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Darlington Refurbishment Program Annual Report

2023 REPORT

AS PER DECISION AND ORDER IN EB-2020-0290

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December 15, 2023

DARLINGTON REFURBISHMENT PROGRAM**INTRODUCTION**

This report provides the status of the Darlington Refurbishment Program, hereafter referred to as the "Program."

Unless otherwise noted, this report includes a summary and a review of the Program performance through September 30, 2023.

This is an annual report to be provided by Ontario Power Generation (OPG) to the Ontario Energy Board (OEB) pursuant to the OEB's decision and order in EB-2020-0290.¹

EXECUTIVE SUMMARY

The Program is a multi-year, multi-phase, mega-project that will enable the Darlington Nuclear Generating Station (Darlington) to continue safe and reliable operation until 2055. The Program includes the replacement of life-limiting critical components, the completion of upgrades to meet applicable regulatory requirements, and the rehabilitation of components at Darlington's four units.

The Release Quality Estimate (RQE) for the four-unit refurbishment is \$12.8 Billion. Under the RQE, the refurbishment of the first unit (Unit 2) was to start in October of 2016 and be returned-to-service in the first quarter of 2020, with the last unit (Unit 4) scheduled to be completed in 2026. The RQE formed the basis of OPG's May 2016 pre-filed evidence in EB-2016-0152. After the development of the RQE, OPG continued detailed planning and preparations and further refined its unit and Program estimates through the Unit 2 Execution Estimate (U2EE) in August 2016, Unit 3 Execution Estimate (U3EE) in August 2020, the Unit 1 Execution Estimate (U1EE) in November 2021 and the Unit 4 Execution Estimate (U4EE) in March 2023. All of which maintain the Program estimate, exclusive of external events such as COVID-19, within the original \$12.8 Billion RQE budget and continue to forecast completion of the Unit 4 refurbishment in 2026. The U3EE formed the basis of OPG's December 2020 pre-filed evidence in EB-2020-0290.¹ OPG measures its performance over the refurbishment of each unit against each unit's execution estimate.

The cost forecast for the overall Darlington Refurbishment Program remains on plan at \$12.8 Billion, excluding the impact of COVID-19. Based on the COVID-19 impacts to date, OPG is forecasting costs of \$130 Million. In addition, OPG is continuing to assess and monitor potential impacts associated with the current extraordinary inflationary environment on the project.

Unit 2 was successfully returned to service on June 4, 2020. Completion of the Unit 2 refurbishment on budget and with a small schedule variance of just over three months, represented a significant achievement in mega-project execution for OPG.

Unit 3 was successfully reconnected to the grid on July 17, 2023, with good quality and safety, within the approved budget, and 169 days ahead of public commitment schedule. Overall, the return to service of Unit 3 represents another significant milestone for the Program with performance improvements exceeding the planned unit over unit efficiencies. Unit 2 and Unit 3 are operating at 100 percent full power.

The U1EE was approved by OPG's Board of Directors in November 2021 in advance of the start of the refurbishment outage on Unit 1, and incorporated additional lessons learned, and strategic improvements based on the Unit 2 and Unit 3 refurbishments. Per the final U1EE, the budget and High Confidence Schedule to complete Unit 1 are \$1,984 Million and 38 months, respectively.

¹ EB-2020-0290, Decision and Order, dated November 15, 2021, Schedule A (OEB Approved Settlement Proposal), Appendix A, p. 1.

Unit 1 refurbishment activities are progressing on schedule and are currently in the third major segment, Reassembly, which involves the installation and reassembly of reactor components, including new feeder tubes and fuel channel assemblies. The third segment is progressing as planned, with the Fuel Channel Installation series targeting completion in the fourth quarter of 2023. Unit 1 is on track to be returned to service in the second quarter of 2025.

