- PNGS units are the smallest in the peer group at 540 MW/unit compared to the peer average of 1,026 MW, a factor for which results have not been normalized.

Initiatives to Improve and Sustain Favourable Performance Include:

- Maximizing generation: See initiatives to improve and sustain favourable performance for Reliability Metrics UCF and FLR.

- Continue to utilize opportunities to reduce operating costs through strategic initiatives, excellence plans, technology deployment and resource planning.

- Employing a portfolio and asset management approach to assess, prioritize and deliver all nuclear operations projects which are developed to meet regulatory commitments (e.g., from the Canadian Nuclear Safety Commission), increase system or unit reliability, address system obsolescence, or optimize station generation.

3-Year Non-Fuel Operating Cost per MWh

Non-Fuel Operating Costs per MWh
EUCG Benchmarking North American Plants (U.S. and Canada)

Good ⇩

Legend: DN — PN — Normalized DN (dashed) — Median (red dashed) — Best Quartile (green dashed)

DN 2023: 62.76
PN 2023: 58.31
Normalized DN 2023: 43.89
Median 2023: 24.64
Best Quartile 2023: 19.64

Y-axis: Canadian $/MWh (15 to 75)
X-axis: 2018, 2019, 2020, 2021, 2022, 2023

* DNGS – Unit 2, Unit 4 until Q3, Unit 3 in-service Q2 (U1 in Refurbishment)

	2023 Non-Normalized Value	2023 Normalized Value
DN	62.76	43.89
PN	58.30	-
Best Quartile	19.64	19.64
Median	24.64	24.64

Factors Contributing to Performance

- DNGS normalized and non-normalized performance declined primarily due to reduced 3-year generation related to the Refurbishment outages schedule with the equivalent of two units being in refurbishment outages the full year in 2023 (Unit 1 full year, Unit 4 offline in Q3 and Unit 3 in-service Q2) compared to one unit for 9 months in 2020 (Unit 2 in-service Q2 and Unit 3 offline in Q3) and higher OM&A costs in 2023 from increased unionized compensation as a result of the Ontario Superior court decision finding Bill 124 of limiting annual wage increases to one percent for a 3-year period unconstitutional.

- PNGS non-normalized performance reflects higher OM&A costs in 2023 from increased unionized compensation as a result of the Bill 124 court ruling (as per above).

- PNGS units are the smallest in the peer group at 540 MW/unit compared to the peer average of 1,026 MW, a factor for which results have not been normalized.

Initiatives to Improve and Sustain Favourable Performance – refer to TGC/MWh.

3-Year Fuel Cost per MWh

Fuel Costs per MWh
EUCG Benchmarking North American Plants (U.S. and Canada)
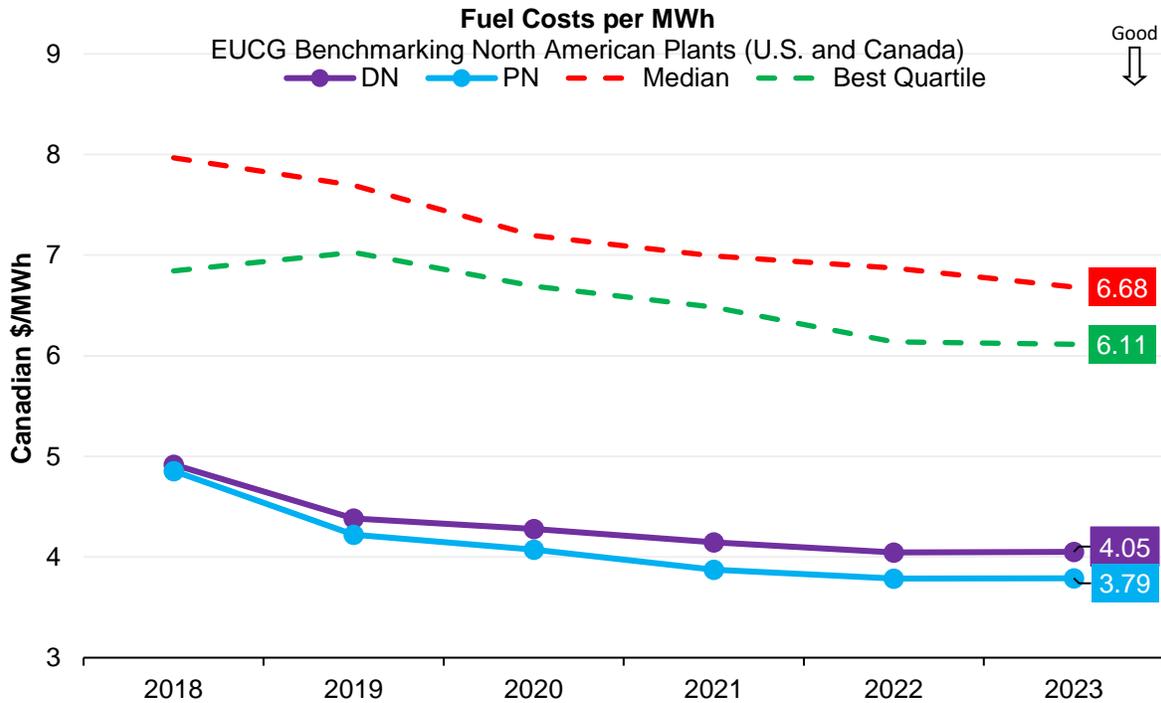
* DNGS – Unit 2, Unit 4 until Q3, Unit 3 in-service Q2 (U1 in Refurbishment)

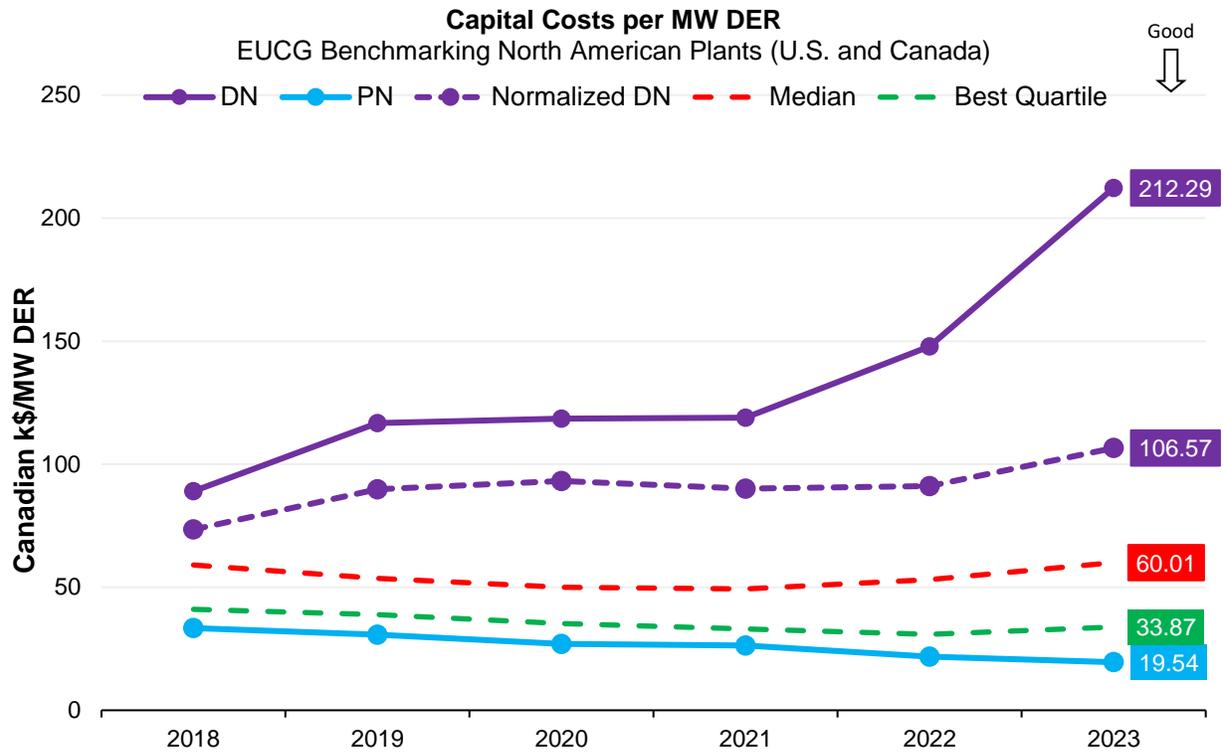|	2023 Value
DN	4.05
PN	3.79
Best Quartile	6.11
Median	6.68

Factors Contributing to Performance

- Fuel costs are lower for OPG than most North American Pressurized Water Reactors or Boiling Water Reactors (PWR/BWR) reactors as CANDUs do not require enriched uranium like PWRs and BWRs.
    - Raw uranium is processed directly into uranium dioxide to make fuel pellets, without the additional cost and process complexity of enriching the fuel as required in light water reactors.
    - CANDU reactors are also the most efficient reactors in using uranium, requiring less uranium than PWRs and BWRs for each megawatt hour of electricity.
    - These two factors provide a significant advantage for OPG and other CANDUs in this cost category.

- Regular entry into the uranium market has allowed OPG to reduce uranium input costs year over year for the past several years. Historical multi-year contracts signed between 2015 and 2021, and for which deliveries were made in 2021, 2022 and 2023, have allowed OPG to take deliveries of uranium on a both fixed price and market price basis during a period of historically low uranium spot market prices (2015-2021) not seen since 2005 and earlier.

- In 2017, the uranium spot market price reached its cyclical low point and has continued an increasing trend up to the present, and this trend is projected to continue. Over the coming years, as historical uranium contracts are completed and new contracts are entered into, the effect of the more recent increasing uranium price trend is expected to place upward pressure on the 3-year rolling average fuel cost per MWh. A slight increase in fuel costs at PNGS from 2022 to 2023 can be attributed to this uranium price trend and by general escalation in fuel conversion and fuel fabrication costs.

Initiatives to Improve and Sustain Favourable Performance

- Certain factors are expected to place upward cost pressures on nuclear fuel supply chains over the next several years, including:
  - Resurgence in global demand for nuclear power due to carbon emissions targets of world governments, leading to increased global demand for uranium, conversion, and enrichment services.
  - Uranium supply constrained by many years of under-investment in new mine development due to low prices, as well as constrained Western conversion and enrichment capacities.
  - Global conflicts, including the war in Ukraine, leading to a bifurcation of global nuclear fuel supply chains, along with legislative actions such as the recent U.S. ban on the import of Russian nuclear fuel products.

- OPG will continue to seek improvements in contract pricing for its nuclear fuel supply to sustain favorable comparative fuel costs, while also ensuring a resilient and robust nuclear fuel supply chain, given recent and ongoing geopolitical and economic events

3-Year Capital Cost per MW DER (Design Electrical Rating)

Capital Costs per MW DER
EUCG Benchmarking North American Plants (U.S. and Canada)

Good ⇩

Legend: DN — PN — Normalized DN — Median — Best Quartile

Y-axis: Canadian k$/MW DER (0 to 250)
X-axis: 2018, 2019, 2020, 2021, 2022, 2023

Labels at 2023: 212.29, 106.57, 60.01, 33.87, 19.54

* DNGS – Unit 2, Unit 4 until Q3, Unit 3 in-service Q2 (U1 in Refurbishment)

	2023 Non-Normalized Value	2023 Normalized Value
DN	212.29	106.57
PN	19.54	-
Best Quartile	33.87	33.87
Median	60.01	60.01

Factors Contributing to Performance

- PNGS is performing in the first quartile with a slight improvement in 2023 and the improvement over the trend period. This reflects reductions in spending while maintaining reliable operations in the period leading up to the end of commercial operations, which is consistent with spending trends observed at other nuclear facilities approaching their end of commercial operations.

- DNGS performance in 2023 showed an increase on a normalized basis as compared to 2022, as the station remained in the third quartile. The large increase in the absolute DNGS Capital Cost per MW in 2023 is mainly due to the reduction in available MW as two units were in refurbishment outages throughout the majority of the 3-year period as well as increased spending on sustaining investments to ensure long term reliability. The change over the trend period reflects increased spending on life extension, performance improvements, sustaining investments, information technology and capital spares to support operations before, during and after Darlington refurbishment.

- Historically, DNGS capital expenditures were better than the industry median. Once the decision to refurbish Darlington and extend end of life was made, OPG began an extensive program to replace obsolete and/or life-expired plant equipment to support performance and reliability of Darlington's unit's post-refurbishment.

Initiatives to Improve and Sustain Favourable Performance Include:

- Employing a portfolio and asset management approach to assess, prioritize, and deliver all nuclear operations projects which are developed to meet regulatory commitments (i.e. from the Canadian Nuclear Safety Commission), increase system or unit reliability, address system obsolescence, or optimize station generation.

2024 Benchmarking Report

Filed: 2025-12-12
EB-2025-0297
Exhibit F2-1-1
Attachment 2
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Methodology and Sources of Data

The Human Performance Error Rate metric is used to benchmark the performance of OPG's Nuclear fleet against other INPO utilities in the area of Human Performance.

18-Month Human Performance Error Rate

18-Month Human Performance Error Rate (Events per 200k ISAR Hours)
INPO North American Plant Level Benchmarking
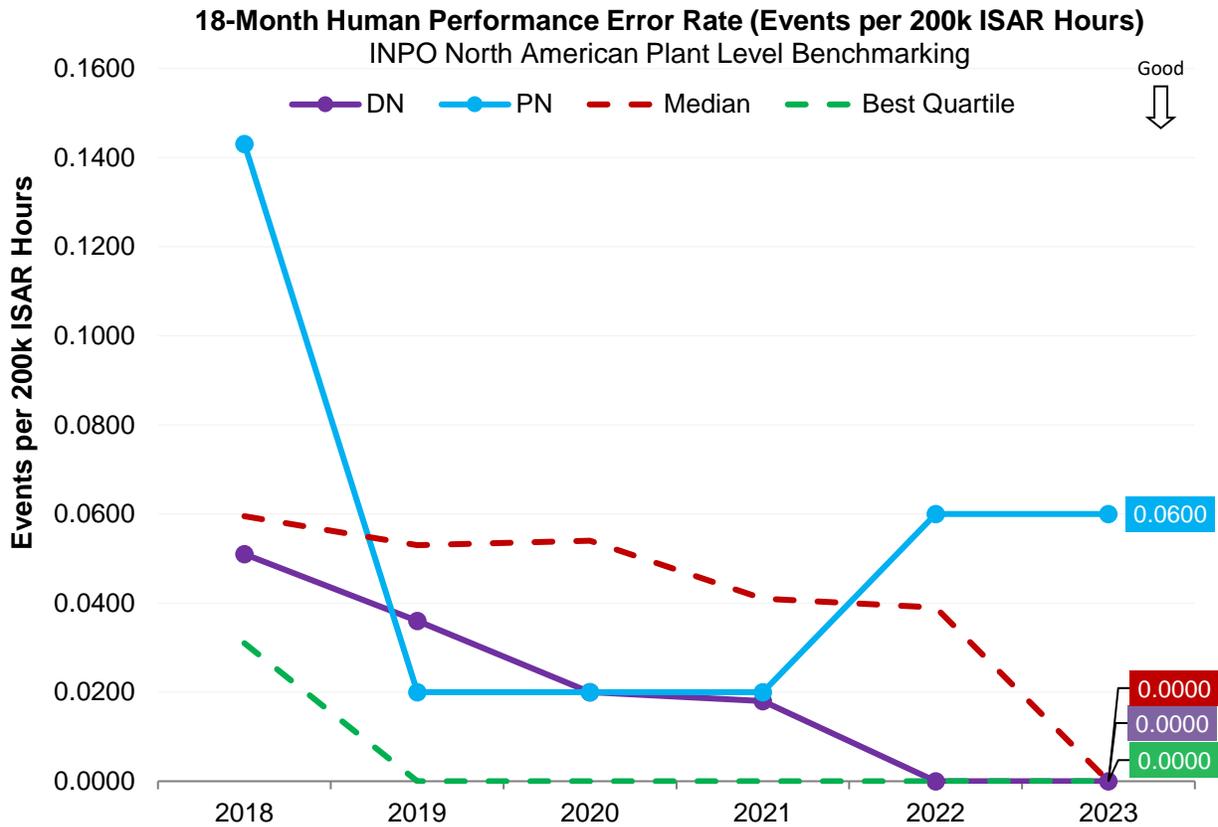
	2023 Value
DN	0.0000
PN	0.0600
Best Quartile	0.0000
Median	0.0000

Factors Contributing to Performance

- DNGS maintained best quartile performance and did not experience any Site Event Free Day Reset (S-EFDR)s in 2023 or in 2022.
- PNGS experienced one S-EFDR event in Q4 2023. Event causes were identified, and corrective actions implemented to address the gaps. All actions have been completed.

Initiatives to Improve and Sustain Favourable Performance Include:

- Continuing to build upon Fail Safe Strategies across the fleet through Pre-Job Briefs (PJB) and Observation & Coaching programs
- Trigger training continued to be deployed
- Supervisors continued to complete Coaching to Enhance Performance training, also with expected completion in Q1 2024.
- Revision and enhancement of Holiday and Outage planning to include more proactive activities, such as the HU Safety Light, becoming Yellow in anticipated higher risk periods.
- Continued focus on the Stop When Unsure campaign as part of the Observation and Coaching improvement plan.
- Further engagement with the TPI (Trending, Prevention, and Intervention) program to provide additional oversight on identified trends.
- Utilization of Validation of Trend (VOT) process to proactively identify and verify emerging trends adverse to safety and quality

Acronyms

Acronym	Meaning
ABF	Auxiliary Boiler Feed
ABFP	Auxiliary Boiler Feedwater Pump
AC	Alternating Current
ACU	Air Conditioning Units
ALARA	As Low as Reasonably Achievable
BLC	Boiler Level Control
BWR	Boiling Water Reactor
CANDU	CANada Deuterium Uranium (type of PHWR)
CC	Corrective Critical
CM	Corrective Maintenance
CN	Corrective Non-Critical
CNSC	Canadian Nuclear Safety Commission
COG	CANDU Owners Group
CPI	Chemistry Performance Index
CRE	Collective Radiation Exposure
CTCS	Condenser Tube Cleaning System
D2O	Heavy Water
DC	Deficient Critical
DER	Design Electrical Rating
DM	Deficient Maintenance
DN	Deficient Non-Critical
DNGS	Darlington Nuclear Generating Station
EACP	Emergency AC Power
EC	Electricity Canada
ECI	Emergency Coolant Injection
ECR	Engineering Change Request
EPS	Emergency Power Supply
eSWP	Electronic Safe Work Plans
EUCG	Electric Utility Cost Group
FIN	Fix It Now
FLR	Forced Loss Rate
FRI	Fuel Reliability Index
GWH	Gigawatt Hours
HIT	High Impact Team
HPER	Human Performance Error Rate
HPSI	High Pressure Safety Injection
HPU	Hydraulic Power Unit

Acronym	Meaning
HTHT	Heat Transport High Temperature
HTS	Heat Transport System
HU	Human Performance
INPO	Institute of Nuclear Power Operators
ISAR	Industrial Safety Accident Rate
ISB	Integrated Station Brief
LBL	Low Boiler Level
MW	Mega-Watt
NFOC	Non-Fuel Operating Cost
NPI	Nuclear Performance Index
O&C	Observation & Coaching
OM&A	Operating, Maintenance & Administrative
OPEX	Operating Experience
OPG	Ontario Power Generation
PAWCS	Post-Accident Water Cooling System
PJB	Pre Job-Brief
PNGS	Pickering Nuclear Generating Station
PHTS	Primary Heat Transport System
PHWR	Pressurized Heavy Water Reactor
PM	Preventive Maintenance
PPP	Purchasing Power Parity
PRL	Plant Reliability List
PWR	Pressurized Water Reactor
QSP	Quality of Safety Practices
RDM	Rapid Delivery Machine
RTR	Reactor Trip Rate
RWPB	Retube Waste Processing Building
SATPS	Systematic Approach to Technical Problem Solving
SCL	Safety Classification and Learning
SDS	Shutdown System
SPNMDI	System Does Not Meet Design Intent
S-EFDR	Site event free day resets
SG	Standby Generators
SIF	Significant Injuries and Fatalities
SIR	Significant Issue Response
SPOC	Single Point of Contact
TGC	Total Generating Costs
TGC/MWH	Total Generating Costs per Mega-Watt Hour
TPI	Trending, Prevention, and Intervention

Acronym	Meaning
TRIF	Total Recordable Injury Rate
TRF	Tritium Removal Facility
UCF	Unit Capability Factor
VOT	Validation of Trend
WANO	World Association of Nuclear Operators
WM	Work Management

Safety and Reliability Definitions

The following definitions are summaries extracted from industry peer group databases.

Total Recordable Injury Frequency (TRIF)

The number of fatalities, lost time injuries, medical treatment injuries and restricted work injuries per 200,000 hours worked.

Industrial Safety Accident Rate (ISAR)

Number of accidents for all utility personnel (permanently or temporarily) assigned to the station, that result in one or more days away from work (excluding the day of the accident) or one or more days of restricted work (excluding the day of the accident), or fatalities, per 200,000 man-hours worked. The selection of 200,000 man-hours worked or 1,000,000 man-hours worked for the indicator will be made by the country collecting the data, and international data will be displayed using both scales. Contractor personnel are not included for this indicator.

Collective Radiation Exposure (CRE)

Total external and internal whole-body exposure determined by a dose control device (e.g., electronic personal dosimeter, dose recording device, etc.) and internal exposure calculations. All measured exposure should be reported for station personnel, contractors, and those personnel visiting the site or station on official utility business.

