Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

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CMD: 24-H5

Date signed/Signé le: 27 FEBRUARY 2024

A Licence Amendment

Ontario Power Generation Inc.

Pickering Nuclear Generating Station

Commission Public Hearing

Scheduled for:

June 2024

Submitted by:

CNSC Staff

Modification d'un permis

Ontario Power Generation Inc.

Centrale nucléaire de Pickering

Audience publique de la Commission

Prévue pour:

Juin 2024

Soumis par:

Le personnel de la CCSN

e-Doc 7052614 (WORD)
e-Doc 7082261 (PDF)

Summary

This CMD presents information about the following matters of regulatory interest with respect to Ontario Power Generation Incorporated (OPG):

- an application to amend the Power Reactor Operating Licence (PROL) of the Pickering Nuclear Generating Station (NGS) to operate units 5–8 to December 31, 2026, and up to 305,000 effective full power hours (EFPH)
- the Periodic Safety Review reassessment conducted by OPG in support of the licence amendment application request
- OPG's compliance with the requirements within the 14 safety and control areas

CNSC staff recommend that the Commission:

- amend the licensing basis to authorize OPG to operate Pickering NGS units 5–8 to December 31, 2026, and up to a maximum of 305,000 EFPH for the pressure tubes of units 5–8
- amend the PROL to remove licence condition 15.3 related to pressure tube assessment and include a new licence condition 6.2 related to an enhanced fitness-for-service program for fuel channels in extended operation

The following items are attached:

- the current PROL 48.01/2028
- the proposed PROL 48.02/2028
- the proposed changes to the licence conditions handbook

Résumé

Le présent CMD fournit de l'information sur les questions d'ordre réglementaire suivantes concernant Ontario Power Generation Incorporated (OPG) :

- une demande de modification du permis d'exploitation d'un réacteur de puissance (PERP) pour autoriser l'exploitation des tranches 5 à 8 de la centrale nucléaire de Pickering jusqu'au 31 décembre 2026 et jusqu'à 305 000 heures équivalentes pleine puissance (HEPP)
- la nouvelle évaluation du bilan périodique de la sûreté effectuée par OPG à l'appui de sa demande de modification de permis
- la conformité d'OPG aux exigences des 14 domaines de sûreté et de réglementation

La Commission pourrait considérer prendre les mesures suivantes :

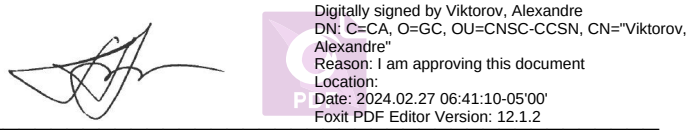
- modifier le fondement d'autorisation pour autoriser OPG à exploiter les tranches 5 à 8 de la centrale nucléaire de Pickering jusqu'au 31 décembre 2026 et jusqu'à un maximum de 305 000 HEPP pour les tubes de force de ces tranches
- modifier le PERP afin d'en retirer la condition de permis 15.3 liée à l'évaluation des tubes de force et d'ajouter une nouvelle condition de permis 6.2 concernant un programme amélioré d'aptitude fonctionnelle pour les canaux de combustible en exploitation prolongée

Les pièces suivantes sont jointes :

- le permis en vigueur, PERP 48.01/2028
- le permis proposé, PERP 48.02/2028
- les changements proposés au manuel des conditions de permis

Signed/Signé le

27 February 2024 / 27 février 2024



Alexandre Viktorov, PhD

Director General

Directorate of Power Reactor Regulation

Directeur général

Direction de la réglementation des centrales nucléaires

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EXECUTIVE SUMMARY

The Pickering Nuclear Generating Station (NGS) is located on the North shore of Lake Ontario, in the city of Pickering, Ontario, and lies within the traditional territory of the Michi Saagiig Anishinaabe people. These lands are covered by the Williams Treaties between Canada and the Mississauga and Chippewa Nations. The facility is owned and operated by Ontario Power Generation Incorporated (OPG).

Pickering NGS consists of 8 reactor units and their associated equipment, which are designed, constructed, and operated to produce electrical power. Units 2 and 3 are in a safe storage state and will remain so until the eventual decommissioning of the station. The site also contains the Pickering Waste Management Facility (PWMF), which is licensed under a separate Class 1B waste facility operating licence.

In August 2018, the Commission renewed OPG's Power Reactor Operating Licence (PROL) for the Pickering NGS, for a period of 10 years. At the time, OPG planned to end commercial operation of all Pickering NGS units by December 31, 2024, followed by a stabilization phase transitioning into safe storage with surveillance. Operation of any Pickering NGS reactor unit beyond 2024 would require a change to the licensing basis, which requires the authorization of the Commission following a public hearing.

In June 2023, OPG submitted a licence amendment application requesting Commission authorization to operate Pickering NGS units 5–8 until December 31, 2026 and to operate pressure tubes of these reactors for up to 305,000 equivalent full power hours (EFPH). In the licence amendment application, OPG confirmed that Pickering NGS units 1 and 4 will be shut down by December 31, 2024. While OPG's PROL remains valid until 2028, CNSC staff are recommending licence condition amendments related to an enhanced fitness-for-service program for fuel channels in extended operation.

To support the licence amendment application request, OPG completed a reassessment of the periodic safety review (PSR) conducted in 2018. The purpose of this reassessment was to assess the impact of extended operations beyond 2024 and to determine new or modified safety improvements for the extended operating period. The results of the PSR reassessment are documented in the associated integrated implementation plan (IIP). The IIP contains 32 commitments, which are planned to be completed by the end of 2024. CNSC staff found that the reassessed PSR met regulatory requirements and that the IIP commitments will enhance the safe operation of the Pickering NGS. Separately, OPG has also provided satisfactory implementation plans for various new or revised regulatory documents and CSA Group (formerly the Canadian Standards Association) standards at CNSC staff's request.

In April 2022, OPG submitted an updated environmental risk assessment (ERA) report and a predictive effects assessment (PEA) addendum report for the Pickering NGS and PWMF sites. The ERA reflects the current operations and incorporates recent monitoring data into the risk assessment process, including ecological and human health risk assessments related to the Pickering site and its activities. OPG's PEA represents the predicted risks to human and ecological receptors related to future activities from transitioning the Pickering NGS to storage with surveillance. CNSC staff are satisfied

that the 2022 ERA captures the environmental risks during operations and that adverse effects to ecological and human health due to the operations of the Pickering NGS are unlikely.

Additionally, CNSC staff prepared an environmental protection review (EPR) report for the Pickering site that summarizes the environmental performance of the Pickering NGS and PWMF from 2016–2022. Overall, CNSC staff found that OPG continues to implement and maintain effective environmental protection measures to adequately protect the environment and the health of people living in and around the Pickering site.

To support extended operation, OPG conducted condition assessments of major components (fuel channels, feeders, and steam generators) of units 5–8, to demonstrate that fitness for service of major components is assured. CNSC staff conclude that OPG has demonstrated that major components at the Pickering NGS are fit for service to December 31, 2026, and that pressure tubes are suitable for operation up to 305,000 EFPH. CNSC staff will continue to verify that OPG demonstrates the ongoing fitness for service of major components at the Pickering NGS during the licence period.

The CNSC made funding available through its Participant Funding Program to assist Indigenous Nations and communities, members of the public, and stakeholders in participating in the regulatory process and to provide value-added information to the Commission through informed and topic-specific interventions. Based on recommendations from an external Funding Review Committee, the CNSC awarded $92,161.48 to 8 applicants.

CNSC staff conclude that OPG has adequately demonstrated, in accordance with regulatory requirements, the fitness for service of major components, including fuel channels, feeders, and steam generators, at the Pickering NGS for continued operation of units 5–8 until the end of 2026. CNSC staff also conclude that OPG remains qualified to carry out the activities authorized in its licence and will continue to make adequate provision for the protection of the environment, the health and safety of persons, and the maintenance of national security. Therefore, CNSC staff recommend that the Commission amend OPG's PROL to authorize OPG to operate Pickering NGS units 5–8 to December 31, 2026, and increase the pressure tube operating limit from up to 295,000 EFPH to up to 305,000 EFPH.

CMD STRUCTURE

This Commission Member Document (CMD) is presented in 2 parts.

Part 1 of this CMD includes:

1. an overview of the matter being presented;
2. overall conclusions and overall recommendations;
3. discussion about the recently published Pickering environmental protection review report;
4. discussion about OPG's periodic safety review reassessment;
5. general discussion pertaining to the safety and control areas (SCAs) that are relevant to this submission;
6. discussion about consultation and engagement with Indigenous Nations and communities and members of the public;
7. discussion about other matters of regulatory interest; and
8. appendices material that complements items 1 through 7.

Part 2 of this CMD provides information pertaining to the current licence, proposed changes to the licence, and proposed changes to the licence condition handbook (LCH).

1. Overview

1.1 Background

The Pickering Nuclear Generating Station (NGS) is located in the Province of Ontario on the North shore of Lake Ontario, in the city of Pickering and the regional municipality of Durham and lies within the traditional territory of the Michi Saagiig Anishinaabe people. These lands are covered by the Williams Treaties between Canada and the Mississauga and Chippewa Nations. The facility lies 32 km northeast of downtown Toronto and 21 km southwest of Oshawa. The facility is owned by Ontario Power Generation Incorporated (OPG), a Canadian corporation, whose head office is located at 700 University Avenue, Toronto, Ontario, M5G 1X6.

Pickering NGS consists of eight CANDU pressurized heavy water nuclear power reactors (units) and their associated equipment. Construction of the facility started in 1966 for Units 1-4 (formerly referred to as Pickering NGS A) and in 1974 for Units 5–8 (formerly referred to as Pickering NGS B). The first criticality for reactor Unit 1was on February 25, 1971, and for Unit 5 was on October 23, 1982. The in-service dates for Units 1-4 ranged from 1971 to 1973, and for Units 5–8 ranged from 1983 to 1986. Figure 1 shows an aerial shot of the Pickering NGS. Units 2 and 3 were defueled in 2008 and will remain in a safe storage state until the eventual decommissioning of the station. Six units remain in operation. Units 1 and 4 each have a net electrical output of 515 MWe (megawatt-electric) and Units 5–8 each have a net electrical output of 516 MWe.

Figure 1- Pickering Nuclear Generating Station

Pickering NGS also produces cobalt-60 (Co-60), a radioactive isotope used for sterilization of medical equipment and food products. Co-60 is harvested from irradiated reactor components (adjuster rods) that are removed from the reactors during planned outages.

In addition to the Pickering NGS, the Pickering Waste Management Facility (PWMF) is also located on the Pickering nuclear site and is separately licensed under a Class 1B Waste Facility Operating Licence. It consists of several installations at three different locations. The PWMF handles and stores used nuclear fuel from the Pickering NGS that has cooled in the irradiated fuel bays of the station for several years. The PWMF also has a facility for the storage of components from past retubing activities from Pickering NGS units 1-4. The PWMF licence was renewed in February 2018.

2018 Pickering NGS Relicensing

In August 2018, the Commission renewed OPG's Power Reactor Operating Licence (PROL) for the Pickering NGS, [1, 2] for a period of 10 years. At that time, OPG planned to cease commercial operation of all Pickering NGS units by December 31, 2024, followed by a stabilization phase (post-shutdown defueling and dewatering) lasting approximately 2-3 years and the beginning of the safe storage with surveillance phase. [3] The safe storage with surveillance phase marks the beginning of station decommissioning. In its 2018 licensing decision, the Commission noted that operation of any Pickering NGS reactor unit beyond December 31, 2024, would constitute a change to OPG's licensing basis and would require a decision from the Commission via a public hearing process whereby Indigenous Nations and communities, members of the public, and other stakeholders would be able to intervene.

As part of the relicensing hearing, the Commission noted several actions it expected or directed to be completed over the current licence period by OPG and CNSC staff. CNSC staff track such actions and report on their status as part of the annual Regulatory Oversight Report on Nuclear Power Generating Sites (NPGS ROR). [4-8] As of January 2024, all such actions have been closed, with the exception of an action to provide updates to the Commission on the ongoing work of Environment and Climate Change Canada (ECCC) regarding the nomination of radionuclides as Chemicals of Mutual Concern.

The Commission directed that, should OPG decide to seek authorization to continue commercial operations of any Pickering NGS unit beyond 2024, OPG shall provide its application and supporting documents, including a completed PSR reassessment, to the CNSC by December 2022. These requirements are captured in the licensing basis for licence conditions 15.1 and 15.4 of OPG's PROL for the Pickering NGS. In a November 2022 decision, [9] the Commission extended the deadline prescribed under these licence conditions to June 30, 2023. OPG's application requesting authorization to operate Pickering NGS units 5–8 to December 31, 2026, has met these requirements.

The timeline of this matter is as follows:

- On August 8, 2018, the Commission renewed OPG's PROL for the Pickering NGS and required OPG to inform the CNSC of its intent to operate any unit beyond 2024 by December 31, 2022. [1]
- On December 16, 2021, OPG informed the CNSC of its intent to operate units 5–8 to the end of 2025. [10]
- On November 24, 2022, the Commission extended OPG's application deadline under the licensing basis for licence conditions 15.1 and 15.4 to June 30, 2023. [9]
- On December 12, 2022, OPG informed the CNSC of its updated intent to operate units 5–8 to September 30, 2026. [11]
- On June 16, 2023, OPG submitted its application requesting authorization to operate Pickering NGS units 5–8 to December 31, 2026. [12]

On January 30, 2024, the province of Ontario announced its support for the possible refurbishment of Pickering NGS units 5–8. CNSC staff note that such activity is beyond the scope of this authorization request. The possible future refurbishment of Pickering NGS units 5–8, were OPG to formally request it, would be considered at a separate public hearing of the Commission.

1.2 Highlights

In June 2023, OPG submitted a licence amendment application [12] requesting Commission authorization to operate Pickering NGS units 5–8 to December 31, 2026. In its application, OPG confirmed that units 1 and 4 will be shut down by December 31, 2024, in accordance with the current licence requirements. OPG is also requesting CNSC authorization for an increased operating limit for units 5–8 pressure tubes from up to 295,000 EFPH to up to 305,000 EFPH.

To support the licence amendment application, OPG completed a re-assessment of the periodic safety review (PSR) conducted in 2018 in accordance with the licensing basis for licence conditions 15.1 and 15.4 of its PROL for the Pickering NGS. The purpose of the PSR re-assessment was to assess the impact of the extended operating period and to determine new or modified safety improvements to be included in an updated Integrated Implementation Plan (IIP).

In addition, OPG has conducted condition assessments of Pickering NGS units 5–8 major components, including fuel channels, feeders, and steam generators. [13] The purpose of this assessment was to demonstrate the fitness for service of major components to the conservatively projected EFPH for each unit and that there remains sufficient margin for continued commercial operations of units 5–8.

With respect to pressure tube fitness for service, CNSC staff are recommending that the Commission remove licence condition 15.3 related to pressure tube assessment and include a new licence condition 6.2 related to an enhanced fitness-for-service program for fuel channels in extended operation. These proposed changes reflect recent Commission decisions regarding the discovery of elevated

hydrogen equivalent concentration in pressure tubes in extended operation. Further discussion on these proposed changes to OPG's PROL for the Pickering NGS can be found in section 4.6.

The purpose of this CMD is to provide CNSC staff's conclusions and recommendations to support the Commission's decision on OPG's licence amendment application requesting continued operations of Pickering NGS units 5–8 to December 31, 2026. This CMD includes CNSC staff's review of OPG's application and supporting documents, with information on:

1. OPG's PSR reassessment (PSR2-B) and the associated IIP actions for the implementation of safety enhancements.
2. The environmental protection review performed by CNSC staff.
3. CNSC staff performance assessments in all safety and control areas (SCAs) during the current licence period.
4. Engagement with the public and Indigenous Nations and communities.

1.3 Overall Conclusions

CNSC staff's review of OPG's application and supporting documents concludes the following:

1. OPG has adequately demonstrated, in accordance with regulatory requirements, the fitness for service of major components, including fuel channels, feeders, and steam generators, of Pickering NGS units 5–8 for continued operation to December 31, 2026.
2. OPG has adequately demonstrated, in accordance with regulatory requirements, that the fuel channels for Pickering NGS units 5–8 are fit for service up to 305,000 EFPH.
3. OPG remains qualified to carry on the activities authorized in the PROL and continues to make provisions to protect workers, people, and the environment.

1.4 Overall Recommendations

CNSC staff recommend that the Commission:

1. **Conclude**, pursuant to paragraphs 24(4)(a) and (b) of the *Nuclear Safety and Control Act* (NSCA), that OPG:
    a) Remains qualified to carry on the activities authorized by the licence.
    b) Will continue to make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.
2. **Amend** the Pickering NGS licensing basis to authorize operation of Pickering NGS units 5–8 to December 31, 2026.

3. **Amend** the pressure tube operating limit to up to 305,000 EFPH.
4. **Amend** the current Pickering NGS licence, PROL 48.01/2028, to
    a) **Remove** licence condition 15.3, Pressure Tube Assessment for Safe Operation: *Before Hydrogen equivalent concentration exceeds 120 ppm, the licensee shall demonstrate that pressure tube fracture toughness will be sufficient for safe operation beyond 120 ppm*.
    b) **Include** licence condition 6.2, Fitness for Service Program for Fuel Channels in Extended Operation: *The licensee shall implement and maintain an enhanced fitness for service program for fuel channels in extended operation*.
5. If the Commission accepts CNSC staff's recommendations, CNSC staff will revise the Pickering NGS LCH as specified in Part 2 of this submission.

2. Environmental Protection Review

CNSC staff reviewed the licence amendment application to identify which type of environmental review was required to be conducted, if applicable. As part of this process, CNSC staff must assess whether a federal lands review under the *Impact Assessment Act* (IAA) is required. For this licence amendment application, a federal lands review is not required because the application does not include activities that meet the definition of a project on federal lands.

CNSC staff conduct environmental protection reviews (EPRs) for all licence applications with potential environmental interactions, in accordance with the CNSC's mandate under the NSCA and associated regulations. The EPR informs the Commission's conclusion on whether the proposal provides adequate protection of the environment and the health of people.

An EPR was conducted for this licence amendment application. CNSC staff's assessment included a review of OPG's licence amendment application and supporting documents, including OPG's 2022 ERA and PEA addendum, annual compliance monitoring reports, and past environmental performance for the facility. As mentioned in section 4.9, CNSC staff have found that the information provided by OPG regarding environmental protection is sufficient to meet the applicable regulatory requirements under the NSCA and associated regulations.

Additionally, CNSC staff prepared an EPR report for the Pickering Nuclear Site that summarizes the environmental performance of the Pickering NGS and Pickering Waste Management Facility (WMF) from 2016-2022. The report is available on the CNSC website.

CNSC staff will continue to verify and ensure that, through ongoing licensing and compliance activities and reviews, the environment and the health of persons are protected and will continue to be protected over the proposed licence period.

3. Periodic Safety Review

3.1 Background

A periodic safety review (PSR) is a comprehensive evaluation of the design, condition, and operation of a nuclear power plant undertaken at a prescribed frequency. It is an effective way to obtain an overall view of plant safety and the quality of the safety documentation, and to determine reasonable and practical safety improvements until the next PSR or, where appropriate, until the end of commercial operations.

To support the 2018 relicensing of the Pickering NGS, OPG conducted a PSR (called PSR2) [14] in accordance with the requirements of REGDOC-2.3.3, *Periodic Safety Reviews*. PSR2 assumed that all Pickering NGS units would end commercial operation by December 31, 2024, followed by a period of stabilization (de-fueling, de-watering) before entering a long-term storage with surveillance state. It was understood that an extension of the commercial operation of Pickering NGS units beyond 2024 would be possible if supported by a reassessment of the impact of such extended operation on the time-dependent elements.

PSR2 was conducted in 4 phases as per REGDOC-2.3.3, which included a PSR basis document, 15 safety factor reports, a global assessment report, and an integrated implementation plan (IIP). CNSC staff's assessment of PSR2 is documented in CMD 18-H6 [3] for the 2018 renewal hearing and the Commission's decision is documented in the 2018 licence renewal Record of Decision. [1] All commitments included in the PSR2 IIP have been completed by OPG and closed by CNSC staff, as of June 2021.

Licence conditions 15.1 and 15.4 of the renewed 2018 PROL for the Pickering NGS were established to define regulatory requirements related to the end of commercial operations, including operation of any unit beyond 2024. The licensing basis for licence conditions 15.1 and 15.4, which is captured in the Pickering NGS LCH, [15] requires that OPG perform and complete a reassessment of the continued validity of the results of PSR2 by or before June 30, 2023, should OPG intend to operate any reactor unit beyond December 31, 2024. Further discussion of the licensing basis requirements of licence condition 15.4 can be found in section 6.7.

OPG has submitted its application requesting authorization to operate Pickering NGS units 5–8 to December 31, 2026. To support this application, OPG has conducted a reassessment of PSR2 as required by licence condition 15.1. This reassessment is referred to as PSR2-B.

3.2 Periodic Safety Review Reassessment (PSR2-B)

Section 15.1 of the Pickering NGS LCH states:

> *As detailed in CMD 22-H107 Record of Decision, for any of the Pickering units to operate beyond December 31, 2024, the licensee shall perform and*

complete by or before June 30, 2023, a reassessment of the continued validity of the PSR results and, as a minimum, shall:

- *Reassess the results of the global assessment included in the PSR Global Assessment Report (GAR);*
- *Include new or revised requirements, expectations and practices that became available since the freeze-date of the PSR stated in P-REP-03680-00001, Pickering NGS Periodic Safety Review 2 (PSR2) Basis Document;*
- *For any newly identified findings, utilize the consolidation, prioritization and ranking methods employed in performing the PSR global assessment to formulate new global issues and resolutions plans;*
- *Evaluate the continued validity of conclusions reached in PSR; and*
- *Revise the IIP by incorporating the results of the reassessment as new or modified IIP actions and submit the revised IIP for CNSC acceptance.*

Additionally, section 15.4 of the LCH states:

As detailed in CMD 22-H107 Record of Decision, OPG shall provide no later than June 30, 2023:

- *The reassessment of the impact of operations beyond 2024, based on the global assessment included in P-REP-03680-00032, Pickering NGS PSR2 Global Assessment Report, and the consequential impact on identifying new findings that could result in new IIP actions; and*
- *Request for CNSC acceptance, by a specific date, of potential new or revised actions in the Pickering NGS Periodic Safety Review 2 (PSR2) Integrated Implementation Plan.*

As required by the licensing basis for licence conditions 15.1 and 15.4, OPG performed a re-assessment of the continued validity of PSR2. This reassessment, called PSR2-B, was carried out in accordance with REGDOC 2.3.3 to confirm that the design, condition, and operation of Pickering NGS supports continuing commercial operation from 2024 to 2026.

To carry out PSR2-B, OPG developed and submitted a strategy document detailing the strategies, activities, and schedule. The PSR2-B strategy followed the requirements set out in sections 15.1 and 15.4 of the LCH and met the elements of REGDOC-2.3.3. The strategy included the following reviews to identify any additional actions required beyond those that had already been achieved in the PSR2 IIP.

- A review of existing PSR2 Global Issues flagged for “Re-assessment Beyond 2024” to identify impacts due to operation of the Pickering NGS beyond 2024.
- A review of gaps from the Darlington PSR, currently underway to support the Darlington licence renewal in 2025, to determine applicability to the Pickering NGS and to identify new Global Issues where applicable.

- A review of the outstanding Regulatory Actions and Open CNSC Action items at the Pickering NGS.

The PSR2-B reviews are documented in the Gap Assessment Report, Global Assessment Report (GAR), and IIP.

CNSC Staff Review of the Gap Assessment

On March 31, 2023, OPG submitted the Global Issue Gap Assessment report, which identified 22 gaps from the review of the PSR2 global issues impacted by Pickering NGS operation beyond 2024, 18 gaps from the assessment of Darlington PSR gaps for applicability to the Pickering NGS, and 1 gap from the review of open regulatory actions.

A total of 41 gaps were identified for input to the global assessment phase. CNSC staff completed the review of the gap assessment report on April 20, 2023, and concluded that it met CNSC regulatory requirements and that the identified gaps were appropriate for further assessment. [16]

CNSC Staff Review of the GAR

On May 2, 2023, OPG submitted the GAR, [17] which consolidated the 41 gaps into 16 global issues (GIs). OPG then prioritized the GIs based on safety significance, assessed them, and developed resolution plans.

In its assessment, OPG identified acceptable deviations where it demonstrated that gaps have a very low safety significance level or are low safety significance level items where a practicable resolution is not readily available. Additionally, OPG identified gaps that required no further action where work is already completed, work is underway outside of PSR2-B, or further analysis has adequately dispositioned the gap. Based on the resolution plans, OPG developed 13 resolution statements to address the GIs.

The 13 resolution statements were then ranked to determine the activities that will be most effective in enhancing safety. They were developed mainly to address gaps related to completion of fitness for service assessments for major components and other structures, systems, and components (SSCs); safety analysis to address the aging of SSCs for the extended period; and gaps against requirements in modern codes and standards. The 13 proposed resolution statements were carried forward to the IIP.

CNSC staff reviewed OPG's GAR and concluded that the report met CNSC regulatory requirements. [18]

CNSC Staff Acceptance of the IIP

The IIP is the last PSR deliverable submitted by OPG for acceptance by CNSC staff. OPG submitted the IIP on May 31, 2023, and has made it available on the OPG website. [19] From the 13 proposed resolution statements carried forward from the GAR, OPG developed a total of 32 IIP commitments with completion criteria and target completion dates. Further details on IIP commitments are provided in section 3.3. The IIP is based on current Canadian experience and reflects the requirements of CNSC REGDOC-2.3.3, as well as guidance of IAEA

SSG-25, *Periodic Safety Review for Nuclear Power Plants* and CSA group (CSA) standard N290.18-17, *Periodic safety review for nuclear power plants.*[1]

CNSC staff reviewed OPG's PSR2-B IIP and determined that it meets CNSC requirements and forms the basis for actions to support safe operation to end of 2026. CNSC staff accepted the IIP on July 11, 2023. [20]

CNSC Staff Oversight of the Effective Implementation of the IIP

CNSC staff will oversee OPG's execution of the PSR2-B IIP commitments as outlined in section 15.1 of the proposed LCH. OPG will follow the developed OPG instruction P-INS-03680-00001, *Pickering IIP Administration* for matters such as IIP management, change control, completion and closure of actions, reporting, roles and responsibilities, and communication with CNSC staff. When an IIP commitment is completed, OPG will provide notification to CNSC staff who will then verify that all relevant completion criteria are met prior to closing the commitment. OPG is required to notify CNSC staff of any changes to the IIP and report on the status of IIP commitments quarterly and annually. Any intent changes to IIP commitments require CNSC staff concurrence prior to implementation.

CNSC staff will report on the status of the IIP commitments to the Commission as part of future annual NPGS RORs.

3.3 Integrated Implementation Plan

The Pickering NGS PSR2-B resulted in 32 IIP commitments. OPG is to complete all IIP commitments by December 31, 2024.

Key IIP actions to enhance the level of safety of the Pickering NGS for the proposed extended operating period include:

1. Update the life cycle management plans for the major components (fuel channels, feeders, steam generators, and reactor components and structures) with the basis for the continued demonstration of fitness for service for the extended operating period to the end of 2026.
2. Demonstrate the continued fitness-for-service for Pickering NGS units 5–8 tight-fitting fuel channel spacers.
3. Update the heat transport system aging safety analyses to support operation until the end of 2026.
4. Update the periodic inspection plan (PIP) for fuel channels.

Table 1 shows the distribution of IIP commitments by SCA. Further detail on the IIP actions for each SCA is provided in section 4.0.

[1] CSA group (formerly the Canadian Standards Association) nuclear standards are available to view on the CSA group community website with a free account.

Table 1: Number of IIP commitments by SCA

Safety and Control Area	IIP Commitments
Management System	2
Safety Analysis	5
Physical Design	2
Fitness for Service	17
Emergency Preparedness and Fire Protection	6
Total	**32**

Table 2 shows the number of PSR2-B IIP commitments [19] to be completed by OPG in 2023 and 2024.

Table 2: OPG PSR2-B IIP commitments completion in 2023 and 2024

Year	IIP Commitments to be Completed
2023	1
2024	31

Based on CNSC staff's review of the GAR and IIP, CNSC staff conclude that:

1. The GAR and IIP meet CNSC regulatory requirements and expectations of REGDOC-2.3.3, and the guidance in IAEA SSG-25 and CSA N290.18-17;
2. The Pickering NGS design, operation, processes, and management system will support continued safe operation of units 5–8 to the end of 2026;
3. The commitments in the IIP will enhance the safe operation of the Pickering NGS reactor units; and
4. OPG has committed to operate Pickering NGS reactor units only if the fitness for service of major components and other SSCs important to safety continues to be demonstrated.

3.4 PSR and IIP Conclusion

As required by the licensing basis for licence conditions 15.1 and 15.4 of OPG's PROL for the Pickering NGS, OPG has performed a reassessment of PSR2, referred to as PSR2-B, consistent with REGDOC-2.3.3 in support of its request for authorization to operate Pickering NGS units 5–8 to December 31, 2026. CNSC staff have reviewed and accepted the results of PSR2-B and conclude that the Pickering NGS design, operation, processes, and management system will support continued safe operation of units 5–8 to the end of 2026.

All commitments included in the PSR2-B IIP are to be completed by OPG by December 31, 2024. These commitments will enhance the safe operation of the

Pickering NGS. The compliance verification criteria for implementing the results of PSR2-B are detailed in section 15.1 of the proposed LCH, which is included in Part 2 of this CMD.

CNSC staff will update the Commission on the status of the Pickering NGS PSR2-B IIP commitments as part of the NPGS ROR.

4. General Assessment of SCAs

This section provides information, organized by Safety and Control Area (SCA), regarding CNSC staff's assessment of OPG's licence amendment application requesting Commission authorization to operate units 5–8 to December 31, 2026, [12] as well as OPG's responses [21, 22] to CNSC staff requests for additional information. [23, 24] The sub-sections are further organized by specific area where appropriate. Information on the CNSC's SCA framework and associated specific areas is included in Appendix C. CNSC staff's assessment considered information gathered during the current licence period, from 2018 through to the end of 2023.

CNSC staff also assessed OPG's Pickering NGS PSR2-B IIP commitments for each SCA and, where appropriate, included such information in the appropriate SCA section. The majority of IIP commitments are related to the fitness for service SCA. Further discussion on the PSR and IIP commitments is included in section 3.