Unit 4 is the last of four units at the Darlington Nuclear Generating Station undergoing refurbishment. The final U4EE was approved by OPG's Board of Directors in March 2023. Per the final U4EE, the budget and High Confidence Schedule to complete Unit 4 is \$2,128 Million and 37 months, respectively.

Unit 4 execution commenced on July 19, 2023, shortly after the return to service of Unit 3. Based on Independent Electricity System Operator (IESO) grid stability constraints, the approval for the outage was delayed 17 days. Unit 4 safely and successfully completed the defueling of the reactor in September 2023. The unit is progressing through Disassembly segment, forecasting completion in the third quarter of 2024, and is on track to be returned to service in the third quarter of 2026.

DARLINGTON REFURBISHMENT PROGRAM STATUS

OVERVIEW

Key Program highlights include:

- **SAFETY:** Safety performance continues to be better than the average construction industry performance in Ontario. The Program is approaching 50 million hours worked with only one Lost Time Injury² (in May 2019) since the start of the Program.
- **QUALITY:** The quality management program is used to identify issues during refurbishment execution by focused surveillance of vendor-performed work. Quality of work to date has surpassed nuclear standards, and in most cases is industry leading. There have been no Significant Quality Events (SQEs) recorded on Unit 4, Unit 3, and Unit 1 to date.
- **SCHEDULE:** Unit 3 refurbishment completed, 169 days ahead of public commitment schedule and was reconnected to the grid on July 17, 2023. Unit 3 continues to progress through the close out phase which is to be completed by the third quarter of 2024. Unit 1 refurbishment activities are progressing on plan, and Critical Path is progressing through the Fuel Channel Installation Series. Unit 1 is expected to return to service (RTS) by the second quarter of 2025. Unit 4 execution began on July 19, 2023, and is progressing on plan through disassembly segment. Unit 4 is expected to return to service by the third quarter of 2026.
- **COST:** OPG is continuing to track to the \$12.8 Billion budget excluding impact of COVID-19. Total Program expenditures to date are \$10 Billion. Excluding COVID-19 impacts, life-to-date expenditures as of September 30, 2023 are \$2,228 Million for Unit 3, \$1,242 Million for Unit 1, and \$351 Million for Unit 4.

PROGRESS

The refurbishment of Unit 3 is 100% complete. Following is a status summary, as of September 30, 2023, some key milestones are as follows:

- U3 Bulkhead Removal completed April 15, 2023.
- First criticality achieved on May 22, 2023.
- Low Power testing completed June 19, 2023.
- U3 Turbine Generator Dynamic Commissioning completed on July 3, 2023.
- First Synchronization and Run-up completed July 10, 2023.
- Reconnection to the electrical grid completed on July 17, 2023.
- Return to service completed on July 18, 2023.

The refurbishment of Unit 1 is 70% complete. Following is a status summary, as of September 30, 2023, some key milestones are as follows:

- Unit 1 Feeder Removal completed on November 2, 2022.
- Pressure Tube (PT) Sever and Sever Bellows was completed on December 17, 2022.
- End Fitting Removal completed on January 26, 2023.
- Removal of the Calandria Tube (CT) was completed on April 27, 2023.
- Tube Sheet Bore Cleaning completed on May 23, 2023.
- Bellows Inspection completed on June 3, 2023.

² A Lost Time Injury is a work injury that results in lost days (minimum of one) beyond the date of injury as a direct result of a safety incident.

- Calandria Tube Install Series completed on August 12, 2023.

The refurbishment of Unit 4 is 11% complete. Following is a status summary, as of September 30, 2023, some key milestones are as follows:

- Unit 4 Shutdown began on July 19, 2023.
- Unit 4 Defueling completed on September 4, 2023.
- Crane Maintenance completed on September 7, 2023.
- End Fitting Cap Installation completed on September 15, 2023.

ANNUAL INTEGRATED IMPLEMENTATION PLAN (IIP) COMMITMENT

- All DNRU3 IIPs are complete and closed.
- Overall, 79% (492 of 622) of IIP commitments have been completed to date. There are 61 overall tasks due in 2023 with 21 IIP items remaining and 40 IIP items are closed/complete. The IIP commitments for 2023 are on track to be achieved.