Visitors, for purposes of this indicator, include only those monitored visitors who are visiting the site or station on official utility business.

Airborne Tritium Emissions per Unit

Tritium emissions to air.

Fuel Reliability Index (FRI)

Inferred from fission product activities present in the reactor coolant. Due to design differences, this indicator is calculated differently for different reactor types. For PHWR's, the indicator is defined as the steady-state primary coolant iodine-131 activity (Becquerels/gram or Microcuries/gram), corrected for the tramp uranium contribution and power level, and normalized to a common purification rate.

Unplanned automatic reactor trips (SCRAMS)

Number of unplanned automatic reactor trips (reactor protection system logic actuations) that occur per 7,000 hours of critical operation. The indicator is further defined as follows:

- Unplanned means that the trip was not an anticipated part of a planned test.
- Trip means the automatic shutdown of the reactor by a rapid insertion of negative reactivity (e.g., by control rods, liquid injection shutdown system, etc.) that is caused by actuation of the reactor protection system. The trip signal may have resulted from exceeding a set point or may have been spurious.
- Automatic means that the initial signal that caused actuation of the reactor protection system logic was provided from one of the sensors' monitoring plant parameters and conditions, rather than the manual trip switches or, in certain cases described in the clarifying notes, manual turbine trip switches (or pushbuttons) provided in the main control room.

- Critical means that, during the steady-state condition of the reactor prior to the trip, the effective multiplication factor (k_{eff}) was essentially equal to one.
- The value of 7,000 hours is representative of the critical hours of operation during a year for most plants and provides an indicator value that typically approximates the actual number of scrams occurring during the year.

Safety System Performance Indicators include the following:
- Auxiliary boiler feedwater system
- Emergency AC power
- High pressure emergency coolant injection system

These systems were selected for the safety system performance indicator based on their importance in preventing reactor core damage or extended plant outage. They include the principal systems needed for maintaining reactor coolant inventory following a loss of coolant, for decay heat removal following a reactor trip or loss of main feedwater, and for providing emergency AC power following a loss of plant off-site power. (Gas cooled reactors have an additional decay heat removal system instead of the coolant inventory maintenance system).

Nuclear Performance Index (NPI) Method 4
INPO sponsored performance measure and is a weighted composite of 10 WANO Performance Indicators related to safety and production performance reliability.

Forced Loss Rate (FLR)
Ratio of all unplanned forced energy losses during a given period of time to the reference energy generation minus energy generation losses corresponding to planned outages and any unplanned outage extensions of planned outages, during the same period, expressed as a percentage.

Unplanned Energy Losses
Either unplanned forced energy losses (unplanned energy generation losses not resulting from an outage extension) or unplanned outage extension of planned outage energy losses.

Unplanned Forced Energy Loss
Energy that was not produced because of unplanned shutdowns or unplanned load reductions due to causes under plant management control when the unit is considered to be at the disposal of the grid dispatcher. Causes of forced energy losses are considered to be unplanned if they are not scheduled at least four weeks in advance. Causes considered to be under plant management control are further defined in the clarifying notes.

Unplanned Outage Extension Energy Loss
Energy that was not produced because of an extension of a planned outage beyond the original planned end date due to originally scheduled work not being completed, or because newly scheduled work was added (planned and scheduled) to the outage less than four weeks before the scheduled end of the planned outage.

Planned Outage Energy Losses
Corresponding to outages or power reductions which were planned and scheduled at least four weeks in advance (see clarifying notes for exceptions).

Reference Energy Generation
Energy that could be produced if the unit were operated continuously at full power under reference ambient conditions throughout the given period. Reference ambient conditions are environmental conditions representative of the annual mean (or typical) ambient conditions for the unit.

Unit Capability Factor (UCF)

Ratio of the available energy generation over a given time period to the reference energy generation over the same time period, expressed as a percentage. Both of these energy generation terms are determined relative to reference ambient conditions.

Available Energy Generation
Energy that could have been produced under reference ambient conditions considering only limitations within control of plant management, i.e., plant equipment and personnel performance, and work control.

Reference Energy Generation
Energy that could be produced if the unit were operated continuously at full power under reference ambient conditions.

Reference Ambient Conditions
Environmental conditions representative of the annual mean (or typical) ambient conditions for the unit.

Chemistry Performance Indicator (CPI)

CPI compares the concentration of selected impurities and corrosion products to corresponding limiting values. Each parameter is divided by its limiting value, and the sum of these ratios is normalized to 1.0. If an impurity concentration is equal to or better than the limiting value, the limiting value is used as the concentration. This prevents increased concentrations of one parameter from being masked by better performance in another. As a result, if a plant is at or below the limiting value for all parameters, its indicator value would be 1.0, the lowest chemistry indicator value attainable under the indicator definition.

The following is used to determine each unit's chemistry indicator value for PHWRs:
- *Inconel-600 or Monel tubes
    - Steam generator blowdown chloride
    - Steam generator blowdown sulfate
    - Steam generator blowdown sodium
    - Final feedwater iron
    - Final feedwater copper
    - Final feedwater dissolved oxygen

- Incoloy-800 tubes
    - Steam generator blowdown chloride
    - Steam generator blowdown sulfate
    - Steam generator blowdown sodium
    - Final feedwater iron
    - Final feedwater dissolved oxygen

Online Deficient Maintenance (DM) Backlog

Average number of active on-line maintenance work orders per operating unit classified as Deficient Critical (DC) or Deficient Non-Critical (DN) that can be worked on without requiring the unit shutdown. This metric identifies deficiencies or degradation of plant equipment components that need to be remedied, but which do not represent a loss of functionality of the component or system.

Online Corrective Maintenance (CM) Backlog

Average number of active on-line maintenance work orders per operating unit classified as Corrective Critical (CC) or Corrective Non-Critical (CN) that can be worked on without requiring the unit shutdown. This metric identifies deficiencies or degradation of components that need to be remedied and represents a loss of functionality of a major component or system.

> *On-line Maintenance*
> Performed with the main generator connected to the grid.

Value for Money Definitions

The following definition summaries are taken from the January 2022 EUCG Nuclear Committee Data Definitions and Nuclear Integrated Information Database.

Capital Costs

All costs associated with improvements and modifications made during the reporting year. These costs should include design and installation costs in addition to equipment costs. Other miscellaneous capital additions such as facilities, computer equipment, moveable equipment, and vehicles should also be included. These costs should be fully burdened with indirect costs, but exclude AFUDC (interest and depreciation), spent fuel storage costs and/or reimbursements, capital write-off expenditures, taxes (except Payroll), and COVID response costs.

Nuclear Fuel Costs

Total cost associated with a load of fuel in the reactor which is burned up in a given year. Fuel burn costs should NOT include spent fuel storage costs or fuel impairment.

> Fuel impairment is the write-down of the value of the Nuclear fuel and thus reduces the amortization or fuel expense, occurs in plants either announcing shutdown or are in a pending shutdown.

Net Generation

Gross electrical output of the unit measured at the output terminals of the turbine-generator minus the normal station service loads during the hours of the reporting period, expressed in Gigawatt hours (GWh).

Design Electrical Rating (DER)

Nominal net electrical output of a unit specified by the utility and used for plant design (DER net expressed in MWe).   Design Electrical Rating should be the value that the unit was certified/designed to produce when constructed. The value would change if a power uprate was completed. After a power uprate, the value should be the certified or design value resulting from the uprate.

Operating Costs (Non-Fuel Operating Costs - NFOC)
All costs associated with normal operations, maintenance, and outage periods that occur within the current EUCG data reporting year. These costs should be fully burdened and reflect the total operating costs for labour, materials & equipment, outside services and other costs, but exclude depreciation, interest, taxes (except Payroll), COVID response costs, spent fuel storage costs and/or reimbursements, capital write-off expenditures, and new plant expenditures

> *New Plant Expenditures*
> All costs for supporting new nuclear generation and licensing efforts

Total Generating Costs (TGC)
Sum of operating costs, fuel costs and capital costs

Total Generating Costs (TGC) per MWh
Sum of operating costs, fuel costs and capital costs divided by Net Generation

Total Generating Costs (TGC) per Unit
Sum of operating costs, fuel costs and capital costs divided by Number of Units at Station

Non-Fuel Operating Costs (NFOC) per MWh
Operating costs divided by Net Generation

Fuel Costs per MWh
Nuclear Fuel costs divided by Net Generation

Capital Cost per MW DER
Capital costs divided by Design Electrical Rating (DER)

<u>Human Performance Definitions</u>
The following definition summary is taken from the Institute of Nuclear Power Operations (INPO) database.

Human Performance Error Rate (HPER)
Represents the number of site level human performance events in an 18-month period per 200,000 Industrial Safety Accident Rate (ISAR) hours worked (including on site supplemental personnel).

Formula = {(# of S-EFDRs) / (Total ISAR Hours + Total Contractor Hours)} x 200,000 Hours
(Calculated as an 18-month rolling average)

> *Non-utility Personnel*
> Includes contractor, supplemental personnel assigned to perform work activities on site or at other buildings that directly support station operation. This includes personnel who deliver and receive equipment, deliver fuel oil, remove trash and radioactive waste, and provide building and grounds maintenance within the owner-controlled areas or facilities that support the station.

Event

An initiating action (error) by an individual or group of individuals (event resulting from an active error) or an initiating action (not an error) by an individual or group of individuals during an activity conducted as planned (event resulting from a flawed defense or latent organizational weakness). They may be related to Nuclear Safety, Radiological Safety, Industrial Safety, Facility Operations or considered to be a Regulatory Event reportable to a regulator or governing agency. OPG Nuclear's criteria for defining station event free day resets have been developed based on INPO guidelines.

Industry Peer Groups

All data provided by the peer groups (WANO, INPO, EC, and EUCG) is confidential. A redacted version of this report, which removes individual plant and unit names, is available from Nuclear Business Planning and Benchmarking should there be a requirement to publicly release this report.

Table 2: Industry Peer Groups

	COG CANDUs (WANO)	All North American PWR and PHWRs (WANO)	INPO AP-928 Workgroup	INPO	EC	EUCG North American Plants (US and Canada)
Safety						
Total Recordable Injury Frequency					X	
Rolling Average Industrial Safety Accident Rate*+		X				
Rolling Average Collective Radiation Exposure*+	X					
Airborne Tritium Emissions (Curies) per Unit	X					
Fuel Reliability Index*	X					
2-Year Reactor Trip Rate*	X					
3-Year Auxiliary Feedwater System Unavailability*	X					
3-Year Emergency AC Power Unavailability*	X					
3-Year High Pressure Safety Injection Unavailability*	X					
Reliability						
Rolling Average WANO NPI +	X					
Rolling Average Forced Loss Rate*+	X					
Rolling Average Unit Capability Factor*+	X					
Rolling Average Chemistry Performance Indicator*+	X					
1-Year On-line Deficient Maintenance Backlog			X			
1-Year On-line Deficient Critical Backlog			X			
1-Year On-line Corrective Maintenance Backlog			X			
1-Year On-line Corrective Critical Backlog			X			
Value for Money						
3-Year Total Generating Costs / MWh						X
3-Year Non-Fuel Operating Costs (OM&A) / MWh						X
3-Year Fuel Costs / MWh						X
3-Year Capital Costs / MW DER						X
Human Performance						
18-Month Human Performance Error Rate				X		

* Sub-indicator of WANO NPI

+ Rolling 2 Year Average PNGS ; Rolling 3 Year Average DNGS

Safety and Reliability Peer Groups

Primary source of benchmarking data for operational performance (Safety and Reliability) indicators is the World Association of Nuclear Operators (WANO). Eleven out of the twenty benchmarking metrics have been compared to the COG CANDU (WANO) panel. Industrial Safety Accident Rate (ISAR) is compared to the All North American PWR and PHWR (WANO) panel.

All WANO performance indicators are presented at the unit and plant levels except the Industrial Safety Accident Rate (ISAR) and Emergency AC Power Unavailability which are only measured at the plant level.

Different peer groups were used for 5 specialized operating metrics which are not tracked through WANO:

- *Total Recordable Injury Frequency*: Electricity Canada panel was utilized. OPG benchmarks against EC Group 1 peers (a subset of all EC members), which incorporates organizations with more that 1,500 employees, including most provincial utilities.

- *On-line Deficient Maintenance Backlog, On-line Deficient Critical Backlog, On-line Corrective Maintenance Backlog, On-line Corrective Critical Backlog:* Institute of Nuclear Power Operations (INPO) AP-928 working group was utilized.

Value for Money Peer Group
For financial performance comparisons, data compiled by the Electric Utility Cost Group (EUCG) was utilized. EUCG is a nuclear industry operating group and the recognized source for cost benchmark information. EUCG cost indicators are presented at the plant level and compared on a net megawatt hour generated basis and on a per megawatt (MW) design electrical rating (DER) basis. The only CANDU operators reporting data to EUCG were OPG and Bruce Power which is not a sufficiently large panel to provide a basis for comparison; hence, the data sets were not limited to a CANDU specific panel. Should more CANDU operators choose to join EUCG in the future, comparisons to a CANDU specific panel will be reconsidered.

Human Performance Peer Group
For human performance comparisons, data was obtained from INPO.

Panels/Members

Table 3: WANO Panel

Operator	Plant
Ameren Missouri	Callaway
American Electric Power Co.	Cook
Arizona Public Service Co.	Palo Verde
Bruce Power	Bruce A Bruce B
Dominion Energy	Millstone North Anna Surry V.C. Summer
Duke Energy	Catawba Harris Mcguire Oconee Robinson
Entergy Nuclear	Waterford
Constellation Energy	Braidwood Byron Calvert Cliffs R.E. Ginna
FirstEnergy Nuclear Operating Co.	Beaver Valley Davis-Besse
Florida Power & Light Co.	St. Lucie Turkey Point

Operator	Plant
International CANDU	Cernavoda Embalse Qinshan 3 Wolsong A Wolsong B
Luminant Generation	Comanche Peak
New Brunswick Power	Point Lepreau
NextEra Energy Resources	Point Beach Seabrook
Northern States Power Company	Prairie Island
Ontario Power Generation	Darlington Pickering
Pacific Gas & Electric Co.	Diablo Canyon
Public Service Enterprise Group Nuclear	Salem
Southern Nuclear Operating Co.	Farley Vogtle
STP Nuclear Operating Co.	South Texas
Tennessee Valley Authority	Sequoyah Watts Bar
Wolf Creek Nuclear Operating Corp.	Wolf Creek

Table 4: EUCG Panel

Operator	Plant	Operator	Plant
AmerenUE	Callaway	FirstEnergy Nuclear Operating Co.	Beaver Valley
American Electric Power Co. Inc.	Cook		Davis-Besse
Arizona Public Service Co.	Palo Verde		Perry
		Florida Power & Light Co.	St Lucie
Bruce Power	Bruce		Turkey Point
Dominion Generation	Millstone	Luminant Generation	Comanche Peak
	North Anna	Nebraska Public Power District	Cooper
	Surry	NextEra Energy Resources	Point Beach
	V.C. Summer		Seabrook
DTE Energy	Fermi	Northern States Power Company	Monticello
Duke Energy	Brunswick		Prairie Island
	Catawba	Ontario Power Generation	Darlington
	Harris		Pickering
	Mcguire	Pacific Gas & Co.	Diablo Canyon
	Oconee	Public Service Enterprise Group Nuclear	Hope Creek
	Robinson		Salem
Energy Northwest	Columbia	Southern Nuclear Operating Co.	Farley
Entergy Nuclear	Arkansas Nuclear One		Hatch
	Grand Gulf		Vogtle
	Indian Point	STP Nuclear Operating Co.	South Texas
	River Bend	Talen Energy	Susquehanna
	Waterford	Tennessee Valley Authority	Browns Ferry
Constellation Energy	Braidwood		Sequoyah
	Byron		Watts Bar
	Calvert Cliffs	Wolf Creek Nuclear Operations Corp.	Wolf Creek
	Clinton		
	Dresden		
	Fitzpatrick		
	Lasalle		
	Limerick		
	Nine Mile		
	Peach Bottom		
	Quad Cities		
	R.E. Ginna		

Table 5: COG CANDUs

Operator	Plant
Bruce Power	Bruce A
	Bruce B
China (CNNP)	Qinshan 3
NASA	Embalse
Korea (KHNP)	Wolsong A
	Wolsong B
New Brunswick Power	Point Lepreau
OPG	Darlington
	Pickering
Romania	Cernavoda

Table 6: Electricity Canada Members

Companies	Companies
Alectra Inc.	IESO
Algonquin Power	London Hydro
AltaLink	Manitoba Hydro
ATCO Electric (Alberta Power Ltd.)	Maritime Electric
Atura Power	New Brunswick Power
BC Hydro	Newfoundland and Labrador Hydro
Canada Power Holdings	Newfoundland Power
Capital Power	Northwest Territories Power Corporation
City of Medicine Hat	Nova Scotia Power/Emera
City of Red Deer	Oakville Enterprises Corporation
Elexicon	Ontario Power Generation
ENMAX	Qulliq Energy Corporation
EPCOR	Rio Tinto
Evolugen	Saint John Energy
FortisAlberta	Saskatoon Light & Power
FortisBC	SaskPower
FortisOntario	TC Energy
Heartland Generation	Toronto Hydro
Hydro One	TransAlta
Hydro Ottawa	Utilities Kingston
Hydro-Québec	Yukon Energy

Table 7: INPO Members for On-Line Maintenance Backlogs

Plant	
Arkansas Nuclear One (ANO)	Millstone
Beaver Valley	Monticello
Braidwood	Nine Mile Point
Browns Ferry	North Anna
Brunswick	Oconee
Byron	Oyster Creek
Callaway	Palo Verde
Calvert Cliffs	Peach Bottom
Catawba	Perry
Clinton	Pilgrim
Columbia Gen	Point Beach
Comanche Peak	Prairie Island
Cook	Quad Cities
Cooper	River Bend
Davis-Besse	Robinson
Diablo Canyon	Salem
Dresden	Seabrook
Duane Arnold	Sequoyah
Farley	South Texas
Fermi 2	St. Lucie
Fitzpatrick	Summer
Ginna	Surry
Grand Gulf	Susquehanna
Harris	Turkey Point
Hatch	Vogtle
Hope Creek	Waterford
LaSalle	Watts Bar
Limerick	Wolf Creek
McGuire	

Table 8: INPO Members for Human Performance Error Rate

Plant	
Arkansas Nuclear One (ANO)	Millstone
Beaver Valley	Monticello
Braidwood	Nine Mile Point
Browns Ferry	North Anna
Brunswick	Oconee
Byron	Oyster Creek
Callaway	Palo Verde
Calvert Cliffs	Peach Bottom
Catawba	Perry
Clinton	Pilgrim
Columbia Gen	Point Beach
Comanche Peak	Prairie Island
Cook	Quad Cities
Cooper	River Bend
Davis-Besse	Robinson
Diablo Canyon	Salem
Dresden	Seabrook
Duane Arnold	Sequoyah
Farley	South Texas
Fermi 2	St. Lucie
Fitzpatrick	Summer
Ginna	Surry
Grand Gulf	Susquehanna
Harris	Turkey Point
Hatch	Vogtle
Hope Creek	Waterford
LaSalle	Watts Bar
Limerick	Wolf Creek
McGuire	

ScottMadden Evaluation of 2024 OPG Nuclear Benchmarking

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1. EXECUTIVE SUMMARY

The benchmarking methods evaluated were those recently performed by OPG in support of its 2025-2031 planning cycle. The scope of our review encompassed the identification of key performance metrics used for comparison, the selection of companies to be included in the peer panels, the preparation of supporting analyses and data displays, and the utilization of benchmarks in the business planning cycle. The purpose of this review was to evaluate the Company's nuclear benchmarking methods and approach.

ScottMadden's analysis determined that OPG's existing benchmarking methods align with previous guidance and industry leading practices. Our review did not identify any concerns with the calculations or data presentations in the benchmarking report. OPG's selection of benchmarking metrics offers a comprehensive perspective on the Company's nuclear performance, and the choice of comparator companies accurately represents its industry peers. Furthermore, the 2024 report is more concise than the 2020 report. This modification improved the clarity of the document and increased the efficiency of its production, without compromising the quality of the performance information it provides. Finally, ScottMadden's review of OPG's Nuclear Business Planning Procedure indicates that this governance approach remains consistent with industry leading practices.

Changes in Comparative Peer Panels

There have been no substantive changes to the peer panels for comparison in the benchmarking report since ScottMadden's evaluation of the 2020 report, and these panels remain valid industry comparisons for OPG. The choice of companies for comparison appropriately reflects their industry peers.

Changes in Comparative Benchmark Metrics

We compared the metrics currently used by OPG to those used by OPG in the 2020 report. We also compared the metrics currently used by OPG to those currently used by other nuclear operators to benchmark their operational and financial performance.

Our review identified no differences between the 2020 and 2024 benchmarking reports in the metrics used to measure performance. The 2024 report presents the data related to backlogs under the reliability cornerstone in a slightly different, yet clear and appropriate, manner, which we support. ScottMadden also supports the inclusion of normalizing adjustments to some value for money metrics, which are presented in conjunction with unadjusted (i.e., non-normalized) versions of those cost metrics. Our review also indicated that OPG's metrics are appropriate when compared to those employed by other nuclear operators. It is our opinion that OPG's suite of benchmarked metrics provides a sufficiently robust view of the Company's nuclear performance.