The intent of this section is to provide the Commission with information on the adequacy of OPG's licence amendment application and existing programs, as well as work undertaken by OPG during the licence period to support continued commercial operations of Pickering NGS units 5–8 until the end of 2026. In addition to demonstrating that its existing programs across all 14 SCAs are adequate for continued operation of units 5–8 until 2026, OPG was also required to demonstrate that units 5–8 major components remain fit for service. The fitness for service SCA is discussed in section 4.6, including CNSC staff's assessment of OPG's assurance of units 5–8 major components' fitness for service. [13]

In its application, [12] OPG submitted that no changes to the existing programs in place at the Pickering NGS are necessary to support continued operation of units 5–8 until the end of 2026. CNSC staff assessed OPG's application and supporting documentation for each of the 14 SCAs. CNSC staff determined that OPG's programs and processes continue to meet the applicable regulatory requirements and CNSC staff agree that no changes to these programs are required to support the continued operation of Pickering NGS units 5–8 until 2026.

While OPG's licence for the Pickering NGS remains valid until 2028, [1] CNSC staff are recommending that the Commission amend the current PROL to require that OPG implement and maintain an enhanced fitness-for-service program for fuel channels in extended operation. OPG has already implemented such a program at the Pickering NGS in accordance with the Commission's decisions regarding elevated hydrogen equivalent concentration in CANDU pressure tubes in extended operation.

Through its compliance oversight, CNSC staff continue to assess OPG's performance against the applicable regulatory requirements within the facility's licensing basis, including the current PROL for the Pickering NGS [2] and the associated LCH. [15] OPG's performance is reported to the Commission annually through the NPGS ROR. [4-8] Performance for the 2023 calendar year, including overall compliance ratings for each SCA, will be included in the 2023 NPGS ROR that will be presented to the Commission in the fall of 2024.

4.1 Management System

The management system SCA covers the framework that establishes the processes and programs required to ensure an organization achieves its safety objectives, continuously monitors its performance against these objectives, and fosters a healthy safety culture.

This CMD covers the following specific areas of this SCA:

- Management system
- Organization
- Performance assessment, improvement, and management review
- Operating experience (OPEX), Problem Identification and Resolution (PI&R)
- Change management
- Safety culture
- Configuration management
- Records management
- Supply and Contractor Management
- Business continuity

Licence condition 1.1 of OPG's PROL requires OPG to implement and maintain a management system. CNSC staff verify OPG's compliance with regulatory requirements in the management system SCA against the compliance verification criteria described in section 1.1 of the Pickering NGS LCH.

4.1.1 Trends

The following table indicates the overall rating trends for the management system SCA over the current licence period:

TRENDS FOR MANAGEMENT SYSTEM				
Overall Compliance Ratings				
2018	**2019**	**2020**	**2021**	**2022**
SA	SA	SA	SA	SA
Comments				
OPG has demonstrated satisfactory (SA) performance in this SCA during the current licence period. Overall, CNSC staff conclude that OPG's programs within the management system SCA meet regulatory requirements and are adequate for continued commercial operations until the end of 2026.				

4.1.2 Discussion

A management system brings together, in a planned and integrated manner, the processes necessary to satisfy requirements and to carry out licensed activities safely across all SCAs. CNSC staff have determined that OPG's management system continues to meet regulatory requirements.

During the licence period, CNSC staff have conducted compliance verification activities to evaluate OPG's performance in this SCA. Inspection areas of focus have included software maintenance, program implementation, change management, records management, supply management, the OPEX program, and the event investigation process, among others. Non-compliant findings identified by CNSC staff have been of low or negligible safety significance, and OPG has implemented satisfactory corrective actions to address these findings.

Details pertaining to the specific areas within this SCA are presented in the following subsections.

Management system and Organization

The OPG management system is defined in a charter that takes authority from the nuclear safety and security policy. The OPG charter provides a framework for the programs and governance that make up the OPG nuclear management system and the organizational structure under which they are implemented. The Chief Nuclear Officer is accountable for the implementation and the effectiveness of the nuclear management system.

CNSC staff regularly assess the compliance of OPG programs against CSA N286-12, *Management system requirements for nuclear facilities* and remain satisfied with the definition of organization roles, responsibilities, and interfaces in OPG documentation.

Performance Assessment, Improvement, and Management Review

OPG has a nuclear oversight program to periodically assess the effectiveness of its management system. This program encompasses the independent (audit) and self-assessment programs, as well as the management review process conducted by OPG senior management. The OPG audit program includes the review of all

programs in the management system. OPG continues to maintain audit and self-assessment programs that comply with the requirements of CSA N286-12.

Operating experience (OPEX), Problem Identification and Resolution (PI&R)

OPG has a performance improvement program at the Pickering NGS that employs the principles of problem prevention, detection, and correction. Additionally, OPG has an operating experience (OPEX) program to share lessons learned from internal and external events and take action when appropriate through its performance improvement program. The OPG OPEX program is compliant with the requirements of CSA N286-12, which CNSC staff regularly verify through ongoing compliance verification activities.

Change management

OPG manages organizational changes and changes to processes, programs, designs, structures, systems, components, equipment, materials, software, and documents in accordance with approved change processes. During the licence period, CNSC staff have reviewed updates to these change processes and have remained satisfied.

CNSC staff verify that changes are controlled and carried out as per OPG governance documentation and CNSC staff continue to oversee the implementation of changes on a risk informed basis.

Safety culture

CNSC requirements and guidance are published in REGDOC-2.1.2, *Safety Culture*, which was fully implemented at the Pickering NGS in 2020. OPG performed a station wide nuclear safety and security culture assessment in 2022. This assessment consisted of a staff survey followed by an on-site evaluation that included document reviews, staff interviews, and focus group sessions. OPG's 2022 assessment found that Pickering NGS has a healthy nuclear safety and security culture. The assessment also identified areas for improvement, and OPG is tracking actions taken to address these findings. The next safety and security culture assessment is expected to be conducted in 2025.

Configuration management

OPG configuration management is an integrated management process that ensures that the physical and operational configuration and the documentation conform to the design and licensing basis requirements. OPG's configuration management program continues to be in compliance with regulatory requirements.

Records management

OPG records management encompasses the control of documents and records. The OPG process for the control of documents includes the development, validation, and approval of safety related documents. Documents are available for use at the location where the work is to be performed and changes to documents are recorded and tracked. The OPG process for the control of records ensures that records are readable, complete, identifiable, traceable, retrievable, preserved and

retained as specified. In 2022, OPG performed a software upgrade to replace its 10-year-old asset suite software.

CNSC staff are satisfied with OPG's records management processes and OPG continues to meet regulatory requirements in this specific area at the Pickering NGS.

Supply and Contractor Management

OPG supply chain services are responsible for establishing and maintaining the OPG nuclear approved supplier list. OPG's supply inspection process describes methods used to manage the qualification of suppliers of items and services required for quality assurance programs or other OPG nuclear quality requirements.

In response to OPG's application, CNSC staff requested further information on the current use of contractors at the Pickering NGS. OPG noted that contractors are pre-qualified to ensure they have implemented a management system that meets the requirements outlined in CSA N286-12 and, since 2018, contractor staff working on-site are more integrated into OPG's maintenance processes. [21]

CNSC staff continue to be satisfied with OPG's performance with respect to supply and contractor management.

Business continuity

OPG has developed adequate contingency plans to maintain or restore critical safety and business functions in the event of disabling circumstances such as a pandemic, severe weather, or labour actions. OPG revised these plans in 2021 to incorporate lessons learned form the COVID-19 pandemic. CNSC staff were satisfied with OPG's implantation of these plans during the COVID-19 pandemic and remain satisfied with OPG's business continuity performance.

4.1.3 Summary

A summary of OPG's past performance, CNSC staff's regulatory focus, and proposed improvements for the management system SCA are presented in the following subsections.

4.1.3.1 Past Performance

OPG's management system at the Pickering NGS continues to meet CNSC regulatory requirements. OPG has maintained satisfactory performance across the specific areas of this SCA during the licence period.

4.1.3.2 Regulatory Focus

CNSC staff will continue to verify OPG's performance and compliance with regulatory requirements in all aspects of the management system SCA at the Pickering NGS.

4.1.3.3 Proposed Improvements

As discussed in section 3, OPG's Pickering NGS PSR2-B IIP includes 2 IIP commitments related to the management system SCA. [19] These actions are regarding the implementation of an engineering change related to failure detection for emergency water system reactor building water level measurement.

4.1.4 Conclusion

CNSC staff conclude that OPG continues to meet regulatory requirements related to the management system SCA. Based on CNSC staff's assessment of OPG's application and performance during the licence period, OPG's existing management system at the Pickering NGS is adequate for continued operation of units 5–8 to December 31, 2026.

4.2 Human Performance Management

The human performance management SCA covers activities that enable effective human performance through the development and implementation of processes that ensure that a sufficient number of workers are in all relevant job areas and have the necessary knowledge, skills, procedures, and tools in place to safely carry out their duties.

This CMD covers the following specific areas of this SCA:

- Human performance program
- Personnel training
- Personnel certification
- Work organization and job design
- Fitness for duty

OPG's PROL includes four licence conditions related to the human performance management SCA:

- Licence condition 2.1 requires OPG to implement and maintain a human performance program.
- Licence condition 2.2 requires OPG to implement and maintain the minimum shift complement and control room staffing for the nuclear facility.
- Licence condition 2.3 requires OPG to implement and maintain training programs.
- Licence condition 2.4 requires OPG to implement and maintain certification programs in accordance with CNSC regulatory document REGDOC-2.2.3, *Personnel Certification, Volume III: Certification of Persons Working at Nuclear Power Plants*.

CNSC staff verify OPG's compliance with regulatory requirements in the human performance management SCA against the compliance verification criteria described in section 2.1, 2.2, 2.3, and 2.4 of the Pickering NGS LCH.

4.2.1 Trends

The following table indicates the overall rating trends for the human performance management SCA over the current licence period:

TRENDS FOR HUMAN PERFORMANCE MANAGEMENT				
Overall Compliance Ratings				
2018	**2019**	**2020**	**2021**	**2022**
SA	SA	SA	SA	SA
Comments				
OPG has demonstrated satisfactory (SA) performance in this SCA during the current licence period. Overall, CNSC staff conclude that OPG's programs within the human performance SCA meet regulatory requirements and are adequate for continued commercial operations until the end of 2026.				

4.2.2 Discussion

Programs within the human performance management SCA are intended to ensure that OPG has a sufficient number of qualified workers available in all relevant job areas and that workers have the necessary knowledge, skills, procedures, and tools in place to safely carry out their duties. CNSC staff determined that OPG continues to maintain programs in human performance, personnel training, personnel certification, work organization and job design, and fitness for duty that meet CNSC regulatory requirements.

During the licence period, CNSC staff have conducted compliance verification activities related to the human performance management SCA. These activities include inspections of the human performance program, the training program, various certification examinations and tests, and the fitness for duty program, as well as reviews of required submissions such as event reports and staffing reports. Non-compliant findings resulting from these activities have been of low or negligible safety significance, and OPG has implemented or proposed satisfactory corrective actions to address all non-compliant findings.

Details pertaining to the specific areas within this SCA are presented in the following subsections.

Human performance program

A human performance program contains an organization's processes and procedures that support workers in safely carrying out their tasks to the desired levels of performance. The program considers and manages the factors that can influence human performance, such as the fitness for duty of workers (workers are physically and mentally capable of performing their duties competently and safely), training, staffing, procedures, processes, and the design of equipment. A human performance program addresses the need for specific training, practice, and rehearsal of emergency tasks, and considers how extreme conditions may influence human performance.

During the licence period, CNSC staff have verified that OPG has a human performance program in place at the Pickering NGS that complies with applicable regulatory requirements. OPG is continuously making improvements to the program to ensure that the human performance program equips workers to conduct their activities safely. [12]

Personnel training

Systematic approach to training (SAT) is the framework endorsed by the CNSC for establishing and maintaining training for persons working in nuclear facilities. An SAT-based training system provides the basis for the analysis, design, development, implementation, evaluation, documentation, and management of training for workers. It also provides a method to demonstrate that the required knowledge, skills, and safety-related attributes have been attained through a performance-based assessment and that program evaluations are carried out to ensure training programs reflect the operations of the facility.

REGDOC-2.2.2, *Personnel Training* sets out the CNSC's requirements for licensees regarding the development and implementation of a training system. REGDOC-2.2.2 also provides guidance on how these requirements should be met. OPG has a well-established SAT-based training system described in OPG documents that is compliant with the CNSC training requirements stipulated in REGDOC-2.2.2.

During the licence period CNSC staff have conducted compliance verification activities of OPG training programs for different job families to verify that the SAT-based training system continues to be adequately implemented at Pickering NGS. These compliance verification activities were performed for leadership, shift manager and control room shift supervisor, fuel handling, emergency response organization, and fire protection training programs.

CNSC staff conclude that the various training programs at Pickering NGS are defined, designed, developed, evaluated, and managed in accordance with the many processes and procedures that constitute the OPG's SAT-based training system and that OPG continues to meet regulatory requirements. CNSC staff continue to closely monitor the performance of OPG in this area through ongoing compliance activities.

Personnel certification

In April 2020, the Commission amended OPG's PROL for the Pickering NGS to replace RD-204, *Certification of Persons Working at Nuclear Power Plants* with REGDOC-2.2.3, *Personnel Certification, Volume III: Certification of Persons Working at Nuclear Power Plants* in licence condition 2.4. REGDOC-2.2.3, *Volume III* specifies the requirements to be met by persons working, or seeking to work, in the various positions for which a certification by the CNSC is required. It also specifies the requirements regarding the programs and processes supporting certification of their workers that nuclear power plant licensees must implement to train and examine persons seeking or holding a certification issued by the CNSC.

The positions at the Pickering NGS that require certification by the CNSC are:

- Responsible health physicist
- Authorized nuclear operator
- Control room shift supervisor
- Shift manager

In its application, OPG indicated that there are adequate numbers of certified personnel and included the number of these certified staff and trainees as of December 31, 2022. [12]

During the licence period, CNSC staff performed reviews of the certification program, including inspections of certification examinations and requalification tests and reviews of confidential staffing reports for certified personnel that detail current staffing levels at the Pickering NGS.

In 2021, based on the planned shutdown of all operating units in 2024, the Pickering NGS initial certification examination program was terminated. In 2023, OPG revived this program to ensure the availability of adequate numbers of certified staff in preparation for the possible operation of units 5–8 beyond 2024. Additionally, OPG is introducing the use of multiple-choice questions in its general certification examinations. The first such certification examination will occur in 2024, and CNSC staff will monitor the performance of this program.

Since 2022, CNSC staff have focused inspections and reviews on the requalification testing program. Through these compliance activities, CNSC staff have verified that the certification program at the Pickering NGS complies with applicable regulatory requirements. CNSC staff will continue to monitor the overall health of OPG's personnel certification programs via compliance activities scheduled as part of the CNSC's baseline inspection program during the licence period.

Work organization and job design

Minimum shift complement is a well-established concept that ensures that there are a sufficient minimum number of qualified staff, including certified staff, at the station at all times in case of a resource-intensive event. OPG has reported a small number of minimum shift complement violations to the CNSC during the licence period. These violations were of short duration and had negligible safety significance. In each case, OPG took appropriate corrective actions. OPG continues to meet CNSC regulatory requirements and has processes and procedures in place to ensure the availability of a sufficient number of qualified staff.

Fitness for duty

OPG monitors the number of hours worked by workers who perform safety-sensitive work at the Pickering NGS, in accordance with the requirements detailed in REGDOC-2.2.4, *Fitness for Duty: Managing Worker Fatigue*. OPG implemented REGDOC-2.2.4 in 2019. OPG has an hours of work process that

ensures hours worked do not exceed regulatory limits, workers have adequate recovery periods between shifts, and worker fatigue is identified and managed.

REGDOC-2.2.4, *Fitness for Duty, Volume II: Managing Alcohol and Drug Use, Version 3* was added to the Pickering NGS LCH in 2021. However, on January 21, 2022, the Federal Court granted an injunction to the Power Workers Union (PWU) putting on hold the implementation of pre-placement and random alcohol and drug testing pending the results of the Federal Court's judicial review.[2] The remainder of the requirements of REGDOC-2.2.4, *Volume II* have remained compliance verification criteria in the LCH. On June 6, 2023, the Federal Court released its decision dismissing the judicial review and supporting the CNSC's position on this matter.[3] The court's judgement stated that the pre-placement and random testing provisions do not infringe on the *Canadian Charter of Rights and Freedoms*, and the CNSC's decision to require pre-placement and random testing was reasonable.

The PWU has appealed this decision, and on October 27, 2023, the Federal Court of Appeal granted a motion to stay the implementation pending the determination of the appeal.[4] As such, CNSC staff have withdrawn the actions on all applicable licensees, including OPG, to implement random and pre-placement testing by December 1, 2023. CNSC staff will revisit the implementation timelines once a decision from the Federal Court of Appeal is received.

4.2.3 Summary

A summary of OPG's past performance, CNSC staff's regulatory focus, and proposed improvements are presented in the following subsections.

4.2.3.1 Past Performance

OPG's human performance management programs in place at the Pickering NGS continues to meet CNSC regulatory requirements and expectations. OPG has maintained satisfactory performance across the specific areas of this SCA during the licence period.

4.2.3.2 Regulatory Focus

CNSC staff will continue to verify OPG's performance and compliance with regulatory requirements in all aspects of the human performance management SCA through normal regulatory oversight activities, including inspections. A focus of this oversight activity will be OPG's implementation of multiple-choice certification examinations.

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[2] *Power Workers Union v. Canada (Attorney General)*, 2022 FC 73 | CanLII

[3] The respondents in the case included the Attorney General of Canada, OPG, Bruce Power, New Brunswick Power & Canadian Nuclear Laboratories.

[4] *Power Workers' Union v. Canada (Attorney General)*, 2023 FCA 215. | CanLII

4.2.3.3 Proposed Improvements

No changes are anticipated for this SCA.

4.2.4 Conclusion

CNSC staff conclude that OPG continues to meet regulatory requirements related to the human performance management SCA. Based on CNSC staff's assessment of OPG's application, supporting documentation, and performance during the licence period, OPG's existing human performance management programs at the Pickering NGS are adequate for continued operation of units 5–8 to December 31, 2026.

4.3 Operating Performance

The operating performance SCA includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.

This CMD covers the following specific areas of this SCA:

- Conduct of licensed activity
- Procedures
- Reporting and trending
- Outage management performance
- Safe operating envelope
- Severe accident management and recovery
- Accident management and recovery

OPG's PROL includes three licence conditions related to the operating performance SCA:

- Licence condition 3.1 requires OPG to implement and maintain an operations program, which includes a set of operating limits.
- Licence condition 3.2 states that OPG shall not restart a reactor after a serious process failure without the prior written approval of the Commission, or the prior written consent of a person authorized by the Commission. (More information on delegation of authority is included in section 6.6)
- Licence condition 3.3 requires OPG to notify and report in accordance with CNSC regulatory document REGDOC-3.1.1, *Reporting Requirements for Nuclear Power Plants*.

CNSC staff verify OPG's compliance with regulatory requirements in the operating performance SCA against the compliance verification criteria described in section 3.1, 3.2, and 3.3 of the Pickering NGS LCH.

4.3.1 Trends

The following table indicates the overall rating trends for the operating performance SCA over the current licence period:

TRENDS FOR OPERATING PERFORMANCE				
Overall Compliance Ratings				
2018	**2019**	**2020**	**2021**	**2022**
FS*	SA	SA	SA	SA
Comments				
OPG has demonstrated satisfactory (SA) performance in this SCA during the current licence period. Overall, CNSC staff conclude that OPG's programs within the operating performance SCA meet regulatory requirements and are adequate for continued commercial operations until the end of 2026. *As of 2019, CNSC staff no longer assign the fully satisfactory (FS) rating				

4.3.2 Discussion

The operations program establishes safe, uniform, and efficient operating practices within the nuclear facility, under all operating conditions, and provides the ability to ensure the facility is operated in accordance with the licensing basis. This includes the documents that define the safe operating envelope (SOE) of the facility.

OPG continues to operate the Pickering NGS in a safe and secure manner. CNSC staff determined that OPG maintains an effective operations program at the Pickering NGS in accordance with regulatory requirements and continues to meet the reporting requirements defined in REGDOC-3.1.1, *Reporting Requirements for Nuclear Power Plants*.

Details pertaining to the specific areas within this SCA are presented in the following subsections.

Conduct of licensed activity

CNSC staff confirm that OPG has implemented an operating policies and principals (OP&Ps) document that establishes the operational activities at the Pickering NGS. The OP&Ps state the operating boundaries within which the station may be operated safely and specify how OPG will operate, maintain, and modify station systems while controlling risk to people. CNSC staff conduct compliance verification activities of Pickering NGS operations against the requirements of the OP&Ps and other applicable requirements and have concluded that licensed activities continue to be conducted safely.

Table 3 shows the number of unplanned reactor transients at Pickering NGS units 5–8 during the licence period. An unplanned transient or power change may indicate problems within the plant equipment and can place undesired strain on plant systems. Reactor transients include reactor trips, stepbacks, and setbacks. Since 2019, OPG has maintained performance with respect to unplanned transients that is in line with the industry average and CNSC staff note an improving trend over the licence period.

Table 3: Unplanned transients reported for Pickering NGS units 5–8

	2018	2019	2020	2021	2022
Unplanned reactor trips	2	0	0	0	1
Stepbacks	0	0	0	0	0
Setbacks	10	5	3	5	1
Total	**12**	**5**	**3**	**5**	**2**

CNSC staff found that all transients were properly controlled and a power reduction was automatically initiated by the reactor control systems.

In a letter dated April 11, 2023, [25] CNSC staff requested that OPG provide implementation plans for 13 new and revised REGDOCs and CSA standards in anticipation of OPG's licence amendment application to operate units 5–8 beyond 2024. As of December 2023, OPG has provided the requested information and has implemented 8 of these new and revised REGDOCs and standards. CNSC staff are satisfied with the current status of OPG's implementation plans and expect OPG to implement the remaining 5 items during the licence period.

Procedures

Procedures are essential for safe execution of authorized activities because they support and guide workers' interactions among themselves and with systems, as well as responses to safety-related events. Procedure development refers to the integration of human factors engineering principles and criteria in a procedure development program. This is to ensure that the resulting procedures support and guide human interaction with plant systems and plant-related events and activities, and are technically accurate, comprehensive, explicit, easy to use, and validated.

CNSC staff oversight in this specific area focuses on verifying that the licensee has an adequate process for the development, verification, validation, implementation, modification, and use of procedures, which takes into account human performance considerations. CNSC staff also verify that there are demonstrated mechanisms to show that procedures are developed in a consistent manner using technical guides for accuracy and usability; these mechanisms ensure appropriate adherence to properly written procedures.

CNSC staff compliance verification activities have found that OPG continues to have mature and efficient governance in place to ensure that procedures are written in a consistent and usable manner. Pickering has clearly documented expectations for procedural use and adherence, and a process to manage procedural change.

Reporting and trending

OPG submits reports for the Pickering NGS in accordance with REGDOC-3.1.1. These reports include required event reports, as well as routine reports such as quarterly safety performance indicator reports. OPG continues to meet regulatory requirements with respect to reporting and trending.

Outage management performance

In order to ensure that Pickering NGS remains fit for service, outages are planned and undertaken by OPG to conduct maintenance, testing, or inspections that cannot be performed when the reactor is at power.

In addition to planned outages, OPG also undertakes forced unplanned outages as required to fix or replace equipment. These outages and their outcomes are communicated to the Commission via Event Initial Reports, the status report on power reactors, or the annual NPGS ROR as required.

OPG continues to meet regulatory requirements regarding outage management performance.

Safe operating envelope (SOE)

A licensed NPP must be controlled in accordance with a set of operational safety requirements, supported by the safety analysis, within the boundaries of the SOE. The SOE is the set of limits and conditions within which the NPP must be operated, and which is monitored and controlled by the operator. The objective of the SOE is to ensure conformance with the safety analyses assumptions and results. OPG's implementation of the SOE maintains the reactors operating in their analyzed states thereby ensuring adequate safety at all times. The SOE is part of the licensing basis.

OPG has implemented an SOE program at the Pickering NGS in accordance with CSA N290.15-10, *Requirements for the Safe Operating Envelope of Nuclear Power Plants*. The limits and conditions defined by the SOE are documented in operational safety requirements (OSR) documents.

Field inspections performed in 2023 identified non-compliant findings related to the SOE at the Pickering NGS. CNSC staff discovered that changes had been made to operating documentation such that the documentation no longer reflected the defined SOE. OPG was found to be non-compliant with the notification requirements of licence condition G.2 and SOE requirements of CSA N290.15. OPG has put corrective actions in place to address the non-compliant findings. CNSC staff continue to monitor the implementation of OPG's corrective actions to prevent recurrence and have been satisfied with these corrective actions to date.

Integrated accident management and recovery

OPG has abnormal incident manuals and emergency operating procedures in place to respond to abnormal incidents in order to return the plant to a safe and controlled state, and to prevent the escalation of abnormal incidents into more serious accidents. A severe accident management program provides an additional layer of defence against the consequences of beyond design basis accidents

(BDBAs), including severe accidents. Severe accident management guidelines ensure that personnel involved in managing a BDBA have the information, procedures, and resources necessary to carry out effective on-site actions.

REGDOC-2.3.2, *Accident Management, Version 2* sets out requirements and guidance for the development, implementation, and validation of integrated accident management for reactor facilities. OPG implemented REGDOC-2.3.2, *Version 2* in April 2023. CNSC staff are satisfied that OPG continues meets regulatory requirements related to accident management and recovery. Additional information pertaining to emergency management, including the conduct of exercises, can be found in section 4.10.

4.3.3 Summary

A summary of OPG's past performance, CNSC staff's regulatory focus, and proposed improvements are presented in the following subsections.

4.3.3.1 Past Performance

OPG's operations program continues to meet CNSC regulatory requirements. In 2023, CNSC staff identified non-compliant findings related to the SOE but are satisfied with OPG's actions to date to address these findings. OPG also continues to maintain satisfactory performance with respect to the reporting requirements of REGDOC 3.1.1.

4.3.3.2 Regulatory Focus

CNSC staff will continue to verify OPG's performance and compliance with regulatory requirements in all aspects of the operating performance SCA through regulatory oversight activities including inspections and reviews of compliance reports and other licensee submissions.

4.3.3.3 Proposed Improvements

No changes are anticipated for this SCA.

4.3.4 Conclusion

CNSC staff conclude that OPG continues to meet regulatory requirements related to the operating performance SCA. Based on CNSC staff's assessment of OPG's application, supporting documentation, and performance during the licence period, OPG's existing operations program at the Pickering NGS is adequate for continued operation of units 5–8 to December 31, 2026.

4.4 Safety Analysis

The safety analysis SCA covers maintenance of the safety analyses that support the overall safety case for the facility. Safety analysis is a systematic evaluation of the potential hazards associated with the conduct of a proposed activity or facility and considers the effectiveness of preventative measures and strategies in reducing the effects of such hazards.

This CMD covers the following specific areas of this SCA:

- Deterministic safety analysis
- Hazard analysis
- Probabilistic safety analysis
- Criticality safety
- Severe accident analysis
- Management of safety issues (including R&D programs)

Licence condition 4.1 of OPG's PROL requires OPG to implement and maintain a safety analysis program. CNSC staff verify OPG's compliance with regulatory requirements in the safety analysis SCA against the compliance verification criteria described in section 4.1 of the Pickering NGS LCH.

4.4.1 Trends

The following table indicates the overall rating trends for the safety analysis SCA over the current licence period:

TRENDS FOR SAFETY ANALYSIS				
Overall Compliance Ratings				
2018	**2019**	**2020**	**2021**	**2022**
FS*	SA	SA	SA	SA
Comments				
OPG has demonstrated satisfactory (SA) performance in this SCA during the current licence period. Overall, CNSC staff conclude that OPG has met the applicable regulatory requirements for the safety analysis SCA at the Pickering NGS and that the programs within this SCA are adequate for continued commercial operations until the end of 2026. *As of 2019, CNSC staff no longer assign the fully satisfactory (FS) rating				

4.4.2 Discussion

OPG has implemented and maintains safety analysis programs at the Pickering NGS in accordance with regulatory requirements. The CNSC requires OPG to conduct safety analyses to demonstrate that the station meets relevant safety requirements and that the design continues to provide adequate prevention and mitigation to protect against accidents.

During the licence period, CNSC staff have reviewed a number of submissions related to the different aspects of safety analysis and no issues of major concern were identified. CNSC staff have also performed inspections, such as of the software quality assurance program, and OPG has provided acceptable corrective action plans to address CNSC staff findings.

Details pertaining to the most significant reviews within the specific areas in this SCA are presented in the following subsections.

Deterministic Safety Analysis

Implementation of REGDOC-2.4.1 Deterministic Safety Analysis

In the 2018 renewal Record of Decision, the Commission expressed its expectation that OPG implement REGDOC-2.4.1, *Deterministic Safety Analysis* during the licence period. In 2021, OPG provided an update on its implementation plan that included implementation activities for the 2022-2024 period, which was accepted by CNSC staff. [26] In December 2023, OPG provided CNSC staff with a status update on OPG's REGDOC-2.4.1 implementation activities, and OPG continues to provide updated implementation plans regularly. [21]

Safety Report Update

In accordance with REGDOC 3.1.1, OPG is required to provide an updated safety report at least every 5 years, or when directed by the CNSC. In October 2022, OPG submitted Part 1 (Plant/Site Description) and Part 2 (Design Description) of the Pickering NGS Units 5–8 Safety Report. [27] Part 3 (Accident Analysis) was last updated and submitted to the CNSC in October 2019. CNSC staff have found that OPG's safety report meets regulatory requirements.

Impact of Aging on the Safety Analysis Margins

As the reactor core ages, aging of various structures, systems, and components (SSCs) have an impact on the overall safety case of the reactor. OPG has an aging management program in place that includes systematic monitoring of aging related parameters important to safety analysis and assessment of the impact of the change in core conditions on existing safety margins.

Presently, Pickering NGS units 5–8 operate at full power with adequate safety margins. In March 2023, [28] OPG submitted the safety analysis for the impact of aging on safety margins for small loss of coolant accident, loss of regulation, and loss of flow for reactor operation until April 2025. CNSC staff were satisfied with OPG's safety case and agreed that the analysis demonstrates that there is adequate safety margin. OPG has committed to update this analysis to account for the proposed operation until the end of 2026 by December 2024, and this commitment has been included in the PSR2-B IIP.

Hazard Analysis and Probabilistic Safety Assessment

A hazards analysis is used to demonstrate the ability of the NPP design to effectively respond to common-cause events by confirming that the NPP design incorporates sufficient diversity and physical separation to cope with these events. It also confirms that credited SSCs are qualified to survive and can function as required during an event.