SAFETY

Safety is a top priority for OPG. OPG has one of the lowest injury rates in the Canadian electricity sector³. In order to maintain this safety performance, OPG continues to set challenging targets for its day-to-day operations. At the end of the third quarter of 2023, the Program reported a Total Recordable Injury Frequency (TRIF) of 0.22 against its internal target of 0.40, reflecting six medically treated injuries from Q1 to Q3 2023. OPG sets very challenging targets for all aspects of its operations and the Program. This expectation has resulted in a Program safety performance that is significantly better than the overall construction industry average as illustrated in Table 1.

The Program is approaching over 50 million hours worked with one Lost Time Injury, which occurred in May 2019 with no Lost Time Injuries since then.

OPG employs a variety of leading indicators to ensure that issues are addressed before incidents occur. OPG's practice of proactively tracking events/safety incidents where no injuries occur, but where there is potential for harm, is one example of a leading indicator. OPG carefully logs and reviews each of these incidents and implements corrective actions to reduce the likelihood of future incidents. In addition, the Safe Work Planning Assessment (SWPA) is being piloted to assess the quality of direct controls implemented to address high-energy hazards within safe work plans. The implementation of the SWPA is expected by the first quarter of 2024.

³ Compared to the Infrastructure Health and Safety Association injury rate.

PERFORMANCE METRICS SUMMARY

Table 1 provides a summary of the Program’s Safety Performance and includes OPG and Vendor workers.

Safety Performance Metrics											
			Historical Actuals							Actual	IHSA ³
Category	Measure	OPG Target	2016	2017	2018	2019	2020	2021	2022	2023 (Q3) YTD ²	Ontario Construction Industry 2022
Safety	TRIF (Total Recordable Injury Frequency) ¹	0.40	0.64	0.49	0.39	0.52	0.35	0.25	0.26	0.22	4.24
	Lost Time Injuries	0	0	0	0	1	0	0	0	0	N/A

Notes:

1. TRIF is the average number of fatalities, Lost Time Injuries, medical treatment injuries and restricted work injuries per 200,000 hours worked.
2. Year-to-Date (YTD).
3. IHSA rating is the most current safety rating for the Ontario Construction Industry (current as of 2022 year-end).

CAMPAIGNS, PROGRAMS, AND INITIATIVES

OPG’s safety performance is underpinned by the practice of monitoring low level precursor issues and proactively taking action to reduce the likelihood of serious events occurring. The following are the key safety campaigns, programs, and initiatives that OPG and its vendor partners advanced in 2023:

- **A Fail-Safe Approach to Safety and Human Performance**

This initiative is currently ongoing, it includes a greater emphasis on safe work planning, event learning, recognition for safety-related improvements and the presence of defenses. Fail-Safe involves a strategy team consisting of OPG and vendors who are engaging workers in practices which utilize safety tools and defenses. Fail-Safe aligns with OPG’s strategic direction to proactively approach safety and human performance. It identifies defenses in place to ensure events occur safely with no adverse consequences to people, the plant or equipment. For 2023, there is a re-focus on incorporating Fail Safe concepts in Safe Work Plans (SWP) and Pre-Job Briefs (PJB) with the use of multiple strong defenses/direct controls, and hazard recognition to build capacity. The generation of progressive metrics to capture the presence of Fail-Safe defenses is ongoing.

- **Remote Monitoring**

OPG (including X-Labs) and CanAtom worked to develop a solution to mitigate the risk of heat stress for workers. Monitoring conditions for heat stress and calculating work rest regimens had been done with the Wet Bulb Global Temperature device in the field, which required the personnel performing the testing to be exposed to the conditions. In the Unit 1 vault, OPG has implemented the X-Labs WIFI Gateway wireless transceiver to transmit sensor data to the cloud for remote monitoring. This enables immediate access to current conditions and reduces wait time by providing real time metrics.