Validation of Data Calculations and Reporting

We conducted a data validation exercise to ensure benchmarking data contained in the 2024 report was assessed, calculated, and reported accurately. Our evaluation found no issues with OPG's assessments, calculations, or presentations of data in the benchmarking report.

Use of Benchmarks in the Business Planning Process

ScottMadden reviewed OPG's Nuclear Business Planning Procedure. We found that this governance remains aligned with industry leading practice and ScottMadden's previous guidance.

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Changes in Report Format and Presentation

We compared the 2020 and 2024 benchmarking reports for consistency in report format and presentation. It is ScottMadden's view that any changes from 2020 to 2024 yielded improvements in the associated clarity and conciseness of the report and the overall purpose of the benchmarking analysis.

2. BACKGROUND

In 2009, OPG retained ScottMadden to assist in formally benchmarking its nuclear financial and non-financial performance with industry peers. This initiative was undertaken consistent with shareholder mandate and pursuant to direction from the Ontario Energy Board (OEB). Since this time, nuclear benchmarking has been a standard part of OPG's annual business planning process. OPG has continued to publish annual benchmarking results, comparing OPG to the nuclear industry in terms of financial and non-financial performance metrics. Results are then used to inform target setting for business planning purposes.

OPG previously retained ScottMadden for a similar review of its benchmarking methods. That review of the 2020 benchmarking report determined that OPG's benchmarking and target-setting processes remained consistent with industry leading practices and supportive of the direction from the OEB. The 2020 review did not find any issues in the content of the report. The review did recommend that OPG focus on site-level comparisons of performance for Pickering and Darlington rather than operator-level comparisons in the future, and OPG implemented these changes. OPG has continued to file a review by ScottMadden regarding OPG's nuclear benchmarking methodologies with its cost-based applications, consistent with OEB direction described in prior decisions.

In an effort to ensure OPG's benchmarking and target setting processes are still responsive to the direction from the Ontario Energy Board (OEB), OPG retained ScottMadden, as an independent evaluator, to examine the current methods used by OPG to benchmark the Company's operational and financial performance against its peer companies in the industry.

3. OBJECTIVES AND SCOPE

Objectives

The purpose of this evaluation is to confirm that the Company's benchmarking methods and approach remain responsive to the original direction from the OEB.

Scope

The benchmarking methods evaluated were those recently performed by OPG in support of its 2025-2031 planning cycle. The scope of our review includes the following:

- Identification of key performance metrics used for comparison
- Selection of companies to be included in the peer panels
- Preparation of supporting analyses and displays of data
- Use of benchmarks in the business planning cycle

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The scope of the review compared the 2024 OPG Nuclear Benchmarking Report to the 2020 OPG Nuclear Benchmarking Report, which was reviewed by ScottMadden in 2020. The two documents were compared in terms of (1) use of appropriate peer companies for comparison, (2) use of industry standard metrics, (3) accuracy of assessments, calculations, and presentations of data, (4) application of the performance benchmarks to inform and guide management during the Company's business planning process, and (5) consistency in format and presentation.

This evaluation also validated the application of the normalization adjustments included by OPG for value for money metrics, which reflected methodologies presented in separate documents prepared by ScottMadden for OPG:

- "OPG Nuclear Cost Performance Benchmarking: A Study of Factors Impacting TGC / MWh Performance with Normalizing Adjustments to Facilitate Closer Comparison"

- "OPG Nuclear Cost Performance Benchmarking: Methodology to Adjust for Refurbishment and Validation of Implementation"[1]

4. CHANGES IN COMPARATIVE PEER PANELS

Approach

To evaluate changes in comparative peer panels, ScottMadden reviewed summary tables as well as individual metrics to determine which peer groups were used for which metrics. This exercise was performed at the plant and unit level.

Key Changes and Justification

There have been no substantive changes to the peer panels for comparison in the benchmarking report since ScottMadden's evaluation of the 2020 report.

ScottMadden's Evaluation

The peer panels for comparison remain valid industry comparisons for OPG, and OPG's choice of companies for comparison appropriately reflects its industry peers.

5. CHANGES IN COMPARATIVE BENCHMARK METRICS

Approach

We compared the metrics currently used by OPG to those used by OPG in 2020. We also reviewed the metrics used by OPG, drawing on our experience with other nuclear operators, to determine their suitability for benchmarking operational and financial performance.

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[1] ScottMadden outlined the methodology for Refurbishment normalization for 2017 and subsequently validated the OPG calculations to ensure the methodology was applied correctly. Subsequently, ScottMadden has validated that the approach of OPG remained consistent with the methodology and assumed that OPG had also continued to accurately perform the calculations consistent with OPG's current corporate cost allocation methodology and organizational structure.

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Key Changes and Justification

Our review identified no differences between the 2020 and 2024 benchmarking reports in the metrics used to measure performance. However, there is a difference in the presentation of online deficient and corrective maintenance backlogs from the 2020 report to the 2024 report. Specifically, the 2020 report only included the current performance year and the benchmark in the performance chart and described the trend in the subsequent observations. The 2024 report includes the current performance year and the prior five years of performance with benchmarks, creating a visual representation of the trend. The trend and other observations are then addressed in the subsequent "Factors Contributing to Performance" and "Initiatives to Improve and Sustain Favorable Performance." ScottMadden supports these enhancements in visual representation and performance commentary.

ScottMadden also supports OPG continuing to include normalizing adjustments to some value for money metrics, which are presented in conjunction with unadjusted (i.e., non-normalized) versions of those cost metrics.

Lastly, ScottMadden found that the metrics used for each cornerstone area (e.g., reliability) in this benchmarking report provide excellent coverage of overall nuclear performance in comparison to the broader industry. They represent key metrics that are well-known and commonly used for executive-level benchmarks in nuclear power generation.

ScottMadden's Evaluation

We compared the metrics currently used by OPG to those used by OPG in the 2020 report. We also reviewed the metrics used by OPG, drawing on our experience with other nuclear operators, and found they were suitable for benchmarking operational and financial performance.

It is our opinion that OPG's suite of benchmarked metrics provides a sufficiently robust view of the Company's nuclear performance.

6. VALIDATION OF DATA CALCULATIONS AND REPORTING

Approach

We conducted a data validation exercise to ensure benchmarking data contained in the 2024 report was assessed, calculated, and reported accurately. Data capture for the benchmarking report occurs in three principal steps:

1. Receipt of the data from the reporting agencies (e.g., WANO, INPO, COG, EUCG, etc.) and posting of this data to OPG-consolidated spreadsheets

2. Custom calculations of the data as needed (e.g., development of two- or three-year rolling averages if not directly reported as such)

3. Development of tables and charts comparing OPG performance to that of associated peer panels

ScottMadden independently validated steps 2 and 3 for available data. We were unable to directly validate step 1 insofar as ScottMadden is not a member utility and does not have direct access to the underlying reports provided by these organizations. Membership rules restrict distribution to third parties.

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In validating step 2, OPG data and associated calculations were examined in detail. Data and calculations for other comparators were examined and validated in aggregate. Aggregate discrepancies could then be followed up by examining the calculation detail to identify the source of the discrepancy, though none were found during this review.

ScottMadden's Evaluation

Our evaluation found no issues with OPG's assessments, calculations, or presentations of data in the benchmarking report.

7. USE OF BENCHMARKS IN THE BUSINESS PLANNING PROCESS

Approach

ScottMadden reviewed OPG's Nuclear Business Planning Procedure (N-PROC-AS-0080 R007) and Nuclear Benchmarking Report Instruction Guide against previous ScottMadden guidance and current industry leading practice.

Summary of Business Planning Process

OPG's nuclear business planning framework consists of five phases: (1) Performance Review, (2) Setting Strategic Direction, (3) Gap Closure Planning, (4) Developing Detailed Business Plan, and (5) Performance Reporting. Throughout this business planning cycle, nuclear performance is compared against the targets from the last business plan, new targets are set, and fleet-wide improvement initiatives to address performance gaps are formulated. Based on the approved strategic direction, generation, cost, and staffing plans are developed. Finally, performance is reported and monitored.

ScottMadden's Evaluation

We found that OPG's Nuclear Business Planning Procedure remains aligned with industry leading practice and ScottMadden's previous guidance.

8. CHANGES IN REPORT FORMAT AND PRESENTATION

Approach

We compared the 2020 and 2024 benchmarking reports for consistency in report format and presentation.

Key Changes and Their Justification

Changes to the 2024 report, compared with the 2020 report, include:

- The same content and flow, with the exception of the elimination of the Major Operator Summary, which is consistent with a prior recommendation from ScottMadden
- Various improvements to clarity and conciseness of the report (e.g., the Executive Summary in the 2024 report addresses performance cornerstones, like Reliability, rather than each individual metric.

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ScottMadden's Evaluation

It is ScottMadden's view that any changes from 2020 to 2024 were appropriate to the overall purpose of the benchmarking analysis. The 2024 report is more concise than the 2020 report. This modification improved the clarity of the document and increased the efficiency of its production, without compromising the quality of the performance information provided.

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OPG Nuclear Cost Performance Benchmarking

A Study of Factors Impacting TGC / MWh
Performance with Normalizing Adjustments
to Facilitate Closer Comparison

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1. BACKGROUND

Context

Ontario Power Generation (OPG) is Ontario's largest electricity generator, producing nearly half of the province's electricity. OPG operates a diverse portfolio of generation assets, including nuclear, hydroelectric, biomass, natural gas, and solar facilities. OPG is committed to meeting Ontario's growing electricity demands reliably and cost-effectively, while minimizing environmental impacts by reducing greenhouse gas and carbon emissions.

Pickering Nuclear Generating Station (PNGS) is one of the two nuclear stations operated by OPG. PNGS has six operating units (two additional units ended commercial operations in 1997), with a net output of 3,094 megawatts (MW), providing about 14 percent of Ontario's electricity needs. The site has been operational since 1971. As of 2023, OPG has extended the operation of PNGS until 2026 and is planning to refurbish units 5, 6, 7, and 8.

Darlington Nuclear Generating Station (DNGS) is OPG's other nuclear station, a four-unit facility with a net output of 3,512 MW, contributing approximately 20 percent of Ontario's electricity needs since the early 1990s. OPG has completed a major mid-life refurbishment of three of the four reactors (units 1, 2, and 3), which involved the replacement of certain life-limiting components. The project began in October 2016 with Unit 2, which returned to service in June 2020, followed by Unit 3, which completed refurbishment in July 2023, and Unit 1, which completed refurbishment in November 2024. Refurbishment of Unit 4 is ongoing, having started in July 2023 and scheduled for completion in the fourth quarter of 2026.

OPG tracks and benchmarks the performance of PNGS and DNGS against industry peers under its nuclear cornerstones of Safety, Reliability, Human Performance, and Value for Money. Value for Money is measured relative to an Electric Utility Cost Group (EUCG) panel of nuclear plants in North America across four metrics, with the headline metric being Total Generating Cost (TGC) per Megawatt-Hour (MWh). Given nuclear power's importance to current operations and plans for future generation capacity, OPG wants to ensure that the cost performance of its operating nuclear plants continues to deliver good value for money. Thus, OPG requested that ScottMadden update the past study of nuclear cost performance using the most current benchmarking data, which is inclusive through 2023.

ScottMadden previously compared Pickering's and Darlington's TGC/MWh to the same measurement of cost performance for other nuclear operators. These past studies facilitated comparisons of OPG plants to others by making various adjustments to baseline comparisons:

- Adjustments to total generating cost (TGC) to normalize for Refurbishment at Darlington, as it is a multi-year mega-project
- Adjustments to total generating cost (TGC) to normalize for technology type (CANDU, BWR, or PWR) and average unit age in months, as these plant characteristics influence cost performance but cannot be impacted by how the plant is managed
- Adjustments to MWhs to address differences in outage length.

Past ScottMadden studies were considered and re-assessed with current data in this examination, which continued to focus on understanding the cost impacts of factors outside the direct control of OPG plant management.

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Current TGC/MWh Performance

Using the EUCG data provided by OPG, TGC/MWh performance for the most recent three-year time period (2021-2023) for PNGS and DNGS appears in the fourth quartile relative to the other sites. However, TGC/MWh performance for DNGS must be adjusted to account for the ongoing Refurbishment, using the established methodology provided under a separate study. The result of the adjustment was a relative improvement in TGC/MWh performance for DNGS as illustrated below.

TGC/MWh performance 2021-'23 for EUCG Panel with DNGS Adjusted for Refurbishment

Actual Total Generating Cost per MWh, 2021-23
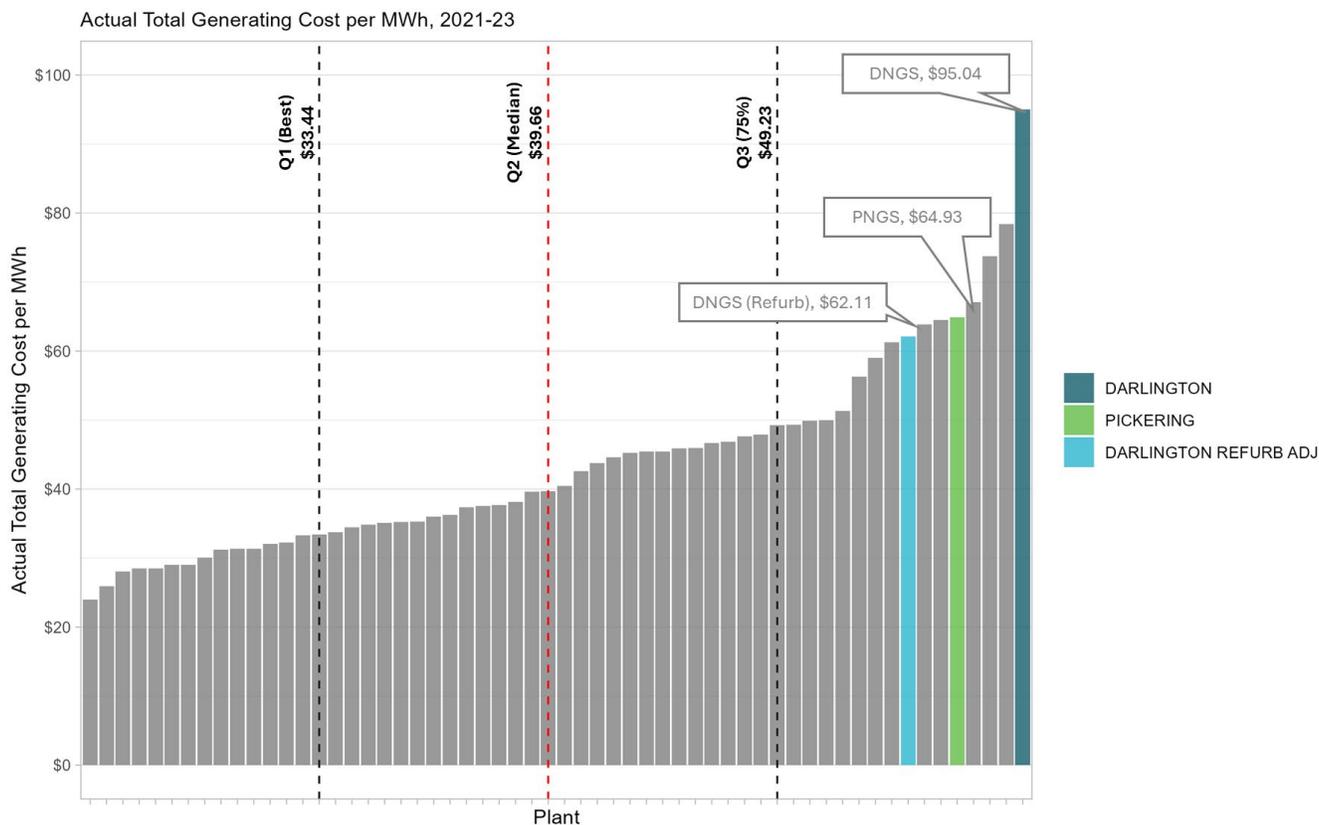
2. ABOUT THE SCOTTMADDEN APPROACH

Scope and Objectives

Consistent with past examination, this study focused on two primary areas of analysis:

- **Econometric** – analysis of site characteristics to understand and quantify the impact on total generating cost (TGC)
- **Nuclear Planned Outages** – analysis of planned outages to determine impacts on energy production (MWh) and establish a basis for normalizing plant production figures. Rather than collecting data via a survey instrument, as was done previously, ScottMadden used actual

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outage hours, number of units, and plant capacity based on extensive data from the Electric Utility Cost Group (EUCG)

The objectives of this investigation were to:

1. Determine whether and to what extent relatively static plant characteristics of a nuclear site influence TGC/MWh performance
2. Quantify and adjust for these characteristics to produce normalized TGC/MWh values that account for plant characteristics that have a significant impact on TGC/MWh performance

We analyzed eighteen years of nuclear plant data (from 2006 to 2023) and 1026 data points per variable to understand and quantify, where possible, relationships between the data and TGC/MWh performance.

Assumptions and Qualifications

In performing this study and preparing this document, ScottMadden assumes that all data provided by OPG and external sources are complete and accurate, including Electric Utility Cost Group (EUCG) data, with plant information blinded, that was provided by OPG.

This ScottMadden report is also subject to the following qualifications:

- ScottMadden does not imply the performance of any additional, specific research beyond what is described in this document.

- ScottMadden does not express an opinion in this document on the effectiveness of management practices at OPG or the appropriateness of any of OPG's costs, outage durations, or other performance characteristics.

- The ScottMadden methodology was prepared for the benefit of OPG and is limited to the subject matter expressly stated in this document; no additional ScottMadden opinion is implied or may be inferred.

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3. EXECUTIVE SUMMARY

ScottMadden focused on two major areas of analysis: 1) econometric analysis and 2) analysis of planned outages.

Econometric Analysis: We used Multiple Linear Regression (MLR) to quantify the relationships between reactor type, site capacity, unit age, and other variables in many combinations (the independent variables) and the EUCG data for TGC (the dependent variable). We developed a robust predictive model for TGC through this analysis of the current dataset. This model explains ~77% of the variability in TGC across the dataset using three variables (reactor type, site capacity, and unit age). The model indicates:

- Relative to BWR plants, CANDU technology increases predicted TGC by over ~C$539[1] million per year

- Relative to BWR plants, PWR technology increases predicted TGC by over ~C$17 million per year

- Each MW of site capacity increases predicted TGC by ~C$291 thousand per year

- Each month of average unit age increases predicted TGC by ~C$77 thousand per year

Once ScottMadden established a mathematically sound quantification of the impact of these site characteristics on TGC, we applied this adjustment method for all sites in the EUCG dataset. However, to be conservative and ensure adjustments were easy to understand, we only performed adjustments for reactor type and unit age, but not for site capacity.[2]

Special Consideration for TGC Adjustments to Plants Undergoing Refurbishment: Our econometric analysis relied on unadjusted (other than for inflation) TGC data. In the case of DNGS, this included costs attributable to unit(s) in Refurbishment. OPG also calculates an adjustment for Refurbishment based on the previously established methodology. To avoid the possibility of making an adjustment for DNGS that is overly influenced by Refurbishment costs, we reduced the DNGS adjustments associated with the econometric model. Specifically, we applied the refurbishment adjustment on a year-by-year basis and proportionally reduced the econometric model adjustments for DNGS by the corresponding annual factors. For example, in 2023 refurbishment costs accounted for 42.9% (~C$684MM / ~C$1,593MM) of total generating costs, so the econometric model technology adjustment ~C$539MM is scaled to the 57.1% (1 – 0.429) of costs not associated with refurbishment in that year. Similarly, the adjustment for average unit age at DNGS is reduced using the same annual

---

[1] All C$ values in this document are in 2023 dollars, unless otherwise indicated

[2] We do not adjust costs for differences in site capacity, despite this being a significant driver of cost, since this would also have required a complex adjustment to generation. Adjusting for site capacity would follow the logic of other adjustments to cost. In this model, that would mean adjusting costs by ~C$291k per MW per year for each site by a multiple of (median capacity in MW across all sites minus the capacity of the specific site in MW). However, such an adjustment for site capacity would also require that we adjust the MWhs produced by the site in kind. This adjustment would require determination of, for example, the capacity factor to use when determining the change in MWh, further complicating the adjustment and magnifying differences across sites in certain periods. ScottMadden thus felt it more conservative and intuitive to adjust only for technology and age of equipment. The median site capacity in the dataset was 1,819 MW, while PNGS and DNGS have 3,100 MW and 3,512 MW of site capacity, respectively. Higher site capacities are related to higher costs, raising TGC/MWh, but higher site capacities also allow for greater MWh of generation, lowering TGC/MWh. The amount of additional MWh of generation produced depends on how consistently the plant operates and at what percentage of capacity.