For Pickering NGS, hazard screening analysis is conducted as an initial step to probabilistic safety assessments (PSAs). This involves the assessment and screening of various types of hazards, including internal and external hazards, both naturally occurring and human induced. Based on the hazard screening process, PSAs are developed for internal events, internal floods, internal fires, seismic events, and high winds.

In 2020, OPG implemented REGDOC 2.4.2, *Probabilistic Safety Assessment for Nuclear Power Plants* at the Pickering NGS. As per the 2018 renewal Record of Decision, updates on OPG's PSA methodology have been provided through the annual NPGS ROR. In accordance with the requirements of REGDOC 2.4.2, OPG updated the Pickering NGS units 5–8 PSAs in 2022, [29] as well as the supporting hazard screening analysis. [30]

CNSC staff found that OPG's 2022 hazard screening analysis for Pickering NGS units 5–8 was prepared in accordance with the requirements of REGDOC-2.4.2. [31] To account for potential impacts of climate change on flood hazard, OPG has agreed with CNSC staff's recommendation to update the probable maximum precipitation estimate using most recent data for the next iteration of the Pickering NGS units 5–8 PSA update process. [21]

CNSC staff have reviewed the updated 2022 Pickering NGS units 5–8 PSAs and found that the PSAs meet the intent of the submission requirements of REGDOC-2.4.2. CNSC staff note that the large release frequency reported in the 2022 Pickering NGS units 5–8 high wind PSA has increased since 2017 and is now above OPG's administrative safety goal but remains below the CNSC accepted safety goal.[5] As a result, OPG will investigate practical opportunities for implementing improvements to further reduce the risk, in accordance with its risk and reliability program. It is CNSC staff's expectation that OPG's risk reduction plan will include consideration of physical changes and improvement in operating procedures, as well as the refinement of the risk analysis.

Criticality Safety

Criticality safety focuses on the prevention of the criticality of fuel outside of the core, for both new and irradiated fuel. Pickering NGS reactors use natural uranium fuel which cannot achieve a criticality in air or in light water. New fuel is stored in such a manner that it cannot be made critical. Irradiated natural uranium fuel is stored under light water and cannot be made critical in any configuration; therefore, no criticality risk exists in the irradiated fuel bays of Pickering NGS.

Severe Accident Analysis

REGDOC-2.4.1 requires performance of deterministic analysis of BDBAs to support the evaluation of safety goals and to demonstrate that the procedures/guidelines and equipment put in place to mitigate consequences of severe accidents can handle the severe accident management needs. REGDOC-2.4.2 requires that assessments of severe accidents be included as part of the Level 2 PSA.

Management of Safety Issues (including R&D programs)

During the licence period, CNSC staff continued to undertake systematic evaluations of OPG research and development (R&D) program activities, as

[5] OPG's administrative safety goal is a frequency of $1x10^{-6}$ per reactor year, or once in 1,000,000 years, as compared to the CNSC accepted safety goal of $1x10^{-5}$ per reactor year, or once in 100,000 years.

submitted to CNSC staff through annual reports in accordance with REGDOC-3.1.1. These evaluations confirm that OPG maintains, or has access to, a robust R&D capability to address any emerging issues.

As detailed at the 2018 relicensing hearing, [3] OPG has been participating in the resolution of CANDU Safety Issues (CSIs). CNSC staff will continue to provide the Commission with the status of CSIs through the annual NPGS ROR.

4.4.3 Summary

A summary of OPG's past performance, CNSC staff's regulatory focus, and proposed improvements are presented in the following subsections.

4.4.3.1 Past Performance

OPG's safety analysis programs continue to meet CNSC regulatory requirements. OPG has maintained satisfactory performance across the specific areas of this SCA during the licence period.

4.4.3.2 Regulatory Focus

CNSC staff will continue to monitor OPG's performance and compliance with regulatory requirements in all aspects of the safety analysis SCA through regulatory oversight activities, including the review of updated safety analysis-related submissions, such as improvement plans related to the high wind PSA.

OPG's revised REGDOC-2.4.1 implementation plan for the 2022-2024 period identifies additional activities to be undertaken, to comply with the requirements of REGDOC-2.4.1. OPG is expected to provide the CNSC with a revised implementation plan by December 2024. CNSC staff will continue to review all related submissions to verify compliance with REGDOC-2.4.1 requirements.

4.4.3.3 Proposed Improvements

As discussed in section 3, OPG's Pickering NGS PSR2-B IIP includes 5 IIP commitments related to the safety analysis SCA. [19] These commitments are related to updating the heat transport system aging safety analysis models and performing the required safety analysis of events most impacted by aging, including small break loss of coolant accident, loss of flow, and neutron overpower protection.

4.4.4 Conclusion

CNSC staff conclude that OPG continues to meet regulatory requirements related to the safety analysis SCA. Based on CNSC staff's assessment of OPG's application, supporting documentation, and performance during the licence period, OPG's safety analyses for the Pickering NGS are adequate for continued operation of units 5–8 to December 31, 2026.

4.5 Physical Design

The physical design SCA relates to activities that impact the ability of structures, systems and components to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.

This CMD covers the following specific areas of this SCA:

- Design governance
- Facility design
- Structure design
- System design
- Component design

OPG's PROL includes three licence conditions related to the physical design SCA:

- Licence condition 5.1 requires OPG to implement and maintain a design program.
- Licence condition 5.2 requires OPG to implement and maintain a pressure boundary program and have in place a formal agreement with an Authorized Inspection Agency.
- Licence condition 5.3 required OPG to implement and maintain an equipment and structure qualification program.

CNSC staff verify OPG's compliance with regulatory requirements in the physical design SCA against the compliance verification criteria described in section 5.1, 5.2, and 5.3 of the Pickering NGS LCH.

4.5.1 Trends

The following table indicates the overall rating trends for the physical design SCA over the current licence period:

TRENDS FOR PHYSICAL DESIGN				
Overall Compliance Ratings				
2018	**2019**	**2020**	**2021**	**2022**
SA	SA	SA	SA	SA
Comments				
OPG has demonstrated satisfactory (SA) performance in this SCA during the current licence period. Overall, CNSC staff conclude that OPG's programs within the physical design SCA meet regulatory requirements and are adequate for continued commercial operations until the end of 2026.				

4.5.2 Discussion

OPG's programs within the physical design SCA ensure that plant design is managed using a well-defined systematic approach. CNSC staff determined that OPG continues to maintain design programs under the physical design SCA in accordance with applicable standards and meet CNSC regulatory requirements.

During the licence period, CNSC staff have conducted several inspections, as well as reviewed event reports and required reporting such as the quarterly pressure boundary reports and the annual fuel performance reports. Inspections have included the physical design, environmental qualification, and seismic programs, as well as the irradiated fuel bays, electrical power systems, and fire protection systems. OPG has addressed all inspection findings to CNSC staff's satisfaction.

Details pertaining to the specific areas within this SCA are presented in the following subsections.

Design governance

Design program

OPG has a design management program that covers changes to systems, structures, components, software, and engineered tools. This program describes the interrelationship between interfacing engineering program and documentation. CNSC staff monitor the design management program through regular compliance verification activities.

Pressure boundary program

OPG has a mature, well-developed pressure boundary program that is comprised of many sub-programs, processes, and procedures to ensure compliance with requirements, including of CSA N285.0, *General requirements for pressure-retaining systems and components in CANDU nuclear power plants*. As required by its PROL, OPG has a formal service agreement with the Technical Standards and Safety Authority as the authorized inspection agency.

On the basis of inspections and document reviews conducted during the licence period, CNSC staff conclude that OPG's pressure boundary program continues to be in compliance with CNSC regulatory requirements.

Human factors in design

OPG's engineering change control process is well-established and ensures that human factors are considered in design activities. In accordance with CSA N290.12-14, *Human Factors in Design for Nuclear Power Plants*, OPG's design process incorporates human factors principles and practices.

Environmental qualification

OPG's environmental qualification program at the Pickering NGS ensures all required SSCs are capable of performing designated safety functions in the harsh environment that could result from design basis accidents. OPG is required to maintain an environmental qualification program in accordance with CSA

N290.13, *Environmental Qualification of Equipment for CANDU Nuclear Power Plants* to ensure equipment remains qualified for the life of the station.

Facility Design and Structure Design

Facility design and structure design pertain to the overall adequacy of the design of the facility and structures. OPG must ensure that changes to any aspects of design do not lead to non-conformance with the licensing basis. CNSC staff review changes against established criteria to ensure that they do not invalidate the limits or introduce hazards that are different in nature from those previously considered. The Pickering NGS facility design and structure design continue to meet regulatory requirements.

System Design and Component Design

System design and component design pertain to the adequacy of the design of specific systems and components. These include, but are not limited to, special safety systems, electrical power systems, instrumentation and control systems, and fuel bundles. CNSC staff verify OPG's design programs through inspections and the review of required submissions, such as annual reports.

Electrical Power Systems

CNSC staff are satisfied with the performance of electrical power systems at the Pickering NGS. A 2023 inspection resulted in one non-compliant finding related to OPG's cables aging program, for which OPG has implemented appropriate corrective actions. CNSC staff conclude that the electrical power system SSCs are adequate for continued commercial operations to the end of 2026.

Fire protection design

OPG implemented the 2017 update to CSA N293-12, *Fire protection for CANDU nuclear power plants* at the Pickering NGS in 2023. CNSC staff have performed inspections during the licence period to confirm that OPG meets the requirements defined by CSA N293-12. More information on OPG's fire protection program is included in section 4.10.

Fuel Design

OPG has a well-developed fuel inspection and monitoring program in place at the Pickering NGS. OPG provides annual fuel performance reports to the CNSC, which CNSC staff review. CNSC staff are satisfied with the performance of the fuel inspection and monitoring program at the Pickering NGS.

4.5.3 Summary

A summary of OPG's past performance, CNSC staff's regulatory focus, and proposed improvements are presented in the following subsections.

4.5.3.1 Past Performance

OPG's design, pressure boundary, and equipment and structure qualification programs in place at the Pickering NGS continue to meet CNSC regulatory

requirements. OPG has maintained satisfactory performance across the specific areas of this SCA during the licence period.

4.5.3.2 Regulatory Focus

CNSC staff will continue to verify OPG's performance and compliance with regulatory requirements in all aspects of the physical design SCA through regulatory oversight activities including inspections and reviews of required licensee submissions, such as annual reports or revisions to program documentation.

4.5.3.3 Proposed Improvements

As discussed in section 3, OPG's Pickering NGS PSR2-B IIP includes 2 IIP commitments related to the physical design SCA. [19] These commitments are regarding the reassessment of existing environmental qualification assessments to support commercial operation of Pickering NGS units 5–8 until the end of 2026. CNSC staff expect OPG to complete these actions in 2024, before the start of the extended commercial operation period.

4.5.4 Conclusion

CNSC staff conclude that OPG continues to meet regulatory requirements related to the physical design SCA. Based on CNSC staff's assessment of OPG's application, supporting documentation, and performance during the licence period, OPG's existing design, pressure boundary, and equipment and structure qualification programs at the Pickering NGS are adequate for continued operation of units 5–8 to December 31, 2026.

4.6 Fitness for Service

The fitness for service SCA covers activities that impact the physical condition of structures, systems and components to ensure that they remain effective over time. This area includes programs that ensure all equipment is available to perform its intended design function when called upon to do so.

This CMD covers the following specific areas of this SCA:

- Equipment fitness for service / equipment performance (reliability)
- Maintenance
- Aging management
- Periodic inspection and testing
- Structural integrity
- Chemistry control

Licence condition 6.1 of OPG's PROL requires OPG to implement and maintain a fitness for service program. CNSC staff verify OPG's compliance with regulatory requirements in the fitness for service SCA against the compliance verification criteria described in section 6.1 of the Pickering NGS LCH.

CNSC staff are recommending that the Commission include a new licence condition 6.2 in OPG's PROL that requires OPG to implement and maintain an enhanced fitness for service program for fuel channels in extended operation.

4.6.1 Trends

The following table indicates the overall rating trends for the fitness for service SCA over the current licence period:

TRENDS FOR FITNESS FOR SERVICE				
Overall Compliance Ratings				
2018	**2019**	**2020**	**2021**	**2022**
SA	SA	SA	SA	SA
Comments				
OPG has demonstrated satisfactory (SA) performance in this SCA during the current licence period and continues to maintain adequate programs to ensure the fitness for service of SSCs. Overall, CNSC staff conclude that OPG's programs within the fitness for service SCA meet regulatory requirements and are adequate for continued commercial operations until the end of 2026.				

4.6.2 Discussion

OPG continues to maintain adequate programs to ensure the fitness for service of the SSCs important to safety, and of other safety related SSCs at the Pickering NGS, in accordance with regulatory requirements. OPG has implemented the following standards and REGDOCs that include requirements related to the fitness for service SCA.

- REGDOC 2.6.1, *Reliability Programs for Nuclear Power Plants*
- REGDOC 2.6.2, *Maintenance Programs for Nuclear Power Plants*
- REGDOC 2.6.3, *Aging Management*
- CSA N285.4-05, *Periodic inspection of CANDU nuclear power plant components*
- CSA N285.5-08, *Periodic inspection of CANDU nuclear power plant containment components*
- CSA N285.8-15 Update 1, *Technical requirements for in-service inspection evaluation of zirconium alloy pressure tubes in CANDU reactors*
- CSA N287.1-14, *General requirements for concrete containment structures for nuclear power plants*
- CSA N287.7-17, *In-service examination and testing requirements for concrete containment structures for CANDU nuclear power plant components*

In April 2023, OPG submitted an assessment demonstrating the continued fitness for service of Pickering NGS units 5–8 major components (feeders, fuel channels and steam generators) to support the continued commercial operations until the

end of 2026. [13] Additionally, OPG has identified several actions in the PSR2-B IIP related to the continued demonstration of major component fitness for service, as well as relevant open CNSC action items. CNSC staff reviewed OPG's fitness for service assessment [13] and found it to be acceptable. [32]

The current Commission approved operating limit for Pickering NGS units 5–8 pressure tubes is 295,000 EFPH. Operation until the end of 2026 is expected to exceed this limit for some units 5–8 pressure tubes, and OPG has requested an increase to the current pressure tube operating limit. [12] OPG has conservatively projected a new end of life for operation of the units 5–8 major components, including pressure tubes, of up to 305,000 EFPH for the lead unit (Unit 6). OPG's projected EFPH of each unit for operation to the end of 2026 is provided in Table 4.

Table 4: Projected EFPH to the end of 2026 for Pickering NGS units 5–8

Unit	Projected EFPH
5	297,500
6	305,000
7	298,000
8	283,000

CNSC staff agreed with OPG's proposed approach to demonstrate the continued fitness for service of major components for operation to the end of 2026 and up to 305,000 EFPH. CNSC staff expect OPG to:

- Complete the IIP actions related to the demonstration of fitness for service of major components.
- Complete the open CNSC action items and OPG commitments related to fitness for service of fuel channels.
- Continue to demonstrate fitness for service of major components on an ongoing basis following established processes and through regular inspections, consistent with the component specific life cycle management plan (LCMP) and regulatory requirements.

Details pertaining to the specific areas within this SCA are presented in the following subsections with highlights on programs and particular systems within these specific areas where appropriate.

Equipment Fitness for Service / Equipment Performance (Reliability)

CNSC staff have verified that OPG has programs in place to manage the impact of aging on equipment and provide condition monitoring through safety system tests, inspections, assessments, and reviews of OPEX. System and component health reports are produced regularly to summarize performance indicators and highlight any issues, such as failures, maintenance backlogs, and aging.

Reliability

OPG maintains a reliability program for systems and components important to safety in accordance with REGDOC-2.6.1. CNSC staff have been satisfied with OPG's reliability program during the licence period.

The performance of systems important to safety (SIS) and components important to safety (CIS) are reported to the CNSC through the Annual Report on Risk and Reliability. During the licence period, the Pickering NGS has shown good reliability for SIS and CIS. A November 2023 type II Inspection further demonstrated the effectiveness of the reliability program.

CNSC staff conclude that the current reliability program for SIS and CIS is adequate to support the continued operations of Pickering NGS units 5–8. CNSC staff will continue to monitor the implementation of OPG's reliability program during the licence period.

Maintenance

CNSC staff consider the existing maintenance program at the Pickering NGS to be acceptable, and continuing implementation of this program is sufficient to support the continued operation of Pickering NGS units 5–8. During the licence period, OPG has improved its performance with respect to maintenance backlogs and the number of preventive maintenance deferrals.

Aging Management

OPG continues to manage aging of the Pickering NGS units 5–8 SSCs following an integrated framework in compliance with REGDOC-2.6.3. Under the Integrated Aging Management Program, OPG has implemented LCMPs for major components, which specify specific activities undertaken to continuously assess component condition and fitness for service.

The LCMPs provide the overall inspection scope to monitor the active aging degradation mechanisms affecting components and to detect the emergence of any new mechanism that could affect component performance. The LCMPs also include specific mitigating strategies to be implemented when fitness for service assessments cannot meet the defined acceptance criteria. OPG updates the LCMPs annually for major components, such as fuel channels, steam generators, feeders, and reactor internals. These updates are to include recent OPEX and, if needed, to adjust the inspection scope and maintenance strategy to ensure that major components operate safely.

CNSC staff consider OPG's integrated aging management program implemented at the Pickering NGS, including major component specific LCMPs, to be acceptable. Continued implementation of this integrated aging management program is sufficient for continued operations. CNSC staff will continue to monitor this program as part of the existing oversight strategy.

Periodic Inspection and Testing

OPG has implemented periodic inspection programs (PIPs) for pressure boundary components, containment components, and containment structures in accordance with CSA N285.4, CSA N285.5, and CSA N287.7.

As part of the PSR2 re-assessment (PSR2-B), OPG performed a gap assessment against the requirements of the 2019 edition of N285.4 for clauses 12, 13, and 14, pertaining to fuel channels, steam generators, and feeders. The gap assessment noted that the governing PIPs for fuel channels needed to be updated to comply with the requirements of the 2019 edition. OPG updated the PIPs for Pickering NGS units 5–8 fuel channels and submitted them for CNSC acceptance. After a detailed review of the gap assessments and updated PIPs for fuel channels, CNSC staff concluded that the updated PIPs are adequate to support continued operation of units 5–8. [33]

For steam generators no gaps were identified, and for feeders three gaps were identified that were deemed to be minor. CNSC staff agreed with OPG's conclusion that no updates to the governing PIP documentation were required.

The Pickering NGS units 5–8 PIPs for other pressure boundary components currently comply with the 2005 edition of CSA N285.4 and some selected requirements from the 2014 edition of CSA N285.4. OPG is currently working towards complete implementation of the 2019 edition of N285.4 and CNSC staff will continue to monitor OPG's progress. PIPs for containment components currently comply with the 2008 edition of CSA N285.5, Update 1, as well as certain requirements of the 2018 edition. OPG is currently working towards full implementation of the 2022 edition of CSA N285.5, and CNSC staff will continue to monitor OPG's progress.

OPG also carries out inspections on non-nuclear (balance-of-plant) pressure boundary components that have the potential to impact nuclear safety. Findings from these activities are reported to the CNSC in accordance with the reporting requirements of REGDOC-3.1.1.

Structural Integrity

OPG follows an approximately 30-month outage cycle for each reactor unit, whereby the reactor is shut down for regular inspection and maintenance activities. During the licence period, OPG has undertaken numerous inspections under the PIPs and in-service inspection programs of Pickering NGS units 5–8 for:

- Pressure boundary components under CSA N285.4
- Containment components under CSA N285.5
- Concrete containment structures under CSA N287.7

OPG evaluated all inspection findings to confirm that structural integrity margins are maintained and to confirm the fitness for service of the inspected SSCs. Where results indicated that margins were reducing, appropriate corrective actions

(such as repairs, replacement of components, or operation with restrictions) were implemented to restore adequate margins.

Fuel Channels

Fuel channels are a key pressure boundary component and are subject to several degradation mechanisms.[6] Based on its mature fuel channel LCMP, OPG has established a rigorous inspection and maintenance approach to inspect and maintain units 5–8 fuel channels. The inspection and testing strategy documented in the LCMP complies with the periodic inspection requirements of CSA N285.4.

OPG regularly monitors the condition of fuel channels via inspections and material surveillance testing programs to ensure that they remain within the fitness for service criteria specified in CSA N285.4 and CSA N285.8.

CNSC staff review all in-service inspection and material surveillance reports, as well as OPG evaluations of the current and future predicted state of pressure tube material. CNSC staff conclude that OPG's programs for demonstrating fitness for service of fuel channels are adequate for the continued operation of units 5–8. CNSC staff will continue to monitor the implementation of the periodic inspection and aging management programs with respect to fuel channels through the CNSC compliance program.

Further information on the monitoring of degradation mechanisms affecting units 5–8 fuel channels is provided below.

Fuel Channel Elongation

Operation of fuel channels results in elongation over time. Fuel channels are designed with bearings to accommodate this slow movement and elongation over the life of the reactor. Fuel channels must remain on-bearing as a design condition for continued operation and to ensure fitness for service. OPG has established robust inspection and maintenance strategies under its LCMP to ensure the fuel channels will remain on bearing until the target end-of-life of each Pickering NGS unit. OPG has planned additional elongation measurements in upcoming inspection outages, as well as necessary maintenance activities, to ensure fuel channels remain on-bearing.

Elevated Hydrogen Equivalent Concentration ([Heq])

In September 2021, CNSC Staff informed the Commission about the discovery of elevated hydrogen equivalent concentration ([Heq]) in CANDU pressure tubes in extended operation. [34] In response to the discovery, the CNSC issued orders to all CANDU reactor licensees in Canada, including to OPG for Pickering NGS units 5–8, informing them of certain conditions pertaining to the demonstration of pressure tube fitness for service prior to the restart of any reactor unit from an outage. In two separate records of decision, [35, 36] the Commission authorized the restart of Pickering NGS units 5–8 after an outage based on the demonstrated

[6] Appendix E.2 of CNSC staff's CMD for the 2018 relicensing hearing (CMD 18-H6) includes a comprehensive description of CANDU fuel channel degradation mechanisms.

low likelihood of flaws that could call into question the fitness for service of pressure tubes in the identified regions of interest (ROIs).

The fitness for service program requirements under licence condition 6.1 have been demonstrated to be effective for assuring safe operation of pressure tubes. However, many of the models and the evaluation processes used to assess pressure tube fitness for service in CSA N285.8 have not been validated for levels of [Heq] that have been observed in the ROIs near the rolled joint burnish marks in some pressure tubes in extended operation in other CANDU units. With respect to Pickering NGS units 5–8, OPG has demonstrated that there are no known active degradation mechanisms for the formation of flaws that are at risk for crack initiation within the pressure tube ROIs. Further, OPG has committed to participate in an industry wide research and development (R&D) program to investigate the elevated [Heq] issue and to develop an appropriate model to predict [Heq] in the vicinity of the inlet and outlet burnish mark.

Licence condition 15.3 had been included in OPG's PROL for better transparency, prior to operation with [Heq] beyond 120 parts per million (ppm), and to provide OPG with clear compliance verification criteria for maintaining pressure tube fracture toughness sufficient for safe operation. The compliance verification criteria for pressure tubes in extended operation has evolved and licence condition 15.3 no longer serves its intended purpose. Therefore, CNSC staff recommend that licence condition 15.3 be removed from OPG's PROL for the Pickering NGS and replaced with a new licence condition as outlined below.

Since the fitness for service criteria established in section 6.1 of the LCH cannot be applied for the ROIs of pressure tubes, CNSC staff recommend that the Commission include a new licence condition 6.2 in OPG's PROL for the Pickering NGS to require that OPG implement and maintain an enhanced fitness for service program for fuel channels in extended operation. To reflect the Commission's recent decisions, [35, 36] CNSC staff's proposed compliance verification criteria for this new licence condition will establish the requirements for OPG to report on the status of its R&D activities and the compliance verification approaches relating to the safe operability of pressure tubes when the validity of the fitness for service criteria established in licence condition 6.1 cannot be confirmed.

CNSC staff recommend that the Commission include the new licence condition 6.2 under the fitness for service SCA, section 6 of the PROL, to capture all fitness for service requirements under the same section of the PROL. CNSC staff recommend that the proposed licence condition 6.2 remain in place until the R&D work committed to by OPG is complete and until OPG can demonstrate, to the Commission's satisfaction, that the fitness for service criteria under licence condition 6.1 applicable to the ROIs of pressure tubes can be met.

CNSC staff will continue to monitor OPG's performance with respect to pressure tube fitness for service, through the compliance verification activities in relation to licence conditions 6.1 and 6.2. The proposed updated PROL, as well as relevant sections of the proposed updated LCH, are included in Part 2 of this

CMD. These proposed changes are in line with those accepted in a recent decision of the Commission. [37] As directed by the Commission as part of this decision, and beginning in November 2023, CNSC staff provide updates to the Commission on the [Heq] research and development program as part of the status report on power reactors presented at each Commission meeting.

Pressure Tube Flaw Assessments

OPG has a well-established process for the detection and evaluation of flaws in pressure tubes. This includes repeat inspection and replication of identified flaws to aid flaw evaluations. Additionally, OPG has established robust inspection strategies under the LCMP to inspect new channels to increase the amount of data supporting the demonstration of fitness for service of pressure tubes.

Due to the elevated outlet and inlet rolled joint [Heq] discoveries in other CANDU units, OPG has performed partial volumetric and dimensional inspections in multiple channels during recent outages to demonstrate with a high degree of confidence that the flaw population density in the regions of interest remains unchanged. OPG's inspections have concluded that there are no new or unexpected flaws in the vicinity of the inlet and outlet rolled joints. Full-length and partial-length volumetric and dimensional inspections in future outages will be used to continue to monitor flaws in this region.

CNSC staff continuously monitor these inspection and assessment results.

Pressure Tube Fracture Toughness

Increasing [Heq] reduces ductility and fracture toughness of pressure tube material. Fracture toughness is an influential property required to demonstrate leak-before-break and fracture protection of the fuel channel.

In 2022, OPG submitted a technical basis for the use of an updated fracture toughness model (Revision 2), expanding the [Heq] validity limit for the model. After a detailed review, CNSC staff conditionally accepted the updated fracture toughness model with limits in its application for deterministic and probabilistic evaluations. [38]

Through normal compliance activities, CNSC staff will continue to monitor the industry's work related to the development of the updated fracture toughness model.

Spacer Mobility and Pressure Tube to Calandria Tube Contact

Contact between pressure tubes (PT) and calandria tubes (CT) may lead to the formation of a brittle zirconium hydride blister at the contact location and eventually may lead to failure of the pressure tube.

Spacers in the annulus gap between the pressure tube and calandria tube (PT-CT) of CANDU fuel channels prevent contact between the two tubes. Most fuel channels in Pickering NGS units 5–8 are equipped with loose-fitting spacers and these spacers can shift and move during normal operating conditions. To ensure that spacers continue to maintain an adequate PT-CT gap, the spacers need to be inspected and periodically repositioned.

OPG has developed a program to predict which channels are more susceptible to spacer movement. Using this information, and other risk criteria such as first time to contact and hydrogen modelling, OPG selectively targets channels for inspection and maintenance. OPG has also performed measurements of the PT-CT gap in multiple channels in each unit to enhance modelling and prediction capabilities.

OPG has established robust inspection and maintenance scopes for upcoming outages under the LCMP to detect any potential PT-CT contact and, if contact is predicted before the end of commercial operations, to perform necessary maintenance.

Through normal compliance activities, CNSC staff continuously monitor assessment results and are satisfied that the likelihood of PT-CT contact is acceptably low.

Tight-fitting fuel channel spacers

Pickering NGS units 5–8 have 39 channels (one in unit 5 and 6, six in unit 7, and 31 in unit 8) equipped with tight-fitting spacers. OPG has inspected these channels and confirmed that the spacers are performing their intended function of maintaining sufficient PT-CT gap. The majority of unit 8 tight-fitting spacers were installed as part of pre-service installation, while the tight-fitting spacers in units 5, 6, and 7 were installed during single fuel channel replacements conducted throughout the life of the units. Therefore, regarding fitness for service, the tight-fitting spacers installed in unit 8 bound the tight-fitting spacers installed in other units. OPG has committed to demonstrate continued fitness for service of these spacers to their intended operational time through condition monitoring and analysis of pre-refurbishment, tight-fitting spacers from Darlington NGS.

Through normal compliance activities, CNSC staff will continue to monitor OPG's work related to the continued demonstration of fitness for service of tight-fitting spacers.

Calandria Tube to Liquid Injection Shutdown System Nozzle Contact

Contact between the CT and adjacent liquid injection shutdown system (LISS) nozzles may lead to fretting of the calandria tube and/or LISS nozzle. OPG has performed repeat CT-LISS gap measurements at Pickering NGS units 5–8 to monitor the gap and ensure adequate margins on time to first contact. OPG has also performed maintenance of the LISS nozzles in Pickering NGS unit 6, the lead unit, to increase the gap. OPG has established robust inspection and maintenance scopes for the upcoming outages under the LCMP to detect, and if needed remove, any potential CT-LISS contact.

CNSC will continue to monitor the effectiveness of these mitigation strategies and assessment results.

<u>Steam Generators</u>

OPG has established a rigorous inspection and maintenance approach, based on its LCMP, to inspect and maintain units 5–8 steam generators. The inspection

strategy documented in the steam generator LCMP complies with the periodic inspection requirements of CSA N285.4.

Under-deposit pitting corrosion is the dominant life limiting degradation mechanism affecting all units 5–8 steam generators. OPG is effectively managing this mechanism by performing regular inspection and maintenance, such as water lancing to remove the under deposits, every 4 to 5 years as part of the planned maintenance outages for each unit.

Through normal compliance activities, CNSC staff are continuously monitoring the effectiveness of inspection and assessment results, including the effectiveness of maintenance and mitigation strategies.

Feeders

OPG has an established inspection and maintenance strategy, under the feeders LCMP, to maintain the fitness for service of the feeders and to ensure that the effects of aging on feeder integrity are appropriately managed. The inspection and testing strategy documented in the feeder LCMP complies with the periodic inspection requirements of CSA N285.4.

Flow accelerated corrosion is the dominant life limiting active degradation mechanism affecting outlet feeders. OPG is effectively managing this corrosion through scheduled wall thickness measurements and stress analysis, using methodologies from feeder fitness for service guidelines, to determine the required wall thickness to maintain adequate safety margin and ensure fitness for service. Regarding inlet feeders, there are no known life limiting active degradation mechanisms and scheduled inspections, as per the LCMP, are deemed to be sufficient to demonstrate continued fitness for service.