- **DataCube – Construction Observations Report**

As of the second quarter of 2023, the DataCube was implemented as a digital tool to capture observations, coaching and actions across all field staff in the Enterprise, including Darlington Refurbishment. The report transforms the way we do work by centralizing information on safety related metrics from the field, identifying trends in real time and making informed decisions to act

on the trends in timely manner. The DataCube has been effective in connecting users by notifying relevant groups on the occurrence of key events and streamlining collaboration between OPG and vendor partners.

- **Power Solutions – Safety Culture**

In addition to our existing safety programs, Power Solutions was officially launched across the Enterprise, including Darlington Refurbishment, to empower field staff with the ability to report issues or provide feedback on conditions anonymously to reconcile the concerns. Power Solutions is frequently used by vendor partners and staff to address issues in an expeditious manner and provide feedback to the leadership team on the culture in the field. Since its inception in the second quarter of 2023, the team has addressed over 90% of the issues that have been reported, further driving open communication and OneTeam collaboration with our vendor partners on our safety value practices.

- **Confined Space App Implementation**

OPG developed and implemented the Confined Space App fleetwide to reduce errors in confined space documentation, provide interlocks, and to ensure unqualified workers are not assigned to confined space work. The App has been found effective in reducing documentation errors and non-compliance instances. The Confined Space App has won one internal and two external awards. It represents industry leading safety technology. Work groups using the App have provided positive feedback by noting the App has made the confined space work process more efficient.

- **Units 314 Proactive Human Performance and Safety Plan**

This initiative builds on the existing plan and has a multi-disciplinary team consisting of OPG and vendor subject matter experts assembling to analyze the human performance, safety and quality events and lessons learned from Unit 2 and Unit 3. This initiative includes mapping these events and developing actions to reduce the likelihood of similar events occurring during the work remaining on Unit 1 and Unit 4.

- **Self-Assessments and Surveillances**

In addition to lessons learned, OPG's Health and Safety group conducts several self-assessments and surveillance on higher risk areas to ensure improvements are incorporated into planning to reduce the risk of injury. Examples of self-assessments and surveillance performed in 2023 include:

- Working at Heights and Falling Objects Self-Assessment.
- Material Handling Self-Assessment.
- Confined Space Self-Assessment on Implementation of Confined Space App.
- Electrical Safety Self-Assessment.
- Worker Protection Program Self-Assessment.
- Foreign Material Exclusion Program.

RADIOLOGICAL SAFETY

OPG's Radiological Protection (RP) program continues to meet regulatory requirements and industry standards. All workers are in compliance within regulatory dose limits. This performance is a result of OPG's robust nuclear safety culture and OPG's "As Low as Reasonably Achievable" (ALARA) radiological safety principles. Lessons learned on Unit 2 and Unit 3 have been incorporated into training and enhanced radiological safety measures on Unit 1 and Unit 4. The Program's ALARA committee continues to monitor and challenge RP performance to ensure ALARA principles result in lower doses to workers.

PERFORMANCE METRICS SUMMARY

Table 2 provides a summary of the Program’s radiological safety performance and includes both OPG and vendor employees.

Table 2 - Radiological Safety Performance Metrics						
	2021 Year End		2022 Year End		2023 End of Q3	
	Actual	Target	Actual	Target	Actual	Target
Unit 3 CRE (person-rem)¹	1,028	1,379	337	633	55	95
Unit 1 CRE (person-rem)¹	N/A	N/A	722	984	416	435
Unit 4 CRE (person-rem)²	N/A	N/A	N/A	N/A	114	120
Unplanned Exposures	0	0	0	0	0	0

Note:

1. A lower number represents a lower amount of radiological exposure.
2. Based on ALARA evaluation of increased CRE to date and comparison with DNRU1, DNRU4 CRE is trending above target. Based on preliminary projections above, the total CRE for DNRU4 will increase from 1,635 person-rem to 2,110 person-rem due to elevated dose rates from the feeders. This is a preliminary estimate.