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proportions. The mechanics of these adjustments are outlined in the figure below. This reduction in the adjustments driven by the econometric model is a change from our prior study. We believe this approach is more conservative (i.e., by reducing the size of the adjustment) given the increased relative magnitude of the adjustment associated with the CANDU reactor type.[3]

Darlington TGC Adjustments Based on Econometric Analysis and Refurbishment Costs

Calculation of Refurbishment Adjustments for Darlington						
1. Total Generating Cost (2021-2023)						$ 4,470,192
	Base					
2021 TGC	$1,467,101					
2022 TGC	$1,409,975					
2023 TGC	$1,593,117					
2. Apply Refurb Adjustment to TGC						$ 1,549,050
	Base					
2021 Adjustment	$279,356					
2022 Adjustment	$585,817					
2023 Adjustment	$683,877					
3. Total Refurb Adjusted Generating Cost (2021-2023)						$ 2,921,142
4. Model Adjustment for Technology						$ (1,006,947)
	Base	Proportion	Inf Factor	Modified Adj		
2021 Adjustment	-$539,468	81.0%	90%	-$395,203		
2022 Adjustment	-$539,468	58.5%	96%	-$303,854		
2023 Adjustment	-$539,468	57.1%	100%	-$307,891		
5. Model Adjustment for Age						$ (52,729)
	Base	Proportion	Inf Factor	Age	Modified Adj	
2021 Adjustment	-$77.26	81.0%	90%	355	-$20,092	
2022 Adjustment	-$77.26	58.5%	96%	367	-$15,970	
2023 Adjustment	-$77.26	57.1%	100%	378	-$16,667	
6. Model Adjusted Generating Cost (2021-2023)						$ 1,861,466

The result of these adjustments only on TGC/MWh performance for the most recent three-year time period (2021-2023) for PNGS and DNGS is summarized below:

- Pickering's relative performance improves to 33rd out of the 57 sites in the EUCG panel or third quartile, approaching the median

- After accounting for Refurbishment, Darlington's relative performance is 34th out of the 57 sites in the EUCG panel, or third quartile, close to the median.

Nuclear Outages Analysis: ScottMadden sought to normalize energy generation to help isolate the impact of other factors on TGC/MWh, enabling a better comparison of cost performance. We used outage data provided by OPG from EUCG and focused the analysis on planned outages to avoid any potential adjustment for unplanned outages. The approach for this normalization is as follows:

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[3] The adjustment for the CANDU reactor type in the prior study was $283,946,104 in 2017 C$. Adjusting for inflation to 2023 C$ would yield an equivalent 2023 adjustment of $343,290,840; however, the adjustment in our econometric model in 2023 C$ is $539,468,076.

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1. Calculate the 18-year average planned outages as a percentage of time online for each plant from 2006-2023

2. Identify the plant with the lowest average percentage of planned outages

3. Using the lowest average planned outage percentage as the benchmark, we adjust MWh for each plant/year to match the benchmark rate, adding MWh when outages are longer and subtracting when outages are shorter

This method was applied to all plants in the EUCG dataset to normalize MWh generation based on a common standard for planned outage duration. The result of these adjustments to TGC and MWh on TGC/MWh performance for the most recent three-year time period (2021-2023) for PNGS and DNGS is summarized below:

- Pickering's relative performance improves further to 28th out of the 57 sites in the EUCG panel in the second quartile

- After accounting for Refurbishment, Darlington's relative performance remains 34th out of the 57 sites in the EUCG panel and remains third quartile

4. ADJUSTING FOR INFLATION

Before performing cost analysis, ScottMadden adjusted dollar values for inflation to ensure that we could establish mathematical relationships that persisted across the eighteen-year dataset. Specifically, we adjusted Total Generating Costs (TGC) from 2006 to 2023 for inflation using the Gross Domestic Product Implicit Price Index Final Domestic Demand (GDP-IPI FDD) in Canada from Statistics Canada, converting all TGC values to 2023 dollars. This index was used in the prior study, and it is commonly used by the OEB for rate-setting matters.[4]

5. ECONOMETRIC ANALYSIS

About The Data

The data used for this analysis contains:

- 57 nuclear sites and 1026 total data points (one / site / year)
- Three reactor types:
    - PWRs – 34 sites
    - BWRs – 20 sites
    - CANDUs – 3 sites
- Nuclear sites with a median capacity of 1,819 MW and median unit capacity of 956 MW
- Primarily sites with either one or two units (51 of 57), but:
    - Three sites (two PWRs and one BWR) with three units
    - One site with four units (CANDU – Darlington)
    - One site with six units (CANDU – Pickering)
    - One site with eight units (CANDU – Bruce)

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[4] GDP-IPI FDD is an inflation factor that is commonly-used and frequently referenced by the OEB in multiple documents.

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It is worth noting that there are three CANDU plants (Bruce, Pickering, and Darlington) in the EUCG data and the technology differs in important ways from the PWR and BWR plants. For example, CANDU plants

- Have greater numbers of smaller capacity units but generally larger total site capacities
- Have different online and outage maintenance requirements but can be refueled online
- Operate in Canada and are subject to a different regulatory and market environment than PWRs and BWRs operating in the US

Predictive Model for Total Generating Costs

ScottMadden used the data described above to analyze how certain site characteristics influence nuclear site costs. We focused the analysis on site characteristics that are outside the operational control of management, and are likely to have a meaningful influence on costs:

- Reactor type – CANDU, PWR, or BWR
- Site capacity – total site capacity across all operating units (MW)
- Number of units – total number of operating units at the site
- Unit size – average capacity of the units at the site (MW)
- Unit age – average age of the units at the site (months)

Specifically, ScottMadden used Multiple Linear Regression (MLR) to quantify the relationships between various combinations of the above site characteristics (the independent variables) and site costs (TGC). Consistent with the previous study, *OPG Nuclear Cost Performance Benchmarking – A Study of Factors Impacting TGC / MWh Performance with Normalizing Adjustments to Facilitate Closer Comparison*, we were able to develop a powerful predictive model, and this model explains ~77% of the variability in TGC with reactor type, site capacity, and average unit age (months). The model indicates:

- Relative to BWR technology, CANDU and PWR technology increases TGC

- Greater site capacity increases TGC

- Higher average unit age increases TGC

The specific, mathematical model for site costs in thousands of Canadian dollars (C$k) is: $f(TGC\ per\ year) = (539{,}468 * (CANDU)) + (17{,}310 * (PWR)) + (291 * (site\ capacity)) + (77 * (unit\ age)) + 134{,}235$. Each coefficient in the formula is the estimated change in TGC corresponding to one unit change in that associated variable when all other variables are held constant. Specifically:

- If the CANDU value is 1, indicating it is a CANDU reactor, predicted TGC would increase by C$539,468k (2023); If 0, it will remain unchanged

- If the PWR value is 1, indicating it is a PWR reactor, predicted TGC would increase by C$17,310k (2023); If 0, it will remain unchanged

- For each MW of site capacity, predicted TGC would increase by C$291k (2023)

- For each month of average unit age, predicted TGC would increase by C$77k (2023)

Put more simply, with all other variables held constant:

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- CANDU technology increases predicted TGC by just over ~C$539 million per year relative to BWR technology

- PWR technology increases predicted TGC by just over ~C$17 million per year relative to BWR technology

- Each MW of site capacity increases predicted TGC by ~C$291 thousand per year

- Each month of average unit age increases predicted TGC by ~C$77 thousand per year

Once we established a mathematically-sound quantification of the impact these site characteristics have on TGC, we adjusted for all sites in the EUCG data set to account for these factors. However, we only perform adjustments for reactor type and unit age, using the process below.[5]

- Reactor Type – if the reactor is a:
  - BWR, we assign no adjustment value
  - PWR, we assign a decrease adjustment value of ~(C$17M per year)
  - CANDU, we assign a decrease adjustment value of ~(C$539M per year)

- We assign a decrease adjustment value equal to the actual number of unit-age months multiplied by ~C$77k

- Inflation – For any year other than 2023, we use the appropriate GDP-IPI FDD value to inflate or deflate the cost adjustment to a value for that specific year

We do not adjust costs for differences in site capacity, despite this being a significant driver of cost, since this would also have required a complex adjustment to generation.[6]

To adjust cost for a given year, we use the GDP-IPI FDD to modify the adjustment value to the appropriate year (e.g., to adjust TGC in 2021, we take the TGC impact from the model above, which is in 2023 dollars, modify it to 2021 dollars, and adjust the value for 2021).

Then, to account for the refurbishment at DNGS, we converted and removed C$279,356k in 2021 and C$585,817k in 2022, and removed C$683,877k in 2023. To avoid double-counting the adjustment values, that is to avoid applying full adjustment amounts for a partial cost due to the refurbishment, we calculated the total refurbishment adjustment as a proportion of the total generating costs for each year. We then applied the proportion not attributable to refurbishment for each year to the economic adjustments outlined above for DNGS.

Finally, we divided the adjusted TGC by actual MWh of generation to get the updated comparison shown in the chart below.

---

[5] Precise adjustment values were C$(-539,468,076) / yr for CANDU, C$(17,309,809) / yr for PWR and C$(-77,257) / month of unit age
[6] See supra note 2

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TGC/MWh performance 2021-'23 for EUCG Panel with All Sites Adjusted Based on Econometric Analysis and DNGS Also Adjusted for Refurbishment

Normalized Total Generating Cost per MWh, 2021-23
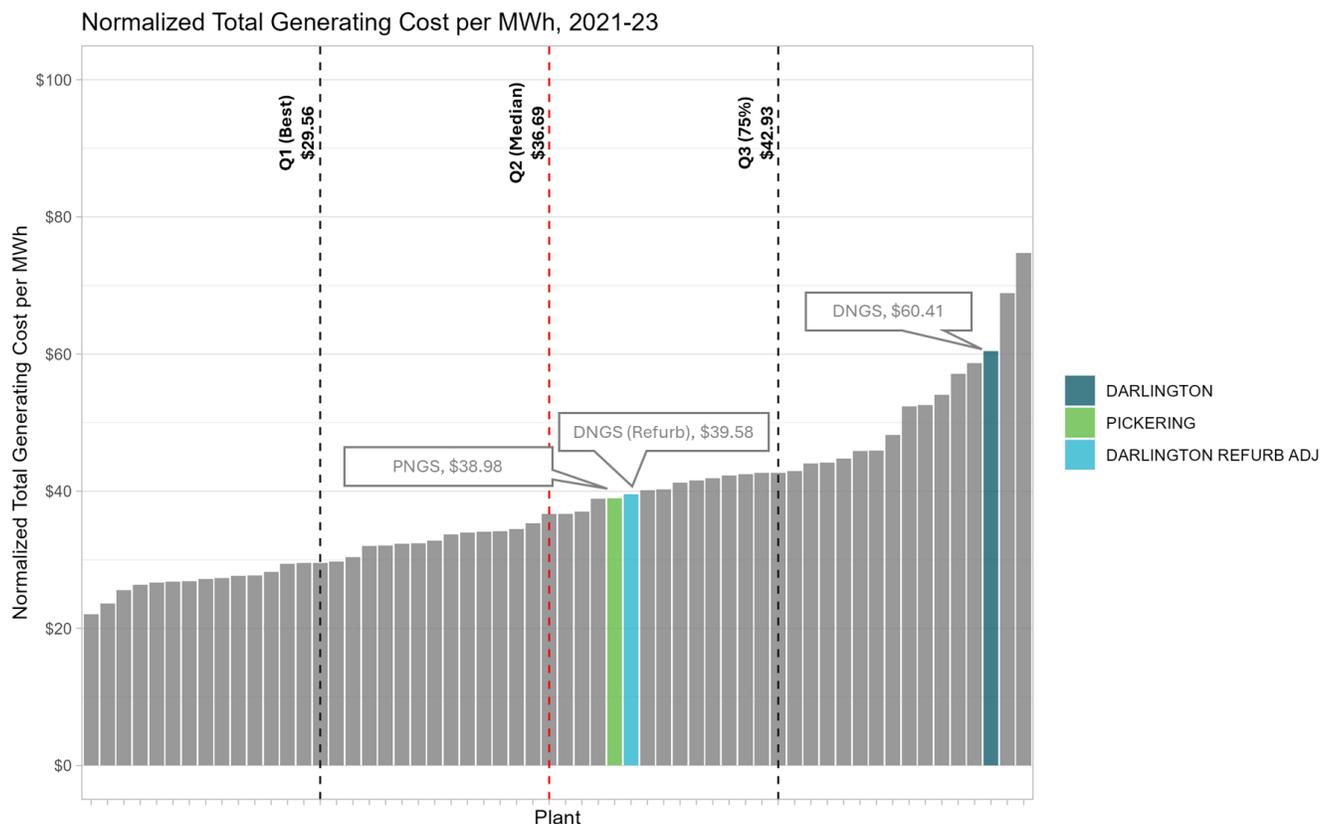
As a result of these adjustments:

- Pickering's relative performance improves to 33rd out of the 57 sites in the EUCG panel or third quartile, approaching the median

- Darlington's relative performance, without accounting for Refurbishment, improves to 55th out of the 57 sites in the EUCG panel. After accounting for Refurbishment, Darlington's relative performance is 34th out of the 57 sites in the EUCG panel, in the third quartile.

6. NUCLEAR OUTAGES ANALYSIS

All reactor types have planned maintenance outages on either 18, 24, 30, or 36-month cycles. Planned maintenance outages for PWRs and BWRs are incorporated into refueling cycles and occur every 18 or 24 months. Planned maintenance outages for CANDU reactors occur every 24, 30, or 36 months. Work to significantly extend the operating life of a plant (life-extension activities) is also approached differently across technologies. For PWR and BWR plants, it is more common to complete this work as part of planned refueling and maintenance outages over a series of multiple outages to minimize time in outage. The scope for this work also differs from one plant to the next due to differences in plant design, market construct, and other factors. Comparable life-extension activities for CANDU plants largely occur during long-duration refurbishment outages where multiple, major plant components are replaced, though some related work can also be incorporated into more frequently recurring planned maintenance outages.

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Due to the higher variability and lower frequency of life-extension activities that occur across reactor technologies and operators, ScottMadden focused only on quantifying and adjusting for the impact of recurring, planned outages on power generation. We analyzed an extensive data set to arrive at an adjustment that normalizes across plants for planned outage durations, as described below.

About The Data

ScottMadden analyzed EUCG data to account for variations in planned outages, which can significantly impact a plant's energy production (MWh). In this study, ScottMadden analyzed plant level data over an eighteen-year period (2006–2023) to understand the impact of planned outages on MWh over a sustained period. The dataset used for this analysis includes:
- Outage Hours – The number of planned outage hours reported for each plant in each year
- Plant Capacity – The full-load plant capacity reported for each unit in each year, reported in MWe

## MWh Adjustment Calculation to Account for Planned Outages

ScottMadden conducted an analysis to normalize MWh generation across the dataset by adjusting for planned outage hours. This involved calculating the expected generation by adding MWh when outages are longer and subtracting when outages are shorter than the benchmark, effectively estimating each plant's potential output if it had experienced benchmarked industry outage rates. This approach can be summarized as follows:

1. **Calculate Average Planned Outage Percentage** (Each Plant From 2006-2023)
   - Total Outage Hours ÷ Number of Units ÷ 8760 (hours in a year)

2. **Identify the Most Efficient Plant** (i.e., Lowest Average Planned Outage % From 2006-2023)
   - Lowest planned outage % serves as benchmark for optimal efficiency
   - This value may be used on a go-forward basis

3. **Determine Adjustment Factor** (Per Plant, Per Year)
   - Plant Planned Outage % - Benchmark Planned Outage %

4. **Calculate Planned Outage Difference** (i.e., Additional or fewer MWh to match benchmark)
   - Adjustment Factor × Reference Energy Generation (Capacity x 8760 hours per year)

5. **Compute Adjusted Generation** (i.e., Adjusted total MWh for benchmark planned outage)
   - Actual Generation + Planned Outage Difference

ScottMadden adjusted the MWh values for all 57 sites from 2006-2023, as described above, to account for the impact of differences in planned outage durations across technology types and outage frequencies. In addition, the Darlington Refurbishment accounted for significant time in planned outage, but this outage time was captured in the reported unit capacity each year, so no further capacity adjustments were needed.

The chart below shows the adjusted TGC values from the econometric analysis divided by the adjusted MWh values from the nuclear outage analysis.

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TGC/MWh performance 2021-'23 for EUCG Panel with All Sites Adjusted Based on Econometric Analysis and Outage Analysis and DNGS Also Adjusted for Refurbishment
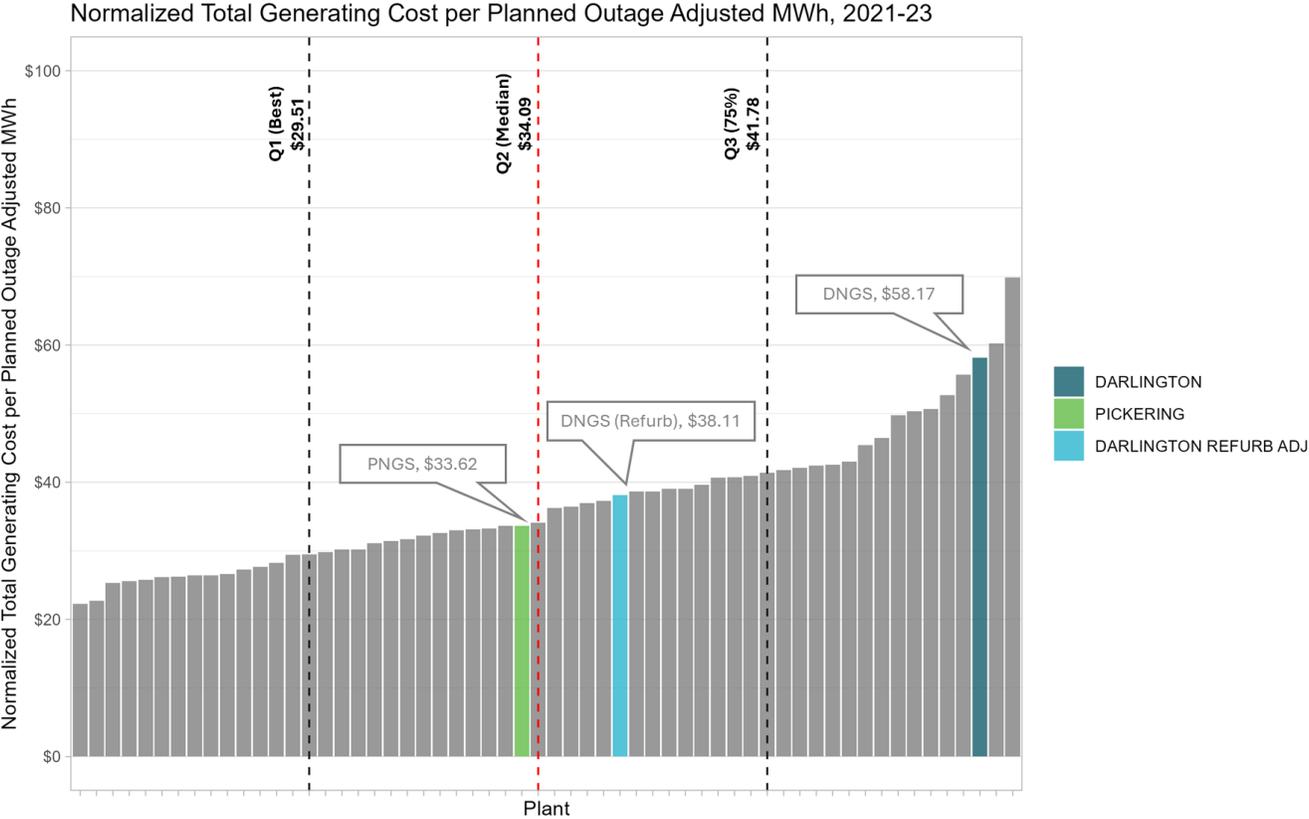
Normalized Total Generating Cost per Planned Outage Adjusted MWh, 2021-23

As a result of these adjustments:

- Pickering's relative performance improves further to 28th out of the 57 sites in the EUCG panel to the second quartile

- Darlington's relative performance without accounting for Refurbishment is 55th out of the 57 sites in the EUCG panel; after accounting for Refurbishment, Darlington's relative performance remains 34th out of the 57 sites in the EUCG panel and remains third quartile

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November 2025

Ontario Power Generation (OPG) - Nuclear Staff Benchmarking

Report Contents

- Executive Summary

- Background and Data Methodology
  - Methodology Overview – OPG
  - Methodology Overview – Benchmark
  - Methodology Overview – Exclusions

- PWR Data Normalization Process

- Benchmark Data

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Executive Summary

Executive Summary

- OPG engaged Indeavor, a company with workforce analytics expertise in the energy sector, to conduct a nuclear staffing benchmark.

- The benchmark methodology began with staffing data from 2-unit United States (U.S.) Pressurized Water Reactor (PWR) sites, selected for their technical comparability to Canada Deuterium Uranium (CANDU) reactors. This data was scaled to reflect operations at OPG's fleet. Non-comparable functions, such as Purchased Services and CANDU-specific activities, were excluded due to the lack of detailed data from benchmarked peers.

- OPG's 2024 staffing headcount is 4,458, which is 9.3% below the benchmark of 4,913.

- Operations and Facilities remain the largest variance categories, consistent with prior benchmarks: −206 in Operations and +171 in Facilities.

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Data Methodology

Methodology Overview – OPG

- OPG reviewed EUCG (Electric Utility Cost Group) staffing data for 2024, and allocated staffing headcount to corresponding Indeavor functions.

  - Indeavor function allocations were determined using a mix of EUCG account mappings, department level information, job titles, business unit classification.

  - To establish a consistent benchmark, any data that was determined to not be comparative was excluded from the analysis.*

- These functional headcount allocations were reviewed and validated by Indeavor for use to compare against the benchmark.

Exclusion list and rationale provided on slide 8

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Methodology Overview – Benchmark

- Surveys were sent out to comparable 2-unit PWR (Pressurized Water Reactor) sites who agreed to participate in the study; sites from across the United States self-reported their staffing data and submitted it to Indeavor for analysis.

- The survey data was normalized to ensure the benchmark was comparative with OPG data.*

- The normalized data was then rounded to the nearest whole number to eliminate any fractional headcounts.

Benchmark normalization methodology described in the next section.