Through normal compliance activities, CNSC staff are continuously monitoring the effectiveness of inspection and assessment results including the predicted minimum wall thickness.

Concrete and Containment Components

OPG has established an aging management plan for containment structures, as well as PIPs for containment components and concrete containment structures. These plans define the activities required to address aging related degradation in containment structures and components. Periodic inspection and testing of the concrete and other containment structures are conducted in accordance with the requirements of CSA N287.7, CSA 285.5, and the approved PIPs. This includes periodic inspections and leakage rate testing of the reactor buildings, vacuum building, and pressure relief duct.

In 2022, OPG conducted a vacuum building outage (VBO) at the Pickering NGS, in accordance with CNSC requirements. During the VBO, all units were shutdown to perform inspections of containment components that are not accessible during normal operations. VBOs are generally performed once every 10 to 12 years.

During the VBO, OPG performed inspections of the vacuum building and pressure relief duct, performed leakage rate testing, and conducted repairs as necessary. Overall, the results of the leakage rate testing of the vacuum building and pressure relief duct were above OPG's operational target, but within regulatory limits. As a result, OPG has put corrective actions in place to improve overall containment performance, and CNSC staff continue to monitor the implementation of OPG's corrective actions.

CNSC staff also conducted an inspection of OPG's activities during the VBO and identified non-compliant findings of low safety significance. CNSC staff will continue to monitor OPG's completion of corrective actions to address these findings.

Chemistry Control

OPG's chemistry control program specifies processes, overall requirements, and licensee accountabilities to ensure effective control of plant chemistry during operational and lay-up conditions. The program also includes control of laboratory methods, sampling and analyses, process chemicals, chemistry control performance monitoring, and reporting. These activities are performed in order to ensure critical plant equipment performs safely and reliably over the life of the station.

OPG provides quarterly reports on safety performance indicators that include the chemistry index and chemistry compliance index in accordance with REGDOC-3.1.1. CNSC staff consider the chemistry control program at the Pickering NGS to be acceptable. CNSC staff conclude that the current chemistry control program is adequate to support continued operation of Pickering NGS units 5–8. CNSC staff will continue to verify the compliance of OPG's chemistry control program as part of routine compliance verification activities.

4.6.3 Summary

A summary of OPG's past performance, CNSC staff's regulatory focus, and proposed improvements are presented in the following subsections.

4.6.3.1 Past Performance

OPG's fitness for service programs in place at the Pickering NGS, including aging management, LCMPs, and PIPs, continue to meet CNSC regulatory requirements. OPG has maintained satisfactory performance across the specific areas of this SCA during the licence period.

4.6.3.2 Regulatory Focus

CNSC staff will continue to verify that OPG demonstrates the ongoing fitness for service of major components and other SSCs at the Pickering NGS during the licence period. CNSC staff expect OPG to augment the major components condition assessments, particularly for pressure tubes, through additional inspections, research and development activities, and analysis to further understand and control aging mechanisms.

4.6.3.3 Proposed Improvements

As discussed in section 3, OPG's Pickering NGS PSR2-B IIP includes 17 IIP commitments related to the fitness for service SCA. [19] These commitments are regarding the continued demonstration of fitness for service of reactor components and structures, fuel channels (including spacers), feeders, and steam generators, as well as updating the fuel channel related PIPs. CNSC staff expect OPG to complete these actions by the end of 2024.

4.6.4 Conclusion

CNSC staff conclude that OPG continues to meet regulatory requirements related to the fitness for service SCA. Based on CNSC staff's assessment of OPG's application, supporting documents such as the assurance of major components' fitness for service, commitments in the PSR2-B IIP, and performance during the licence period, OPG's existing fitness for service programs at the Pickering NGS are adequate for continued operation of units 5–8 to December 31, 2026.

CNSC staff recommend that the Commission authorize OPG to operate units 5–8 pressure tubes up to 305,000 EFPH. CNSC staff note that OPG is expected to demonstrate, to CNSC staff's satisfaction, the ongoing fitness for service of Pickering NGS units 5–8 up until the planned end of commercial operations.

To reflect advancements in understanding related to pressure tube behaviour following identified elevated [Heq] in pressure tubes in extended operation, CNSC staff recommend that the Commission remove the existing licence condition 15.3 and include in OPG's PROL for the Pickering NGS a new licence condition 6.2 to require that OPG implement and maintain an enhanced fitness for service program for fuel channels in extended operation.

4.7 Radiation Protection

The radiation protection SCA covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*. The program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled and maintained as low as reasonably achievable (ALARA).

This CMD covers the following specific areas of this SCA:

- Application of ALARA
- Worker dose control
- Radiation protection program performance
- Radiological hazard control

Licence condition 7.1 of OPG's PROL requires OPG to implement and maintain a radiation protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days. CNSC staff verify OPG's compliance with regulatory requirements in the radiation protection SCA against the

compliance verification criteria described in section 7.1 of the Pickering NGS LCH.

4.7.1 Trends

The following table indicates the overall rating trends for the radiation protection SCA over the current licence period:

TRENDS FOR RADIATION PROTECTION				
Overall Compliance Ratings				
2018	**2019**	**2020**	**2021**	**2022**
SA	SA	SA	SA	SA
Comments				
OPG has implemented and maintained an effective radiation protection program at Pickering NGS, as required by the *Radiation Protection Regulations*. Over the licence period, no worker has received a radiation dose in excess of regulatory dose limits at the Pickering NGS. OPG has demonstrated satisfactory (SA) performance in this SCA during the current licence period. Overall, CNSC staff conclude that OPG's programs within the radiation protection SCA meet regulatory requirements and are adequate for continued commercial operations until the end of 2026.				

4.7.2 Discussion

The *Radiation Protection Regulations* require licensees to establish a radiation protection program to keep exposures ALARA, taking economic and social factors into account, through the implementation of a number of controls, including:

- Management control over work practices
- Personnel qualification and training
- Control of occupational and public exposures to radiation
- Planning for unusual situations

OPG's radiation protection program and its associated supporting governance documents are designed to address the requirements in the *Radiation Protection Regulations*. CNSC staff's assessment of OPG's programs within this SCA have determined that OPG has implemented and maintained an effective radiation protection program at the Pickering NGS that has met regulatory requirements. Detailed data pertaining to the radiation protection SCA, including doses to workers, is provided to the Commission through the annual NPGS RORs. [4-8]

Details pertaining to the specific areas within this SCA are presented in the following subsections.

Application of ALARA

OPG's commitment to the ALARA principle has been demonstrated through the implementation of the radiation protection program at the Pickering NGS. OPG's radiation protection program adheres to the ALARA principle by integrating ALARA measures into planning, scheduling, and work control; and by monitoring performance against ALARA targets for work conducted.

With respect to the operation of Pickering NGS units 5–8 until the end of 2026, OPG has identified [12] that the ALARA principle will continue to be implemented in accordance with OPG's radiation protection program. Some examples of current and ongoing ALARA initiatives include:

- Compliance with the annually established collective dose targets for units 5–8 that are based on the work projected to be performed during this time period
- Implementation of dose goals to improve individual and station dose performance
- Increased line accountability for both individual and work group dose
- Application of radiation protection lessons learned and operating experience
- Use of robotics to perform tasks in radioactive work areas
- Use of dynamic learning activities in simulated radioactive work environments
- Use of remote monitoring and real time data transmission
- Use of specialized resin in heat transport ion exchange columns to remove radiological contaminants and reduce dose rates from system equipment

In December 2022, CNSC staff conducted a desktop inspection to review the application of ALARA at the Pickering NGS and identified non-compliant findings of low and negligible safety significance. During the inspection, CNSC staff reviewed OPG's 5-year ALARA plan and found that OPG did not have the governance support documents in place to drive the creation and content of this plan. As a result, CNSC staff requested that OPG develop governance support documents to formalize the requirements for creating and maintaining a 5-year ALARA plan and create an implementation plan for corrective actions. CNSC staff will continue to monitor and assess OPG's implementation of these corrective actions and its 5-year ALARA plan at the Pickering NGS.

CNSC staff are satisfied with OPG's efforts in applying the ALARA principle to keep worker doses ALARA over the licence period.

Worker Dose Control

OPG's radiation protection program is designed to ensure that doses to workers are controlled and do not exceed regulatory limits. During the licence period, OPG has maintained radiation doses to nuclear energy workers below regulatory dose limits, as shown in Table 5.

Table 5: Average and maximum effective doses to workers at the Pickering NGS from 2018 to 2022

	2018	2019	2020	2021	2022	Regulatory Limit
Average Effective Dose	2.1 mSv	1.5 mSv	2.4 mSv	1.7 mSv	1.8 mSv	50 mSv/year
Maximum Individual Effective Dose	15.7 mSv	14.8 mSv	16.6 mSv	14.2 mSv	13.4 mSv	

OPG uses a CNSC licensed dosimetry service to monitor, assess, record, and report doses of ionizing radiation received by employees, visitors, and contractors. Doses to individuals are reported to the National Dose Registry. The appropriate types of dosimetry, criteria, and procedures are implemented through OPG's radiation protection program.

OPG uses a combination of action levels, staff training and qualification, dose management tools (work planning and management oversight), and personal protective equipment to ensure radiation doses to workers are controlled and kept ALARA. Action levels are established for unplanned dose in a single shift, as well as accumulated dose in a one-year dosimetry period.

During the licence period, OPG reported one action level exceedance, which was for an internal intake of tritium that resulted in a total effective dose of 1.59 mSv to a Nuclear Energy Worker; this is well below the regulatory limit of 50 mSv in a one-year dosimetry period. CNSC staff confirmed that OPG implemented corrective actions to prevent a recurrence.

CNSC staff are satisfied with OPG's efforts over the current licence period in controlling the radiation doses to workers at Pickering NGS.

Radiation Protection Program Performance

The oversight applied by OPG in implementing and improving its radiation protection program is effective in protecting workers at Pickering NGS. OPG continually measures the performance of its radiation protection program against industry-established objectives, goals, and targets and it benchmarks its program against industry leading stations.

CNSC staff are satisfied with the performance of OPG's radiation protection program at Pickering NGS over the licence period.

Radiological Hazard Control

OPG's radiation protection program requires monitoring and control of all radiological hazards at the Pickering NGS. The program measures related to radiological hazard control include radiological zoning, contamination control, dose rate control, and area and airborne radiation monitoring and control.

Radiological hazards are eliminated when possible or controlled with engineered barriers and signage identifying the level and extent of hazard areas. Where possible, radiation fields encountered by workers during operation and maintenance activities are further reduced using temporary shielding.

With respect to the operation of units 5–8 until the end of 2026, OPG has confirmed [22] that radiological hazards at the Pickering NGS have not had significant changes over several years and have been stable, other than dose reduction initiatives such as new resins designed to improve removal of impurities in the heat transport system. Further, as there is no change to OPG's radiation protection program, the processes used to plan radiological work and control radiological hazards will ensure that the additional operation time will not adversely impact the ability to execute radiological work. [22]

CNSC staff are satisfied with OPG's efforts to continue to implement its radiological hazard controls to protect workers and ensure radioactive contamination is controlled within the Pickering NGS site boundaries.

4.7.3 Summary

A summary of OPG's past performance, CNSC staff's regulatory focus, and proposed improvements are presented in the following subsections.

4.7.3.1 Past Performance

CNSC staff have assessed OPG's programs under the radiation protection SCA and found that OPG continues to meet regulatory requirements. OPG has maintained satisfactory performance across the specific areas of this SCA during the licence period.

4.7.3.2 Regulatory Focus

CNSC staff will continue to verify OPG's performance and compliance with regulatory requirements in all aspects of the radiation protection SCA, including maintaining radiation protection instruments and equipment, controlling contamination, and verifying that the protection of workers is optimized and that worker doses are kept ALARA.

4.7.3.3 Proposed Improvements

No changes are anticipated for this SCA.

4.7.4 Conclusion

CNSC staff conclude that OPG continues to meet regulatory requirements related to the radiation protection SCA. CNSC staff are satisfied that OPG's radiation protection program and implementing procedures will continue to maintain worker doses below regulatory limits and ALARA. Based on CNSC staff's assessment of OPG's application, associated supporting information, and performance during the licence period, OPG's existing radiation protection program at the Pickering NGS is adequate for continued operation of units 5–8 to December 31, 2026.

4.8 Conventional Health and Safety

The conventional health and safety SCA covers the implementation of a program to manage workplace safety hazards and to protect personnel and equipment.

This CMD covers the following specific areas of this SCA:

- Performance
- Practices
- Awareness

Licence condition 8.1 of OPG's PROL requires OPG to implement and maintain a conventional health and safety program. CNSC staff verify OPG's compliance with regulatory requirements in the conventional health and safety SCA against the compliance verification criteria described in section 8.1 of the Pickering NGS LCH.

4.8.1 Trends

The following table indicates the overall rating trends for the conventional health and safety SCA over the current licence period:

TRENDS FOR CONVENTIONAL HEALTH AND SAFETY				
Overall Compliance Ratings				
2018	**2019**	**2020**	**2021**	**2022**
FS*	SA	SA	SA	SA
Comments				
OPG has demonstrated satisfactory (SA) performance in this SCA during the current licence period. Overall, CNSC staff conclude that OPG's programs within the conventional health and safety SCA meet regulatory requirements and are adequate for continued commercial operations until the end of 2026. *As of 2019, CNSC staff no longer assign the fully satisfactory (FS) rating				

4.8.2 Discussion

A conventional health and safety program minimizes the risk to the health and safety of workers posed by conventional (non-radiological) hazards in the workplace. Pursuant to regulations made under the *Canada Labour Code*, OPG's conventional health and safety program is regulated by the Ontario Ministry of Labour, Immigration, Training and Skills Development in accordance with the Ontario *Occupational Health and Safety Act* (OHSA) and the Ontario *Labour Relations Act*. Related legislation includes the *Ontario Workplace Safety and Insurance Act* and the *Ontario Human Rights Code*.

During the licence period, CNSC staff have observed safe work practices during inspections and other activities at the Pickering NGS. This includes observations of good housekeeping, compliance with applicable labour codes (e.g., scaffolding and worker protection such as barriers and hazard signs), and proper use of personal protective equipment. CNSC staff inspections have also identified low

and negligible non-compliant findings in the conventional health and safety SCA. In every case, OPG has taken appropriate corrective actions, generally immediately and without the need for enforcement action.

CNSC staff have assessed that OPG continues to have a highly effective health and safety program that provides safe work practices and conditions to achieve a high level of personnel safety at the Pickering NGS.

Details pertaining to the specific areas within this SCA are presented in the following subsections.

Performance

As required by REGDOC 3.1.1, OPG reports on accident severity rate (ASR), accident frequency (AF), and industrial safety accident rate (ISAR) in quarterly safety performance indicator reports.[7] CNSC staff review these quarterly reports and are satisfied that OPG has met the reporting requirements related to conventional health and safety during the licence period. Table 6 includes the annual ASR, AF, and ISAR during the licence period, along with the industry average (in brackets).

Table 6: Annual ASR, AFR, and ISAR for the Pickering NGS from 2018 to 2022 with industry averages in brackets

	2018	2019	2020	2021	2022
Accident Severity Rate (Industry average)	6.40 (2.6)	0.00 (1.5)	0.00 (0.5)	0.00 (0.05)	0.00 (0.35)
Accident Frequency (Industry average)	0.25 (0.34)	0.14 (0.26)	0.14 (0.24)	0.07 (0.16)	0.22 (0.25)
Industrial Safety Accident Rate (Industry average)	0.04 (0.07)	0.00 (0.04)	0.00 (0.03)	0.00 (0.01)	0.00 (0.03)

OPG has maintained performance that has generally remained below industry average, with the exception of ASR in 2018. Performance indicators for the conventional health and safety SCA are reported annually to the Commission through the NPGS ROR. OPG also posts information related to accident frequency on its website as part of the quarterly Pickering Nuclear Performance Report. CNSC staff are satisfied with OPG's performance with respect to this SCA during the licence period.

[7] Appendix B of REGDOC 3.1.1 provides the specifications for each SPI and the calculations for ASR, AFR, and ISAR are defined under SPI 21.

Practices

The CNSC has a Memorandum of Understanding with the Ontario Ministry of Labour (MOL) to cooperate and exchange information and technical expertise related to their respective areas of jurisdiction, such as occupational health and safety practices at nuclear facilities. There has been regular communication between CNSC staff and the MOL regional office regarding any conventional health and safety issues at the Pickering site.

CNSC staff did not identify any significant issues with OPG's compliance against the Ontario OHSA and the Ontario *Labour Relations Act*. OPG's conventional health and safety program covers all major activities on site under the OHSA.

Awareness

The conventional health and safety work practices at the Pickering NGS continued to achieve a high degree of personnel safety. OPG personnel at all levels exhibit proactive attitude towards anticipating work related hazards and preventing unsafe conditions. There continues to be a safe and efficient working environment where situational awareness and safe work practices are ensured.

4.8.3 Summary

A summary of OPG's past performance, CNSC staff's regulatory focus, and proposed improvements are presented in the following subsections.

4.8.3.1 Past Performance

OPG continues to meet CNSC staff expectations and requirements pertaining to the conventional health and safety SCA at the Pickering NGS. OPG has maintained satisfactory performance across the specific areas of this SCA during the licence period.

4.8.3.2 Regulatory Focus

CNSC staff will continue to verify OPG's performance and compliance with regulatory requirements in all aspects of the conventional health and safety SCA through inspections and on-site walk downs.

4.8.3.3 Proposed Improvements

No changes are anticipated for this SCA.

4.8.4 Conclusion

CNSC staff conclude that OPG continues to meet regulatory requirements related to the conventional health and safety SCA and protect workers from conventional hazards. Based on CNSC staff's assessment of OPG's application and performance during the licence period, OPG's existing conventional health and safety program at the Pickering NGS is adequate for continued operation of units 5–8 to December 31, 2026.

4.9 Environmental Protection

The Environmental Protection SCA covers programs that identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of licensed activities.

This CMD covers the following specific areas of this SCA:

- Environmental risk assessment
- Effluent and emissions control (releases)
- Assessment and monitoring
- Protection of people
- Environmental management system (EMS)

Licence condition 9.1 of OPG's PROL requires OPG to implement and maintain an environmental protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days. CNSC staff verify OPG's compliance with regulatory requirements in the environmental protection SCA against the compliance verification criteria described in section 9.1 of the Pickering NGS LCH.

4.9.1 Trends

The following table indicates the overall rating trends for the environmental protection SCA over the current licence period:

TRENDS FOR ENVIRONMENTAL PROTECTION				
Overall Compliance Ratings				
2018	**2019**	**2020**	**2021**	**2022**
SA	SA	SA	SA	SA
Comments				
OPG has demonstrated satisfactory (SA) performance in this SCA during the current licence period. Overall, CNSC staff conclude that appropriate protective measures are in place to prevent unreasonable risk to the environment and to people, and that OPG's programs within the environmental protection SCA meet regulatory requirements and are adequate for continued commercial operations until the end of 2026.				

4.9.2 Discussion

OPG's environmental protection program includes policies, station instructions, methods, and procedures to identify, control, and monitor releases of radioactive and hazardous substances, and to protect the health and safety of people and the environment. CNSC staff confirm that OPG maintains an environmental protection program that meets regulatory requirements. CNSC staff have verified the performance of the environmental protection program through compliance

activities including technical assessment of quarterly and annual reports, event report reviews, and inspections.

OPG is compliant with the following REGDOCs and standards at the Pickering NGS:

- REGDOC-2.9.1, *Environmental Protection: Environmental Principles, Assessments and Protection Measures, Version 1.2*
- CSA N288.1-14, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*
- CSA N288.3.4-13, *Performance testing of nuclear air-cleaning systems at nuclear facilities*
- CSA N288.4-19, *Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills*
- CSA N288.5-11, *Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills*
- CSA N288.6-12, *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills*
- CSA N288.7-15, *Groundwater protection programs at Class I nuclear facilities and uranium mines and mills*
- CSA N288.8-17, *Establishing and implementing action levels for releases to the environment from nuclear facilities*

The following sections detail CNSC staff's assessment of the SCA across the relevant specific areas. Additional details and information on CNSC staff's assessment of the environmental protection SCA can be found in the EPR report for the Pickering site. CNSC staff found that OPG continues to implement and maintain effective environmental protection measures to adequately protect the environment and the health of people living in and around the Pickering site. As indicated in the annual NPGS RORs, [4-8] the CNSC publishes annual radionuclide loadings to the environment from nuclear facilities, including nuclear generating stations, on the CNSC Open Government Portal.

Environmental risk assessment

An environmental risk assessment (ERA) of nuclear facilities is a systematic process to identify, quantify, and characterize the risk posed by contaminants and physical stressors in the environment on human and other biological receptors, including the magnitude and extent of the potential effects associated with a facility. The ERA serves as the basis for the development of site-specific environmental protection control measures, including effluent and emissions monitoring program and the environmental monitoring program. The results of these programs, in turn, inform and refine future revisions of the ERA.

In April 2022, OPG submitted an updated ERA report for the Pickering NGS Site. This report includes risks associated with both the Pickering NGS and the PWMF

and is based on effluent monitoring and other environmental monitoring data for the five-year period between 2016 and 2020, as well as other years of data as needed. The ERA included an ecological risk assessment and a human health risk assessment for radiological and non-radiological contaminants of potential concern (COPCs) and physical stressors related to the Pickering NGS Site and its activities.

The purpose of the 2022 ERA was to reflect current operations and incorporate recent monitoring data into the risk assessment process. The ERA encompasses normal operations at the Pickering NGS Site. OPG's 2022 Predictive Effects Assessment (PEA) addendum for Pickering nuclear safe storage represents the predicted risks to human and ecological receptors related to future activities from transitioning the station from commercial operations to the stabilization and storage with surveillance phase. OPG has posted its ERA and PEA on its website.

CNSC staff completed a detailed technical review of the 2022 ERA and PEA addendum and found them to be consistent with the overall methodology of CSA N288.6-12. [39, 40] CNSC staff are satisfied with the 2022 ERA and PEA addendum, and adverse effects to ecological and human health due to releases of COPCs to the air and water from the Pickering NGS site were found to be unlikely.

Although OPG's 2022 ERA report for the Pickering NGS site provides a complete evaluation of all potential risks to human health and the environment associated with the facility operations, CNSC staff provided recommendations to OPG to further validate ERA conclusions and to improve the quality of the ERA. In response to CNSC staff's comments, OPG committed to continue to engage with local Indigenous Nations and communities to develop ongoing and meaningful dialogue, and to engage prior to and during the preparation of the next ERA to incorporate Indigenous Knowledge and perspectives. Future ERAs will include a section in the report that discusses what was heard from the engagement activities and how this feedback has been considered in the assessment.

An ERA is required to be reviewed and revised every five years, or earlier, should there be significant changes in either the facility or activity, or in the science on which the ERA is based. As no major modifications are expected as a result of the request to extend operation of Pickering NGS units 5–8 to the end of 2026, CNSC staff are satisfied that the 2022 ERA captures the environmental risks during continued operations and that adverse effects to ecological and human health due to the Pickering NGS site are unlikely.

Effluent and emissions control (releases)

OPG has controls in place to minimize airborne and waterborne effluents and emissions for radiological and non-radiological contaminants of potential concern, and to ensure that releases are within regulatory limits and ALARA.

OPG has implemented an effluent and emissions monitoring program in compliance with REGDOC-2.9.1 and relevant standards, including CSA N288.5-11. This program contains derived release limits (DRLs) and action levels (ALs).

The DRLs represent the maximum acceptable level of emitted contaminants from the processes at the site and are derived from the dose limit for members of the public. The DRLs are established with a methodology consistent with CSA N288.1-14. Additionally, CNSC staff confirmed through a technical assessment in 2022 that OPG's methodology and proposed ALs were compliant with CSA N288.8-17.

The radiological releases to air and water from the facility have been maintained well below the established DRLs throughout the licence period.

OPG also monitors non-radiological substances release to air and the water. Releases of hazardous substances have largely been below the limits established by the Ontario Ministry of Environment Conservation and Parks. Where exceedances did occur, they posed negligible risk to human health and the environment.

Based on compliance activities, CNSC staff have found that the effluent monitoring program currently in place continues to protect human health and the environment.

Assessment and monitoring

OPG is required to maintain an environmental monitoring program (EMP), in compliance with REGDOC-2.9.1 and relevant standards, including CSA N288.4-19.

The environmental monitoring requirements of the EMP provide details about monitoring locations, frequencies, and environmental parameters to be measured. The data collected under the EMP are compared with predictions in OPG's ERA to confirm that there is negligible risk to the environment and human health from the Pickering NGS.

OPG monitors a wide range of medias, including:

- air monitoring
- fruits and vegetables monitoring
- animal feed monitoring
- eggs and poultry monitoring
- milk monitoring
- soil and sand monitoring
- surface water (Water Supply Plant monitoring and lake water)
- well water monitoring
- groundwater monitoring
- sediment monitoring
- fish monitoring

Based on monitoring results, CNSC staff have concluded that the operation of the Pickering NGS has had no adverse impact on the environment and people.

Groundwater monitoring

Groundwater is sampled at over 100 sampling locations across the Pickering site for radionuclides and other contaminants. In 2020, OPG implemented a groundwater protection program (GWPP) that is in accordance with CSA 288.7-15, which includes a groundwater monitoring program (GWMP). The purpose of the GWPP is to minimize or prevent releases and impacts to groundwater, as well as to confirm that adequate measures are in place to control and/or monitor these releases.

The monitoring data for the level of groundwater confirm that groundwater flow is controlled. Groundwater levels within the protected area[8] are below lake level. This represents flow into the protected area, rather than out to the environment, caused by the influence of the Pickering site's subsurface drains and sumps.

Tritium observed in nearby off-site wells over the past five years of monitoring remain well below Health Canada's Guidelines for Drinking Water Quality and the Ontario Drinking Water Quality Standards, confirming that off-site impacts due to atmospheric deposition are negligible. Within the protected area, elevated concentrations of tritium have been observed, which continue to be effectively contained due to the influence of the subsurface drains that ensure groundwater flow into the protected area. Groundwater monitoring program results continue to confirm the site perimeter concentrations of tritium remain low, indicating no off-site impacts.

Detectable proportions of petroleum hydrobcarbons (PHCs) have been found in the groundwater in the vicinity of standby generators. Monitoring data confirms that concentrations are improving over time and that these PHCs exhibit limited mobility below the surface. At shoreline wells, proportions of PHCs remain below detection limits, and thus below provincial groundwater quality standards.

Based on a review of the ERA and the results from OPG's GWMP and EMP, CNSC staff conclude that that OPG's reported radiological and non-radiological releases of COPCs to groundwater have remained low and there are no adverse effects on groundwater quantity or quality from the site. CNSC staff conclude that there are no anticipated adverse effects to groundwater protection as a result of continued commercial operations to the end of 2026.

Protection of people

Under this specific area, CNSC staff assess and evaluate information to ensure that members of the public are not exposed to unreasonable risk with respect to hazardous substances discharged from the Pickering NGS and that the radiation

[8] The protected area is an area surrounded by a barrier that encompasses a nuclear power plant, it is located within the larger site perimeter.

dose received by a member of the public from radionuclides does not exceed the regulatory annual public dose limit of 1 millisievert per year (mSv/year).

Small amounts of radionuclides are released to air and water from the routine operation at the Pickering NGS. CNSC staff confirm that OPG monitors radiological releases from the Pickering NGS to calculate public dose in order to demonstrate compliance with the public dose limit, and to meet the CNSC's requirement for following the ALARA principle, taking into account social and economic factors. The estimated maximum annual dose for a member of the public (0.0019 mSv in 2022) has remained well below the regulatory public dose limit (1 mSv/year) for the duration of the licence period, as shown in Table 7.

Table 7: Maximum effective dose to a member of the public from 2018 to 2022 from the Pickering NGS

	2018	2019	2020	2021	2022	Regulatory Limit
Maximum Effective Dose (mSv)	0.002 mSv	0.002 mSv	0.001 mSv	0.002 mSv	0.002 mSv	1 mSv/year

OPG's human health risk assessment evaluated critical receptors' exposure to non-radiological releases, such as nitrogen oxides through inhalation and exposure to hydrazine through the ingestion of water and fish. The exposure estimate demonstrated no adverse health effects expected from non-radiological releases from the Pickering Site.

CNSC staff conclude that people living in the vicinity of the Pickering NGS are protected from the impacts of releases of radiological and non-radiological substances from the facility.

Environmental management system

OPG completed implementation of REGDOC-2.9.1, Version 1.2 in 2023. OPG has established and implemented a corporate EMS for the site in accordance with REGDOC-2.9.1 and is also registered and certified under the International Organization for Standardization (ISO) standard 14001:2015 (a standard that helps an organization achieve the intended outcomes of its EMS). CNSC staff review OPG's annual internal audits; management reviews; and environmental goals, targets, and objectives to ensure compliance with REGDOC-2.9.1. While the CNSC does not consider ISO 14001 certification as part of the criteria for meeting the requirements of REGDOC-2.9.1, the results of these third-party audits are reviewed by CNSC staff as part of the compliance program.

The implementation of the EMS ensures that OPG continues to improve environmental performance at the Pickering NGS.

Independent environmental monitoring program (IEMP)

CNSC staff conducted IEMP sampling around the Pickering Site in 2021. The sampling plan focused on radiological and hazardous contaminants and considered OPG's EMP and the CNSC's regulatory knowledge of the site.

CNSC staff collected air, water, soil, sand, and vegetation samples in publicly accessible areas outside the perimeter of the Pickering Site. Representatives of Curve Lake First Nation participated in the sampling.

Samples collected were analyzed by qualified laboratory specialists in the CNSC's Ottawa laboratory using appropriate protocols. The levels of radioactive particulates, tritium oxide, gross beta, gross alpha, gamma, pH, total dissolved solids, hydrazine, ammonia, iron, aluminum, zinc, and cadmium in all the samples measured during the 2021 IEMP sampling campaign were below available guidelines/screening levels. The levels were similar to the range of results from the 2014, 2015, and 2017 IEMP sampling campaigns at the Pickering NGS site.

The CNSC's 2021 IEMP results are consistent with results submitted by OPG, supporting the CNSC's assessment that the licensee's environmental protection program is effective. The results add to the body of evidence that people and the environment in the vicinity of the Pickering NGS Site are protected and that there are no anticipated health effects.

All IEMP results are published on the CNSC's IEMP web page.

4.9.3 Summary

A summary of OPG's past performance, CNSC staff's regulatory focus, and proposed improvements are presented in the following subsections.

4.9.3.1 Past Performance

CNSC staff have assessed OPG's programs under the environmental protection SCA at the Pickering NGS and conclude that OPG has met applicable regulatory requirements during the licence period. OPG has maintained satisfactory performance across the specific areas of this SCA during the licence period.