QUALITY

Refurbishment of a Darlington unit involves many thousands of removal and installation activities, which are required to be executed with a high degree of precision. Many of the installation activities involve precision fit-up tasks and highly technical welding operations that are critical. A certain amount of rework is to be expected on a program of this nature.

The quality management program is used to identify issues during refurbishment execution by focused surveillance of vendor performed work. There has been no Significant Quality Events declared for Unit 3 or Unit 1 to date. There has been significant improvement in the quality of welding activities on the Unit 3 Feeder program as compared to Unit 2 and the same good performance is being continued in Unit 1.

Incorporation of lessons learned, and Kaizen/Six Sigma lean practices have improved industrial and radiological safety, tooling, schedule management, organizational alignment, and enhanced safety and Foreign Material Exclusion (FME) planning and oversight. Critical path, and cost-savings have resulted from initiatives such as two trolley defuel, breathing air tie ins, combined Pressure Tube/Calandria Tube removal strategy, Gantry Crane System, System Scaffolding, and many other initiatives. A culture of continuous improvement has resulted in the collection and implementation of lessons learned and continues to drive performance in Unit 1 and 4 Return to Service, with a robust performance with Unit 3 Return to Service. The most significant improvement elements from Unit 3 include Operational Transfer Plans, and Refurb Outage Control Centre Change Management.

SCHEDULE

OPG measures Program progress against two schedules:

1. A longer High Confidence Schedule
2. A shorter Working Schedule

The difference between these two schedules is that the High Confidence Schedule includes additional contingency amounts quantified based on detailed risk analysis. These contingency amounts are expected to be utilized over the course of the Program. The Working Schedule is used to calculate performance metrics, for example, the Schedule Performance Index (SPI), and manage day-to-day activities, allowing for early escalation of issues⁴. The use of both a Working Schedule and High Confidence Schedule is an industry leading best practice for large and complex projects.

Based on the strong performance and completion of Unit 3 to date, OPG has advanced its High Confidence Schedule for Units 1 and 4 as part of the U1EE and U4EE forecast. Given inherent schedule risks that remain from factors such as the ongoing execution of the units in an overlapped manner (Units 1 and 4), OPG continues to maintain its previous public commitment durations for each unit.

PERFORMANCE METRICS SUMMARY

Table 3A provides a summary of the Unit 1 schedule performance relative to the U1EE Working Schedule and High Confidence Schedule.

Table 3A - Unit 1 Schedule Performance Metric			
Measure	2022 Year End Actual	2023 Q3 Actual	Working Schedule Target
Days Ahead of / Behind High Confidence Schedule LTD ¹	12 Days Ahead	30 days Ahead	N/A
Critical Path Days Ahead of / Behind Working Schedule LTD ²	17 Days Behind at Completion of Sever Bellows (W113)	16 Days Behind at Completion of CT Install (W118)	14-Oct-2024
SPI ³ (Schedule Performance Index)	0.93	0.99	1.00
Forecast Working Schedule Completion Date ²	14-Oct-2024	12-Oct-2024	N/A

Notes:

1. Days Ahead/Behind is calculated as progress for all work currently completed relative to the LTD allotment of Contingency Days available in the High Confidence Schedule.
2. Critical Path Days Ahead/Behind and Forecast Working Schedule Completion Date are calculated as progress for all work currently completed relative to the Working Schedule and do not consider projected gains or losses for future work.
3. SPI is calculated for construction, commissioning, and inspection work packages only against the Working Schedule and SPI calculation includes both critical path and the non-critical path works.

⁴ This strategy provides an early indication of potential risks or issues and allows OPG to proactively manage Program performance.

Table 3B provides a summary of the Unit 4 schedule performance relative to the U4EE Working Schedule and High Confidence Schedule.