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Benchmarking Methodology – Exclusions

To ensure that both OPG staffing and Benchmark staffing numbers were in alignment and reflect an accurate headcount comparison, some data sets were excluded.

Function	PWR Benchmark	OPG	Rationale
Capital Staffing	Excluded	Excluded	Staffing tied to capital projects/one-time initiatives/refurbishments was not included because it is not representative of the operations.
Outage Execution Activities	Not provided	Excluded	Not representative of the operations.
Nuclear Waste and Decommissioning	Not provided	Excluded	Not applicable for PWR sites.
Security and Security Support	Excluded	Excluded	Excluded to remain compliant with OPG security policy.
Purchased Services (Managed Tasks)	Not provided	Excluded	Excluded due to the lack of detailed data from benchmarked peers.*
CANDU Specific Activities	Not applicable	Excluded	Full detail discussed within PWR normalization section of report.

Excluding Purchased Services is a methodological change from previous studies. Without the ability to interview benchmark sites and fully analyze PWR contract staffing, the data was excluded from both data sets.

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PWR Data Normalization

PWR Data Survey Participants

NEXTera ENERGY	**DUKE ENERGY**	**entergy**	**TVA**
3 Sites Provided	**2 Sites Provided**	**1 Site Provided**	**3 Sites Provided**
EUCG Account Level	*Indeavor Functional Level*	*Indeavor Functional Level*	*EUCG Account Level*

- To generate the comparable benchmark, surveys were sent to PWR nuclear operating centers within the US to request their current staffing levels. Sites self reported staffing data in one of 2 formats.
  - ○ EUCG Account Level Data [A]
  - ○ Indeavor Function Data [B]

- PWR Staffing Survey data was then normalized to be able to provide an accurate comparison with OPG staffing.

A, B – Full list in Appendix

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PWR Data Normalization

Once the survey data was received, it was normalized as follows:

1. Data was normalized as needed to ensure it was consistent across participants

   - Data provided at the EUCG Account level was normalized using historical ratios to split the EUCG account groups into the respective Indeavor functions. [c]

   - Data provided at the Indeavor Functional level was left at the level provided.

   - With the survey data at the same level, each function was averaged across the data set to create the baseline data for the benchmark.

2. To establish a benchmark, any data that was not consistent between PWR and OPG data sets was excluded from the analysis.*

3. Included survey data was then adjusted to account for process and technological differences between CANDU and PWR. The listed functions are unique to CANDU reactor designs and have no comparable equivalent with PWR reactor designs:

   - Fuel Handling

   - Heavy Water Handling

   - Spent Fuel/Radwaste

   - Tritium Removal Facility

   - Feeder and Fuel Channel Support

4. The data was then adjusted to account for the difference between 35 hour and 40 hour work weeks. This adjustment accounts for any staffing differences due to the yearly variance of the same position worked at 40 hours in the U.S. and 35 hours in Canada.

5. To scale staffing for reactor count differences between 2-Unit and 4-Unit sites, the work week normalized staffing data was scaled to account for 2 additional reactor units at Pickering B and Darlington. Data was also adjusted to include staffing for cross-tied operations for Units 2 & 3 at Pickering A.

6. The normalized fractional headcounts were rounded up to the nearest whole number, as less than one person cannot be staffed.

C – Full list in Appendix
* Exclusion list provided on slide 8

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Benchmark Data

Site Headcount – Total
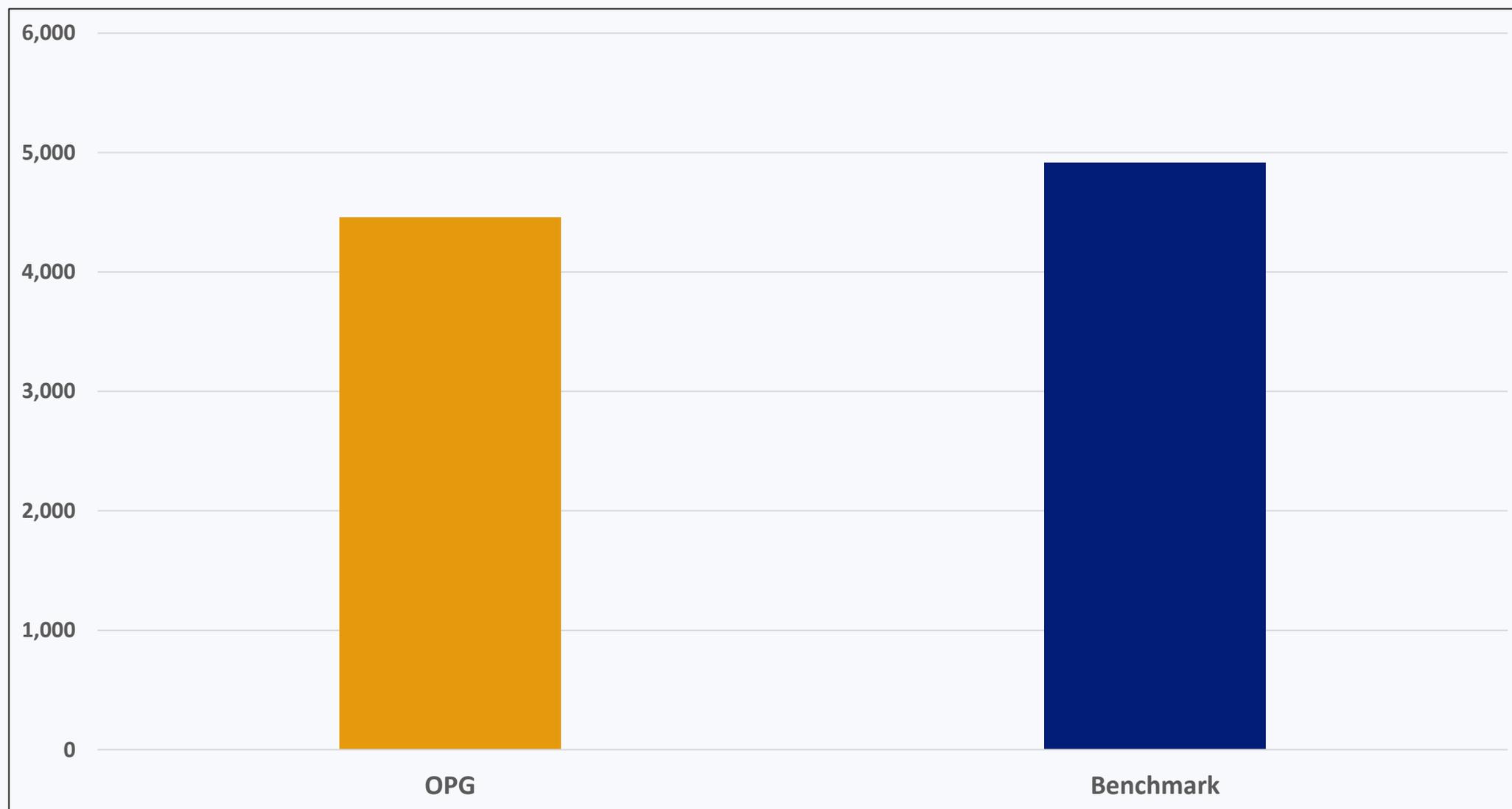
OPG Headcount is 455 (-9.3%) below benchmark

Site Headcount – Indeavor Functions
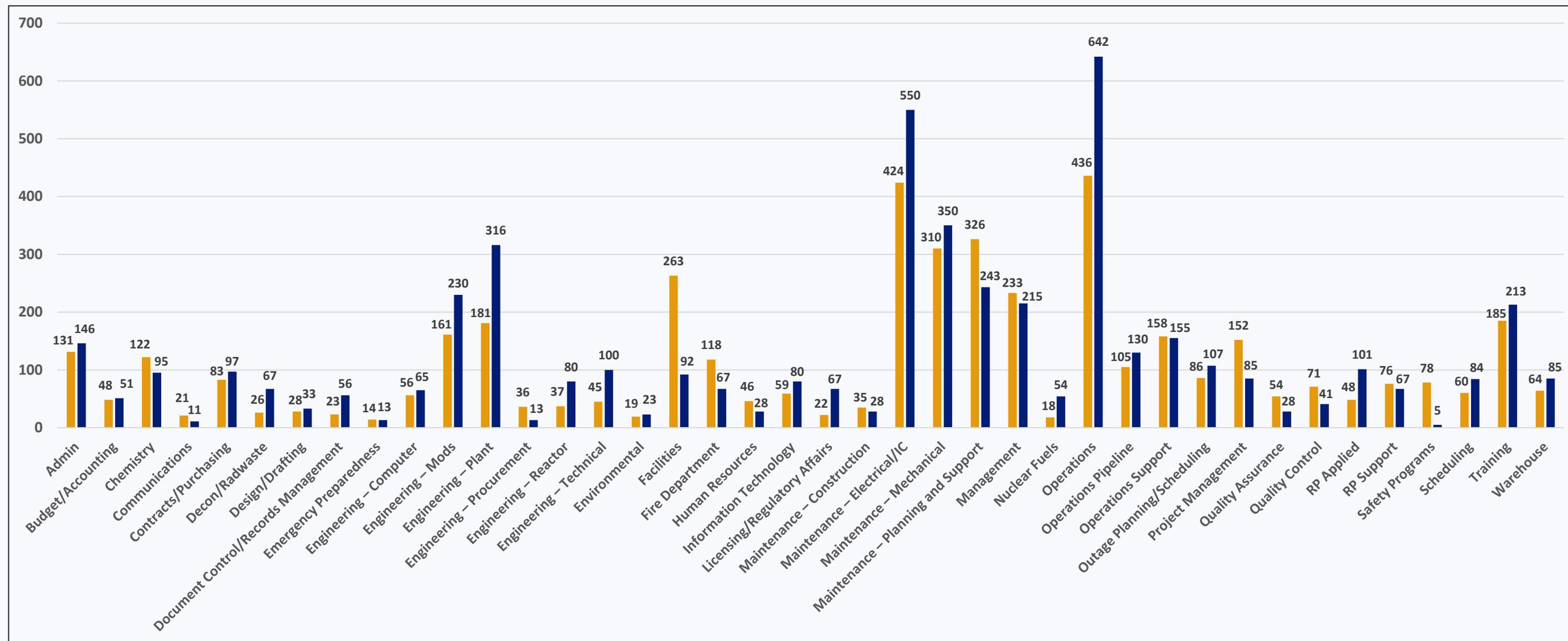
Variance Analysis

Headcount Variance by Function – Highlights

5 Functions were above the benchmark by more than 50 headcount;
6 Functions were below the benchmark by more than 50 headcount.

Above Benchmark
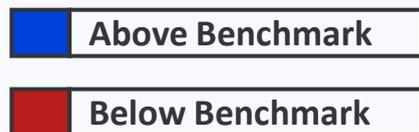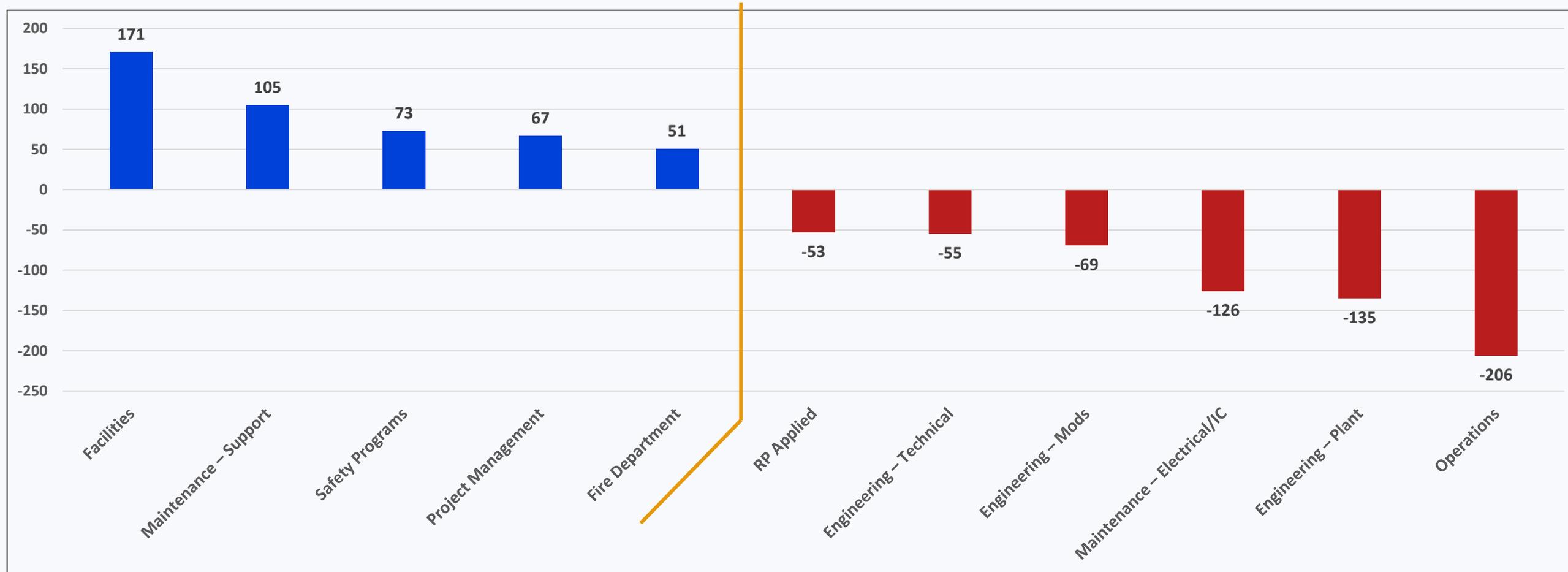
Below Benchmark

The 11 functions shown represent 64% of the total headcount variance across all functions.

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Headcount Variance by Function

Legend: Above Benchmark (blue), Below Benchmark (red)

Overall EUCG Account % of Total Staffing
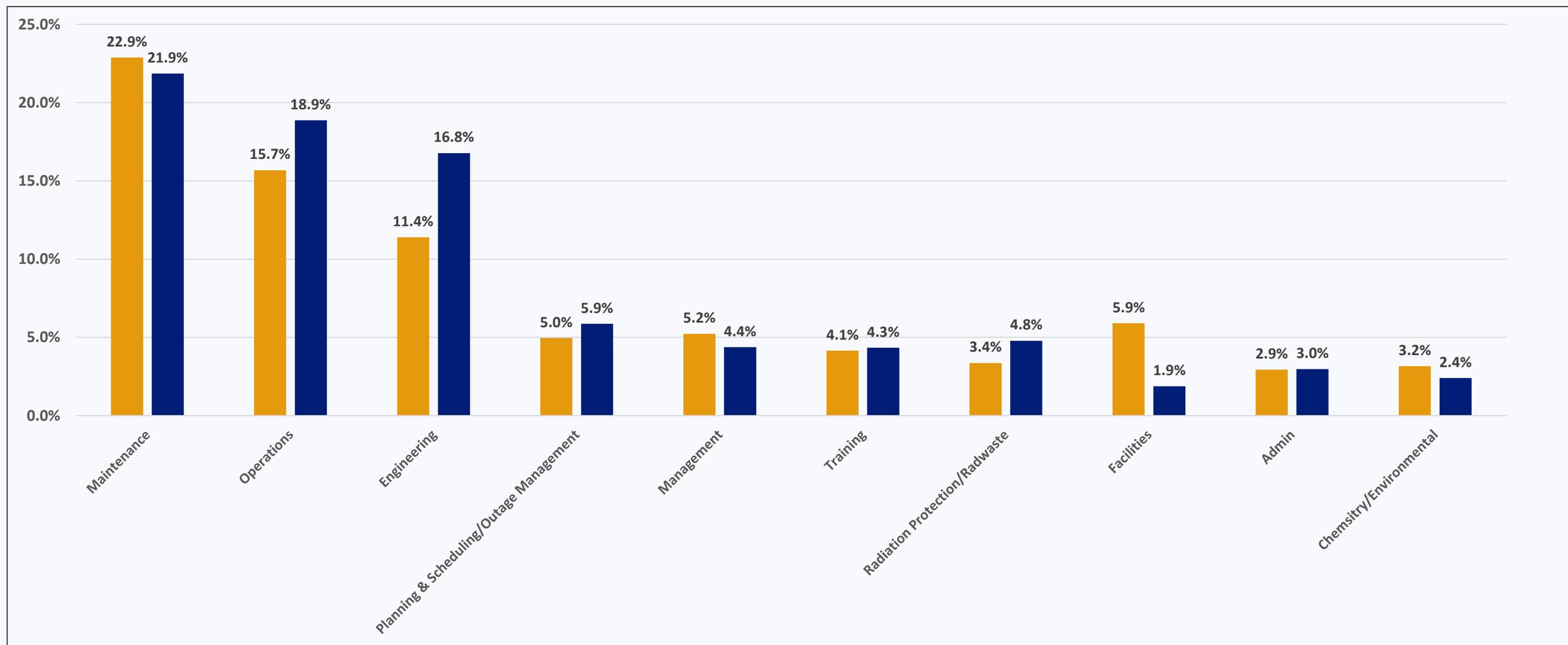
Only the top 10 EUCG accounts are shown for visualization purposes. Ranked by the average of OPG and benchmark % of total staffing.

Average breakdown of functions not shown is 1.3%

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Appendix

Appendix – A

EUCG Code	EUCG Account
AD01*	Admin
ENGTOT	Engineering
LP01	Security
LP03	Corrective Action Program and OE
LP02	Quality Assurance/Quality Control
LP04	Safety and Health
LP05	Licensing
LP06	Emergency Preparedness
LP07	Dedicated Fire Responders
MS01	Materials Management & Warehousing
MS02	Contracts & Purchasing
MS03	Procurement Engineering
NFTOT	Fuel Management
OP01	Operations
OP02	Chemistry/Environmental
OP03	Radiation Protection/Radwaste
SS01	Information Technology
SS02	Business Services
SS03	Records Management and Procedures
SS04	Human Resources
SS05	Housekeeping and Facilities Management
SS06	Communications and Community Relations
SS07	Nuclear Officers, Executives, Management Assistance and Industry Associations
TRTOT	Training - Develop and Conduct
WM01	Planning & Scheduling/Outage Management
WM02	Maintenance
WM05*	Project Management

AD01 and WM05 are not official EUCG account codes, they are used only for data analysis purposes

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Appendix – B

Indeavor Function	
Admin	Maintenance – Construction
Budget/Accounting	Maintenance – Electrical/IC
Chemistry	Maintenance – Mechanical
Communications	Maintenance – Planning and Support
Contracts/Purchasing	Management
Decon/Radwaste	Nuclear Fuels
Design/Drafting	Operations
Document Control/Records Management	Operations Pipeline
Emergency Preparedness	Operations Support
Engineering – Computer	Outage Planning/Scheduling
Engineering – Mods	Project Management
Engineering – Plant	Quality Assurance
Engineering – Procurement	Quality Control
Engineering – Reactor	RP Applied
Engineering – Technical	RP Support
Environmental	Safety Programs
Facilities	Scheduling
Fire Department	Training
Human Resources	Warehouse
Information Technology	
Licensing/Regulatory Affairs	

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Appendix – C

EUCG Function	Indeavor Function	FTE Ratio
Admin	Admin	1.00
Engineering	Design/Drafting	0.03
Engineering	Engineering – Computer	0.09
Engineering	Engineering – Mods	0.31
Engineering	Engineering – Plant	0.39
Engineering	Engineering – Reactor	0.09
Engineering	Engineering – Technical	0.10
Security	Security Support	1.00
Corrective Action Program and OE	Corrective Action Program and OE	1.00
Quality Assurance/Quality Control	Quality Assurance	0.37
Quality Assurance/Quality Control	Quality Control	0.63
Safety and Health	Emergency Preparedness	0.23
Safety and Health	Safety Programs	0.77
Licensing	Licensing/Regulatory Affairs	1.00
Dedicated Fire Responders	Fire Department	1.00
Materials Management & Warehousing	Warehouse	1.00
Contracts & Purchasing	Contracts/Purchasing	1.00
Procurement Engineering	Engineering – Procurement	1.00
Fuel Management	Nuclear Fuels	1.00
Operations	Operations	0.61
Operations	Operations Support	0.19
Operations	Operations Pipeline	0.20
Chemistry/Environmental	Chemistry	0.89
Chemistry/Environmental	Environmental	0.11
Radiation Protection/Radwaste	Decon/Radwaste	0.21
Radiation Protection/Radwaste	RP Applied	0.34
Radiation Protection/Radwaste	RP Support	0.44
Business Services	Budget/Accounting	1.00
Records Management and Procedures	Document Control/Records Management	1.00
Human Resources	Human Resources	1.00
Housekeeping and Facilities Management	Facilities	1.00
Communications and Community Relations	Communications	1.00
Nuclear Officers, Executives, Management Assistance and Industry Associations	Management	0.98
Nuclear Officers, Executives, Management Assistance and Industry Associations	Management Support	0.02
Training - Develop and Conduct	Training	1.00
Planning & Scheduling/Outage Management	Maintenance Planning	0.34
Planning & Scheduling/Outage Management	Outage Planning/Scheduling	0.37
Planning & Scheduling/Outage Management	Scheduling	0.29
Maintenance	Maintenance – Construction	0.02
Maintenance	Maintenance – Electrical/IC	0.46
Maintenance	Maintenance – Mechanical	0.33
Maintenance	Maintenance – Support	0.19
Project Management	Project Management	1.00

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LLP

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Box 270, TD South Tower
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P. 416.865.0040 | F. 416.865.7380

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Charles Keizer
ckeizer@torys.com
P. 416-865-7510

BY EMAIL

CONFIDENTIAL — PRIVILEGED

February 10, 2025

Scott Madden Management Consultants
3495 Piedmont Road, NE
Building Ten, Suite 805
Atlanta, GA 30305-8800

Attention: Marc Miller, Partner

Re: Retainer Letter Agreement – Ontario Power Generation – Nuclear Benchmarking and Business Planning Processes

Dear Mr. Miller,

We represent Ontario Power Generation ("OPG") in connection with payment amount and other proceedings (collectively, "Proceedings") before the Ontario Energy Board (the "Board").