4.9.3.2 Regulatory Focus

CNSC staff will continue to verify and monitor OPG's performance and compliance with regulatory requirements in all aspects of the environmental protection SCA during the licence period.

4.9.3.3 Proposed Improvements

OPG plans to implement the 2020 version of CSA N288.1, *Guidelines for modelling radionuclide environmental transport, fate, and exposure associated with the normal operation of nuclear facilities* by December 2024.

4.9.4 Conclusion

CNSC staff conclude that OPG has implemented and maintains an effective environmental protection program at the Pickering NGS that meets regulatory requirements. Based on CNSC staff's assessment of OPG's application,

associated supporting information, and performance during the licence period, OPG's environmental protection program at the Pickering NGS is adequate for continued operation of units 5–8 to December 31, 2026.

4.10 Emergency Management and Fire Protection

The emergency management and fire protection SCA covers emergency plans and emergency preparedness programs that exist for emergencies and for non-routine conditions. This area also includes any results of participation in exercises.

This CMD covers the following specific areas of this SCA:

- Conventional emergency preparedness and response
- Nuclear emergency preparedness and response
- Fire emergency preparedness and response

OPG's PROL includes two licence conditions related to the emergency management and fire protection SCA:

- Licence condition 10.1 requires OPG to implement and maintain an emergency preparedness program.
- Licence condition 10.2 requires OPG to implement and maintain a fire protection program.

CNSC staff verify OPG's compliance with regulatory requirements in the emergency management and fire protection SCA against the compliance verification criteria described in section 10.1 and 10.2 of the Pickering NGS LCH.

4.10.1 Trends

The following table indicates the overall rating trends for the emergency management and fire protection SCA over the current licence period:

TRENDS FOR EMERGENCY MANAGEMENT AND FIRE PROTECTION				
Overall Compliance Ratings				
2018	**2019**	**2020**	**2021**	**2022**
SA	SA	SA	SA	SA
Comments				
OPG has demonstrated satisfactory (SA) performance in this SCA during the current licence period. Overall, CNSC staff conclude that OPG's programs within the emergency management and fire protection SCA meet regulatory requirements and are adequate for continued commercial operations until the end of 2026.				

4.10.2 Discussion

OPG has implemented and maintains an emergency preparedness program and conducts exercises in accordance with REGDOC 2.10.1, *Nuclear Emergency Preparedness and Response*. OPG has also implemented and maintains a fire

protection program in accordance with CSA N293-12, *Fire Protection for Nuclear Power Plants*. During the licence period, CNSC staff have been satisfied that OPG has implemented and maintains effective emergency management and fire protection programs at the Pickering NGS.

Off-site emergency response planning for the Pickering NGS is the jurisdiction of the province of Ontario. Emergency Management Ontario (EMO) maintains the Provincial Nuclear Emergency Response Plan (PNERP) Master Plan, which establishes a framework for the response to a nuclear or radiological emergency in Ontario. The PNERP was last updated in 2017. EMO is currently working on an update to the PNERP, which is anticipated to undergo public review during the current licence period. EMO also maintains the PNERP Implementing Plan for the Pickering NGS, which describes the measures that should be undertaken to mitigate the off-site effects of a nuclear emergency at the Pickering NGS and was last updated in 2019. The province is currently updating the PNERP, and OPG is required to ensure that its plans remain consistent with the PNERP.

CNSC staff have performed inspections at the Pickering NGS to verify OPG's compliance in the emergency management and fire protection SCA during the licence period. These include inspections of full-scale nuclear exercises, the fire protection program, and the nuclear emergency preparedness and response program, as well as various field inspections and walk downs. In 2023, CNSC staff identified certain non-compliances related to OPG's emergency management and fire protection programs at the Pickering NGS. OPG continues to improve these programs to meet regulatory requirements and performance objectives, and CNSC staff will continue to monitor OPG's corrective actions to verify that they meet regulatory requirements.

Details pertaining to the specific areas within this SCA are presented in the following subsections.

Conventional Emergency Preparedness and Response

OPG continues to maintain satisfactory conventional emergency response programs at the Pickering NGS. Emergency response personnel are available on-site 24-hours a day to respond to any type of emergency. Training and equipment continue to be maintained for medical response, hazardous materials, and other conventional hazards that may be present.

Nuclear Emergency Preparedness and Response

The nuclear emergency preparedness program at the Pickering NGS is described in OPG's *Consolidated Nuclear Emergency Plan*. The plan identifies the concepts, structure, roles, and resources to implement and maintain an effective OPG response capability in the event of a nuclear emergency.

OPG continues to demonstrate its preparedness to respond to a nuclear emergency at the Pickering site in accordance with regulatory requirements. OPG has established and continues to maintain its emergency response organization and works together with off-site emergency management agencies and organizations.

OPG has conducted two full scale emergency exercise during the licence period, in 2020 and 2023. CNSC staff participated in these exercises to test the CNSC's emergency response plans and procedures. CNSC staff also conducted on-site inspections during these exercises to confirm OPG's compliance with the requirements of REGDOC 2.10.1. These exercises successfully demonstrated their objectives to, among other things, test preparedness to respond to a nuclear emergency and assess the interoperability of participating organizations.

Fire Emergency Preparedness and Response

Fire protection at the Pickering NGS is achieved through the implementation of a comprehensive fire protection program to minimize the risk to the health and safety of persons and to the environment from fire, through appropriate fire protection system design, fire safe operation, and fire prevention. OPG continues to demonstrate its preparedness to prevent and respond to a fire though a comprehensive and dedicated fire response capability.

In response to a CNSC staff request for further information pertaining to OPG's plan to construct a new fire hall within the Pickering NGS protected area, OPG indicated that it is currently undertaking a project to construct the new fire hall. OPG is targeting completion by the end of 2024. [21]

As per N293-12, OPG is required to submit to the CNSC a third-party fire protection audit every 3 years. OPG's most recent third-party audit was provided in October 2023 and will be reviewed by CNSC staff. CNSC staff's review of the 2020 third-party audit did not identify any issues. In 2023, OPG implemented CSA N293-12, *Update 1*, at the Pickering NGS.

Field inspections carried out by CNSC staff during 2023 identified several non-compliant findings related to the maintenance of fire emergency response equipment and the utilization of fire fighting equipment and tools. OPG has implemented corrective action plans to address these non-compliances, including ensuring that all equipment inspections are verified by separate staff. CNSC staff will continue to monitor OPG's implementation of corrective actions to address these non-compliances.

4.10.3 Summary

A summary of OPG's past performance, CNSC staff's regulatory focus, and proposed improvements are presented in the following subsections.

4.10.3.1 Past Performance

OPG continues to maintain effective emergency management and fire protection programs at the Pickering NGS that meet regulatory requirements. OPG has maintained satisfactory performance across the specific areas of this SCA during the licence period.

4.10.3.2 Regulatory Focus

CNSC staff will continue to verify OPG's performance and compliance with regulatory requirements in all aspects of the emergency management and fire

protection SCA. Compliance activities will include inspections and reviews of required licensee submissions such as third-party fire protection audits.

4.10.3.3 Proposed Improvements

As discussed in section 3, OPG's Pickering NGS PSR2-B IIP includes 6 IIP commitments related to the emergency management and fire protection SCA. [19] These commitments are regarding the review of exiting governance to align with the 2015 *National Building Code of Canada* and the 2015 *National Fire Code of Canada*.

Additionally, OPG will be constructing a new fire hall within the protected are of the Pickering NGS, which is currently targeting completion by the end of 2024.

4.10.4 Conclusion

CNSC staff conclude that OPG continues to meet regulatory requirements related to the emergency management and fire protection SCA. Based on CNSC staff's assessment of OPG's application, supporting documentation, and performance during the licence period, OPG's existing emergency management and fire protection programs at the Pickering NGS are adequate for continued operation of units 5–8 to December 31, 2026.

4.11 Waste Management

The Waste Management SCA covers internal waste-related programs that form part of the facility's operations up to the point where the waste is removed from the facility to a separate waste management facility. This area also covers the planning for decommissioning.

This CMD covers the following specific areas of this SCA:

- Waste characterization
- Waste minimization
- Waste management practices
- Decommissioning plans

OPG's PROL includes two licence conditions related to the waste management SCA:

- Licence condition 11.1 requires OPG to implement and maintain a waste management program.
- Licence condition 11.2 requires OPG to implement and maintain a decommissioning plan.

CNSC staff verify OPG's compliance with regulatory requirements in the waste management SCA against the compliance verification criteria described in section 11.1 and 11.2 of the Pickering NGS LCH.

4.11.1 Trends

The following table indicates the overall rating trends for the waste management SCA over the current licence period:

TRENDS FOR WASTE MANAGEMENT				
Overall Compliance Ratings				
2018	**2019**	**2020**	**2021**	**2022**
SA	SA	SA	SA	SA
Comments				
OPG has demonstrated satisfactory (SA) performance in this SCA during the licence period. Overall, CNSC staff conclude that OPG's programs within the waste management SCA meet regulatory requirements and are adequate for continued commercial operations until the end of 2026.				

4.11.2 Discussion

In addition to the Pickering NGS, the PWMF is also located on the Pickering nuclear site and is licensed separately under a Class 1B Waste Facility Operating Licence. OPG's request to operate units 5–8 until 2026 will not impact the operation of the PWMF. The PWMF operating licence was renewed in February 2018 and is also valid until 2028.

OPG is compliant with the following standards at the Pickering NGS:

- REGDOC-2.11.1, *Waste Management, Volume I: Management of Radioactive Waste*
- CSA N292.0-19, *General principles for the management of radioactive waste and irradiated fuel*
- CSA N292.2-13, *Interim dry storage of irradiated fuel*
- CSA N292.3-14, *Management of Low and Intermediate Level Radioactive Waste*
- CSA N294-19, *Decommissioning of Facilities Containing Nuclear Substances*

OPG has a mature waste management program at Pickering NGS that meets the requirements of CSA N292.3-14. OPG also maintains a preliminary decommissioning plan (PDP) for the Pickering NGS in accordance with CSA N294-19. CNSC staff are satisfied that OPG has implemented and maintains an effective waste management program at the Pickering NGS that meets applicable regulatory requirements.

Details pertaining to the specific areas within this SCA are presented in the following subsections.

Waste characterization, Waste minimization, and Waste management practices

OPG has a waste management program at the Pickering NGS that governs activities to minimize, control and properly dispose of radioactive, hazardous, and conventional waste. The waste management program documentation describes how waste is managed throughout its lifecycle to the point of disposal. This includes waste generation, storage, processing, recycling, and removal/transfer activities. OPG uses waste management procedures to ensure that waste generated at the facility is separated properly. Waste receptacles are located throughout the facility for likely clean and active waste.

In accordance with REGDOC 3.1.1, OPG provides quarterly reports on safety performance indicators, which includes low- and intermediate-level radioactive solid waste generated at the Pickering NGS. CNSC staff have been satisfied with the reports submitted during the licence period. CNSC staff have also conducted inspections of OPG's waste management program at the Pickering NGS during the licence period and identified various non-compliant findings of negligible safety significance. All such findings have been adequately addressed by OPG.

Decommissioning plans

In accordance with paragraph 3(k) of the *Class I Nuclear Facilities Regulations*, OPG is required to maintain a decommissioning plan throughout the life of the station.

OPG's Preliminary Decommissioning Plan (PDP) for the Pickering NGS sets out the strategy and the preliminary plan by which the facility will be decommissioned after the permanent shutdown. Decommissioning involves administrative and technical actions taken to allow the removal of some or all of the regulatory controls from a facility, location, or site where nuclear substances are managed, used, processed, or stored. Decommissioning activities are conducted in a manner that ensures that the health, safety, and security of workers, people, and the environment are protected. After decommissioning, OPG will retain ownership of the property and the site will then be available for other industrial, non-nuclear OPG uses, also known as a "brownfield".[9]

OPG's PDP was last updated and presented to the Commission in 2022. [41] CNSC staff verified that OPG's PDP complies with requirements, including CSA N294-19, *Decommissioning of facilities containing nuclear substances*, which OPG implemented in 2021. OPG is required to update its PDP every 5 years. OPG's next PDP will reflect the implementation of REGDOC-2.11.2, *Decommissioning*.

In OPG's responses to CNSC staff requests for information pertaining to this application, [21] OPG noted that its PDP assumes continued operation of Pickering NGS units 5–8 until the end of 2025. This was the current plan at the time of the latest PDP update. CNSC staff expect OPG to update its PDP to reflect operations of Pickering NGS units 5–8 until the end of 2026 and are satisfied with OPG's proposed plan to include such updates in the next PDP revision.

[9] A brownfield is a former industrial land that has the potential to be developed for new industrial uses.

Further details about OPG's decommissioning strategy are described in section 6.7 and information about the related financial guarantee is described in section 6.2. Separately, units 1 and 4 are planned to end commercial operations in 2024, followed by stabilization activities to transition the units to safe storage with surveillance. OPG is required to prepare a detailed decommissioning plan for these units during the licence period and in advance of safe storage with surveillance.

4.11.3 Summary

A summary of OPG's past performance, CNSC staff's regulatory focus, and proposed improvements are presented in the following subsections.

4.11.3.1 Past Performance

OPG's waste management program in place at the Pickering NGS, as well as OPG's PDP, continue to meet regulatory requirements. OPG has maintained satisfactory performance across the specific areas of this SCA during the licence period.

4.11.3.2 Regulatory Focus

CNSC staff will continue to verify OPG's performance and compliance with regulatory requirements in all aspects of the waste management SCA through regulatory oversight activities including on-site inspections, the review of required reports, and revisions to relevant program documentation.

4.11.3.3 Proposed Improvements

OPG will update its PDP for the Pickering NGS to incorporate the proposed operation of Pickering NGS units 5–8 to December 31, 2026, as part of the planned 5-year PDP update cycle.

4.11.4 Conclusion

CNSC staff conclude that OPG continues to meet regulatory requirements related to the waste management SCA. Based on CNSC staff's assessment of OPG's application, supporting documentation, and performance during the licence period, OPG's waste management program at the Pickering NGS is adequate for continued operation of units 5–8 to December 31, 2026.

4.12 Security

The Security SCA covers the programs required to implement and support the security requirements stipulated in the regulations, the licence, orders, or expectations for the facility or activity.

This CMD covers the following specific areas of this SCA:

- Facilities and equipment
- Response arrangements

- Security practices
- Drills and exercises
- Cyber security

Licence condition 12.1 of OPG's PROL requires OPG to implement and maintain a security program. CNSC staff verify OPG's compliance with regulatory requirements in the security SCA against the compliance verification criteria detailed in section 12.1 of the Pickering NGS LCH.

4.12.1 Trends

The following table indicates the overall rating trends for the security SCA over the current licence period:

TRENDS FOR SECURITY				
Overall Compliance Ratings				
2018	**2019**	**2020**	**2021**	**2022**
SA	SA	SA	BE	BE
Comments				
As discussed as part of the 2021 and 2022 NPGS RORs, [7, 8] OPG's recent performance in this SCA has been rated at below expectations (BE). CNSC staff have increased regulatory scrutiny in this SCA and are satisfied that OPG is adequately addressing the identified issues. Overall, CNSC staff conclude that OPG's programs within the security SCA are adequate for continued commercial operations until the end of 2026.				

4.12.2 Discussion

OPG maintains a security program at the Pickering NGS in accordance with the requirements of the *Nuclear Security Regulations* (NSR) and CNSC regulatory documents.

As a result of CNSC staff compliance activities conducted in 2021 and 2022, CNSC staff have not been satisfied with OPG's performance within the security SCA at the Pickering NGS. CNSC staff have conducted inspections and found that OPG has not met all applicable regulatory requirements across multiple specific areas of the security SCA. CNSC staff observed performance that did not meet staff expectations in this SCA in 2021 and 2022. However, following enhanced regulatory scrutiny, CNSC staff have observed notable improvements in 2023 and OPG is moving towards full compliance. Details on the non-compliant findings identified by CNSC staff, as well as the corrective actions undertaken by OPG, are confidential in nature.

In early 2023, the CNSC issued an Administrative Monetary Penalty (AMP) to OPG as a result of a failure to comply with a licence condition in relation to its security program at the Pickering and Darlington Nuclear Generating Stations. The AMP was issued to promote compliance and deter recurrence. Information on the AMP is available on the CNSC's website. OPG has put corrective actions in

place to address the non-compliances and has paid the penalty amount. There is no immediate risk to safety and security at the Pickering NGS, and CNSC staff are satisfied with OPG's corrective actions to date. CNSC staff will continue to follow-up on proposed corrective actions during the licence period.

Details pertaining to the specific areas within this SCA are presented in the following subsections.

Facilities and Equipment

OPG has processes in place to prevent security events and maintain the security equipment at Pickering NGS. In September 2023, OPG implemented REGDOC 2.12.1, *High Security Facilities, Volume II: Criteria for Nuclear Security Systems and Devices*, and the updated REGDOC 2.12.3, *Security of Nuclear Substances: Sealed Sources and Category I, II and III Nuclear Material, Version 2.1* at the Pickering NGS.

Response Arrangements

OPG maintains a nuclear response force that meets the requirements of the NSR and REGDOC 2.12.1, *High Security Facilities, Volume I: Nuclear Response Force, Version 2*. OPG implemented REGDOC 2.12.1*, Volume I: Version 2* at the Pickering NGS in 2020. Additional requirements related to security personnel are included in REGDOC 2.2.4, *Fitness for Duty, Volume III: Nuclear Security Officer Medical, Physical, Psychological Fitness*, which OPG also implemented in 2020.

Security Practices

OPG has procedures in place at Pickering NGS to guide plant and security personnel in security practices. In 2021, CNSC staff conducted a reactive field inspection at the Pickering NGS following observations made at the Darlington NGS related to security practices. This inspection identified non-compliant findings that required OPG to implement corrective actions. CNSC staff will continue to verify OPG's actions to address identified non-compliances.

Drills and Exercises

OPG maintains a drill and exercise program and continues to conduct drills at the Pickering NGS in accordance with regulatory requirements. In addition to conducting mandatory drills every 30 days, OPG continues to hold major security exercises every two years in accordance with Section 36(2) of the NSR under the CNSC Performance Testing Program.

Due to the COVID-19 pandemic, the Commission temporarily exempted OPG and other high security site licensees from the requirements of Section 36(2) of the NSR for 12 to 24 months. This exemption is described in the Commission's *Record of Decision* on the matter. [42] Pickering NGS will resume security exercises as per the Section 36(2) of the NSR in March 2024.

Cyber Security

In November 2019, OPG implemented CSA N290.7-14*, Cyber Security for Nuclear Power Plants and Small Reactor Facilities* at the Pickering NGS.

CNSC staff completed a fleet-wide cyber security program desktop inspection in 2022. This inspection focused on the design, implementation, and maintenance of the cyber security program at the Pickering NGS and identified non-compliant findings. These findings were of low safety significance, and OPG has implemented a satisfactory corrective action plan to address them.

4.12.3 Summary

A summary of OPG's past performance, CNSC staff's regulatory focus, and proposed improvements are presented in the following subsections.

4.12.3.1 Past Performance

OPG's security program at the Pickering NGS has not met all CNSC regulatory requirements in 2021 and 2022, and OPG's performance was below expectations across various specific areas of this SCA. However, there is no immediate risk to nuclear security and OPG has corrective actions in place to address the non-compliances identified by CNSC staff.

4.12.3.2 Regulatory Focus

CNSC staff's focus in the Security SCA is the correction of identified non-compliances in OPG's performance at the Pickering NGS. CNSC staff will continue increased regulatory scrutiny of OPG's performance in this SCA.

4.12.3.3 Proposed Improvements

No changes are anticipated for this SCA other than those required to bring OPG into compliance with regulatory requirement.

4.12.4 Conclusion

CNSC staff were not satisfied with OPG's performance with respect to the security SCA in 2021 and 2022. However, CNSC staff are satisfied that OPG continues to implement adequate corrective actions to address the identified non-compliances and that the issues do not present an immediate risk to safety or security. Based on CNSC staff's assessment of OPG's application, supporting documentation, and performance during the licence period, CNSC staff conclude that OPG's security program at the Pickering NGS is adequate for continued operation of units 5–8 to December 31, 2026.

4.13 Safeguards and Non-Proliferation

The safeguards and non-proliferation SCA covers the programs and activities required for the successful implementation of the obligations arising from the Canada/International Atomic Energy Agency (IAEA) safeguards agreements as well as all other measures arising from the *Treaty on the Non-Proliferation of Nuclear Weapons.*

This CMD covers the following specific areas of this SCA:

- Nuclear material accountancy and control
- Access and assistance to the IAEA
- Operational and design information
- Safeguards equipment, containment and surveillance
- Import and export (requires separate authorization)

Licence condition 13.1 of OPG's PROL requires OPG to implement and maintain a safeguards program. CNSC staff verify OPG's compliance with regulatory requirements in the safeguards and non-proliferation SCA against the compliance verification criteria detailed in section 13.1 of the Pickering NGS LCH.

4.13.1 Trends

The following table indicates the overall rating trends for the safeguards and non-proliferation SCA over the current licence period:

TRENDS FOR SAFEGUARDS AND NON-PROLIFERATION				
Overall Compliance Ratings				
2018	**2019**	**2020**	**2021**	**2022**
SA	SA	SA	SA	SA
Comments				
OPG has demonstrated satisfactory (SA) performance in this SCA during the current licence period. Overall, CNSC staff conclude that OPG's programs within the safeguards and non-proliferation SCA meet regulatory requirements and are adequate for continued commercial operations until the end of 2026.				

4.13.2 Discussion

CNSC staff determined that Pickering NGS has an effective safeguards program that conforms to measures required by the CNSC to meet Canada's international safeguards obligations as well as other measures arising from the Treaty on the Non-Proliferation of Nuclear Weapons.

Nuclear Material Accountancy and Control

Pickering NGS has complied with CNSC's regulatory requirements in accordance with REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*. OPG has submitted the required monthly general ledgers, among other required forms, during the licence period.

Access and Assistance to the IAEA

Pickering NGS has granted adequate access and assistance to the IAEA for safeguards activities during the licence period.

During the licence period, the IAEA has performed several inspections and verification activities, including 4 physical inventory verifications, 7 design

information verifications, 18 unannounced inspections, and 2 complementary accesses. In all cases, OPG provided the IAEA with the necessary access and assistance to perform the activities and complied with all regulatory requirements. The has IAEA identified an issue with the accessibility of fuel bundle stacks for verification in select rows of the irradiated fuel bays due to the installation of inspection platforms. However, the IAEA have applied containment and surveillance measures to these rows and OPG has committed to providing verification assistance at the earliest possible opportunity during the facility's decommissioning phase.

Operational and Design Information

OPG submitted its annual operational programs and additional protocol declarations, as well as quarterly updates to the operational program in a timely manner. CNSC staff reviewed these documents and determined that they met requirements. OPG has provided revisions to their design information questionnaire throughout the licence period, to reflect the safeguards-relevant changes to the facility and its safeguards program.

Safeguards Equipment, Containment and Surveillance

OPG has provided the assistance required for the IAEA's safeguards equipment, containment, and surveillance activities.

Import and Export

The scope of the non-proliferation program is limited to the tracking and reporting of foreign obligations and origins of nuclear material. CNSC staff have determined that OPG has complied with the CNSC's regulatory requirements in this respect.

4.13.3 Summary

A summary of OPG's past performance, CNSC staff's regulatory focus, and proposed improvements are presented in the following subsections.

4.13.3.1 Past Performance

OPG's safeguards program at the Pickering NGS continues to meet CNSC regulatory requirements. OPG has maintained satisfactory performance in the specific areas of this SCA during the licence period.

4.13.3.2 Regulatory Focus

CNSC staff will continue to verify OPG's performance and compliance with regulatory requirements in all aspects of the safeguards and non-proliferation SCA through regulatory oversight activities including participation in IAEA inspections, performance of CNSC evaluations, and ongoing assessment of compliance with reporting requirements.

4.13.3.3 Proposed Improvements

No changes are anticipated for this SCA.

4.13.4 Conclusion

CNSC staff conclude that OPG continues to meet regulatory requirements related to the safeguards and non-proliferation SCA. Based on CNSC staff's assessment of OPG's application, supporting documentation, and performance during the licence period, OPG's existing safeguards program at the Pickering NGS is adequate for continued operation of units 5–8 to December 31, 2026.

4.14 Packaging and Transport

The packaging and transport SCA covers the safe packaging and transport of nuclear substances to and from the licensed facility.

This CMD covers the following specific areas of this SCA:

- Package design and maintenance
- Packaging and transport
- Registration for use

Licence condition 14.1 of OPG's PROL requires OPG to implement and maintain a packaging and transport program. CNSC staff verify OPG's compliance with regulatory requirements in the packaging and transport SCA against the compliance verification criteria described in section 14.1 of the Pickering NGS LCH.

4.14.1 Trends

The following table indicates the overall rating trends for the packaging and transport SCA over the current licence period:

TRENDS FOR PACKAGING AND TRANSPORT				
Overall Compliance Ratings				
2018	**2019**	**2020**	**2021**	**2022**
SA	SA	SA	SA	SA
Comments				
OPG has demonstrated satisfactory (SA) performance in this SCA during the current licence period. Overall, CNSC staff conclude that OPG's programs within the packaging and transport SCA meet regulatory requirements and are adequate for continued commercial operations until the end of 2026.				

4.14.2 Discussion

The packaging and transport program ensures that the transportation of radioactive material is conducted in accordance with the requirements of the *Transportation of Dangerous Goods Regulations* (TDGR) and the *Packaging and Transport of Nuclear Substances Regulations, 2015* (PTNSR 2015). CNSC staff determined that packaging and transport of radioactive materials at the Pickering NGS continues to meet regulatory requirements.

Details pertaining to the specific areas within this SCA are presented in the following subsections.

Package Design and Maintenance

The PTNSR 2015 applies to the packaging and transport of nuclear substances, including the design, production, use, inspection, maintenance and repair of packages, and the preparation, consigning, handling, loading, carriage and unloading of packages. OPG's package designs and maintenance program meets these requirements. Where necessary, OPG package designs are certified by the CNSC.

Packaging and Transport

OPG has programs in place to ensure compliance with the requirements of both the PTNSR 2015 and the TDGR for all shipments of nuclear substances to and from the Pickering NGS site. Shipments of nuclear substances within the nuclear facility where access to the property is controlled are exempted from the application of the PTNSR 2015 and the TDGR.

In accordance with the TDGR, OPG personnel who handle, offer for transport, or transport dangerous goods at the Pickering NGS site must be trained and issued a training certificate by OPG.

Registration for Use

OPG's packaging and transport program covers the registration for use of certified packages as required by the regulations.

4.14.3 Summary

A summary of OPG's past performance, CNSC staff's regulatory focus, and proposed improvements are presented in the following subsections.

4.14.3.1 Past Performance

OPG's packaging and transport program at the Pickering NGS meets CNSC regulatory requirements. OPG has maintained satisfactory performance in the specific areas of this SCA during the licence period.

4.14.3.2 Regulatory Focus

CNSC staff will continue to provide regulatory oversight of shipments transported to and from the Pickering NGS site to ensure regulatory requirements are met.

4.14.3.3 Proposed Improvements

No changes are anticipated for this SCA.

4.14.4 Conclusion

CNSC staff conclude that OPG continues to meet regulatory requirements related to the packaging and transport SCA. Based on CNSC staff's assessment of OPG's application, supporting documentation, and performance during the licence

period, OPG's existing packaging and transport program at the Pickering NGS is adequate for continued operation of units 5–8 to December 31, 2026.

5. Indigenous and Public Consultation and Engagement

5.1 Indigenous Consultation and Engagement

The common-law duty to consult with Indigenous Nations and communities applies when the Crown contemplates actions that may adversely affect potential or established Indigenous and/or treaty rights. The CNSC ensures that all of its licence decisions under the NSCA uphold the honour of the Crown and consider Indigenous peoples' potential or established Indigenous and/or treaty rights pursuant to section 35 of the *Constitution Act*, 1982.

CNSC staff remain committed to building long-term relationships with Indigenous Nations and communities who have interest in CNSC-regulated facilities within their traditional and/or treaty territories. The CNSC's Indigenous engagement practices include sharing information, discussing topics of interest, seeking feedback and input on CNSC processes, and providing opportunities to participate in environmental monitoring programs, such as the CNSC's Independent Environmental Monitoring Program (IEMP). The CNSC also provides funding support, through its Participant Funding Program, for Indigenous peoples to meaningfully participate in Commission proceedings and ongoing regulatory activities.

CNSC staff identified the following Indigenous Nations and communities who have Indigenous and/or Treaty rights in the area where the Pickering NGS is located:

- Alderville First Nation
- Curve Lake First Nation (CLFN)
- Hiawatha First Nation (HFN)
- Mississaugas of Scugog Island First Nation (MSIFN)
- Chippewas of Beausoleil First Nation
- Chippewas of Georgina Island First Nation
- Chippewas of Rama First Nation

In addition, CNSC staff have identified the following Indigenous Nations and communities that have expressed an interest in the Pickering NGS:

- Mohawks of the Bay of Quinte
- Métis Nation of Ontario (MNO) Region 8
- Six Nations of the Grand River
- Mississaugas of the Credit First Nation

In addition, in September 2023, CNSC staff sent a notification letter to the identified Indigenous Nations and communities to inform them of CNSC staff's receipt and review of OPG's request for Commission authorization to operate Pickering NGS units 5–8 to December 31, 2026. The letter contained information on the nature of OPG's request and the public Commission Hearing, as well as details on how to participate in the Commission hearing process through interventions and details regarding the Pickering NGS licence amendment application specific Participant Funding Program (PFP) funding opportunity. CNSC staff also offered to meet with interested Indigenous Nations and communities to discuss the application, and raised OPG's application in regular meetings under Terms of Reference agreements with CLFN, HFN, MSIFN, and MNO.

On August 24th, 2023, CNSC staff, HFN, and CLFN discussed the licensing process for OPG's request for Commission authorization for the Pickering NGS at a monthly joint meeting. CNSC staff, HFN, and CLFN discussed fish impingement and entrainment limits and OPG's Fisheries Act Authorization for the Pickering NGS. CNSC staff followed up with more information on the applicability of OPG's previous impingement and entrainment studies over the course of the proposed extended operations. CNSC staff have also offered to hold a multi-party meeting with DFO, HFN, and CLFN to assist in answering their questions about the regulation of fish impingement and entrainment. CNSC staff continue to follow up with CLFN, HFN, MSIFN, and MNO in monthly meetings on their interests and questions regarding OPG's application and the Pickering NGS facility. Both CLFN and HFN have applied for and received PFP funding to participate in this Commission hearing.