Table 3B – Unit 4 Schedule Performance Metrics		
Measure	2023 Q3 Actual	Working Schedule Target
Days Ahead of / Behind High Confidence Schedule LTD ¹	11 Days Ahead	N/A
Critical Path Days Ahead of / Behind Working Schedule LTD ²	5 Days Ahead (At Completion of End Fitting Install W017)	15 - Feb - 2026
SPI ³ (Schedule Performance Index)	1.00	1.00
Forecast Working Schedule Completion Date ²	13- Jan - 2026	N/A

Notes:

1. Days Ahead/Behind is calculated as progress for all work currently completed relative to the LTD allotment of Contingency Days available in the High Confidence Schedule.
2. Critical Path Days Ahead/Behind and Forecast Working Schedule Completion Date are calculated as progress for all work currently completed relative to the Working Schedule and do not consider projected gains or losses for future work.
3. SPI is calculated for construction, commissioning, and inspection work packages only against the Working Schedule and SPI calculation includes both critical path and the non-critical path works.

COST

Total Program expenditures to date are \$10 Billion with the current remaining estimate to complete the Program at \$2.8 Billion. The overall program estimate at completion remains at \$12.8 Billion (excluding COVID-19 impacts).

After the approval of the RQE in 2015, OPG established the U2EE⁵ in August 2016, the final U3EE⁶ in August 2020, the U1EE in November 2021, and the U4EE in March 2023. Detailed planning associated with the final U1EE and U4EE confirmed that the overall Program and associated contingencies were within the \$12.8 Billion set at RQE, exclusive of COVID-19 impact. The COVID-19 impact is forecasted to be \$130 Million.

The planning, pre-requisite and execution work for Unit 1 and Unit 4 refurbishments has and will incorporate the benefits of experience with the first two units, Unit 2 and Unit 3, and additional strategic improvements. The refurbishment of Unit 4 is scheduled to be completed by the third quarter 2026.

OPG continues to assess and seek ways to manage the impact of the COVID-19 pandemic on the project's total cost, which is otherwise continuing to track to the \$12.8 Billion budget.

⁵ A copy of U2EE is provide in EB-2016-0152 (Ex. L-4.3-1, Staff-055).

⁶ A copy of U3EE is provided in EB-2020-0290 (Ex. D2-2-7, Attachment 1).

Table 4 provides a summary of the cost performance metrics for Unit 3, Unit 1, and Unit 4.

Table 4 – Cost Performance Metrics Unit 3, Unit 1 & Unit 4¹ (Millions)				
Unit	CPI (Q3 2023)	LTD Q3 2023 Actual Cost	Current Estimate to Complete	Current Estimate at Completion
Unit 3	1.03	\$2,228	\$263	\$2,491
Unit 1	0.97	\$1,242	\$742	\$1,984
Unit 4	1.02	\$351	\$1,777	\$2,128

Notes:

1. Program expenditures include capital and OM&A costs consistent with OEB-approved amounts.

Table 5 provides a summary of the Total Program Actual Cost Incurred vs. Forecast Cumulative Capital Costs for all Units (excluding the impacts of COVID-19).

Table 5 – Total Program Actual vs. Forecast Cumulative Costs EB-2020-0290 (Millions)		
	Forecast Cumulative Costs¹	Actual Cost Incurred
Q1 2021	7,746	7,637
Q2 2021	8,048	7,861
Q3 2021	8,324	8,076
Q4 2021	8,575	8,289
Q1 2022	8,849	8,518
Q2 2022	9,153	8,758
Q3 2022	9,438	9,003
Q4 2022	9,735	9,268
Q1 2023	10,050	9,510
Q2 2023	10,327	9,784
Q3 2023	10,576	10,014
Q4 2023	10,836	
Q1 2024	11,101	
Q2 2024	11,380	
Q3 2024	11,617	
Q4 2024	11,829	
Q1 2025	11,982	
Q2 2025	12,126	
Q3 2025	12,283	
Q4 2025	12,439	
Q1 2026	12,577	
Q2 2026	12,662	