We confirm that, on behalf of and to assist us in providing legal advice to OPG in connection with certain Proceedings, Torys LLP ("Torys") has engaged ScottMadden (the "Consultant" or "you") effective as of the date hereof ("Effective Date") to provide consulting services as described in this letter. By signing back a copy of this letter, the Consultant agrees that this letter contains the agreed-upon terms and conditions of its retainer with Torys effective on the Effective Date, subject to amendment by written agreement between the parties (the "Retainer Agreement").

1.   No Conflict

The Consultant does not have any conflict of interest or other constraints on its ability to provide expert advice in connection with this Retainer Agreement. You confirm that you are free to provide your services to Torys in connection with Torys' representation of OPG in the Proceedings. You agree that during this engagement you will not provide, directly or indirectly, any services to any other party in connection with the matters at issue in the Proceedings.

2. Consultant Expertise

The Consultant has been selected to provide consulting services to Torys in connection with the Proceedings, namely by undertaking an independent review of nuclear cost performance benchmarking. The sponsors of the work of the Consultant and the persons who have the relevant expertise will be Marc Miller, one of your consultants as he determines, and staff from your research organization as needed (the "Sponsors").

3. Scope of Services and Work Product

The Consultant will:

(a) Analyze OPG's nuclear benchmarking by (i) reviewing key performance metrics used for comparison; (ii) reviewing companies included in the peer panels; (iii) preparing supporting analysis and displays; (iv) reviewing the use of benchmarks in the business planning cycle; and (v) reviewing and comparing OPG's current 2024 benchmarking report to the Consultant's most recent assessment of the same report and the Consultant's 2021 improvement recommendations (the "Study");

(b) if requested by Torys, produce a report detailing the Study's methodology, analysis performed, and the ensuing findings and recommendations (the "Report"), which may be filed with the Board in the Proceedings; and

(c) if requested by Torys, provide support during the hearing of the Proceedings and testify before the Board in the Proceedings, in connection with the scope of the services provided hereunder ("Application Support" and, together with the Study and the Report, the "Services").

Assuming a February 10, 2025 start date, the Study will be completed by February 24, 2025, and the Report, if requested, will be completed by March 31, 2025

4. Fees and Invoices

The Consultant acknowledges that the price for the Consultant to perform the Study and to deliver a written Report, if requested, shall not exceed ▮▮▮▮▮▮▮ (not including HST) based on actual time spent by the team working to provide the Services, plus travel and living expenses which are billed as incurred with no mark-up, and administrative support costs (billed at 1% of professional fees), without prior written approval from Torys.

The Consultant's fee for its Services (including Application Support, if requested by Torys) shall be charged at the following hourly rates:

Partner	▮	Associate	▮
Director		Benchmarking Manager	
Manager		Senior Analyst	
Director of Research		Survey Manager	
Clean Tech Manager		Analyst/Research Analyst	
Senior Associate			

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Any disbursements for additional incidentals incurred by the Consultant in relation to this Retainer Agreement must be pre-approved by Torys or OPG in writing. Torys reserves the right to deduct any applicable non-resident withholding taxes from any amounts owing to the Consultant under this Retainer Agreement and remit such amounts to the applicable taxation authority.

The Consultant shall direct all invoices relating to Services performed by it under this Retainer Agreement to Torys, to the attention of:

> Charles Keizer
> Torys LLP
> 79 Wellington St. W., 30th Floor
> Box 270, TD South Tower
> Toronto, Ontario M5K 1N2
> ckeizer@torys.com

with a copy to OPG, to the attention of:

> Peter Cuff
> Assistant General Counsel, Law Division
> Ontario Power Generation
> 700 University Avenue, H18 E27.1
> Toronto, ON M5G 1X6
> peter.cuff@opg.com

Invoices shall include at least the following information:

(a) identification of the billing period to which the account relates;

(b) an itemized summary of the services that have been undertaken by you, including a brief description thereof, the date on which the services were rendered, the time spent on the services, the individual who performed the services, and the billing rate of such individual; and

(c) an itemized and brief description of all expenses incurred during the billing period, with copies of supporting invoices.

Torys will send your invoice to OPG for its approval and if OPG does not approve your invoice, Torys will send it back to you for revision. Once OPG approves the invoice, Torys will submit the invoice to OPG's payment system. OPG pays invoices once per month (on the 25th of each month) and, for payment to be made on the 25th of a particular month, the invoice must have been approved in OPG's payment system by the 25th of the prior month. Once Torys receives the payment from OPG, Torys will send payment to you.

5.   Confidentiality

All work performed by the Consultant in connection with this Retainer Agreement, including all findings, opinions and conclusions the Consultant reaches in relation to this Retainer Agreement, and any communications relating thereto, are strictly privileged and confidential and shall not be disclosed to any other person or party without the prior written consent of Torys or OPG. The Consultant agrees to designate all written communications and material accordingly. The Consultant further agrees to notify Torys in the event that the Consultant receives a request to

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disclose information relating to this matter, and agrees to cooperate with Torys, to the fullest extent permitted by law, to prevent or limit the disclosure of such material or otherwise preserve the privileged and confidential status of such material.

The Consultant agrees to hold in confidence: (a) all information provided to the Consultant, and (b) the Consultant's opinions to Torys and to OPG as they relate to the information, whether the information or opinions are documentary or oral (collectively, the "Confidential Information"). The Consultant will not disclose the Confidential Information to any person unless Torys or OPG authorizes you in writing to do so. All documents given to the Consultant in connection with this Retainer Agreement remain the property of Torys or of OPG, and are held in trust by the Consultant as agent. The Consultant agrees to return these documents on request. During the engagement, the Confidential Information shall be segregated from other OPG data (including on electronic information systems) and shall not be accessible to individuals other than the Consultant, Torys, and OPG employees requiring access).

The Consultant will not refer to Torys or to OPG, directly or indirectly, in connection with the promotion of its services, without obtaining the prior written consent of Torys or OPG, as the case may be.

6.   **Intellectual Property**

Nothing in this Retainer Agreement shall be deemed to transfer, license, assign, permit the use of, or otherwise convey an interest in whole or in part to the Consultant of any intellectual property belonging to OPG or any of its representatives or any third party whose intellectual property is in OPG's custody or control, and the use by the Consultant of any such intellectual property shall be subject to the prior written approval of OPG.

Torys and OPG shall at all times have full rights and title to all works prepared, generated or created by the Consultant pursuant to this Retainer Agreement, including without limitation any reports, presentations, status updates, or other documents created by the Consultant, and any related works, modifications or additions thereto (the "Work Product"), and may at all times take possession of or use any completed or partially completed Work Product, notwithstanding any provision, express or implied, to the contrary. Without limiting the generality of the foregoing, OPG shall own all intellectual property rights in all Work Product, and the Consultant hereby waives and assigns to OPG any such rights, and agrees to give OPG and its representatives all assistance as may be reasonably required to perfect such rights including, without limitation, obtaining waiver of moral rights from any of the Consultant's employees, partners or other representatives.

Anything contained in this agreement to the contrary notwithstanding, nothing in this Retainer Agreement shall prevent Consultant from utilizing any general know-how, ideas, techniques, concepts, methods, processes, or other knowledge applied in performing the Services, on behalf of itself or its future customers. Consultant may (i) perform the same or similar services for others, and (ii) retain one copy of deliverables produced in connection with the Services hereunder for the sole purpose of documenting the conduct of its work and its exercise of due professional care in connection with the Services, provided that any of OPG's confidential information is treated in accordance with the confidentiality requirements of this Retainer Agreement.

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7. Controlled Nuclear Information

The Consultant has been made aware of certain Canadian federal requirements relating to the import and export of controlled nuclear information, and recognizes that it is an offence for any person to export controlled nuclear information from Canada without an export permit issued for the purpose by the Canadian Nuclear Safety Commission. The Consultant agrees not to remove or cause to be removed from Canada any controlled nuclear information during the performance of the Services, and will promptly raise the issue with OPG where the Consultant is in doubt as to whether information to be removed from Canada as part of the Services may be – or contain – controlled nuclear information.

8. Termination

Torys may terminate this Retainer Agreement at any time on written notice to the Consultant. Torys will pay, or will cause OPG to pay, for work performed up to the date of the notice of termination. Upon the termination or expiration of this Retainer Agreement, the Consultant shall return to Torys and delete any and all electronic copies the Consultant may have of all documents and materials in its possession relating to the Services or this Retainer Agreement, including all Confidential Information (defined above) and Work Product, whether completed or not.

9. Liability and Indemnification

The Consultant shall be liable for and shall indemnify and hold harmless OPG and Torys from all claims, demands, actions, penalties, damages, losses, judgments and settlements, liabilities, costs, expenses, including legal fees and other related costs and expenses arising out of, related to, or incident to, the Consultant or any of its representatives' performance of the Services under this Retainer Agreement, including, without limitation:

a) any breach, violation or non-performance by the Consultant or any of its representatives of any terms, conditions, warranties, obligations or covenants contained in this Retainer Agreement;

b) any breach or violation by the Consultant or any of its representatives of any applicable laws; and

c) any actions, omissions, negligence or wilful misconduct of the Consultant or any of its representatives.

10. Intellectual Property Protection

The Consultant expressly warrants that the manufacture, delivery, sale or use of the Consultant's Services will not infringe any Canadian or foreign patents, trademarks, copyrights, industrial design or other intellectual property rights and the Consultant shall indemnify and save OPG harmless from all claims, judgments and decrees that may be entered against OPG or its representatives and against all damage, liability, costs and expenses (including legal fees and other attendant costs and expenses) OPG incurs by reason of any infringement or claim thereof.

11. Limitation of Liability

Except for breach of confidentiality obligations, gross negligence, wilful misconduct, fraud, breach of applicable laws, breach of privacy laws, and the Consultant's obligation to indemnify under

section 10 (Intellectual Property Protection), the Consultant's total liability for any claim arising out of the performance of the Services, regardless of the form of claim, will in no event exceed total fees paid to Consultant hereunder and under no circumstances will either party be liable for any damages in respect of any incidental, punitive, special, indirect or consequential loss, even if that party had been advised of the possibility of such damages including, but not limited to, loss of profits, loss of revenues, failure to realize expected savings, loss of data, loss of business opportunity, or similar losses of any kind.

12. **Insurance**

    (a) Unless otherwise specified in this Retainer Agreement, the Consultant shall, during the term of this Retainer Agreement, and at its own expense, maintain and keep in full force and effect:

        i. commercial general liability insurance on an occurrence basis having a minimum inclusive coverage limit, including personal injury and property damage, of not less than one million dollars ($1,000,000.00) per occurrence, which shall be extended to cover contractual liability, products and completed operations liability, owners/contractors protective liability and must also contain a cross liability clause and a severability of interest clause, and must name OPG and its affiliates as additional insureds; and

        ii. errors and omissions insurance (professional liability) in the amount of not less than two million dollars ($2,000,000.00).

    (b) All insurance coverages and limits required to be maintained by the Consultant shall be primary to any insurance maintained by OPG, which shall be excess and non-contributory. Prior to the commencement of the delivery of the Services, the Consultant shall deliver to OPG a certificate of insurance which evidences the Consultant's compliance with this Section, including the provision of a thirty (30) day prior written notice of cancellation, non-renewal or adverse material change, to OPG. The Consultant agrees that the insurance described herein does in no way limit the Consultant's liability pursuant to the indemnity provisions of this Retainer Agreement.

13. **Independence**

By entering into this Retainer Agreement, the Consultant acknowledges and agrees that the Sponsors have received a copy of Rule 13A of the Board's *Rules of Practice and Procedure* concerning expert evidence, and agree to accept the responsibilities that are or may be imposed on them by that rule with respect to testimony before the Board. A copy of the rule and the relevant form are attached as Schedules 'A' and 'B' hereto.

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14.   **Entire Agreement**

This Retainer Agreement, together with all Schedules attached hereto and any agreements and other documents to be delivered pursuant to this Retainer Agreement, constitute the complete agreement between Torys and the Consultant or their respective agents with respect to the subject matter hereof and supersedes any and all prior agreements and understandings. This Retainer Agreement may be amended only in a writing that refers to this Retainer Agreement and is signed by both parties.

Sincerely,

TORYS LLP

Charles Keizer
Partner

Agreed and Accepted by:

ScottMadden Management Consultants

By: _____

    Name: Marc Miller
    Title: Partner

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SCHEDULE 'A'

Rule 13A of the Board's Rules of Practice and Procedure

13A. Expert Evidence

13A.01 A party may engage, and two or more parties may jointly engage, one or more experts to give evidence in a proceeding on issues that are relevant to the expert's area of expertise.

13A.02 An expert shall assist the Board impartially by giving evidence that is fair and objective.

13A.03 An expert's evidence shall, at a minimum, include the following:

(a) the expert's name, business name and address, and general area of expertise;

(b) the expert's qualifications, including the expert's relevant educational and professional experience in respect of each issue in the proceeding to which the expert's evidence relates;

(c) the instructions provided to the expert in relation to the proceeding and, where applicable, to each issue in the proceeding to which the expert's evidence relates;

(d) the specific information upon which the expert's evidence is based, including a description of any factual assumptions made and research conducted, and a list of the documents relied on by the expert in preparing the evidence;

(e) in the case of evidence that is provided in response to another expert's evidence, a summary of the points of agreement and disagreement with the other expert's evidence; and

(f) an acknowledgement of the expert's duty to the Board in **Form A** to these Rules, signed by the expert.

13A.04 In a proceeding where two or more parties have engaged experts, the Board may require two or more of the experts to:

(a) in advance of the hearing, confer with each other for the purposes of, among others, narrowing issues, identifying the points on which their views differ and are in agreement, and preparing a joint written statement to be admissible as evidence at the hearing; and

(b) at the hearing, appear together as a concurrent expert panel for the purposes of, among others, answering questions from the Board and others as permitted by the Board, and providing comments on the views of another expert on the same panel.

13A.05 The activities referred to in **Rule 13A.04** shall be conducted in accordance with such directions as may be given by the Board, including as to:

(a) scope and timing;

(b) the involvement of any expert engaged by the Board;

(c) the costs associated with the conduct of the activities;

(d) the attendance or non-attendance of counsel for the parties, or of other persons, in respect of the activities referred to in paragraph (a) of **Rule 13A.04**; and

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(e) any issues in relation to confidentiality.

13A.06 A party that engages an expert shall ensure that the expert is made aware of, and has agreed to accept, the responsibilities that are or may be imposed on the expert as set out in this **Rule 13A** and **Form A**.

SCHEDULE 'B'

FORM A

Proceeding: ....

ACKNOWLEDGMENT OF EXPERT'S DUTY

1. My name is ....(*name*). I live at .... (*city*), in the .... (*province/state*) of ....

2. I have been engaged by or on behalf of................................. (*name of party/parties)* to provide evidence in relation to the above-noted proceeding before the Ontario Energy Board.

3. I acknowledge that it is my duty to provide evidence in relation to this proceeding as follows:

    (a) to provide opinion evidence that is fair, objective and non-partisan;
    (b) to provide opinion evidence that is related only to matters that are within my area of expertise; and
    (c) to provide such additional assistance as the Board may reasonably require, to determine a matter in issue.

4. I acknowledge that the duty referred to above prevails over any obligation which I may owe to any party by whom or on whose behalf I am engaged.

Date ....

_____
Signature

TORYS
LLP

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Box 270, TD South Tower
Toronto, Ontario M5K 1N2 Canada
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Charles Keizer
ckeizer@torys.com
P. 416-865-7510

BY EMAIL

CONFIDENTIAL — PRIVILEGED

October 1, 2024

ScottMadden, Inc.
3495 Piedmont Road, NE
Building Ten, Suite 805
Atlanta, GA 30305-8800

Attention: Marc Miller, Partner

Re: Retainer Letter Agreement – Ontario Power Generation – Total Generating Cost Normalization for Strategic Hiring in Nuclear

Dear Mr. Miller,

We represent Ontario Power Generation ("OPG") in connection with payment amount and other proceedings (collectively, "Proceedings") before the Ontario Energy Board (the "Board").

We confirm that, on behalf of and to assist us in providing legal advice to OPG in connection with certain Proceedings, Torys LLP ("Torys") has engaged ScottMadden, Inc. (the "Consultant" or "you") effective as of the date hereof ("Effective Date") to provide consulting services as described in this letter. By signing back a copy of this letter, the Consultant agrees that this letter contains the agreed-upon terms and conditions of its retainer with Torys effective on the Effective Date, subject to amendment by written agreement between the parties (the "Retainer Agreement").

1.   No Conflict

The Consultant does not have any conflict of interest or other constraints on its ability to provide expert advice in connection with this Retainer Agreement. You confirm that you are free to provide your services to Torys in connection with Torys' representation of OPG in the Proceedings. You agree that during this engagement you will not provide, directly or indirectly, any services to any other party in connection with the matters at issue in the Proceedings.

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2.   **Consultant Expertise**

The Consultant has been selected to provide consulting services to Torys in connection with the Proceedings, namely by undertaking an independent review of nuclear cost performance benchmarking. The sponsors of the work of the Consultant and the persons who have the relevant expertise will be Marc Miller, one of your senior consultants as he determines, your benchmarking manager and staff from your research organization as needed (the "Sponsors").

3.   **Scope of Services and Work Product**

The Consultant will:

(a)   Conduct a new, holistic study of nuclear cost performance by (i) developing a complete and current data set for analysis and benchmarking, (ii) finalizing metrics to assess cost performance; and (iii) determining cost metric normalizations and peer group changes to account for non-controllable factors and facilitate more reasonable benchmark comparisons (the "Study");

(b)   if requested by Torys, produce a report detailing the Study's methodology, analysis performed and the ensuing findings and recommendations (the "Report"), which may be filed with the Board in the Proceedings; and

(c)   if requested by Torys, provide support during the hearing of the Proceedings and testify before the Board in the Proceedings, in connection with the scope of the services provided hereunder ("Application Support" and, together with the Study and the Report, the "Services").

Assuming an October 1, 2024 start date, the Study will be completed by December 10, 2024 and the Report, if requested, will be completed by January 6, 2025.

4.   **Fees and Invoices**

The Consultant acknowledges that the price for the Consultant to perform the Study and to deliver a written Report, if requested, shall not exceed ▇▇▇▇▇▇▇▇ (not including HST) based on actual time spent by the team working to provide the Services, plus travel and living expenses which are billed as incurred with no mark-up, and administrative support costs (billed at 1% of professional fees), without prior written approval from Torys.

The Consultant's fee for its Services (including Application Support, if requested by Torys) shall be charged at the following hourly rates:

Partner	▇	Associate	▇
Director	▇	Benchmarking Manager	▇
Manager	▇	Senior Analyst	▇
Director of Research	▇	Survey Manager	▇
Clean Tech Manager	▇	Analyst/Research Analyst	▇
Senior Associate	▇		

Any disbursements for additional incidentals incurred by the Consultant in relation to this Retainer Agreement must be pre-approved by Torys or OPG in writing. Torys reserves the right to deduct

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any applicable non-resident withholding taxes from any amounts owing to the Consultant under this Retainer Agreement and remit such amounts to the applicable taxation authority.

The Consultant shall direct all invoices relating to Services performed by it under this Retainer Agreement to Torys, to the attention of:

> Charles Keizer
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> 79 Wellington St. W., 30th Floor
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> ckeizer@torys.com

with a copy to OPG, to the attention of:

> Peter Cuff
> Assistant General Counsel, Law Division
> Ontario Power Generation
> 700 University Avenue, H18 E27.1
> Toronto, ON M5G 1X6
> peter.cuff@opg.com

Invoices shall include at least the following information:

(a) identification of the billing period to which the account relates;

(b) an itemized summary of the services that have been undertaken by you, including a brief description thereof, the date on which the services were rendered, the time spent on the services, the individual who performed the services, and the billing rate of such individual; and

(c) an itemized and brief description of all expenses incurred during the billing period, with copies of supporting invoices.

Torys will send your invoice to OPG for its approval and if OPG does not approve your invoice, Torys will send it back to you for revision. Once OPG approves the invoice, Torys will submit the invoice to OPG's payment system. OPG pays invoices once per month (on the 25th of each month) and, for payment to be made on the 25th of a particular month, the invoice must have been approved in OPG's payment system by the 25th of the prior month. Once Torys receives the payment from OPG, Torys will send payment to you.

5.   Confidentiality

All work performed by the Consultant in connection with this Retainer Agreement, including all findings, opinions and conclusions the Consultant reaches in relation to this Retainer Agreement, and any communications relating thereto, are strictly privileged and confidential and shall not be disclosed to any other person or party without the prior written consent of Torys or OPG. The Consultant agrees to designate all written communications and material accordingly. The Consultant further agrees to notify Torys in the event that the Consultant receives a request to disclose information relating to this matter, and agrees to cooperate with Torys, to the fullest

extent permitted by law, to prevent or limit the disclosure of such material or otherwise preserve the privileged and confidential status of such material.