On September 11, 2023, CNSC staff and MSIFN met and discussed the licensing process for OPG's request for Commission authorization for the Pickering NGS at a monthly meeting. Following the meeting, CNSC staff shared OPG's application, [12] CNSC staff's request for further information, [23] OPG's Pickering NGS assurance of fitness for service, [13] and OPG's Pickering NGS periodic safety review reassessment (discussed in section 3). MSIFN applied for and received PFP funding to participate in this Commission Hearing.

The identified Indigenous Nations and communities have been encouraged to participate in the regulatory review process and in the public Commission Hearing to advise the Commission directly of any concerns they may have in relation to OPG's request for Commission authorization to operate Pickering NGS units 5–8 until December 31, 2026. CNSC staff note that, to date, many questions and concerns from Indigenous Nations and Communities raised in the context of discussions on the Pickering NGS licence amendment application pertain to the potential future refurbishment of the Pickering NGS, should OPG choose to pursue and apply to the CNSC for authorization for those activities. CNSC staff have encouraged OPG to continue early engagement with Indigenous Nations and communities about their long-term plans for the Pickering NGS site. CNSC staff are committed to continuing to engage with CLFN and HFN on their concerns about fish impingement and entrainment at the Pickering NGS. CNSC staff are

also committed to continuing to share information on monitoring and the regulation of impacts to fish, as well as to answer questions and address concerns raised by CLFN and HFN. CNSC staff remain open to meeting with Indigenous Nations and communities to discuss OPG's request for Commission authorization, ongoing operations at the Pickering NGS facility, and to encourage and maintain productive and respectful relationships.

Ongoing Engagement and Collaboration

CNSC staff have been engaging with the identified Indigenous Nations and communities on an ongoing basis concerning nuclear projects and activities at the Pickering site and have Terms of Reference in place for long-term engagement with several of the identified Indigenous Nations and communities, including with HFN, CLFN, MSIFN, and the MNO. The Terms of References provide a forum for collaboration and a structure for regular meetings to address areas of interest regarding CNSC-regulated facilities and activities, including the Pickering NGS. During these recurring meetings, CNSC staff provided updates specific to the Pickering NGS and reminders of upcoming engagement activities and submission deadlines.

In advance of the 2021 IEMP sampling campaign around the Pickering NGS, notification emails were sent to potentially interested Indigenous Nations and communities to inform them of the sampling campaign and to seek input on the sampling plan. CNSC staff invited suggestions for species of interest, valued components, and potential sampling locations where traditional practices and activities may take place.

CLFN expressed an interest in participating in the campaign and joined CNSC staff in the field for a day of sampling. Having CLFN representatives participate in IEMP sampling provided an opportunity for mutual learning and understanding while supporting transparency and building trust. CNSC staff are committed to continuing to provide Indigenous Nations and communities with opportunities to participate in IEMP planning and sampling related to Pickering NGS and other sites of interest moving forward.

CNSC staff are committed to ongoing engagement and collaboration with interested Indigenous Nations and communities and will continue to provide opportunities for meaningful long-term engagement over the remaining licence period and through future licensing activities at the Pickering NGS.

5.1.1 Licensee Indigenous Engagement Activities

REGDOC-3.2.2, *Indigenous Engagement* sets out requirements and guidance for licensees whose proposed projects may raise the Crown's Duty to Consult. Although OPG's request for Commission authorization does not raise the formal requirements of REGDOC-3.2.2, OPG has conducted engagement activities with potentially interested Indigenous Nations and communities in relation to their application and maintains ongoing engagement on the operations of the Pickering NGS.

In August 2021, OPG established a Framework Agreement with CLFN to support ongoing, regular engagement on OPG's nuclear generation operations, including Pickering NGS. In the fall of 2022, OPG and MSIFN also entered into a Framework Agreement to support regular engagement on OPG's operations. These Framework Agreements establish monthly meetings to share information and updates on OPG's operations with CLFN and MSIFN respectively. CNSC staff have been informed that OPG and HFN have also recently finalized a Framework Agreement together.

OPG shares information on their station operations, plans for the end of commercial operation, environmental reporting, employment/procurement opportunities, and other topics viewed as priorities by the Indigenous Nations and communities they engage with. OPG focused the engagement based on priority interests pertaining to waste storage and transportation, the thermal plume and potential impacts to fish and habitat, OPG's Fisheries Act Authorization regarding fish impingement and entrainment, Pickering NGS end of commercial operations and decommissioning, and OPG's environmental monitoring program and mitigation efforts.

In advance of OPG's announcement of their intent to seek Commission authorization to operate Pickering NGS Units 5–8 to the end of 2026 and to conduct a feasibility study on potential refurbishment, OPG made phone calls to the Chiefs of the Williams Treaties First Nations. OPG held further discussions after the announcement regarding their intent to extend operations to the end of 2026 with CLFN, HFN, and MSIFN.

Overall, CNSC staff are satisfied with OPG's engagement efforts in relation to their request for Commission authorization and encourage OPG to continue to engage with interested Indigenous Nations and communities about the Pickering NGS, address any Pickering NGS specific concerns and questions and keep the CNSC informed of their engagement, as appropriate.

5.1.2 Conclusion

Based on the information received and reviewed to date, including the fact that the Commission is not being asked to authorize new activities, CNSC staff do not expect this licence amendment application to cause any new adverse impacts to potential or established Indigenous and/or Treaty rights.

CNSC staff have informed and engaged all identified Indigenous Nations and communities of the licence amendment application and provided opportunities to apply for participant funding and participate in the regulatory review and Commission hearing process providing Indigenous Nations and communities the opportunity to advise the Commission directly of any concerns they may have in relation to this request. In addition, CNSC staff verified that OPG has informed and engaged with the identified Indigenous Nations and communities of their application seeking authorization to operation Pickering NGS units 5–8 until the end of 2026 and are overall satisfied with OPG's engagement efforts.

The CNSC remains committed to meaningful, ongoing engagement with Indigenous Nations and communities who have an interest in CNSC-regulated facilities and activities, including the Pickering NGS facility.

5.2 CNSC Public Consultation and Engagement

The NSCA mandates the CNSC to disseminate objective scientific, technical, and regulatory information to the public concerning its activities and the activities it regulates. CNSC staff fulfill this mandate in a variety of ways, including by hosting in-person and virtual information sessions and through annual regulatory reports.

5.2.1 Discussion

CNSC staff have engaged with members of the public during the licence period, including a September 2023 open house held in the community near the Pickering and Darlington NGSs. CNSC staff post information about Commission proceedings, regulatory actions, and events on the CNSC website regarding the Pickering NGS. Additionally, the annual NPGS ROR includes regulatory information on the Pickering NGS. RORs are presented to the Commission at meetings where members of the public and Indigenous Nations and communities have the opportunity to intervene.

In December 2023, OPG presented a mid-term update on the Pickering NGS at a public meeting of the Commission. CNSC staff provided their regulatory perspective through an appendix to the 2022 NPGS ROR. [8] The mid-term update allowed for participation of members of the public and Indigenous Nations and communities, both orally and in writing.

CNSC public engagement specific to OPG's request for authorisation to operate Pickering NGS units 5–8 until the end of 2026 is described further in section 5.4.

5.2.2 Conclusion

CNSC staff will continue to disseminate objective scientific, technical, and regulatory information to the public regarding the Pickering NGS, in accordance with the CNSC mandate.

5.3 Licensee Public Information and Engagement

A Public Information and Disclosure Program (PIDP) is a regulatory requirement for licence applicants and licensees of Class I nuclear facilities, uranium mines and mills and certain Class II nuclear facilities. These requirements are found in REGDOC-3.2.1, *Public Information and Disclosure*. Licence condition G.6 of OPG's PROL requires OPG to implement and maintain a public information and disclosure program. CNSC staff evaluate OPG's compliance with respect to public information and disclosure against the compliance verification criteria detailed in section G.6 of the Pickering NGS LCH.

The primary goal of the PIDP is to ensure that information related to the health, safety and security of persons and the environment, and other issues associated

with the lifecycle of nuclear facilities are effectively communicated to the public. The program must include a commitment and protocol for ongoing timely communication of information related to the licensed facility during the course of the licence period.

CNSC's expectations of a licensee's public information program and disclosure protocol are commensurate with the level of risk of the facility, as well as the level of public interest in the licensed activities. The program and protocol may be further influenced by the complexity of the nuclear facility's lifecycle and activities, and the risks to public health and safety and the environment perceived to be associated with the facility and activities.

5.3.1 Discussion

In 2023, CNSC staff conducted a desktop inspection of OPG's PIDP. Non-compliant findings were of low or negligible significance and CNSC staff have found OPG's proposed corrective actions satisfactory.

In light of the critical focus on transparency and ease of access to information, CNSC staff encourage OPG to review their fleetwide PIDP annually and update it accordingly to ensure that information is relevant, timely, and accurately communicates the activities of most interest to the public. If updates to the PIDP are made, OPG is required to send revisions of their public disclosure protocol to the CNSC indicating any feedback received from members of the public, the changes, and the reasons for the changes to the protocol. OPG has improved its PIDP during the licence period, for example OPG now publishes annual monitoring reports on its website, including for fish impingement monitoring and groundwater monitoring, as well as operations and licensing information.

Since changes to the activities at the Pickering NGS site are not expected, CNSC staff are satisfied that OPG's current PIDP remains adequate for the proposed extended operation of the Pickering NGS.

5.3.2 Conclusion

CNSC staff conclude that OPG's PIDP for the Pickering NGS continues to meet regulatory requirements and is adequate for continued commercial operations of Pickering NGS units 5–8 to December 31, 2026.

5.4 Participant Funding Program

The CNSC made funding available through its PFP to assist Indigenous Nations and communities, members of the public, and other stakeholders in participating in the regulatory process for OPG's request for Commission authorization regarding the Pickering NGS and to provide value-added information to the Commission through informed and topic-specific interventions. This funding was offered to review OPG's application and associated documents, prepare interventions and participate in the Commission's public hearing.

5.4.1 Discussion

The Notice of Public Hearing, posted on August 8, 2023, included notification of a PFP opportunity in the amount of $100,000. The participant funding opportunity was also advertised on the CNSC website and was included in notification emails sent to Indigenous Nations and communities. Those interested in obtaining participant funding were invited to submit a completed participant funding application before October 2, 2023.

An independent Funding Review Committee reviewed the applications and made recommendations on the allocation of funding to the eligible recipients for the provision of new, distinctive, and valuable information to the CNSC through informed and topic-specific interventions. Funding criteria are listed in the PFP guide. Based on recommendations from the Funding Review Committee, the CNSC awarded the following amounts in participant funding to the following applicants, as shown in Table 8.

Table 8: OPG Request for Commission Authorization to Operate Pickering NGS to the end of 2026 - Participant Funding Program Awards

Applicant	Maximum Amount of Available Funding
Métis Nation of Ontario	$13,200.00
Paul Sedran	$1,500.00
Canadian Association of Nuclear Host Communities	$15,000.00
Canadian Environmental Law Association	$15,000.00
Mississaugas of Scugog Island First Nation	$18,233.93
Curve Lake First Nation	$5,610.00
Hiawatha First Nation	$13,860.00
Northwatch	$9,757.55
TOTAL	**$92,161.48**

5.4.2 Conclusion

The PFP was offered to assist interested Indigenous Nations and communities, members of the public, and other stakeholders to prepare for, and participate in, the Commission's public hearing process. CNSC staff will continue to encourage the public and Indigenous Nations and communities to participate in the Commission's public proceedings with value-added information and perspectives.

6. Other Matters of Regulatory Interest

6.1 Cost Recovery

Paragraph 24(2)(c) of the NSCA requires that a licence application is accompanied by the prescribed fee. The *CNSC Cost Recovery Fees Regulations* (CRFR) set out the specific requirements based on the activities to be licensed. An applicant for a Class I facility licence is subject to Part 2 of CRFR, which is based on Regulatory Activity Plan fees.

6.1.1 Discussion

CNSC staff have determined that OPG is in good standing with respect to CRFR requirements for the Pickering NGS.

OPG's licence amendment application requesting authorization to operate Pickering NGS until the end of 2026 is not a new application and, as such, the applicant is not required to submit the initial fee of $25,000 as described in paragraph 7(1)(a). In this case, OPG is subject to paragraph 5(2) of the NSCA, which relates to quarterly invoices sent to licensees.

6.1.2 Conclusion

After reviewing CNSC records, CNSC staff conclude OPG is in good standing with respect to CRFR requirements for the Pickering NGS. Based on OPG's previous performance, there is no concern over payment of future cost recovery fees.

6.2 Financial Guarantees

Under subsection 24(5) of the *NSCA*, OPG is required to provide a financial guarantee in a form that is acceptable to the Commission. The financial guarantee for decommissioning is established to fund the activities described in the Preliminary Decommissioning Plan (PDP). These requirements are found in REGDOC-3.3.1, *Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities*.

6.2.1 Discussion

OPG maintains a consolidated financial guarantee for decommissioning its Ontario assets, including the Pickering NGS. The Commission accepted OPG's revised consolidated financial guarantee for the 2023-2027 period on December 6, 2022. [41]

In accordance with the PROL and as described in section G.5 of the Pickering NGS LCH, OPG is required to revise decommissioning plans, including the associated cost estimates and financial guarantee, on a five-year cycle. OPG's next financial guarantee submission is due in 2027.

OPG's financial guarantee includes segregated funds established pursuant to the Ontario Nuclear Funds Agreement between OPG and the Province of Ontario, as well as the trust fund for the management of used nuclear fuel established

pursuant to the *Nuclear Fuel Waste Act*. The total required amount for each year in the 2023-2027 period is projected to be satisfied without the need for a provincial guarantee because the projected value of the Nuclear Funds exceeds the decommissioning liability.

OPG is required to submit annual reports on its financial guarantee. As of 2023, the current CNSC requirement is $20,480 million and the total guarantee available is $23,998 million. [43] CNSC staff's review of OPG's 2023 report and applicable financial statements confirmed that OPG's available funds are sufficient to cover the required financial guarantee.

OPG's current financial guarantee is based on assumed commercial operations of Pickering NGS units 5–8 until the end of 2025. As noted in the 2023 annual report and further detailed in response to CNSC staff's request for further information, [21] OPG assessed the impact of operating units 5–8 until September 2026. OPG found that this would reduce the required financial guarantee by $16 million and that additional operation of units 5–8 until the end of 2026 would have an immaterial impact on the assessment. CNSC staff are satisfied that the financial guarantee amount remains sufficient.

6.2.2 Conclusion

OPG maintains a financial guarantee for Pickering NGS in accordance with regulatory requirements, which was accepted by the Commission in 2022. CNSC staff conclude that OPG's current financial guarantee is adequate for continued operation of units 5–8 to December 31, 2026.

6.3 Fisheries Act Authorization

The Fisheries Act and Fisheries Act authorization (FAA) are under the purview of Fisheries and Oceans Canada (DFO). In a memorandum of understanding signed between CNSC and DFO outlining areas for cooperation and administration of the Fisheries Act, DFO remains accountable for issuing Fisheries Act authorizations including approving any offset measures.

6.3.1 Discussion

OPG's FAA was issued by DFO in 2018 and authorizes OPG to carry out certain activities related to the operation of the Pickering NGS that are likely to result in harm to fish. The FAA also requires OPG to install a fish diversion system and implement offsetting measures.

In April 2023, OPG applied to DFO for an administrative amendment to their FAA for the Pickering NGS. This proposed amendment reflects operation of Pickering NGS units 5–8 beyond 2024. DFO has confirmed that an amendment to OPG's FAA is not required to operate Pickering NGS units 5–8 until December 31, 2026, and that OPG's FAA remains valid until December 31, 2028. [44]

6.3.2 Conclusion

CNSC staff conclude that OPG has followed the appropriate process to apply for an amendment to its FAA for the Pickering NGS. While the issuance of a licence under the NSCA is not contingent on a licensee having a valid FAA, it is the duty of the licensee to ensure that they are in compliance with other Acts of Parliament.

6.4 Improvement Plan and Significant Future Activities

CNSC staff continue to engage with OPG regarding planned significant future activities, including those related to decommissioning for units 1 and 4 and possible life extension for units 5 to 8 that will impact the Pickering NGS site over the next several years.

OPG reassessed its Periodic Safety Review (PSR) that was completed for the 2018-2028 licence period to support operation of units 5–8 to the end of 2026, which is discussed in section 3.

6.4.1 Discussion

As the Pickering NGS nears its planned end of life during the current licence period, there are significant activities currently in the planning stages that will impact the Pickering NGS site. Namely, the end of commercial operations of units 1 and 4 and the transitioning of the units to a period of safe storage with surveillance, as well as the possible refurbishment of units 5–8.

Permanent Shutdown of Units 1 and 4 in 2024

With the pending permanent shutdown of units 1 and 4 by the end of 2024, CNSC staff have conducted technical reviews of high-level preliminary information provided by OPG on its planned safe storage activities, including proposed design modifications.

Additionally, CNSC staff will establish a protocol with OPG to perform preliminary reviews of aspects of OPG's detailed decommissioning plan. CNSC staff anticipate submission of OPG's detailed decommissioning plan at least 2 years in advance of the start of the storage with surveillance period. For more information on OPG's plan for the end of commercial operations of the Pickering NGS, refer to section 6.7.

Possible Refurbishment of Pickering NGS Units 5–8

In September 2022, the Ontario government directed OPG to update its feasibility assessment for refurbishing Pickering NGS units 5–8 for operation beyond 2026, and on January 30, 2024, announced its support for OPG to proceed with a project to refurbish units 5–8.

CNSC staff continue to provide early regulatory engagement with OPG to communicate regulatory expectations regarding refurbishment. The possible refurbishment of units 5–8 would be considered at a public hearing of the Commission, separate from this matter, where members of the public, civil

society organizations, and Indigenous Nations and communities would have the opportunity to intervene.

6.4.2 Conclusion

CNSC staff are satisfied with the information provided by OPG regarding significant future activities at the Pickering NGS site and CNSC staff and OPG continue early engagement on such activities. CNSC staff will continue to provide updates to the Commission on the future of the Pickering NGS site through the status report on power reactors and the annual NPGS ROR.

6.5 Nuclear Liability Insurance

Pursuant to section 7 of the *Nuclear Liability and Compensation Act* (NLCA), OPG is required to maintain nuclear liability insurance for the Pickering NGS.

The NLCA is administered by Natural Resources Canada (NRCan). The Pickering NGS site is currently designated, pursuant to section 7 of the NLCA, as a nuclear installation in Item 4, Column 1 of the Schedule of the *Nuclear Liability and Compensation Regulations* (NLCR).

6.5.1 Discussion

The Pickering NGS installation contains two facilities that are authorized to contain nuclear material as defined in the NLCA, those are an eight-unit power reactor facility and a facility for the storage of irradiated fuel. These facilities are listed in item 4, column 4 in the Schedule of the NLCR. Section 4 of the NLCR describes classes of nuclear installations and ranks the risk of each class. The Pickering NGS installation falls under the "Power Reactor Class" pursuant to paragraph 4(2)(a) of the NLCR, and OPG's liability amount is prescribed at $1 billion pursuant to paragraph 24(1)(d) of the NLCA.

6.5.2 Conclusion

CNSC staff confirmed with NRCan that OPG is compliant with the NLCA financial security obligations.

6.6 Delegation of Authority

The Commission may include in a licence any condition it considers necessary for the purposes of the NSCA. The Commission may also delegate authority to CNSC staff with respect to the administration of licence conditions, or portions thereof.

There is one licence condition in the Pickering NGS PROL that contain the phrase "a person authorized by the Commission":

- Licence condition 3.2 (restart after a serious process failure) – "The licensee shall not restart a reactor after a serious process failure without the prior written approval of the Commission, or prior written consent of a person authorized by the Commission."

With respect to licence condition 3.2, in 2018 the Commission delegated the authority for consent to restart a reactor after a serious process failure to the following CNSC staff:

- Director, Pickering Regulatory Program Division
- Director General, Directorate of Power Reactor Regulation
- Executive Vice-President and Chief Regulatory Operations Officer, Regulatory Operations Branch

No changes to the above Commission delegation are recommended in relation to the proposed operation of Pickering NGS units 5–8 until the end of 2026.

6.7 Current Requirements for End of Commercial Operations

Licence condition 15.4 of OPG's PROL requires that OPG implement and maintain plans for end of commercial operations of all Pickering NGS units. As described in CNSC staff's CMD for the 2018 Pickering NGS renewal hearing (CMD 18-H6), [2] OPG had intended to cease commercial operation of all Pickering NGS units by the end of 2024 and undertake stabilization activities to transition the units to a safe storage state. Therefore, the compliance verification criteria described at the 2018 renewal hearing and included in section 15.4 of the current Pickering NGS LCH are based on the assumed end of commercial operation for all units in 2024 and the transition to a safe storage state during the current licence period.

Should the Commission authorize the operation of Pickering NGS units 5–8 until the end of 2026, updates to reflect this authorization will be necessary in the Pickering NGS LCH. The relevant sections of this proposed LCH are included in Part 2 of this CMD. In addition to the fitness for service related changes discussed in section 4.6 of this CMD, the proposed LCH also includes updates to sections 6.1, 15.1, and 15.4 to reflect the proposed operation of Pickering NGS units 5–8 until the end of 2026 and proposed increase of the pressure tube operating limit. These updates include the removal of requirements related to requesting authorization for further changes to the end of commercial operations date.

While CNSC staff are aware that OPG intends to pursue the refurbishment of Pickering NGS units 5–8, such activity is beyond the scope of this authorization request and would be considered at a separate public hearing of the Commission. At this time, the licencing basis for the Pickering NGS assumes that, following the end of commercial operations, all units will transition to a safe storage state. CNSC staff recognize the significance of the possible future refurbishment of units 5–8 and have included CNSC staff's initial regulatory expectations related to such a project in the updated LCH. These expectations include the submission of a project execution plan and the conduct of a comprehensive PSR.

6.7.1 OPG's End of Commercial Operations Strategy

As detailed in the updated *Pickering Site Strategic Plan*, [45] except for the proposed change to the shutdown date of Pickering NGS units 5–8 to the end of

2026, OPG's strategy for the end of commercial operations remains the same as described at the 2018 relicensing hearing. Pickering NGS units 1 and 4 will shutdown as planned by December 31, 2024, and Pickering NGS units 5–8 will shut down before the end of 2026. The strategy consists of the following stages:

- Stabilization from 2024 to 2028
- Storage with Surveillance from 2028 to 2050
- Dismantling and Demolition from 2050 to 2061
- Site Restoration from 2061 to 2065

OPG has requested authorization to operate Pickering NGS units 5–8 to December 31, 2026. [12] However, to date OPG has indicated that it intends to end commercial operation of units 5–8 by September 30, 2026. In its updated site strategic plan, [45] OPG indicated that this additional time has been included in its application to accommodate a possible request from the Province of Ontario for flexibility in shutdown dates. CNSC staff have only considered December 31, 2026, in the assessment of OPG's application. OPG may choose to end commercial operations of units 5–8 at any time before the authorized date.

Separate from this authorization request, CNSC staff expect OPG to provide an updated strategy and site strategic plan to reflect the possible refurbishment of units 5–8.

6.7.2 Sustainable Operations Plan (SOP) and Stabilization Activities Plan (SAP)

Section 15.4 of the Pickering NGS LCH details requirements related to the establishment and implementation of end of commercial operation plans. These plans include the Sustainable Operations Plan (SOP) and Stabilization Activities Plan (SAP).

The purpose of the SOP [46] is to manage anticipated challenges while approaching the end of commercial operation. OPG is required to develop and implement the SOP at least 5 years preceding the permanent shutdown of the first Pickering NGS unit. In accordance with this requirement, OPG submitted its first SOP of the current licence period to CNSC staff on December 12, 2019.

In contrast, the purpose of the SAP [46] is to manage the anticipated challenges during the transition period from shutdown to a safe storage state. OPG is required to develop the SAP at least 3 years prior to, and implement it immediately after, the permanent shutdown of the first Pickering NGS unit. In accordance with this requirement, OPG submitted its SAP to CNSC staff on December 8, 2021.

OPG is required to submit annual updates to the SOP and SAP by December 15 of each year as set out in the LCH. These updates are expected to incorporate CNSC staff comments and feedback on the previous version, as well as any other improvements or necessary changes to reflect new information. This includes any lessons learned from the shutdown of previous units, such as the planned 2024

shutdown of Pickering NGS units 1 and 4 in advance of the proposed 2026 shutdown of units 5–8. CNSC staff are satisfied with OPG's performance related to providing timely annual updates to the SOP and SAP that make necessary improvements and incorporate CNSC staff feedback.

The proposed operation of Pickering NGS units 5–8 to 2026 will not impact the annual updates of the SOP and SAP, and CNSC staff expect annual updates to continue. However, should the Commission authorize operation of units 5–8 until 2026, the SAP will not be implemented for these units until shutdown in 2026 and will incorporate lessons learned from the prior shutdown of units 1 and 4.

The SOP and SAP presume that the units will transition to a safe storage state to await future decommissioning. The possible future refurbishment of any Pickering NGS unit is not within the scope of the current SOP and SAP. Any changes to the SOP and SAP as a result of such work being pursued by OPG would be considered in future annual updates.

6.7.3 Conclusion

CNSC staff are satisfied that OPG has met all applicable requirements of licence condition 15.4 related to requesting authorization to operate Pickering NGS units 5–8 beyond 2024. CNSC staff are also satisfied that OPG has met and will continue to meet the requirements related to annual updates to the SOP and SAP.

CNSC staff are aware of the province of Ontario's support for the possible refurbishment of Pickering NGS units 5–8 and note that such activity is beyond the scope of this authorization request. The possible future refurbishment of Pickering NGS units 5–8, were OPG to request it, would be considered at a separate public hearing of the Commission.

7. Overall Conclusions and Recommendations

CNSC staff conclude the following:

1. OPG has adequately demonstrated in accordance with regulatory requirements the fitness for service of major components, including fuel channels, feeders, and steam generators, at the Pickering NGS for continued operation of units 5–8 to December 31, 2026.
2. OPG has adequately demonstrated in accordance with regulatory requirements that the fuel channels for Pickering NGS units 5–8 are fit for service up to 305,000 EFPH.
3. OPG remains qualified to carry on the activities authorized in the PROL and continues to make provisions to protect workers, people, and the environment.

Therefore, CNSC staff recommend that the Commission:

1. **Conclude**, pursuant to paragraphs 24(4)(a) and (b) of the *Nuclear Safety and Control Act* (NSCA), that OPG:
    c) Remains qualified to carry on the activities authorized by the licence.
    d) Will continue to make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.
2. **Amend** the Pickering NGS licensing basis to authorize operation of Pickering NGS units 5–8 to December 31, 2026.
3. **Amend** the pressure tube operating limit to up to 305,000 EFPH.
4. **Amend** the current Pickering NGS licence PROL 48.01/2028, to
    c) **Remove** licence condition 15.3, Pressure Tube Assessment for Safe Operation: *Before Hydrogen equivalent concentration exceeds 120 ppm, the licensee shall demonstrate that pressure tube fracture toughness will be sufficient for safe operation beyond 120 ppm*.
    d) **Include** licence condition 6.2, Fitness for Service Program for Fuel Channels in Extended Operation: *The licensee shall implement and maintain an enhanced fitness for service program for fuel channels in extended operation*.
5. If the Commission accepts CNSC staff's recommendations, CNSC staff will revise the Pickering NGS LCH as specified in Part 2 of this submission.

References

1. Record of Decision in the Application to Renew the Nuclear Power Reactor Operating Licence for the Pickering Nuclear Generating Station, 2018-H6
2. Pickering Nuclear Generating Station: Nuclear Power Reactor Operating Licence, April 9, 2020, e-Doc 6113988
3. CNSC Staff Submission for the 2018 Pickering Nuclear Generating Station Relicensing Hearing, CMD 18-H6
4. Regulatory Oversight Report for Canadian Nuclear Power Generating Sites: 2018, CMD 19-M30
5. Regulatory Oversight Report for Canadian Nuclear Power Generating Sites: 2019, CMD 20-M24
6. Regulatory Oversight Report for Canadian Nuclear Power Generating Sites: 2020, CMD 21-M36
7. Regulatory Oversight Report for Canadian Nuclear Power Generating Sites: 2021, CMD 22-M34
8. Regulatory Oversight Report for Canadian Nuclear Power Generating Sites: 2022, CMD 23-M36
9. Record of Decision - OPG - Application to extend the deadline for filing documents related to the end of commercial operation for the Pickering Nuclear Generating Station, from December 31, 2022 to June 30, 2023, DEC 2022-H107
10. OPG Letter, J. Franke to K. Campbell, Pickering NGS – Intent to Pursue CNSC Authorization for Operation of Pickering Units 5-8 through December 2025, December 16, 2021, CD# P-CORR-00531-22820, e-Doc 6706801
11. OPG Letter, J. Franke to R. Richardson, Intent to Seek CNSC Authorization to Operate Pickering NGS Units 5-8 Beyond December 31, 2024 to September 30, 2026; December 12, 2022, CD# P-CORR-00531-23091, e-Doc 6940452
12. OPG Letter, J. Franke to D. Saumure, Pickering Nuclear Generating Station – Power Reactor Operating Licence Amendment Application, June 16, 2023, CD# P-CORR-00531-23266, e-Doc 7067421
13. OPG Letter, J. Franke to R. Richardson, Pickering NGS - Assurance of Major Components Fitness-for-Service for the Conservative Projected Operating Hours of Pickering Units 5-8, April 19, 2023, CD# NK30-CORR-00531-08660, e-Doc 7028233
14. OPG Letter, R. Lockwood to A. Viktorov, Pickering NGS Periodic Safety Review 2 - Submission of Integrated Implementation Plan Revision 1, March 1, 2018, CD# P-CORR-00531-05311, e-Doc 5470841
15. Pickering NGS Licence Conditions Handbook: LCH-PR-48.00/2028-R006, January 2, 2023, e-Doc 7209144

16. CNSC Letter, R. Richardson to J. Franke, Pickering NGS – CNSC staff Review of Periodic Safety Review 2-B (PSR2-B) Submission of Global Issue Gap Assessment Report, April 20, 2023, e-Doc 7014996

17. OPG Letter, J. Franke to R. Richardson, Pickering NGS: Periodic Safety Review 2-B (PSR2-B) Submission of Global Assessment Report (GAR), May 2, 2023, CD# P-CORR-00531-23244, e-Doc 7037990

18. CNSC Letter, R. Richardson to J. Franke, Pickering NGS – CNSC staff Review of Periodic Safety Review 2-B (PSR2-B) Submission of Global Assessment Report (GAR), May 16, 2023, e-Doc 7031548

19. OPG Letter, J. Franke to R. Richardson, Pickering NGS: Periodic Safety Review 2-B (PSR2-B) Submission of Integrated Implementation Plan (IIP), May 31, 2023, CD# P-CORR-00531-23259, e-Doc 7054326

20. CNSC Letter, R. Richardson to J. Franke, Pickering NGS – CNSC staff Review of Periodic Safety Review 2-B (PSR2-B) -Submission of Integrated Implementation Plan (IIP), July 11, 2023, e-Doc 7034901

21. OPG Letter, J. Franke to R. Richardson, Pickering NGS - OPG Responses to Power Reactor Operating Licence Application - CNSC staff Requests for Additional Information, September 29, 2023, CD# P-CORR-00531-23372, e-Doc 7137893

22. OPG Email, S. Chae to D. MacDonald, Pickering NGS – Power Reactor Operating Licence Application – OPG Response to Further CNSC Staff Follow-up Questions", October 23, 2023, CD# P-CORR-00531-23433, e-Doc 7152046.