Q3 2026	12,723	
Q4 2026	12,800	

Notes:

1. Total Program forecast cumulative costs (inclusive of capital and OM&A costs) are per the EB-2020-0290, Ex. L-D2-02-Environmental Defence-005, Chart 1 and exclude COVID-19 impacts. The expenditures are based on the U3EE, which did not separate between capital and OM&A costs. As stated in the interrogatory response, as OPG continues to execute Units 4 and 1, and implements further Lessons Learned and Strategic Initiatives to both units, the forecast quarterly expenditure profile may change. OPG will continue to report on this basis for ease of comparability.
2. Actuals are based on life-to-date total Program spend, inclusive of both capital and OM&A costs, and exclude COVID-19 impacts.

ENGINEERING

The strategy for Design Engineering is to replicate the Engineering Changes (ECs) from Unit 2 and Unit 3 for Units 1 and 4 and modify them based on lessons learned. Unit 1 EC replication has been completed.

Major engineering accomplishments for the period include:

- Completion of Turbine Generator (TG) dynamic commissioning and EC Available for Services (AFS) on Unit 3.
- Completion of TG modification related pre-energization Construction Completion Declarations on Unit 1.
- Feeders ensure clean campaign boroscope inspections on Unit 1 were completed, part of our FME program. This helps to protect the integrity of the fuel and aid the team in reaching the corporate goal of zero fuel defects.

PROCUREMENT

PROCUREMENT STATUS FOR UNIT 1

98% of purchase orders were issued and 96% of materials for Unit 1 have been delivered to site, with remaining materials on track for the planned need date.

PROCUREMENT STATUS FOR UNIT 4

88% of purchase orders were issued and 76% of materials for Unit 4 have been delivered to site, with remaining materials on track for the planned need date.

CONSTRUCTION

CONSTRUCTION PROGRESS SUMMARY

As of September 30, 2023, Unit 3 construction activities were 100% completed.

As of September 30, 2023, the execution of Unit 1 is 70% complete overall and non-critical path, or bulkwork, activities are 81% complete. The following major accomplishments occurred within the period:

- Unit 1 Feeder Removal was completed on November 2, 2022.
- PT Sever and Sever Bellows was completed on December 17, 2022.

- End Fitting Removal was completed on January 26, 2023.
- Calandria Tube Removal was completed on April 27, 2023.
- Tube sheet Bore Cleaning was completed on May 23, 2023.
- Bellows Inspection was completed on June 3, 2023.
- Calandria Tube Install Series was completed on August 12, 2023.
- Fuel Channel Install Series is currently in progress.

As of September 30, 2023, the refurbishment of Unit 4 is 11% complete overall and non-critical path, or bulkwork, activities are 12% complete. The following major accomplishments occurred within the period:

- Unit 4 Shutdown began on July 19, 2023.
- Unit 4 Defueling was completed on September 4, 2023.
- Crane Maintenance was completed on September 7, 2023.
- End Fitting Cap Installation was completed on September 15, 2023.

LABOUR RELATIONS ISSUES SUMMARY

Members of the Society of Energy Professionals at the Electrical Safety Authority (ESA) commenced strike action on September 20, 2023. There are a small number of ESA employees that perform limited inspections at OPG facilities.

There is minimal risk of this labour disruption impacting OPG operations. OPG is currently in collective bargaining with the Canadian Union of Skilled Workers and negotiations are ongoing. There is no immediate risk of labour disruption. Risk assessments are underway to determine any potential impact from labour disruption to the DRP.

The OPG Labour Contingency Planning Team has been activated, is monitoring both situations and is prepared to respond if required.