The Consultant agrees to hold in confidence: (a) all information provided to the Consultant, and (b) the Consultant's opinions to Torys and to OPG as they relate to the information, whether the information or opinions are documentary or oral (collectively, the "Confidential Information"). The Consultant will not disclose the Confidential Information to any person unless Torys or OPG authorizes you in writing to do so. All documents given to the Consultant in connection with this Retainer Agreement remain the property of Torys or of OPG, and are held in trust by the Consultant as agent. The Consultant agrees to return these documents on request. During the engagement, the Confidential Information shall be segregated from other OPG data (including on electronic information systems) and shall not be accessible to individuals other than the Consultant, Torys, and OPG employees requiring access).

The Consultant will not refer to Torys or to OPG, directly or indirectly, in connection with the promotion of its services, without obtaining the prior written consent of Torys or OPG, as the case may be.

6.   **Intellectual Property**

Nothing in this Retainer Agreement shall be deemed to transfer, license, assign, permit the use of, or otherwise convey an interest in whole or in part to the Consultant of any intellectual property belonging to OPG or any of its representatives or any third party whose intellectual property is in OPG's custody or control, and the use by the Consultant of any such intellectual property shall be subject to the prior written approval of OPG.

Torys and OPG shall at all times have full rights and title to all works prepared, generated or created by the Consultant pursuant to this Retainer Agreement, including without limitation any reports, presentations, status updates, or other documents created by the Consultant, and any related works, modifications or additions thereto (the "Work Product"), and may at all times take possession of or use any completed or partially completed Work Product, notwithstanding any provision, express or implied, to the contrary. Without limiting the generality of the foregoing, OPG shall own all intellectual property rights in all Work Product, and the Consultant hereby waives and assigns to OPG any such rights, and agrees to give OPG and its representatives all assistance as may be reasonably required to perfect such rights including, without limitation, obtaining waiver of moral rights from any of the Consultant's employees, partners or other representatives.

Anything contained in this agreement to the contrary notwithstanding, nothing in this Retainer Agreement shall prevent Consultant from utilizing any general know-how, ideas, techniques, concepts, methods, processes, or other knowledge applied in performing the Services, on behalf of itself or its future customers. Consultant may (i) perform the same or similar services for others, and (ii) retain one copy of deliverables produced in connection with the Services hereunder for the sole purpose of documenting the conduct of its work and its exercise of due professional care in connection with the Services, provided that any of OPG's confidential information is treated in accordance with the confidentiality requirements of this Retainer Agreement.

7.   **Controlled Nuclear Information**

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The Consultant has been made aware of certain Canadian federal requirements relating to the import and export of controlled nuclear information, and recognizes that it is an offence for any person to export controlled nuclear information from Canada without an export permit issued for the purpose by the Canadian Nuclear Safety Commission. The Consultant agrees not to remove or cause to be removed from Canada any controlled nuclear information during the performance of the Services, and will promptly raise the issue with OPG where the Consultant is in doubt as to whether information to be removed from Canada as part of the Services may be – or contain – controlled nuclear information.

8. **Termination**

Torys may terminate this Retainer Agreement at any time on written notice to the Consultant. Torys will pay, or will cause OPG to pay, for work performed up to the date of the notice of termination. Upon the termination or expiration of this Retainer Agreement, the Consultant shall return to Torys and delete any and all electronic copies the Consultant may have of all documents and materials in its possession relating to the Services or this Retainer Agreement, including all Confidential Information (defined above) and Work Product, whether completed or not.

9. **Liability and Indemnification**

The Consultant shall be liable for and shall indemnify and hold harmless OPG and Torys from all claims, demands, actions, penalties, damages, losses, judgments and settlements, liabilities, costs, expenses, including legal fees and other related costs and expenses arising out of, related to, or incident to, the Consultant or any of its representatives' performance of the Services under this Retainer Agreement, including, without limitation:

a) any breach, violation or non-performance by the Consultant or any of its representatives of any terms, conditions, warranties, obligations or covenants contained in this Retainer Agreement;

b) any breach or violation by the Consultant or any of its representatives of any applicable laws; and

c) any actions, omissions, negligence or wilful misconduct of the Consultant or any of its representatives.

10. **Intellectual Property Protection**

The Consultant expressly warrants that the manufacture, delivery, sale or use of the Consultant's Services will not infringe any Canadian or foreign patents, trademarks, copyrights, industrial design or other intellectual property rights and the Consultant shall indemnify and save OPG harmless from all claims, judgments and decrees that may be entered against OPG or its representatives and against all damage, liability, costs and expenses (including legal fees and other attendant costs and expenses) OPG incurs by reason of any infringement or claim thereof.

11. **Limitation of Liability**

Except for breach of confidentiality obligations, gross negligence, wilful misconduct, fraud, breach of applicable laws, breach of privacy laws, and the Consultant's obligation to indemnify under section 10 (Intellectual Property Protection), the Consultant's total liability for any claim arising

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out of the performance of the Services, regardless of the form of claim, will in no event exceed total fees paid to Consultant hereunder and under no circumstances will either party be liable for any damages in respect of any incidental, punitive, special, indirect or consequential loss, even if that party had been advised of the possibility of such damages including, but not limited to, loss of profits, loss of revenues, failure to realize expected savings, loss of data, loss of business opportunity, or similar losses of any kind.

12. **Insurance**

   (a) Unless otherwise specified in this Retainer Agreement, the Consultant shall, during the term of this Retainer Agreement, and at its own expense, maintain and keep in full force and effect:

      i. commercial general liability insurance on an occurrence basis having a minimum inclusive coverage limit, including personal injury and property damage, of not less than one million dollars ($1,000,000.00) per occurrence, which shall be extended to cover contractual liability, products and completed operations liability, owners/contractors protective liability and must also contain a cross liability clause and a severability of interest clause, and must name OPG and its affiliates as additional insureds; and

      ii. errors and omissions insurance (professional liability) in the amount of not less than two million dollars ($2,000,000.00).

   (b) All insurance coverages and limits required to be maintained by the Consultant shall be primary to any insurance maintained by OPG, which shall be excess and non-contributory. Prior to the commencement of the delivery of the Services, the Consultant shall deliver to OPG a certificate of insurance which evidences the Consultant's compliance with this Section, including the provision of a thirty (30) day prior written notice of cancellation, non-renewal or adverse material change, to OPG. The Consultant agrees that the insurance described herein does in no way limit the Consultant's liability pursuant to the indemnity provisions of this Retainer Agreement.

13. **Independence**

By entering into this Retainer Agreement, the Consultant acknowledges and agrees that the Sponsors have received a copy of Rule 13A of the Board's *Rules of Practice and Procedure* concerning expert evidence, and agree to accept the responsibilities that are or may be imposed on them by that rule with respect to testimony before the Board. A copy of the rule and the relevant form are attached as Schedules 'A' and 'B' hereto.

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14.   **Entire Agreement**

This Retainer Agreement, together with all Schedules attached hereto and any agreements and other documents to be delivered pursuant to this Retainer Agreement, constitute the complete agreement between Torys and the Consultant or their respective agents with respect to the subject matter hereof and supersedes any and all prior agreements and understandings. This Retainer Agreement may be amended only in a writing that refers to this Retainer Agreement and is signed by both parties.

Sincerely,

TORYS LLP

Charles Keizer
Partner

Agreed and Accepted by:

ScottMadden, Inc.

By: _____

Name: Logan Toms
Title: Partner, Finance and Risk

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SCHEDULE 'A'

Rule 13A of the Board's Rules of Practice and Procedure

13A. Expert Evidence

13A.01 A party may engage, and two or more parties may jointly engage, one or more experts to give evidence in a proceeding on issues that are relevant to the expert's area of expertise.

13A.02 An expert shall assist the Board impartially by giving evidence that is fair and objective.

13A.03 An expert's evidence shall, at a minimum, include the following:

(a) the expert's name, business name and address, and general area of expertise;

(b) the expert's qualifications, including the expert's relevant educational and professional experience in respect of each issue in the proceeding to which the expert's evidence relates;

(c) the instructions provided to the expert in relation to the proceeding and, where applicable, to each issue in the proceeding to which the expert's evidence relates;

(d) the specific information upon which the expert's evidence is based, including a description of any factual assumptions made and research conducted, and a list of the documents relied on by the expert in preparing the evidence;

(e) in the case of evidence that is provided in response to another expert's evidence, a summary of the points of agreement and disagreement with the other expert's evidence; and

(f) an acknowledgement of the expert's duty to the Board in **Form A** to these Rules, signed by the expert.

13A.04 In a proceeding where two or more parties have engaged experts, the Board may require two or more of the experts to:

(a) in advance of the hearing, confer with each other for the purposes of, among others, narrowing issues, identifying the points on which their views differ and are in agreement, and preparing a joint written statement to be admissible as evidence at the hearing; and

(b) at the hearing, appear together as a concurrent expert panel for the purposes of, among others, answering questions from the Board and others as permitted by the Board, and providing comments on the views of another expert on the same panel.

13A.05 The activities referred to in **Rule 13A.04** shall be conducted in accordance with such directions as may be given by the Board, including as to:

(a) scope and timing;

(b) the involvement of any expert engaged by the Board;

(c) the costs associated with the conduct of the activities;

(d) the attendance or non-attendance of counsel for the parties, or of other persons, in respect of the activities referred to in paragraph (a) of **Rule 13A.04**; and

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(e) any issues in relation to confidentiality.

13A.06 A party that engages an expert shall ensure that the expert is made aware of, and has agreed to accept, the responsibilities that are or may be imposed on the expert as set out in this **Rule 13A** and **Form A**.

<u>SCHEDULE 'B'</u>

FORM A

Proceeding: ....

ACKNOWLEDGMENT OF EXPERT'S DUTY

1.　　My name is ....(*name)*. I live at .... (*city)*, in

　　　the .... (*province/state*) of ....

2.　　I have been engaged by or on behalf of................................. (*name of*

　　　party/parties) to provide evidence in relation to the above-noted proceeding

　　　before the Ontario Energy Board.

3.　　I acknowledge that it is my duty to provide evidence in relation to this proceeding

　　　as follows:

　　　(a) to provide opinion evidence that is fair, objective and non-partisan;
　　　(b) to provide opinion evidence that is related only to matters that are within my
　　　　　　area of expertise; and
　　　(c) to provide such additional assistance as the Board may reasonably require, to
　　　　　　determine a matter in issue.

4.　　I acknowledge that the duty referred to above prevails over any obligation which I

　　　may owe to any party by whom or on whose behalf I am engaged.

Date...

_____
Signature

50886261.1

TORYS LLP

BY EMAIL

CONFIDENTIAL — PRIVILEGED

February 13, 2025

Brad Jones
Senior Vice President of Revenue, Indeavor
834 E. Washington Ave Suite 257
Madison, WI 53703

Attention: Brad Jones, Senior Vice President of Revenue

Re: Retainer Letter Agreement – Ontario Power Generation – Nuclear Benchmarking

Dear Mr. Jones,

We represent Ontario Power Generation ("OPG") in connection with payment amount and other proceedings (collectively, "Proceedings") before the Ontario Energy Board (the "Board").

We confirm that, on behalf of and to assist us in providing legal advice to OPG in connection with certain Proceedings, Torys LLP ("Torys") has engaged Indeavor (the "Consultant" or "you") effective as of the date hereof ("Effective Date") to provide consulting services as described in this letter. By signing back a copy of this letter, the Consultant agrees that this letter contains the agreed-upon terms and conditions of its retainer with Torys effective on the Effective Date, subject to amendment by written agreement between the parties (the "Retainer Agreement").

1.   **No Conflict**

The Consultant does not have any conflict of interest or other constraints on its ability to provide expert advice in connection with this Retainer Agreement. You confirm that you are free to provide your services to Torys in connection with Torys' representation of OPG in the Proceedings. You agree that during this engagement you will not provide, directly or indirectly, any services to any other party in connection with the matters at issue in the Proceedings.

2.   **Consultant Expertise**

The Consultant has been selected to provide consulting services to Torys in connection with the Proceedings, namely by undertaking an independent review of nuclear staffing benchmarking. The sponsors of the work of the Consultant and the persons who have the relevant expertise will be Dan Scholz, Lakshya Gupta, Andrew Mering, Tim Lines, and staff from your research organization as needed (the "Sponsors").

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3. Scope of Services and Work Product

The Consultant will:

    (a)   Analyze OPG's nuclear staffing levels by comparing them to industry benchmarks (the "Study");

    (b)   if requested by Torys, produce a report detailing the Study's methodology, analysis performed, and any findings and recommendations (the "Report"), which may be filed with the Board in the Proceedings; and

    (c)   if requested by Torys, provide support during the hearing of the Proceedings and testify before the Board in the Proceedings, in connection with the scope of the services provided hereunder ("Application Support" and, together with the Study and the Report, the "Services").

Assuming a March 31, 2025 start date, the Consultant will undertake reasonable efforts to complete the Study by May 15, 2025 and to complete the Report, if requested, by May 30, 2025.

4. Fees and Invoices

The Consultant acknowledges that the price for the Consultant to perform the Study and to deliver a written Report, if requested, shall not exceed ███████████ (not including HST) based on actual time spent by the team working to provide the Services, plus travel and living expenses which are billed as incurred with no mark-up, and administrative support costs (billed at 1% of professional fees), without prior written approval from Torys.

The Consultant's fee for its Services shall be charged in accordance as follows:

Services (per section 3)	Fees
Study	███████ USD
Report	███████ USD
Application Support	Hourly Rate (as outlined in the table below)

Two separate invoices will be issued for the Study. The first invoice for the ███████████ will be issued after the Consultant has collected all the data for the Study, and the second invoice ███████████ will be issued after the Consultant has analyzed all the data for the Study.

Name	Title/Role	Location	Hourly Rate (USD)
Dan Scholz	Project Manager	Chattanooga, TN	███████
Lakshya Gupta	Labor Expert	Long Beach, CA	
Andrew Mering	Nuclear Ops Expert	Madison, WI	
Tim Lines	Analyst	Minneapolis, MN	
Name	**Title/Role**	**Location**	**Hourly Rate (USD)**

Any disbursements for additional incidentals incurred by the Consultant in relation to this Retainer Agreement must be pre-approved by Torys or OPG in writing. Torys reserves the right to deduct any applicable non-resident withholding taxes from any amounts owing to the Consultant under this Retainer Agreement and remit such amounts to the applicable taxation authority.

The Consultant shall direct all invoices relating to Services performed by it under this Retainer Agreement to Torys, to the attention of:

> Charles Keizer
> Torys LLP
> 79 Wellington St. W., 30th Floor
> Box 270, TD South Tower
> Toronto, Ontario M5K 1N2
> ckeizer@torys.com

with a copy to OPG, to the attention of:

> Peter Cuff
> Assistant General Counsel, Law Division
> Ontario Power Generation
> 700 University Avenue, H18 E27.1
> Toronto, ON M5G 1X6
> peter.cuff@opg.com

Invoices shall include at least the following information:

(a) identification of the billing period to which the account relates;

(b) an itemized summary of the services that have been undertaken by you, including a brief description thereof, the date on which the services were rendered, the time spent on the services, the individual who performed the services, and the billing rate of such individual; and

(c) an itemized and brief description of all expenses incurred during the billing period, with copies of supporting invoices.

Torys will send your invoice to OPG for its approval and if OPG does not approve your invoice, Torys will send it back to you for revision. Once OPG approves the invoice, Torys will submit the invoice to OPG's payment system. OPG pays invoices once per month (on the 25th of each month) and, for payment to be made on the 25th of a particular month, the invoice must have been approved in OPG's payment system by the 25th of the prior month. Once Torys receives the payment from OPG, Torys will send payment to you.

5.   Confidentiality

All work performed by the Consultant in connection with this Retainer Agreement, including all findings, opinions and conclusions the Consultant reaches in relation to this Retainer Agreement, and any communications relating thereto, are strictly privileged and confidential and shall not be disclosed to any other person or party without the prior written consent of Torys or OPG. The Consultant agrees to designate all written communications and material accordingly. The Consultant further agrees to notify Torys in the event that the Consultant receives a request to disclose information relating to this matter, and agrees to cooperate with Torys, to the fullest extent permitted by law, to prevent or limit the disclosure of such material or otherwise preserve the privileged and confidential status of such material.

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The Consultant agrees to hold in confidence: (a) all information provided to the Consultant, and (b) the Consultant's opinions to Torys and to OPG as they relate to the information, whether the information or opinions are documentary or oral (collectively, the "Confidential Information"). The Consultant will not disclose the Confidential Information to any person unless Torys or OPG authorizes you in writing to do so. All documents given to the Consultant in connection with this Retainer Agreement remain the property of Torys or of OPG, and are held in trust by the Consultant as agent. The Consultant agrees to return these documents on request. During the engagement, the Confidential Information shall be segregated from other OPG data (including on electronic information systems) and shall not be accessible to individuals other than the Consultant, Torys, and OPG employees requiring access).

The Consultant will not refer to Torys or to OPG, directly or indirectly, in connection with the promotion of its services, without obtaining the prior written consent of Torys or OPG, as the case may be.

6.   **Intellectual Property**

Nothing in this Retainer Agreement shall be deemed to transfer, license, assign, permit the use of, or otherwise convey an interest in whole or in part to the Consultant of any intellectual property belonging to OPG or any of its representatives or any third party whose intellectual property is in OPG's custody or control, and the use by the Consultant of any such intellectual property shall be subject to the prior written approval of OPG.

Torys and OPG shall at all times have full rights and title to all works prepared, generated or created by the Consultant pursuant to this Retainer Agreement, including without limitation any reports, presentations, status updates, or other documents created by the Consultant, and any related works, modifications or additions thereto (the "Work Product"), and may at all times take possession of or use any completed or partially completed Work Product, notwithstanding any provision, express or implied, to the contrary. Without limiting the generality of the foregoing, OPG shall own all intellectual property rights in all Work Product, and the Consultant hereby waives and assigns to OPG any such rights, and agrees to give OPG and its representatives all assistance as may be reasonably required to perfect such rights including, without limitation, obtaining waiver of moral rights from any of the Consultant's employees, partners or other representatives.

Anything contained in this agreement to the contrary notwithstanding, nothing in this Retainer Agreement shall prevent Consultant from utilizing any general know-how, ideas, techniques, concepts, methods, processes, or other knowledge applied in performing the Services, on behalf of itself or its future customers. Consultant may (i) perform the same or similar services for others, and (ii) retain one copy of deliverables produced in connection with the Services hereunder for the sole purpose of documenting the conduct of its work and its exercise of due professional care in connection with the Services, provided that any of OPG's confidential information is treated in accordance with the confidentiality requirements of this Retainer Agreement.

7.   **Intellectual Property Protection**

The Consultant expressly warrants that the manufacture, delivery, sale or use of the Consultant's Services will not infringe any Canadian or foreign patents, trademarks, copyrights, industrial design or other intellectual property rights and the Consultant shall indemnify and save OPG harmless from all claims, judgments and decrees that may be entered against OPG or its

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representatives and against all damage, liability, costs and expenses (including legal fees and other attendant costs and expenses) OPG incurs by reason of any infringement or claim thereof.

8. **Controlled Nuclear Information**

The Consultant has been made aware of certain Canadian federal requirements relating to the import and export of controlled nuclear information, and recognizes that it is an offence for any person to export controlled nuclear information from Canada without an export permit issued for the purpose by the Canadian Nuclear Safety Commission. The Consultant agrees not to remove or cause to be removed from Canada any controlled nuclear information during the performance of the Services, and will promptly raise the issue with OPG where the Consultant is in doubt as to whether information to be removed from Canada as part of the Services may be – or contain – controlled nuclear information.

9. **Termination**

Torys may terminate this Retainer Agreement at any time on written notice to the Consultant. Torys will pay, or will cause OPG to pay, for work performed up to the date of the notice of termination. Upon the termination or expiration of this Retainer Agreement, the Consultant shall return to Torys and delete any and all electronic copies the Consultant may have of all documents and materials in its possession relating to the Services or this Retainer Agreement, including all Confidential Information (defined above) and Work Product, whether completed or not.

10. **Liability and Indemnification**

The Consultant shall be liable for and shall indemnify and hold harmless OPG and Torys from all claims, demands, actions, penalties, damages, losses, judgments and settlements, liabilities, costs, expenses, including legal fees and other related costs and expenses arising out of, related to, or incident to, the Consultant or any of its representatives' performance of the Services under this Retainer Agreement, including, without limitation:

a) any breach, violation or non-performance by the Consultant or any of its representatives of any terms, conditions, warranties, obligations or covenants contained in this Retainer Agreement;

b) any breach or violation by the Consultant or any of its representatives of any applicable laws; and

c) any actions, omissions, negligence or wilful misconduct of the Consultant or any of its representatives.

11. **Limitation of Liability**

Except for breach of confidentiality obligations, gross negligence, wilful misconduct, fraud, breach of applicable laws, breach of privacy laws, and the Consultant's obligation to indemnify under section 10 (Intellectual Property Protection), the Consultant's total liability for any claim arising out of the performance of the Services, regardless of the form of claim, will in no event exceed total fees paid to Consultant hereunder and under no circumstances will either party be liable for any damages in respect of any incidental, punitive, special, indirect or consequential loss, even if that party had been advised of the possibility of such damages including, but not limited to, loss

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of profits, loss of revenues, failure to realize expected savings, loss of data, loss of business opportunity, or similar losses of any kind.