23. CNSC Letter, R. Richardson to J. Franke, Pickering NGS – Power Reactor Operating Licence Application – CNSC staff Requests for Additional Information, August 18, 2023, e-Doc 7100538

24. CNSC Letter, R. Richardson to J. Franke, Pickering NGS – Power Reactor Operating Licence Application – CNSC staff Requests for Additional Information, November 2, 2023, e-Doc 7146031

25. CNSC Letter, R. Richardson to J. Franke, Pickering NGS – Implementation of New and Revised REGDOCs and CSA Standards, April 11, 2023, e-Doc 6987903

26. CNSC Letter, R. Richardson and J. Burta to M. Knutson, CNSC staff review of OPG Status Update on REGDOC-2.4.1 Deterministic Safety Analysis Implementation, April 1, 2022, e-Doc 6760262

27. OPG Letter, J. Franke to R. Richardson, Pickering NGS Units 5 to 8: Updated Safety Report - Parts 1 and 2: Facility Description, October 20, 2022, CD# NK30-CORR-00531-08586, e-Doc 6905547

28. OPG Letter, J. Franke to R. Richardson and A. Mathai, Progress Report on OPG Heat Transport System Aging Safety Analysis, March 8, 2023, CD# N-CORR-00531-23574, e-Doc 6998429

29. OPG Letter, J. Franke to R. Richardson, Pickering NGS – Units 5 to 8: Completion of Pickering 'B' Probabilistic Safety Assessment Update, December 15, 2022, CD# NK30-CORR-00531-08580, e-Doc 6937341

30. OPG Letter, J. Franke to K. Campbell, Pickering NGS - Units 5 to 8: Submission of Pickering 'B' Hazard Screening Analysis, January 26, 2022, CD# NK30-CORR-00531-08395, e-Doc 6726780

31. CNSC Letter, R. Richardson to J. Franke, Pickering NGS - Units 5 to 8: Submission of Pickering 'B' Hazard Screening Analysis, February 2, 2023, e-Doc 6958076

32. CNSC Letter, R. Richardson to J. Franke, Pickering NGS – CNSC staff Review of Assurance of Major Components Fitness-for-Service for the Conservative Project Operating Hours of Pickering Units 5-8, July 11, 2023, e-Doc 7076923

33. CNSC Letter, R. Richardson to J. Franke, Pickering NGS, Units 5-8 - CNSC Staff Review of Revised PIP Plan for Fuel Channels, December 20, 2023, e-Doc 7189128

34. Minutes of the Commission Meeting of September 3, 2021 regarding Hydrogen Equivalent Concentration in Pressure Tubes, November 17, 2021

35. Record of Decision - Ontario Power Generation - Request for Authorization to Restart Pickering Nuclear Generating Station B Unit 5 following a forced outage, DEC 2021-H111

36. Record of Decision - Ontario Power Generation - Request for Authorization to Restart Pickering Nuclear Generating Station B Units 6-8 following future outages, DEC 2021-H112

37. Record of Decision - Application to Amend the Power Reactor Operating Licence for the Bruce Nuclear Generating Stations A and B with Respect to Fitness for Service Requirements, DEC 23-H103

38. CNSC staff update on elevated hydrogen equivalent concentration discovery events in the pressure tubes of reactors in extended operation, CMD 22-M37

39. CNSC Letter, R. Richardson to J. Franke, Pickering NGS – Revised Environmental Risk Assessment Report for Pickering Safe Nuclear and OPG Responses to CNSC Comments, September 8, 2023, e-Doc 7109206

40. CNSC Letter, R. Richardson to J. Franke, Pickering NGS – Revised 2022 Predictive Effects Assessment Addendum Report and OPG Responses to CNSC Comments, September 8, 2023, e-Doc 7108831

41. Record of Decision - Application for Acceptance of Ontario Power Generation's Revised Consolidated Financial Guarantee, DEC 2022-H104

42. Record of Decision - Bruce Power Inc., Canadian Nuclear Laboratories, Hydro-Quebec, New Brunswick Power Corporation, and Ontario Power Generation Inc. - Temporary exemption under section 7 of the Nuclear Safety and Control Act of High-

Security Site Licensees from subsection 36(2) of the Nuclear Security Regulations, DEC 2021-H101

43. OPG Letter, A. Cipolla to R. Richardson, A. Mathai, and N. Greencorn; OPG - Submission of the 2023 Annual Report for the 2023-2027 CNSC Financial Guarantee, February 27, 2023, CD# N-CORR-00531-23486, e-Doc 6990272

44. DFO Letter, H. Oakman to J. Franke, Amendment of Pickering Nuclear Generating Station 16-HCAA-00256 – Amendment not required, September 29, 2023, e-Doc 7140497

45. OPG Email, B. Stavropoulos to R. Richardson, Pickering NGS - CNSC Staff's Written Notification of Document Change: P-PLAN-09314-00003, Pickering Site Strategic Plan, Revision 002, June 15, 2023, CD# P-CORR-00531-23299, e-Doc 7067266

46. CNSC Letter, A. Viktorov to R. Lockwood, Pickering NGS: Regulatory Expectations for Pickering End of Commercial Operation, August 2, 2017, e-Doc 5307950

Glossary

For definitions of terms used in this document, see REGDOC-3.6, *Glossary of CNSC Terminology*, which includes terms and definitions used in the *Nuclear Safety and Control Act* and the Regulations made under it, and in CNSC regulatory documents and other publications.

Additional terms and acronyms used in this CMD are listed below.

AF	Accident frequency
ALARA	As low as reasonably achievable
Als	Action levels
AMP	Administrative monetary penalty
ASR	Accident severity rate
BE	Below expectations
CANDU	Canada deuterium uranium
CMD	Commission member document
COPCs	Contaminants of potential concern
CSIs	CANDU Safety Issues
DFO	Fisheries and Oceans Canada
DRLs	Derived release limits
EFPH	Effective full power hours / Equivalent full power hours
EMO	Emergency Management Ontario
EMS	Environmental management system
EPR	Environmental protection review
ERA	Environmental risk assessment
FAA	Fisheries Act authorization
FS	Fully satisfactory
GAR	Global assessment report
GIs	Global issues
GWMP	Groundwater monitoring program.
GWPP	Groundwater protection program
IAA	Impact Assessment Act
IAEA	International Atomic Energy Agency
IEMP	Independent environmental monitoring program
IIP	Integrated implementation plan
ISAR	Industrial safety accident rate
ISO	International Standards Organization
LCH	Licence conditions handbook
LCMP	Life cycle management plan

LRCS	Law, regulations, codes, and standards
MOL	Ministry of Labour (Ontario)
mSv	Millisievert
NGS	Nuclear generating station
NLCA	Nuclear Liability and Compensation Act
NLCR	Nuclear Liability and Compensation Regulations
NPGS	Nuclear power generating station
NRCan	Natural Resources Canada
NSR	Nuclear Security Regulations
OP&Ps	Operating policies and principals
OPEX	Operating experience
OPG	Ontario Power Generation
OSR	Operational safety requirements
PDP	Preliminary decommissioning plan
PEA	Predictive effects assessment
PFP	Participant funding program
PHCs	Petroleum hydrocarbons
PI&R	Problem identification and resolution
PIDP	Public information and disclosure program
PIP	Periodic inspection program
PNERP	Provincial Nuclear Emergency Response Plan (Ontario)
PROL	Power reactor operating licence
PSA	Probabilistic safety assessment
PSR	Periodic safety review
PSR2	OPG's PSR to support the 2018 Pickering relicensing
PSR2-B	OPG's reassessment of PSR2 to support continued operation beyond 2024
PTNSR	Packaging and Transport of Nuclear Substances Regulations
PWMF	Pickering Waste Management Facility
R&D	Research and development
ROR	Regulatory oversight report
SA	Satisfactory
SAP	Stabilization activities plan
SAT	Systematic approach to training
SCA	Safety and control area
SOE	Safe operating envelope
SOP	Sustainable operations plan
SSC	Structures, systems, and components
TDGR	Transport of Dangerous Goods Regulations

A. Safety Performance Rating Levels

Satisfactory (SA)

Licensee meets all of the following criteria:

- Performance meets CNSC staff expectations
- Licensee non-compliances or performance issues, if any, are not risk-significant
- Any non-compliances or performance issues have been, or are being, adequately corrected

Below Expectations (BE)

One or more of the following criteria apply:

- Performance does not meet CNSC staff expectations
- Licensee has risk-significant non-compliance(s) or performance issue(s)
- Non-compliances or performance issues are not being adequately corrected

Unacceptable (UA)

One or both of the following criteria apply:

- Risk associated with a non-compliance or performance issue is unreasonable
- At least one significant non-compliance or performance issue exists with no associated corrective action

Note: Starting in 2019, facility performance assessment ratings were simplified and the "Fully Satisfactory (FS)" was replaced by the "Satisfactory (SA)" rating. It is important to recognize that a facility that received an SCA performance rating of FS in previous Regulatory Oversight Report and now has a rating of SA, does not necessarily indicate a reduction in performance.

B. Basis for the Recommendation(s)

B.1 Summary of CNSC Assessment of Application

CNSC's staff assessment of OPG's licence amendment application included a completeness check, a sufficiency check, and a technical assessment against regulatory requirements. The completeness check verified whether the application included the prescribed information in accordance with the *Nuclear Safety and Control Act* and applicable regulations. For all facilities (i.e., Class I and Class II facilities), it is important to consider and address all licence amendment application requirements within the applicable CNSC regulations. As an application for an amendment of the licensing basis, OPG is subject to the requirements pursuant to section 6 of the *General Nuclear Safety and Control Regulations*.

The sufficiency check verified whether the application included sufficient and quality information in order for CNSC staff to conduct the technical assessment. The technical assessment verified whether the application included adequate safety and control measures to address CNSC requirements. Documents originally submitted as part of the application may have been revised, updated, or replaced over the course of the assessment to address CNSC requirements.

Pursuant to Section 6 of the *General Nuclear Safety and Control Regulations* Application for Amendment, Revocation or Replacement of Licence	**Location in Application or Supporting Document(s)**	**Complete?**	**Sufficient?**	**Adequate?**
6 *An application for the amendment, revocation or replacement of a licence shall contain the following information:*				
(a) *a description of the amendment, revocation or replacement and of the measures that will be taken and the methods and procedures that will be used to implement it;*	Section 2.0 of OPG's application describes OPG's requested licensing basis amendment. Section 4.0 of OPG's application describe measures, methods, and procedures that will implement the licensing basis amendment. Reference 1 of OPG's application further describes the measures, methods, and procedures that will be used to implement the proposed licensing basis amendment.	Yes	Yes	Yes
(b) *a statement identifying the changes in the information contained in the most recent application for the licence;*	Section 4.0 and 6.0 of OPG's application describes the information changes across the 14 safety and control areas.	Yes	Yes	Yes

Pursuant to Section 6 of the *General Nuclear Safety and Control Regulations* Application for Amendment, Revocation or Replacement of Licence	**Location in Application or Supporting Document(s)**	**Complete?**	**Sufficient?**	**Adequate?**
(c) *a description of the nuclear substances, land, areas, buildings, structures, components, equipment and systems that will be affected by the amendment, revocation or replacement and of the manner in which they will be affected; and*	Section 3.0 of OPG's application contains a description of the Pickering NGS site, including buildings and structures impacted by the proposed licensing basis amendment. Section 4.1.3 describes the components, equipment, and systems that will be affected by the proposed licensing basis amendment. Reference 1 of OPG's application further describes how components, equipment, and systems will be affected by the proposed licensing basis amendment.	Yes	Yes	Yes
(d) *the proposed starting date and the expected completion date of any modification encompassed by the application.*	Section 2.0 of OPG's application describes that the proposed licensing basis amendment is for continued operation from December 31, 2024, to no later than December 31, 2026. Section 4.1.3.1, reference 18 and appendix A of OPG's application describe the start and completion date of modifications related to the periodic safety review reassessment performed to support the proposed licensing basis amendment.	Yes	Yes	Yes

B.2 Technical Basis

The technical basis for the recommendations presented in this CMD includes regulatory documents, national standards, and international guidance documents, and is specified in the applicable sections of the Pickering NGS LCH.

C. Safety and Control Area Framework

The safety and control areas discussed in section 0 are comprised of specific areas of regulatory interest which vary between facility types.

C.1 Safety and Control Areas Defined

The following table provides a high-level definition of each SCA.

SAFETY AND CONTROL AREA FRAMEWORK		
Functional Area	**Safety and Control Area**	**Definition**
Management	Management System	Covers the framework that establishes the processes and programs required to ensure an organization achieves its safety objectives, continuously monitors its performance against these objectives, and fosters a healthy safety culture.
	Human Performance Management	Covers activities that enable effective human performance through the development and implementation of processes that ensure that a sufficient number of licensee personnel are in all relevant job areas and have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.
	Operating Performance	Includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.
Facility and Equipment	Safety Analysis	Covers maintenance of the safety analysis that supports that overall safety case for the facility. Safety analysis is a systematic evaluation of the potential hazards associated with the conduct of a proposed activity or facility and considers the effectiveness of preventive measures and strategies in reducing the effects of such hazards.
	Physical Design	Relates to activities that impact on the ability of structures, systems, and components to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.

SAFETY AND CONTROL AREA FRAMEWORK		
Functional Area	**Safety and Control Area**	**Definition**
	Fitness for Service	Covers activities that impact on the physical condition of structures, systems, and components to ensure that they remain effective over time. This area includes programs that ensure all equipment is available to perform its intended design function when called upon to do so.
Core Control Processes	Radiation Protection	Covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*. The program must ensure that contamination levels and radiation doses received by individuals are monitored and controlled and maintained ALARA.
	Conventional Health and Safety	Covers the implementation of a program to manage workplace safety hazards and to protect workers.
	Environmental Protection	Covers programs that identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of licensed activities.
	Emergency Management and Fire Protection	Covers emergency plans and emergency preparedness programs that exist for emergencies and for non-routine conditions. This are also includes any results of participation in exercises.
	Waste Management	Covers internal waste-related programs which form part of the facility's operations up to the point where the waste is removed from the facility to a separate waste management facility. This area also covers the planning for decommissioning.
	Security	Covers the programs required to implement and support the security requirements stipulated in the regulations, the licence, orders, or expectations for the facility or activity.

SAFETY AND CONTROL AREA FRAMEWORK		
Functional Area	**Safety and Control Area**	**Definition**
	Safeguards and Non-Proliferation	Covers the programs and activities required for the successful implementation of the obligations arising from the Canada/International Atomic Energy Agency (IAEA) safeguards agreements, as well as all other measures arising from the *Treaty on the Non-Proliferation of Nuclear Weapons*.
	Packaging and Transport	Covers programs for the safe packaging and transport of nuclear substances to and from the licensed facility.

C.2 Specific Areas for this Facility Type

The following table identifies the specific areas that comprise each SCA for Pickering NGS:

SPECIFIC AREAS FOR THIS FACILITY TYPE		
Functional Area	**Safety and Control Area**	**Specific Areas**
Management	Management System	▪ Management System ▪ Organization ▪ Performance Assessment, Improvement and Management Review ▪ Operating Experience (OPEX), Problem Identification and Resolution (PI&R) ▪ Change Management ▪ Safety Culture ▪ Configuration Management ▪ Records Management ▪ Supply and Contractor Management ▪ Business Continuity
	Human Performance Management	▪ Human Performance Programs ▪ Personnel Training ▪ Personnel Certification ▪ Work Organization and Job Design ▪ Fitness for Duty
	Operating Performance	▪ Conduct of Licensed Activity ▪ Procedures ▪ Reporting and Trending ▪ Outage Management Performance ▪ Safe Operating Envelope ▪ Severe Accident Management and Recovery ▪ Accident Management and Recovery
Facility and Equipment	Safety Analysis	▪ Deterministic Safety Analysis ▪ Hazard Analysis

SPECIFIC AREAS FOR THIS FACILITY TYPE		
Functional Area	**Safety and Control Area**	**Specific Areas**
		▪ Probabilistic Safety Analysis ▪ Criticality Safety ▪ Severe Accident Analysis ▪ Management of Safety Issues (including R&D Programs)
	Physical Design	▪ Design Governance ▪ Site Characterization ▪ Facility Design ▪ Structure Design ▪ System Design ▪ Components Design
	Fitness for Service	▪ Equipment Fitness for Service/Equipment Performance ▪ Maintenance ▪ Structural Integrity ▪ Aging Management ▪ Chemistry Control ▪ Periodic Inspection and Testing
Core Control Processes	Radiation Protection	▪ Application of ALARA ▪ Worker Dose Control ▪ Radiation Protection Program Performance ▪ Radiological Hazard Control
	Conventional Health and Safety	▪ Performance ▪ Practices ▪ Awareness
	Environmental Protection	▪ Effluent and Emissions Control (releases) ▪ Environmental Management System (EMS) ▪ Assessment and Monitoring ▪ Protection of People ▪ Environmental Risk Assessment

SPECIFIC AREAS FOR THIS FACILITY TYPE		
Functional Area	**Safety and Control Area**	**Specific Areas**
	Emergency Management and Fire Protection	▪ Conventional Emergency Preparedness and Response ▪ Nuclear Emergency Preparedness and Response ▪ Fire Emergency Preparedness and Response
	Waste Management	▪ Waste Characterization ▪ Waste Minimization ▪ Waste Management Practices ▪ Decommissioning Plans
	Security	▪ Facilities and Equipment ▪ Response Arrangements ▪ Security Practices ▪ Drills and Exercises ▪ Cyber security
	Safeguards and Non-Proliferation	▪ Nuclear Material Accountancy and Control ▪ Access and Assistance to the IAEA ▪ Operational and Design Information ▪ Safeguards Equipment, Containment and Surveillance ▪ Import and Export
	Packaging and Transport	▪ Package design and maintenance ▪ Packaging and transport ▪ Registration for use

PART 2

Part 2 of this CMD provides all relevant information pertaining directly to the licence, including:

1. The current licence;
2. Proposed changes to the licence conditions of the current licence;
3. The proposed licence; and
4. The draft licence conditions handbook.

Current Licence

The current licence (PROL 48.01/2028) is provided on the following pages of the document.

Word: e-Doc 6113980	PDF: e-Doc 6113988

Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

PDF Ref.: e-Doc 6113988
Word Ref.: e-Doc 6113980
File / Dossier: 2.01

NUCLEAR POWER REACTOR OPERATING LICENCE

PICKERING NUCLEAR GENERATING STATION

I) LICENCE NUMBER: **PROL 48.01/2028**

II) LICENSEE: Pursuant to section 24 of the *Nuclear Safety and Control Act* this licence is issued to:

Ontario Power Generation Inc.
700 University Avenue
Toronto, Ontario
M5G 1X6

III) LICENCE PERIOD: This licence is valid from September 1, 2018 to August 31, 2028, unless suspended, amended, revoked or replaced.

IV) LICENSED ACTIVITIES:

This licence authorizes the licensee to:

(i) operate the Pickering Nuclear Generating Station (hereinafter "the nuclear facility") at a site located in the City of Pickering, in the Regional Municipality of Durham, in the Province of Ontario;

(ii) possess, transfer, use, package, manage and store the nuclear substances that are required for, associated with, or arise from the activities described in (i);

(iii) import and export the nuclear substances, except controlled nuclear substances, that are required for, associated with, or arise from the activities described in (i);

(iv) possess, transfer, produce, package, manage, and store produce Cobalt-60;

(v) possess, transfer, manage and store heavy water from other nuclear facilities;

(vi) transport Category II nuclear material by road vehicle from the nuclear facility spent fuel bay to the onsite waste storage facility;

(vii) possess, transfer, export, package, manage and store nuclear substances, except controlled nuclear substances, from the Western Waste Management Facility;

(viii) possess and use prescribed equipment and prescribed information that are required for, associated with, or arise from the activities described in (i); and

(ix) possess, use, manage and store enriched uranium as required for fission chambers for the Pickering Nuclear Generating Station units 1 and 4 Shutdown System Enhancement, including spares.

V) EXPLANATORY NOTES:

(i) Nothing in this licence shall be construed to authorize non-compliance with any other applicable legal obligation or restriction.

(ii) Unless otherwise provided for in this licence, words and expressions used in this licence have the same meaning as in the *Nuclear Safety and Control Act* and associated Regulations.

(iii) The Pickering NGS Licence Conditions Handbook (LCH) provides compliance verification criteria used to verify compliance with the conditions in the licence. The LCH also provides information regarding delegation of authority, applicable versions of documents and non-mandatory guidance on how to achieve compliance.

VI) CONDITIONS:

G. General

G.1 The licensee shall conduct the activities described in Part IV of this licence in accordance with the licensing basis, defined as:

(i) the regulatory requirements set out in the applicable laws and regulations;
(ii) the conditions and safety and control measures described in the facility's or activity's licence and the documents directly referenced in that licence;
(iii) the safety and control measures described in the licence application and the documents needed to support that licence application;

unless otherwise approved in writing by the Canadian Nuclear Safety Commission (CNSC, hereinafter "the Commission").

G.2 The licensee shall give written notification of changes to the facility or its operation, including deviation from design, operating conditions, policies, programs and methods referred to in the licensing basis.

G.3 The licensee shall control the use and occupation of any land within the exclusion zone.

G.4 The licensee shall provide, at the nuclear facility and at no expense to the Commission, suitable office space for employees of the Commission who customarily carry out their functions on the premises of that nuclear facility (onsite Commission staff).

G.5 The licensee shall maintain a financial guarantee for decommissioning that is acceptable to the Commission.

G.6 The licensee shall implement and maintain a public information and disclosure program.

1. Management System

1.1 The licensee shall implement and maintain a management system.

2. Human Performance Management

2.1 The licensee shall implement and maintain a human performance program.

2.2 The licensee shall implement and maintain the minimum shift complement and control room staffing for the nuclear facility.

2.3 The licensee shall implement and maintain training programs.

2.4 The licensee shall implement and maintain certification programs in accordance with CNSC regulatory document REGDOC-2.2.3, *Personnel Certification, Volume III: Certification of Persons Working at Nuclear Power Plants*. [Amended 2020-04]

Persons appointed to the following positions require certification:

(i) Responsible Health Physicist;
(ii) Shift Manager;
(iii) Control Room Shift Supervisor; and
(iv) Authorized Nuclear Operator.

3. Operating Performance

3.1 The licensee shall implement and maintain an operations program, which includes a set of operating limits.

3.2 The licensee shall not restart a reactor after a serious process failure without the prior written approval of the Commission, or prior written consent of a person authorized by the Commission.

3.3 The licensee shall notify and report in accordance with CNSC regulatory document REGDOC-3.1.1, *Reporting Requirements for Nuclear Power Plants*.

4. Safety Analysis

4.1 The licensee shall implement and maintain a safety analysis program.

5. Physical Design

5.1 The licensee shall implement and maintain a design program.

5.2 The licensee shall implement and maintain a pressure boundary program and have in place a formal agreement with an Authorized Inspection Agency.

5.3 The licensee shall implement and maintain an equipment and structure qualification program.

6. Fitness for Service

6.1 The licensee shall implement and maintain a fitness for service program.

7. Radiation Protection

7.1 The licensee shall implement and maintain a radiation protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

8. Conventional Health and Safety

8.1 The licensee shall implement and maintain a conventional health and safety program.

9. Environmental Protection

9.1 The licensee shall implement and maintain an environmental protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

10. Emergency Management and Fire Protection

10.1 The licensee shall implement and maintain an emergency preparedness program.

10.2 The licensee shall implement and maintain a fire protection program.

11. Waste Management

11.1 The licensee shall implement and maintain a waste management program.

11.2 The licensee shall maintain a decommissioning plan.

12. Security

12.1 The licensee shall implement and maintain a security program.

13. Safeguards and Non-Proliferation

13.1 The licensee shall implement and maintain a safeguards program.

14. Packaging and Transport

14.1 The licensee shall implement and maintain a packaging and transport program.

15. Nuclear Facility-Specific

15.1 The licensee shall implement the Integrated Implementation Plan.

15.2 The licensee shall maintain Units 2 and 3 in the safe storage phase.

15.3 Before Hydrogen equivalent concentration exceeds 120 ppm, the licensee shall demonstrate that pressure tube fracture toughness will be sufficient for safe operation beyond 120 ppm.

15.4 The licensee shall implement and maintain plans for the end of commercial operations of all Pickering units.

15.5 The licensee shall implement and maintain a Cobalt-60 program for activities described under Part IV) of this licence.

15.6 The licensee shall limit the import and export of nuclear substances to those occurring as contaminants in laundry, packaging, shielding or equipment.

SIGNED at OTTAWA April 9, 2020

Velshi, Rumina

Digitally signed by Velshi, Rumina
DN: C=CA, O=GC, OU=CNSC-CCSN, CN="Velshi, Rumina"
Reason: I am the author of this document
Location: your signing location here
Date: 2020-04-09 16:07:01
Foxit PhantomPDF Version: 9.7.1

Rumina Velshi
President
CANADIAN NUCLEAR SAFETY COMMISSION

Proposed Licence Changes

Overview

The changes being recommended in the Pickering Nuclear Generating Station (NGS) PROL and related LCH support the implementation of an enhanced fitness for service program for fuel channels in extended operation.

Licence Conditions

Considering recent Commission decisions and advancements in understanding of pressure tube behaviour, CNSC staff recommend removing licence condition (LC) 15.3 and adding a new LC 6.2.

PROPOSED LICENCE CHANGES		
Existing PROL	**Proposed PROL**	**Reasons for Change**
15.3 Before hydrogen equivalent concentrations exceed 120 ppm, the licensee shall demonstrate that pressure tube fracture toughness will be sufficient for safe operation beyond 120 ppm.	15.3 (Removed)	LC 15.3 is no longer applicable based on the recent Commission decisions and results of CNSC staff assessments of findings of elevated Heq in some pressure tubes in extended operation.
	6.2 The licensee shall implement and maintain an enhanced fitness for service program for fuel channels in extended operation.	Since the fitness for service criteria established under LC 6.1 cannot be confirmed in the regions of interest of pressure tubes, a new LC 6.2 is recommended to establish the requirements for reporting the status of OPG's R&D activities, as well as the interim approaches to assessing the safe operability of pressure tubes when the validity of the fitness for service criteria established in LC 6.1 cannot be confirmed.

Licence Format

No change to the licence format is being requested or recommended.

Licence Period

No change to the licence period is being requested or recommended.

Proposed Licence

The proposed licence (PROL 48.02/2028) is provided on the following pages of the document.

Word: e-Doc 7185401	PDF: e-Doc 7185442

Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

PDF Ref.: e-Doc 7185442
Word Ref.: e-Doc 7185401
File / Dossier: 2.01

NUCLEAR POWER REACTOR OPERATING LICENCE

PICKERING NUCLEAR GENERATING STATION

I) LICENCE NUMBER: **PROL 48.02/2028**

II) LICENSEE: Pursuant to section 24 of the *Nuclear Safety and Control Act* this licence is issued to:

Ontario Power Generation Inc.
700 University Avenue
Toronto, Ontario
M5G 1X6

III) LICENCE PERIOD: This licence is valid from September 1, 2018 to August 31, 2028, unless suspended, amended, revoked or replaced.

IV) LICENSED ACTIVITIES:

This licence authorizes the licensee to:

(i) operate the Pickering Nuclear Generating Station (hereinafter "the nuclear facility") at a site located in the City of Pickering, in the Regional Municipality of Durham, in the Province of Ontario;

(ii) possess, transfer, use, package, manage and store the nuclear substances that are required for, associated with, or arise from the activities described in (i);

(iii) import and export the nuclear substances, except controlled nuclear substances, that are required for, associated with, or arise from the activities described in (i);

(iv) possess, transfer, produce, package, manage, and store produce Cobalt-60;

(v) possess, transfer, manage and store heavy water from other nuclear facilities;

(vi) transport Category II nuclear material by road vehicle from the nuclear facility spent fuel bay to the onsite waste storage facility;

(vii) possess, transfer, export, package, manage and store nuclear substances, except controlled nuclear substances, from the Western Waste Management Facility;

(viii) possess and use prescribed equipment and prescribed information that are required for, associated with, or arise from the activities described in (i); and

(ix) possess, use, manage and store enriched uranium as required for fission chambers for the Pickering Nuclear Generating Station units 1 and 4 Shutdown System Enhancement, including spares.

V) EXPLANATORY NOTES:

(i) Nothing in this licence shall be construed to authorize non-compliance with any other applicable legal obligation or restriction.

(ii) Unless otherwise provided for in this licence, words and expressions used in this licence have the same meaning as in the *Nuclear Safety and Control Act* and associated Regulations.

(iii) The Pickering NGS Licence Conditions Handbook (LCH) provides compliance verification criteria used to verify compliance with the conditions in the licence. The LCH also provides information regarding delegation of authority, applicable versions of documents and non-mandatory guidance on how to achieve compliance.

VI) CONDITIONS:

G. General

G.1 The licensee shall conduct the activities described in Part IV of this licence in accordance with the licensing basis, defined as:

(i) the regulatory requirements set out in the applicable laws and regulations;
(ii) the conditions and safety and control measures described in the facility's or activity's licence and the documents directly referenced in that licence;
(iii) the safety and control measures described in the licence application and the documents needed to support that licence application;

unless otherwise approved in writing by the Canadian Nuclear Safety Commission (CNSC, hereinafter "the Commission").

G.2 The licensee shall give written notification of changes to the facility or its operation, including deviation from design, operating conditions, policies, programs and methods referred to in the licensing basis.

G.3 The licensee shall control the use and occupation of any land within the exclusion zone.

G.4 The licensee shall provide, at the nuclear facility and at no expense to the Commission, suitable office space for employees of the Commission who customarily carry out their functions on the premises of that nuclear facility (onsite Commission staff).