ENVIRONMENTAL ISSUES SUMMARY

There was one infraction on Refurbishment Unit 3 in June 2023 due to an Environmental Compliance Approval (ECA), It was Non-Compliance for Boiler Morpholine exceeding the ECA Limits. There were two contributing causes identified:

- 1) Insufficient resource priority for boiler sampling and analysis after chemical addition, thus an opportunity to terminate morpholine addition earlier was missed.
- 2) The morpholine pump stroke rate (and thus dosing rate) was found greater than expected.

Reoccurrence control has been addressed via a Station Condition Record corrective action evaluation.

As well, there was one reportable spill on Refurbishment Unit 3 on October 2022 due to a refrigerant leak from an HVAC system due to a valve and O-ring fitting failure. The equipment was isolated and repaired.

The remaining refrigerant was recovered and degraded components were replaced. Radiological and conventional emissions remain well below regulatory limits.

TESTING, START-UP, AND COMMISSIONING

UNIT 3 RETURN-TO-SERVICE

On July 17, 2023, Darlington Nuclear Generating Station's Unit 3 reconnected to the electricity grid following refurbishment.

PROGRAM RISKS AND RISK MANAGEMENT

OPG uses a robust risk management process that identifies, classifies, quantifies, and mitigates risks. Industry experience dictates that there will be uncertainties that cannot be avoided on a Program of this size. As such, OPG maintains a detailed inventory of risks and contingency amounts in accordance with the recommended practices of the Association for the Advancement of Cost Engineering, a leading authority in the area of cost estimation. These contingency amounts are expected to be used over the course of the Program.

The following major risks are being managed by OPG:

1. **Availability of Skilled Resources / Supervision of Future Units:** The Program has experienced resource challenges with skilled trades resource availability. OPG monitors market demand conditions and has skilled trade forecasts to predict risks and develop mitigation plans for future resource challenges (resource optimization, industry sharing, and resource recruiting. Collaboration with industry partners continues with Bruce Power, Electrical Power Systems Construction Association, Construction Labour Relations Association of Ontario, and Provincial Building and Construction Trades Council of Ontario ensuring a fulsome understanding of resource demand profiles across Ontario. A strong relationship continues with all Building Trade Unions, Durham College, Durham District School Board, Kawartha Pine Ridge District School Board (KPRDSB) and the Indigenous Opportunities Network to maximize recruiting efforts for future projects.
2. **Inflation:** OPG is managing its response to extraordinary inflationary impacts at a corporate level where DRP exposure is continuing to be assessed and monitored. Mitigation actions have been implemented through supply chain and OPG continues to monitor inflation trends for further mitigation actions as required.

STAFFING

REFURBISHMENT RESOURCES

Table 6 provides a summary of the OPG Resources on the Program.

Table 6 – Full Time Equivalent (FTE) Resources by Year (Plan vs. Actual)					
Measure	2019	2020	2021	2022	2023
Planned at RQE	758	747	N/A		
Planned at U3EE	N/A		880	944	N/A
Planned at U4EE	N/A				1026 ¹
Actual	850	722	690	718	765 ²

Notes:

1. The variance of OPG resources against plan is primarily driven by the contracting strategy for certain maintenance activities.
2. Actual FTEs for 2023 are as of September Year to Date.

EFFORTS TO FILL OPEN POSITIONS

Talent acquisition initiatives are in place to fill open positions.

OPG has several Talent Management programs and initiatives in place to attract, retain, and develop qualified personnel across the company, including for the duration of the Program. Management continues to leverage industry best practices and utilize enterprise-wide talent and succession planning processes. This helps to ensure employees continue to develop and improve in their current role and/or are prepared to be successful in a future role for which they have been identified as a potential succession candidate, ensuring capability is sustained throughout the Program.

OPG's Enterprise Projects Management Organization is focused on implementing a standardized and scalable project delivery model throughout the enterprise. This organization has implemented a training program specifically designed to advance project management capability across the organization.

To further support employee development and succession planning programs, Career Path documents have been developed for several Enterprise Projects roles for project professionals and business units where their transferrable skillsets can be utilized.