12. **Insurance**

(a) Unless otherwise specified in this Retainer Agreement, the Consultant shall, during the term of this Retainer Agreement, and at its own expense, maintain and keep in full force and effect:

   i. commercial general liability insurance on an occurrence basis having a minimum inclusive coverage limit, including personal injury and property damage, of not less than one million dollars ($1,000,000.00) per occurrence, which shall be extended to cover contractual liability, products and completed operations liability, owners/contractors protective liability and must also contain a cross liability clause and a severability of interest clause, and must name OPG and its affiliates as additional insureds; and

   ii. errors and omissions insurance (professional liability) in the amount of not less than two million dollars ($2,000,000.00).

(b) All insurance coverages and limits required to be maintained by the Consultant shall be primary to any insurance maintained by OPG, which shall be excess and non-contributory. Prior to the commencement of the delivery of the Services, the Consultant shall deliver to OPG a certificate of insurance which evidences the Consultant's compliance with this Section, including the provision of a thirty (30) day prior written notice of cancellation, non-renewal or adverse material change, to OPG. The Consultant agrees that the insurance described herein does in no way limit the Consultant's liability pursuant to the indemnity provisions of this Retainer Agreement.

13. **Independence**

By entering into this Retainer Agreement, the Consultant acknowledges and agrees that the Sponsors have received a copy of Rule 13A of the Board's *Rules of Practice and Procedure* concerning expert evidence, and agree to accept the responsibilities that are or may be imposed on them by that rule with respect to testimony before the Board. A copy of the rule and the relevant form are attached as Schedules 'A' and 'B' hereto.

14. **Responsibility Statement**

The Consultant agrees that the Services provided for herein will be performed in a timely, competent, professional manner in accordance with recognized professional consulting standards for similar services to be performed by a leading consulting advisory firm, and that adequate qualified personnel will be assigned for that purpose. If, during the performance of the Services or prior to the Board's issuance of final, non-appealable order(s) disposing of all relevant relief sought in the Application, such Services prove to be faulty or defective by reason of a failure to meet such standards, the Consultant agrees that upon prompt written notification from Torys, such faulty or defective portion of the Services will be redone at no cost to Torys or OPG, up to a maximum amount equivalent to the cost of the Services rendered under this Retainer Agreement, or, at Torys' request, the Consultant will refund an amount equal to the amount paid for the faulty or defective portion of the Services.

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15.   **Entire Agreement**

This Retainer Agreement, together with all Schedules attached hereto and any agreements and other documents to be delivered pursuant to this Retainer Agreement, constitute the complete agreement between Torys and the Consultant or their respective agents with respect to the subject matter hereof and supersedes any and all prior agreements and understandings. This Retainer Agreement may be amended only in a writing that refers to this Retainer Agreement and is signed by both parties.

16.   **Governing Law**

This Retainer Agreement shall be construed and otherwise governed pursuant to the laws of the Province of Ontario and the federal laws of Canada applicable therein.

Sincerely,

TORYS LLP

Charles Keizer
Partner

Agreed and Accepted by:

Indeavor

By:

Bradley Jones

box SIGN   187KXVW4-4Q3Q7LLX
Name: Brad Jones
Title: SVP of Revenue, Indeavor

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SCHEDULE 'A'

Rule 13A of the Board's Rules of Practice and Procedure

13A. Expert Evidence

13A.01 Where a party intends to engage one or more experts to give evidence in a proceeding on issues that are relevant to the expert's area of expertise, Rule 13 applies to that evidence.

13A.02 An expert shall assist the OEB impartially by giving evidence that is fair and objective.

13A.03 An expert's evidence shall, at a minimum, include the following:

(a) the expert's name, business name and address, and general area of expertise;

(b) the expert's qualifications, including the expert's relevant educational and professional experience in respect of each issue in the proceeding to which the expert's evidence relates;

(c) the instructions provided to the expert in relation to the proceeding and, where applicable, to each issue in the proceeding to which the expert's evidence relates;

(d) the specific information upon which the expert's evidence is based, including a description of any factual assumptions made and research conducted, and a list of the documents relied on by the expert in preparing the evidence;

(e) in the case of evidence that is provided in response to another expert's evidence, a summary of the points of agreement and disagreement with the other expert's evidence; and

(f) an acknowledgement of the expert's duty to the OEB in **Form A** to these Rules, signed by the expert.

13A.04 In a proceeding where two or more parties have engaged experts, the OEB may require two or more of the experts to:

(a) in advance of the hearing, confer with each other for the purposes of, among others, narrowing issues, identifying the points on which their views differ and are in agreement, and preparing a joint written statement to be admissible as evidence at the hearing; and

(b) at the hearing, appear together as a concurrent expert panel for the purposes of, among others, answering questions from the OEB and others as permitted by the OEB, and providing comments on the views of another expert on the same panel.

13A.05 The activities referred to in **Rule 13A.04** shall be conducted in accordance with such directions as may be given by the Board, including as to:

(a) scope and timing;

(b) the involvement of any expert engaged by the OEB;

(c) the costs associated with the conduct of the activities;

(d) the attendance or non-attendance of counsel for the parties, or of other persons, in respect of the activities referred to in paragraph (a) of **Rule 13A.04**; and

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(e) any issues in relation to confidentiality.

13A.06 A party that engages an expert shall ensure that the expert is made aware of, and has agreed to accept, the responsibilities that are or may be imposed on the expert as set out in this **Rule 13A** and **Form A**.

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SCHEDULE 'B'

FORM A

Proceeding: ....

ACKNOWLEDGMENT OF EXPERT'S DUTY

1.   My name is ......Daniel J. Scholz............(*name*). I live at ...Signal Mtn.. (*city*), in

the ....State............. (*province/state*) of ......Tennessee.....

2.   I have been engaged by or on behalf of......Tory's.................... (*name of*

party/parties) to provide evidence in relation to the above-noted proceeding

before the Ontario Energy Board.

3.   I acknowledge that it is my duty to provide evidence in relation to this proceeding

as follows:

(a) to provide opinion evidence that is fair, objective and non-partisan;

(b) to provide opinion evidence that is related only to matters that are within my

area of expertise; and

(c) to provide such additional assistance as the Board may reasonably require, to

determine a matter in issue.

4.   I acknowledge that the duty referred to above prevails over any obligation which I

may owe to any party by whom or on whose behalf I am engaged.

Date ...Apr. 8, 2025.................

Dan Scholz

box SIGN   197PX6ZV-4Q3Q7LLX

Signature

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Numbers may not add due to rounding.

Filed: 2025-12-12
EB-2025-0297
Exhibit F2
Tab 1
Schedule 1
Table 1a

Table 1a
Operating Costs Summary - OPG Nuclear Facilities ($M)

Line No.	Cost Item	2020 Actual	2021 Actual	2022 Actual	2023 Actual	2024 Actual	2025 Budget	2026 Budget	2027 Plan	2028 Plan	2029 Plan	2030 Plan	2031 Plan
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	OM&A:												
1	OPG Nuclear Facilities Base OM&A	1,313.9	1,316.0	1,305.7	1,418.9	1,433.5	1,303.0	1,210.2	840.4	850.7	898.4	916.8	1,225.4
2	OPG Nuclear Facilities Project OM&A	99.5	111.6	89.5	141.1	107.9	75.6	73.3	76.1	82.4	84.0	84.8	83.2
3	OPG Nuclear Facilities Outage OM&A	293.9	382.8	265.0	318.1	358.1	127.0	209.4	223.7	112.7	219.1	121.6	142.2
4	Pickering Cyclical Maintenance OM&A	0.0	0.0	0.0	0.0	0.0	0.0	25.0	168.4	160.9	168.9	169.9	106.6
5	Subtotal OPG Nuclear Facilities OM&A	1,707.3	1,810.4	1,660.2	1,878.1	1,899.5	1,505.6	1,517.8	1,308.6	1,206.7	1,370.4	1,293.2	1,557.4
6	Darlington Refurbishment OM&A	19.0	35.6	22.3	39.0	59.7	10.5	1.8	0.0	0.0	0.0	0.0	0.0
7	Darlington New Nuclear OM&A[1,3]	13.1	95.4	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	DNNP Operational Readiness	0.0	0.0	0.0	1.1	2.3	17.3	0.0	0.0	0.0	0.0	0.0	0.0
9	Other New Nuclear OM&A[2,3]	0.0	0.0	0.0	7.6	15.1	62.1	136.4	0.0	0.0	0.0	0.0	0.0
10	Pickering Refurbishment Feasibility Study[3]	0.0	0.0	0.2	17.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	Pickering Refurbishment OM&A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.3	94.1	84.9	52.7	46.5
12	Allocation of Corporate Costs	352.7	359.7	366.2	406.3	400.8	411.5	416.1	417.5	412.1	432.7	444.7	471.6
13	Allocation of Centrally Held Costs	215.0	209.3	76.3	(18.5)	104.7	(48.1)	(47.2)	(35.4)	(30.8)	(60.1)	(33.3)	(21.6)
14	Asset Service Fees	55.6	65.0	71.1	74.3	77.1	85.6	93.3	72.7	73.9	89.5	99.0	99.4
15	Subtotal Other OM&A	655.3	765.1	538.5	527.6	659.8	538.9	600.3	555.1	549.3	547.0	563.1	596.0
16	**Total OPG Nuclear Facilities OM&A**	2,362.6	2,575.5	2,198.7	2,405.7	2,559.3	2,044.5	2,118.2	1,863.7	1,756.0	1,917.4	1,856.3	2,153.5
17	**OPG Nuclear Facilities Fuel Costs**	234.9	232.0	222.5	218.4	211.8	255.1	239.2	150.9	221.7	223.6	261.2	306.1
	Other Operating Cost Items:												
18	Depreciation and Amortization	448.6	504.8	626.6	685.6	753.7	540.3	617.7	663.3	708.5	730.3	779.8	992.6
19	Income Tax	158.6	(20.2)	81.0	83.5	(59.9)	180.1	(63.3)	(16.6)	(16.6)	(16.6)	(16.6)	(16.6)
20	Property Tax	14.7	13.8	13.7	14.3	14.6	12.2	13.5	14.0	14.2	14.5	14.8	15.0
21	**Total OPG Nuclear Facilities Operating Costs**	3,219.4	3,306.0	3,142.6	3,407.5	3,479.5	3,032.2	2,925.3	2,675.2	2,683.8	2,869.1	2,895.5	3,450.6

Notes:

1 For amounts in 2020 to 2022 refer to EB-2023-0336, Ex. H1-1-1, Table 20, line 2.

2 Actual and budget amounts in the Other New Nuclear OM&A category primarily relate to impact assessment preparation for potential new nuclear generation at OPG strategic sites. No amounts related to new nuclear generation projects is included in the revenue requirement for OPG's nuclear facilities.

3 Refer to Ex. F2-1-1, Section 5.0

Table 1b
Operating Costs Summary - DNNP Facilities ($M)

Line No.	Cost Item	2026 Budget	2027 Plan	2028 Plan	2029 Plan	2030 Plan	2031 Plan
		(a)	(b)	(c)	(d)	(e)	(f)
	OM&A:						
1	**DNNP Facilities Base OM&A**	3.9	4.3	5.0	5.3	34.4	119.0
2	**DNNP Facilities Outage OM&A**	0.0	0.0	0.0	0.0	0.1	48.6
3	**DNNP Operational Readiness**	28.8	45.9	46.3	40.0	40.2	0.0
4	**Subtotal DNNP Facilities OM&A**	32.7	50.2	51.3	45.3	74.7	167.6
5	**Allocation of Corporate Costs**	23.9	30.5	34.8	36.5	42.7	49.8
6	**Allocation of Centrally Held Costs**	(3.7)	(3.7)	(4.1)	(4.0)	4.5	13.2
7	**Asset Service Fees[1]**	6.0	0.9	0.7	5.2	19.7	62.7
8	**Subtotal Other OM&A**	26.3	27.7	31.4	37.6	66.8	125.7
9	**Total OM&A**	58.9	77.9	82.8	82.9	141.5	293.3
10	**Nuclear Fuel Service Fee[2]**	0.0	9.1	13.8	12.7	18.1	49.8
	Other Operating Cost Items:						
11	**Depreciation and Amortization**	0.0	0.0	0.0	0.0	22.6	109.7
12	**Income Tax**	0.0	0.0	0.0	0.0	0.0	0.0
13	**Property Tax**	0.0	0.0	0.0	0.0	0.8	3.7
14	**Total DNNP Facilities Operating Costs**	58.9	87.1	96.6	95.6	183.0	456.6

Notes:
1 Refer to Ex. C1-1-2, Section 4.5
2 Refer to Ex. F3-3-1, Table 1, line 10.

Numbers may not add due to rounding.

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Exhibit F2
Tab 1
Schedule 1
Table 2a

Table 2a (Two Pages)
Staff Summary - Regular and Non-Regular (FTEs) - OPG Nuclear Facilities

Line No.	Group	2020 Actual	2021 Actual	2022 Actual	2023 Actual	2024 Actual	2025 Budget	2026 Budget	2027 Plan	2028 Plan	2029 Plan	2030 Plan	2031 Plan
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	OPG Nuclear Facilities OM&A:												
1	**Regular Staff**	4,379.4	4,038.8	3,652.6	3,793.0	4,096.2	4,278.7	3,967.1	3,100.9	3,083.6	3,100.7	3,102.4	3,714.9
	Non-Regular Staff												
2	Term and Extended Temporary	584.7	766.7	887.0	927.0	599.2	202.2	174.7	0.0	0.0	0.0	0.0	0.0
3	Temporary	766.7	812.6	577.6	582.7	525.5	258.9	322.4	161.0	141.6	195.4	146.2	147.7
4	EPSCA	76.7	94.2	99.3	88.2	100.0	54.2	25.4	22.0	21.6	21.6	21.0	20.0
5	**Total Non-Regular Staff**	1,428.1	1,673.5	1,563.9	1,597.9	1,224.7	515.3	522.6	183.0	163.2	217.0	167.3	167.7
6	**Subtotal OPG Nuclear Facilities OM&A**	5,807.5	5,712.3	5,216.5	5,390.9	5,320.9	4,794.0	4,489.7	3,283.9	3,246.8	3,317.7	3,269.7	3,882.6
	OPG Nuclear Facilities Capital:												
7	**Regular Staff**	221.8	179.3	190.9	202.0	249.7	378.9	440.7	469.0	459.8	459.5	472.0	477.4
	Non-Regular Staff												
8	Term and Extended Temporary	5.2	11.7	20.0	25.7	25.1	29.0	17.0	0.0	0.0	0.0	0.0	0.0
9	Temporary	51.1	32.0	18.8	2.0	7.0	65.6	94.1	59.0	57.5	40.2	38.5	35.5
10	EPSCA	26.0	32.7	45.5	47.1	42.6	43.8	28.2	22.4	17.8	7.8	7.0	7.0
11	**Total Non-Regular Staff**	82.2	76.4	84.3	74.7	74.7	138.4	139.3	81.4	75.3	48.0	45.5	42.5
12	**Subtotal OPG Nuclear Facilities Capital**	304.0	255.6	275.2	276.7	324.3	517.3	580.0	550.4	535.2	507.5	517.5	519.9
	Darlington Refurbishment Program:												
13	**Regular Staff**	432.5	394.0	404.0	446.7	499.9	486.5	55.8	0.0	0.0	0.0	0.0	0.0
	Non-Regular Staff												
14	Term and Extended Temporary	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	Temporary	117.0	83.3	69.7	67.2	69.2	50.8	21.6	0.0	0.0	0.0	0.0	0.0
16	EPSCA	128.6	224.2	252.2	295.1	271.1	188.9	29.3	0.0	0.0	0.0	0.0	0.0
17	**Total Non-Regular Staff**	245.6	307.4	321.9	362.3	340.4	239.7	50.9	0.0	0.0	0.0	0.0	0.0
18	**Subtotal Darlington Refurbishment**	678.2	701.5	725.9	809.0	840.3	726.2	106.7	0.0	0.0	0.0	0.0	0.0
	Pickering Refurbishment Program:												
19	**Regular Staff**	0.0	0.0	0.0	7.6	159.5	835.8	1,177.1	2,299.6	2,323.7	2,350.0	2,309.5	1,670.5
	Non-Regular Staff												
20	Term and Extended Temporary	0.0	0.0	0.0	0.0	0.8	0.0	21.3	7.0	7.0	7.0	0.0	0.0
21	Temporary	0.0	0.0	0.0	0.1	10.3	7.0	128.5	30.7	14.9	14.9	21.9	22.3
22	EPSCA	0.0	0.0	0.0	0.1	3.2	31.0	109.7	350.2	473.4	419.0	335.0	252.9
23	**Total Non-Regular Staff**	0.0	0.0	0.0	0.1	14.3	38.0	259.4	387.9	495.2	440.9	356.9	275.2

24	**Subtotal Pickering Refurbishment Program**	0.0	0.0	0.0	7.8	173.8	873.8	1,436.5	2,687.5	2,819.0	2,790.8	2,666.5	1,945.6
	DNNP Facilities Capital:												
25	**Regular Staff**	0.0	0.0	73.9	107.0	139.7	201.0	0.0	0.0	0.0	0.0	0.0	0.0
	Non-Regular Staff												
26	Temporary	0.0	0.0	5.4	9.1	10.4	18.0	0.0	0.0	0.0	0.0	0.0	0.0
27	EPSCA	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	**Total Non-Regular Staff**	0.0	0.0	5.4	9.3	10.4	18.0	0.0	0.0	0.0	0.0	0.0	0.0
29	**Subtotal DNNP Facilities Capital**	0.0	0.0	79.3	116.3	150.1	219.0	0.0	0.0	0.0	0.0	0.0	0.0
	Darlington & Other New Nuclear OM&A:												
30	**Regular Staff**	5.9	44.3	4.8	21.9	27.2	50.6	95.1	0.0	0.0	0.0	0.0	0.0
	Non-Regular Staff												
31	Temporary	0.6	2.0	2.6	0.6	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	EPSCA	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	**Total Non-Regular Staff**	0.6	2.2	2.7	0.6	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	**Subtotal Darlington & Other New Nuclear**	6.5	46.5	7.5	22.5	28.5	50.6	95.1	0.0	0.0	0.0	0.0	0.0
	Nuclear Provision:												
35	**Regular Staff**	332.4	344.0	359.6	400.5	537.9	938.9	794.7	725.1	696.9	603.9	609.0	610.7
	Non-Regular Staff												
36	Term and Extended Temporary	8.3	16.1	20.2	33.0	31.1	9.0	2.3	0.0	0.0	0.0	0.0	0.0
37	Temporary	45.7	51.3	49.6	48.7	48.1	38.5	42.2	31.0	29.3	24.0	24.0	24.0
38	EPSCA	3.0	4.4	4.1	4.0	10.2	3.3	2.3	2.3	2.2	2.0	2.0	2.0
39	**Total Non-Regular Staff**	57.0	71.9	73.9	85.6	89.4	50.8	46.7	33.3	31.5	26.0	26.0	26.0
40	**Subtotal Nuclear Provision**	389.4	416.0	433.4	486.1	627.3	989.7	841.5	758.4	728.4	629.9	635.0	636.7
	OPG Nuclear Non-Energy Direct:												
41	**Regular Staff**	17.7	20.3	45.1	41.8	40.1	35.5	35.9	39.0	39.0	39.0	39.0	39.0
	Non-Regular Staff												
42	Term and Extended Temporary	0.7	0.4	0.9	2.9	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	Temporary	1.1	0.8	0.6	1.9	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	EPSCA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	**Total Non-Regular Staff**	1.8	1.2	1.5	4.8	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	**Subtotal OPG Nuclear Non-Energy Direct**	19.5	21.5	46.6	46.6	42.1	35.5	35.9	39.0	39.0	39.0	39.0	39.0
47	**Total OPG Nuclear Facilities**	7,205.1	7,153.4	6,784.4	7,155.9	7,507.3	8,206.1	7,585.4	7,319.2	7,368.4	7,284.9	7,127.7	7,023.8

Numbers may not add due to rounding.

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Exhibit F2
Tab 1
Schedule 1
Table 2b

Table 2b
Regular and Non-Regular (FTEs) - DNNP Facilities

Line No.	Group	2026 Budget	2027 Plan	2028 Plan	2029 Plan	2030 Plan	2031 Plan
		(a)	(b)	(c)	(d)	(e)	(f)
	DNNP Facilities OM&A:						
1	**Regular Staff**	89.9	141.6	144.2	121.0	197.2	237.9
	Non-Regular Staff						
2	Term and Extended Temporary	0.0	0.0	0.0	0.0	0.0	0.0
3	Temporary	6.4	3.3	2.4	1.4	3.4	0.6
4	EPSCA	0.0	0.0	0.0	0.0	0.0	0.0
5	**Total Non-Regular Staff**	6.4	3.3	2.4	1.4	3.4	0.6
6	**Subtotal DNNP Facilities OM&A Staff**	96.4	144.9	146.6	122.5	200.6	238.5
	DNNP Facilities Capital:						
7	**Regular Staff**	189.0	215.0	207.5	185.4	55.1	0.0
	Non-Regular Staff						
8	Term and Extended Temporary	0.0	0.0	0.0	0.0	0.0	0.0
9	Temporary	11.0	10.0	9.0	5.7	1.1	0.0
10	EPSCA	0.0	0.0	0.0	0.0	0.0	0.0
11	**Total Non-Regular Staff**	11.0	10.0	9.0	5.7	1.1	0.0
12	**Subtotal DNNP Facilities Capital**	200.0	225.0	216.5	191.1	56.2	0.0
13	**Total DNNP Facilities OM&A and Capital**	296.4	369.9	363.1	313.6	256.8	238.5