G.5 The licensee shall maintain a financial guarantee for decommissioning that is acceptable to the Commission.

G.6 The licensee shall implement and maintain a public information and disclosure program.

1. Management System

1.1 The licensee shall implement and maintain a management system.

2. Human Performance Management

2.1 The licensee shall implement and maintain a human performance program.

2.2 The licensee shall implement and maintain the minimum shift complement and control room staffing for the nuclear facility.

2.3 The licensee shall implement and maintain training programs.

2.4 The licensee shall implement and maintain certification programs in accordance with CNSC regulatory document REGDOC-2.2.3, *Personnel Certification, Volume III: Certification of Persons Working at Nuclear Power Plants*. [Amended 2020-04]

Persons appointed to the following positions require certification:

(i) Responsible Health Physicist;
(ii) Shift Manager;
(iii) Control Room Shift Supervisor; and
(iv) Authorized Nuclear Operator.

3. Operating Performance

3.1 The licensee shall implement and maintain an operations program, which includes a set of operating limits.

3.2 The licensee shall not restart a reactor after a serious process failure without the prior written approval of the Commission, or prior written consent of a person authorized by the Commission.

3.3 The licensee shall notify and report in accordance with CNSC regulatory document REGDOC-3.1.1, *Reporting Requirements for Nuclear Power Plants*.

4. Safety Analysis

4.1 The licensee shall implement and maintain a safety analysis program.

5. Physical Design

5.1 The licensee shall implement and maintain a design program.

5.2 The licensee shall implement and maintain a pressure boundary program and have in place a formal agreement with an Authorized Inspection Agency.

5.3 The licensee shall implement and maintain an equipment and structure qualification program.

6. Fitness for Service

6.1 The licensee shall implement and maintain a fitness for service program.

6.2 The licensee shall implement and maintain an enhanced fitness for service program for fuel channels in extended operation. [Amended 2024-mm]

7. Radiation Protection

7.1 The licensee shall implement and maintain a radiation protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

8. Conventional Health and Safety

8.1 The licensee shall implement and maintain a conventional health and safety program.

9. Environmental Protection

9.1 The licensee shall implement and maintain an environmental protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

10. Emergency Management and Fire Protection

10.1 The licensee shall implement and maintain an emergency preparedness program.

10.2 The licensee shall implement and maintain a fire protection program.

11. Waste Management

11.1 The licensee shall implement and maintain a waste management program.

11.2 The licensee shall maintain a decommissioning plan.

12. Security

12.1 The licensee shall implement and maintain a security program.

13. Safeguards and Non-Proliferation

13.1 The licensee shall implement and maintain a safeguards program.

14. Packaging and Transport

14.1 The licensee shall implement and maintain a packaging and transport program.

15. Nuclear Facility-Specific

15.1 The licensee shall implement the Integrated Implementation Plan.

15.2 The licensee shall maintain Units 2 and 3 in the safe storage phase.

15.3 Removed. [Amended 2024-mm]

15.4 The licensee shall implement and maintain plans for the end of commercial operations of all Pickering units.

15.5 The licensee shall implement and maintain a Cobalt-60 program for activities described under Part IV) of this licence.

15.6 The licensee shall limit the import and export of nuclear substances to those occurring as contaminants in laundry, packaging, shielding or equipment.

SIGNED at OTTAWA _____

_____

[Name]
President
CANADIAN NUCLEAR SAFETY COMMISSION

Draft Licence Conditions Handbook

The relevant sections of the draft LCH are provided on the following pages of the document.

Word: e-Doc 7028463	PDF: e-Doc 7209054

Canada's Nuclear Regulator

e-Doc 7028463

DRAFT

LICENCE CONDITIONS HANDBOOK

SECTIONS 6, 15.1, 15.3, & 15.4
PREPARED FOR CMD 24-H05

LCH-PR-48.00/2028-R007

ASSOCIATED WITH

PICKERING NUCLEAR GENERATING STATION
NUCLEAR POWER REACTOR OPERATING LICENCE

PROPSED LICENCE # PROL 48.02/2028

Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire
Canada

6 SCA – FITNESS FOR SERVICE

6.1 Fitness for Service Program

Licence Condition 6.1:

The licensee shall implement and maintain a fitness for service program.

Preamble:

The fitness for service SCA includes the following SpAs:

- Equipment fitness for service/equipment performance (Reliability)
- Maintenance
- Structural integrity (Addressed in other SpAs)
- Aging management
- Chemistry control
- Periodic inspection and testing

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
Equipment Fitness for Service/Equipment Performance (Reliability)		
N-PROG-MA-0026	Equipment Reliability	No
N-PROG-RA-0016	Risk and Reliability Program	No
N-STD-RA-0033	Reliability and Monitoring of Systems Important to Safety	No
P-REP-03611-00012	PNGS Systems and Components Important to Safety	Yes
P-LIST-06937-00001	Pickering A and B List of Safety Related Systems	Yes
Maintenance		
I-PROG-AS-0001	Conduct of Inspection and Maintenance Services	No
N-PROG-MA-0004	Conduct of Maintenance	No

N-PROG-MA-0017	Component and Equipment Surveillance	Yes
N-PROG-MA-0025	Major Components	No
N-PROC-MA-0024	System Performance Monitoring	No
Aging Management		
N-PROG-MP-0008	Integrated Aging Management	No
N-PROC-MP-0060	Aging Management Process	No
N-STD-MA-0024	Obsolescence Management	No
N-PLAN-01060-10003	Reactor Components and Structures Life Cycle Management Plan	Yes
N-PLAN-01060-10008	Reactor Components and Structures Life Cycle Management Plan: Technical Basis Document	No
N-PROC-MA-0044	Fuel Channel Life Cycle Management	No
N-PLAN-01060-10002	Fuel Channels Life Cycle Management Plan	Yes
N-PLAN-01060-10001	Feeders Life Cycle Management Plan	Yes
N-PLAN-01060-10007	Feeders Life Cycle Management Plan: Technical Basis Document	No
N-PLAN-33110-10009	Steam Generators Life Cycle Management Plan	Yes
NA44-PLAN-33110-10003	Pickering Units 1 and 4 Steam Generator Life Cycle Management Plan (Except Appendix B)	No
NK30-PLAN-33110-10008	Pickering Units 5-8 Steam Generator Life Cycle Management Plan (excluding Sheet Sections 001 to 007)	No
N-PLAN-01060-10004	Aging Management Plan for Containment Structures	Yes
NA44-PLAN-34220-00002	Life Cycle and Aging Management Program Plan for Fiberglass-Reinforced Plastic Components in the Pickering NGS Vacuum Building	Yes
Chemistry Control		
N-PROG-OP-0004	Chemistry	No
Periodic Inspection and Testing		
I-STD-AS-0003	Non-Destructive Examination	No
I-PROG-AS-0001	Conduct of Inspection and Maintenance Services	No
N-PROC-MA-0052	Flaw Dispositioning	No

FITNESS FOR SERVICE

General Pressure Boundaries		
NA44-PIP-03641.2-00001	Pickering Nuclear Generating Station A Periodic Inspection Plan For Unit 1	Yes
NA44-PIP-03641.2-00007	Pickering Nuclear Generating Station A Periodic Inspection Plan For Unit 4	Yes
NK30-PIP-03641.2-00001	Pickering B Periodic Inspection Program Unit 5	Yes
NK30-PIP-03641.2-00002	Pickering B Periodic Inspection Program Unit 6	Yes
NK30-PIP-03641.2-00003	Pickering B Periodic Inspection Program Unit 7	Yes
NK30-PIP-03641.2-00004	Pickering B Periodic Inspection Program Unit 8	Yes
Fuel Channels		
N-REP-31100-10041	Acceptance Criteria and Evaluation Procedures for Material Surveillance Pressure Tube	Yes
NA44-PIP-31100-00005	Pickering Nuclear 1,4 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	Yes
NK30-PIP-31100-00005	Pickering Nuclear 5-8 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	Yes
N-REP-31100-10061	Compliance Plan for Long-Term Use of CSA N285.8 For In-Service Evaluation of Zirconium Alloy Pressure Tubes	Yes
Feeders		
NA44-PIP-33126-00001	Pickering Nuclear Units 1& 4 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	Yes
NK30-PIP-33126-00001	Pickering Nuclear Units 5-8 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	Yes
COG-JP-4107-V06	Fitness-for-Service Guidelines for Feeders in CANDU Reactors	Yes
Steam Generators		
NA44-PLAN-33110-10003 Sheet Section 003	Pickering Units 1 and 4 Steam Generator Life Cycle Management Plan Technical Basis—In Service Inspection Plan	Yes
NK30-PLAN-33110-10008 Sheet Section 006	Pickering Units 5-8 In-Service Inspection Plan	Yes
COG Report 07-4089	Fitness-For-Service Guidelines for Steam Generator and Preheater Tubes	Yes

FITNESS FOR SERVICE

Containment Components		
NA44-PIP-03642.2-00001	Pickering Nuclear Generating Station A Periodic Inspection Program For Containment Components	Yes
NK30-PIP-03642.2-00001	Pickering Nuclear Generating Station "B" Periodic Inspection Program For Containment Components	Yes
P-PIP-03642.2-00001	Pickering Nuclear Generating Station A Periodic Inspection Program For Unit 0 Containment Components	Yes
Concrete Containment Structures		
N-PROC-MA-0066	Administrative Requirements for In-Service Examination and Testing for Concrete Containment Structures	Yes
NA44-PIP-03643.2-00001	Pickering Nuclear GSA – Reactor Building Periodic Inspection Program	Yes
NK30-PIP-03643.2-00001	Pickering Nuclear GSB – Reactor Building Periodic Inspection Program	Yes
NA44-PIP-03643.2-00002	Pickering Nuclear GS – PRD & VB Periodic Inspection Program	Yes
NA44-PIP-03643.2-00003	Pickering Nuclear GS – Vacuum Building Post Tensioning Rods Periodic Inspection Program	Yes
NA44-REP-34200-00017	Pickering NGS "A" Reactor Building and Pressure Relief Duct In-service Integrated Leakage Rate Test Requirements in accordance with CSA N287.7-17	Yes
NK30-REP-34200-00014	Pickering NGS B Reactor Building In-service Leakage Rate Test Requirements In Accordance With CSA N287.7-17	Yes
NA44-REP-25100-00009	Pickering NGS Vacuum Building In-service Integrated Leakage Rate Test Requirements in Accordance with CSA N287.7-17	Yes
Balance of Plant		
N-PROC-MP-0060	Aging Management Process	No

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
Equipment Fitness for Service/Equipment Performance (Reliability)				
CNSC	REGDOC-2.6.1	Reliability Programs for Nuclear Power Plants	2017	2020-10-23
Maintenance				
CNSC	REGDOC-2.6.2	Maintenance Programs for Nuclear Power Plants	2017	2020-10-23
Aging Management				
CNSC	REGDOC 2.6.3	Aging Management	2014	2017-12-14
Periodic Inspection and Testing				
CSA	N285.4	Periodic Inspection of CANDU Nuclear Power Plant Components	2005 2019+	2013-09-01
CSA	N285.8	Technical Requirements for In-Service Inspection Evaluation of Zirconium Alloy in Pressure Tubes in CANDU Reactors	2015	2016-12-05
CSA	N285.5	Periodic Inspection of CANDU Nuclear Power Plant Containment Components	2008 and Update No. 1 (January 2011) (2018)***	2013-09-01 2019-02-19
CSA	N287.1	General requirements for concrete containment structures for nuclear power plants	2014	2018-09-01
CSA	N287.2*	Material requirements for concrete containment structures for CANDU nuclear power plants	2008	2013-09-01
CSA	N287.7	In-service Examination and Testing Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants	2017	2021-10-08
CSA	N291	Requirements for safety-related structures for CANDU nuclear power plants	2008	2018-09-01**

* CSA N287.2 is required by CSA N287.7 Clause 6.5.1(repair materials).
** See LC 5.1 for additional details.
*** Compliance with the 2018 edition is only for the clauses specified under “CVC Related to CSA N285.5” in this LCH
+ Compliance with the 2019 edition is only for the clauses specified under “CVC Related to CSA N285.4” in this LCH

Equipment Fitness for Service/Equipment Performance (Reliability)

The equipment fitness for service/equipment performance relates to the reliability of the facility's SSCs. These requirements help to assure that the systems important to safety (SIS) can meet their defined design, and performance criteria throughout the lifetime of the facility.

The equipment fitness for service/equipment performance SpA includes the following review topics and requirements from CSA N286 (clauses identified below) and REGDOC-2.6.1:

- Reliability Program (N286 Clauses 7.9.5, 7.9.5 (a) – (d)):
  - Systems Important to Safety (SIS);
  - Reliability of SIS;
  - Reliability Targets; and
  - Reliability Assessments.

Reliability Program

The licensee shall establish a reliability program in accordance with REGDOC-2.6.1 that includes setting reliability targets, performing reliability assessments, testing and monitoring, and reporting for plant systems whose failure affect the risk of a release of radioactive or hazardous material.

As detailed in OPG correspondence P-CORR-00531-06190 (e-doc 6406903), OPG has initiated Document Change Requests to reflect the rebrand of RD/GD-98 (now REGDOC-2.6.1) during the next revision of the affected OPG governance documents.

Systems Important to Safety and Reliability Targets

OPG has developed the lists of systems important to safety for both Pickering NGS-A and Pickering NGS-B as required by REGDOC-2.6.1. The systems important to safety, along with their unavailability target, are documented in P-REP-03611-00012 "*PNGS Systems and Components Important to Safety*".

CNSC staff will review the annual report on risk and reliability required by REGDOC-3.1.1 to ensure the performance of systems important to safety meets their reliability requirements and if not, that the licensee has taken appropriate corrective actions. See LC 3.3 for more information on this report.

Maintenance Program

A nuclear power plant maintenance program consists of policies, processes and procedures that provide direction for maintaining SSCs of the plant. The intent of a maintenance program is to ensure that the SSCs remain capable of maintaining their function as described in the safety analysis. A maintenance program uses organized activities, both administrative and technical, to keep SSCs in good operating condition, and to ensure that they function as per design.

The maintenance SpA includes the following review topics and requirements from CSA N286 (clauses identified below) and REGDOC-2.6.2:

- Maintenance Program (Clauses 7.9.9, 7.9.9 (a) – (d)):
  - Work management (Clauses 4.8, 4.8.1, 4.8.2, 4.8.3);
  - Preventive Maintenance;

- Corrective Maintenance;
- System Health Monitoring (7.9.10, 7.9.10 (a) – (c), 7.9.4, 7.9.4 (a) – (c)); and
- Maintenance records (Clause 4.7.4).

As detailed in OPG correspondence P-CORR-00531-06190 (e-doc 6406903), OPG has initiated Document Change Requests to reflect the rebrand of RD/GD-210 (now REGDOC-2.6.2) during the next revision of the affected OPG governance documents.

Aging Management

The aging management SpA includes the following review topics and requirements:

- Integrated Aging Management (REGDOC-2.6.3):
  - Lifecycle Management:
    - Major pressure boundary components (fuel channels, feeders and steam generators) and reactor components and structures;
    - Concrete Containment Structures; and
  - Periodic Inspection (See SpA for Periodic Inspection).

Aging management is comprised of activities (engineering, operational, inspection, and maintenance actions) implemented proactively to ensure the reliability and availability of required safety functions of SSCs throughout the life of a nuclear power plant. Consistent with the intent of the *Class I Nuclear Facilities Regulations*, licensees are expected to establish, implement, and improve programs for managing aging, including obsolescence, of SSCs to ensure that required safety functions are maintained.

Managing the aging effects of a reactor facility is necessary to ensure the availability of required safety functions throughout the facility's service life, with consideration given to changes that occur over time and with use. This requires addressing both physical aging and obsolescence of SSCs that can, directly or indirectly, have an adverse effect on the safe operation of the reactor facility.

The following SSC-specific aging management programs (or LCMPs) shall be submitted to CNSC for review as a "prior notification" documents:

- Reactor Components and Structures Life Cycle Management Plan;
- Fuel Channels Life Cycle Management Plan;
- Feeders Life Cycle Management Plan;
- Steam Generators Life Cycle Management Plan;
- Aging Management Plan for Containment Structures; and
- Life Cycle and Aging Management Program Plan for Fiberglass-Reinforced Plastic Components in the Pickering NGS Vacuum Building.

The SSC-specific aging management programs, which are submitted in accordance with LC G.2, are licensing basis documents. As such any changes to the SSC-specific aging management plans will be reviewed by CNSC staff to confirm that they remain within the licensing basis and include all prior OPG commitments with respect to the inspection scope and other relevant commitments related to the

continued operation of the Pickering Units. When considering possible changes to activities identified in the LCMPs, the licensee shall engage CNSC staff early enough to confirm that the changes are within the licensing basis. Administrative or other such changes to the documents are subject to normal notification requirements as indicated in the written notification table for this section.

In addition, the aging management plans are also subject to the integrated implementation plan actions, which are detail under LC 15.1.

Fuel Channel Aging Management

The current operating limit for the Pickering NGS-A Units 1 and 4 pressure tubes is 247,000 Effective Full Power Hours (EFPH), which was approved by the Commission on June 3, 2014, e-Doc 4448178. The current operating limit for Pickering NGS-B Units 5 to 8 pressure tubes is 305,000 EFPH.

Continued use of Fracture Toughness Model(s)

Licensee shall submit an impact assessment for CSA N285.8-15 Clause 7 evaluations whenever a fracture toughness test result challenges the model's lower prediction bound, and where the model is applied in the Clause 7 evaluation(s).

Validation of the Cohesive Zone-based Fracture Toughness Model (Clause D13.2.3 of CSA N285.8-15)

As detailed in CNSC letter e-doc 6366701 (N-CORR-00531-22348), OPG shall produce and submit an uncertainty assessment report for the next revision of the Cohesive Zone-based fracture toughness model (CZM-R2).

The licensee shall, on a semi-annual basis submit the following until all the activities under the R&D test plan have been completed:

- the latest fracture toughness test results from the executed R&D test plan pertaining to the Cohesive Zone-based fracture toughness Model;
- an assessment of the fracture toughness test results against the applicable model predictions; and
- any updates to the test plan and schedule.

Chemistry Control

The licensee's chemistry control SpA includes the following review topics and requirements from CSA N286:

- Chemistry Control Program (Clauses 7.9.11, 7.9.11 (a) – (c)):
  - Preserve integrity of SSCs important to safety;
  - Manage the harmful effects of chemical impurities and corrosion on plant SSCs; and
  - Implement the ALARA principle to manage the buildup of radioactive material and occupational radiation exposure.
  - Limit the release of chemicals and radioactive materials to the environment.
- Chemical Surveillance (effectiveness of chemistry control in plant systems):

- Chemical parameters;
- Operational specifications;
- Parameter monitoring, measurement and sampling including post-accident sampling; and
- Trending.

- Chemistry Specifications for systems, and
- Storage and Handling.

Chemistry Control and Monitoring Program

Chemistry control and monitoring program establishes processes and overall requirements to ensure effective control and monitoring of plant chemistry during operational and lay-up conditions, to ensure critical plant equipment performs safely and reliably over the life of the stations.

The chemistry control program shall specify processes, specifications, overall requirements, parameter monitoring, data trending and evaluation to ensure effective control of plant chemistry during operational and lay-up conditions.

The licensee shall also maintain a set of technical basis documents for chemistry control and monitoring.

Periodic Inspection and Testing

The purpose of a periodic inspection program (PIP) or an in-service inspection (ISI) program is to provide assurance that the likelihood of a failure that could endanger the environment and/or radiological health and safety of persons has not increased significantly since the plant was put into service.

The periodic inspection and testing SpA includes the following review topics and requirements:

- Periodic Inspection/In-Service Inspection:
  - General Pressure Boundaries (CSA N285.4);
  - Fuel Channels (CSA N285.4);
  - Feeders (CSA N285.4);
  - Steam Generators (CSA N285.4);
  - Containment Components (CSA N285.5);
  - Concrete Containment Structures (CSA N287 Series);
  - Safety-related Structures (CSA N291); and
  - Balance of Plant Systems and Components.

Periodic and in-service inspection programs are established to confirm that pressure-boundary components; containment structures and components, continue to meet their design requirements. The condition of safety significant balance of plant pressure retaining systems and components, as well as, safety-related structures are monitored for degradation through in-service inspection programs.

Personnel conducting non-destructive examinations shall be certified in accordance with the edition of CAN/CGSB 48.9712/ISO 9712 currently adopted for use by the National Certification Body (NCB) of Natural Resources Canada for the appropriate examination method. If the NCB does not offer

certification for a specific inspection method, the relevant alternate requirements of Clause 5 of CSA N285.4 or Clause 6 of N285.5 shall apply to ensure that personnel are appropriately trained and qualified.

OPG shall prepare, update and revise, as necessary, PIP documents in accordance with the requirements of the applicable CSA Standards listed in the licence condition. The currently accepted PIP documents are listed in the written notification table for this section. Revisions to OPG's PIP documents require CNSC acceptance prior to implementation.

OPG shall carry out periodic inspections in accordance with CNSC accepted PIP documents. If a deviation from the accepted PIP program is anticipated during inspection planning activities, OPG shall obtain CNSC acceptance prior to conducting the affected inspection. However, for any findings, discoveries or deviations from the accepted PIP that are identified during an inspection, OPG shall inform the CNSC and provide justification in the corresponding inspection report submission.

Selection Criteria for Pressure Tube Inspection

In reference to inspected pressure tubes, and to resolve probabilistic core assessment flaw removal assumptions, OPG is to provide evidence that a sample of the pressure tubes with the highest cumulative probability of developing through-wall cracking determined from probabilistic core assessments is included in their pressure tube volumetric inspection program (see CNSC letter 6415008, N-CORR-00531-22440). To validate probabilistic core assessment predictions, OPG is to include consideration for higher risk tubes from the probabilistic core assessments in the selection criteria for fuel channel inspection campaigns.

Evaluation of Pressure Tube Crevice Corrosion Flaws in Units 5 to 8

CNSC accepted a "Level 2" approach for the evaluation of crevice corrosion flaws (CNSC letter, e-Doc 3915570, N-CORR-00531-0566). CNSC subsequently accepted an amendment to the "Level 2" approach with removal of the requirement to re-inspect the deepest crevice corrosion (CC) flaw in each Unit during all UDM inspection campaigns and to re-inspect all CC flaws with a measured change in depth equal to or greater than 0.15 mm during the next inspection campaign. (CNSC letter, e-Doc 6364025, NK30-CORR-00531-08096).

CVC Related to CSA N285.4-05 and N285.4-14

Permanent exemptions to the requirements of the standard that receive regulatory acceptance shall be incorporated, including supporting technical basis, into the PIP documents, listed in the "Written Notification" table for this section.

CNSC staff have accepted OPG's disposition of the gaps arising from the Pickering Periodic Safety Review 2 (PSR2) for compliance against N285.4-14 (OPG letter P-CORR-00531-05335, e-Doc 5582509) and the subsequent PIP revisions addressing these gaps (CNSC letter, e-Doc 5912774).

If it is determined that deterioration related to erosion-corrosion or environmentally assisted cracking is credible on systems covered by the current PIPs at the Pickering units, OPG shall evaluate the need to adopt the requirements of Clauses 7.4.7 or 7.4.8 of CSA N285.4-14 Update No. 1 into their existing PIP and submit the evaluation for CNSC staff review and acceptance.

General Pressure Boundaries (N285.4 Clauses 3 to 11):

OPG shall comply with the 2005 edition of N285.4 including Update No. 1, June 2007, with the exception of clauses (including sub-clauses) 6.1.4.2, 8.2.2, 8.2.5, 8.3.1, 8.3.2, 8.3.3, 9.4 and Table 5, for which OPG shall comply with the 2019 edition of this standard (CNSC letter, e-Doc 6118024).

CNSC staff have accepted the Pickering-A NGS PIP documents (e-Doc 3345880) and the Pickering-B NGS PIP documents (e-Doc 1379036).

Fuel Channel (FC) Pressure Tubes (PT) (CSA N285.4 Clause 12):

CNSC staff have accepted the Pickering Units 1&4 and the Pickering Units 5-8 PIP documents (e-Doc 5912774).

Evaluation of results and dispositions for Pickering NGS pressure tubes

With respect to N285.4-05 clause 12.2.5.1.3, CNSC staff have accepted OPG's revised compliance plan N-REP-31100-10061 R005 (N-CORR-00531-22279, e-Doc 6366785), for the use of CSA N285.8-15 "In-Service Evaluation of Zirconium Alloy Pressure Tubes", as the evaluation method used for the fitness-for-service assessment of the Fuel Channels in Pickering 1 & 4 and 5 to 8 units. CNSC staff's acceptance of the revised plan is subject to two conditions as detailed in CNSC letter e-Doc 6441842 (N-CORR-00531-22497).

Calandria Tube (CT) to Liquid Injection Shutdown System (LISS) Nozzle Gap Measurements in Pickering Unit 6

As detailed in CNSC letter e-Doc 6575865, OPG shall re-inspect the most limiting predicted CT-LISS nozzle gaps prior to Unit 6 reaching 286,000 EFPH.

Pressure Tube to Calandria Tube contact assessment for inspected channels in Pickering Units 5 to 8

With respect to N285.4-05 clause 12.2.4.6.2 (c), OPG is exempt from reporting the maximum change in the gap since the previous inspection and the rate of change of the gap. To satisfy the other requirements in Clause 12.2.4.6.2 (c), OPG shall continue to report (i) the minimum pressure tube to calandria tube gap, and (ii) the location of the minimum gap (see CNSC letter e-doc 6067886)

With respect to N285.4-05 clause 12.2.5.2.3 (d), when pressure tube to calandria tube contact cannot be precluded, a disposition following a CNSC accepted methodology is required. The licensee shall use "Heq concentration less than Blister Formation Threshold" as the evaluation failure criteria. Further, the maximum allowable evaluation period shall not exceed two hot years, from the last Body-of-Tube Heq concentration measurement in the affected Unit (or otherwise justified).

Licensee may operate a unit beyond the maximum evaluation period of two hot years, provided that a "time at risk" assessment is performed for the requested extension of the evaluation period, and submitted to the CNSC for acceptance. The "time at risk" assessment shall demonstrate that the predicted hydride blister depth will be less than 0.10 mm when the tube-specific Heq is unknown at the start of the evaluation period, and 0.15 mm when the tube-specific Heq is known at the start of the evaluation period.

PT Flaw Assessments (hydrided region overload)

With respect to CSA N285.8-15 Clause 5.4.3.1 (g), CNSC staff conditionally accepted OPG's concession request up to December 31, 2024 (CNSC letter e-Doc 6882809), which coincides with the completion of OPG's plan to assess the Rapid Cooldown Transient in Flaw Assessments (see CNSC letter for terms of conditions).

PT Material Testing

With respect to N285.4-05 clause 12.4.4.2, CNSC staff have accepted (e-Doc 3895468) OPG's procedural updates and technical justifications for pressure tube material testing submitted in e-Doc 3848127, N-CORR-00531-05488.

Probabilistic Leak-Before-Break (PLBB) Assessments (CSA N285.8)

With respect to Clause 7.4.3.2 of CSA N285.8-15, the maximum allowable conditional probability over the evaluation period of pressure tube failure caused by a growing axial crack exceeding the critical crack length during the sequence of events from pressure tube through-wall penetration to reactor shutdown shall be less than or equal to 0.10 ruptures per through-wall crack, This applies to the assessed most limiting pressure tube in the reactor core. CNSC staff reserve the right to revisit the acceptance criterion periodically, and to make adjustments as needed.

Probabilistic Fracture Protection Assessments (CSA N285.8)

Probabilistic Fracture Protection (PFP) evaluations completed for pressure tubes in accordance with CSA Standard N285.8 Clause 4.3.2.2 shall use the acceptance criteria and evaluation process documented in the August 21, 2023, correspondence from OPG (e-Doc 7110527, CD# N-CORR-00531-23737).

Fuel Channel Feeder Pipes (N285.4 Clause 13):

CNSC staff have accepted the Pickering Units 1&4 PIP and the Pickering Units 5-8 PIP documents (e-Doc 5912774).

With respect to N285.4-05 clause 13.2.5.1.3, CNSC staff have accepted OPG's request to use the updated feeder fitness-for-service guidelines: COG-JP-4107-V06 Revision 3, "Fitness-for-Service Guidelines (FFSG) for Feeders in CANDU Reactors" (e-Doc 3922168 and e-Doc 4001054).

Steam Generator Tubes (N285.4 Clause 14):

CNSC staff have accepted the Pickering Units 1&4 PIP and the Pickering Units 5-8 PIP documents (e-Doc 5912774).

CNSC staff have accepted the revised *"performance based disposition process*" (e-Doc 6344283) for steam generator inspections and dispositions, which allows the restart of the NGS without a formal CNSC approval of the disposition before restart, subject to an agreed upon set of conditions. Under this process, OPG will analyze and assess the inspection results and disposition the findings using the applicable FFSG. Prior to returning the steam generators to service, OPG is required to confirm, in writing, that the current CNSC accepted disposition for the unit has not been invalidated by the latest inspection findings.

With respect to N285.4-05 clause 14.2.5.1.3, CNSC staff have accepted OPG's request to use COG Report 07-4089 R2 "Fitness-for-Service Guidelines for Steam Generator and Preheater Tubes", with the following exceptions (see CNSC letter e-doc 5503070):

a) Paragraph IB-2 (d) *Requirements for Application of FFSG* – Before the CNSC can grant regulatory acceptance of a steam generator disposition using steam generator tube loading based on actual operating transient data rather than on design basis transients, the licensee must justify that the loads used are conservatively bounding for future operations.
b) Table ID-2: *Maximum Allowable Probabilities of Not Satisfying Leak-Before-Break for a Reactor Unit* – If the licensee intends to use probabilistic assessment methods for leak-before-break as

described in Section ID-2.3.2.2, then it must be demonstrated that the probabilistic acceptance criteria in Table ID-2 (10^{-2}) appropriately demonstrates that steam generator tube structural integrity margins are maintained when compared to deterministic leak-before-break acceptance criteria.

CVC Related to CSA N285.5

CNSC staff have accepted the Pickering NGS A, B and Unit 0 PIP Programs meeting the requirements of N285.5-08 Update No. 1 (e-Doc 4038995), with the exception of Clauses (including the sub-clauses) 7.1, 7.5, 7.7, 9.2.2, 9.2.5, 9.3.1, 9.3.2, 9.3.3, 9.3.4 and Table 4, for which OPG shall comply with the 2018 edition of this standard (see CNSC letter e-Doc 5785001). CNSC staff have accepted the use of the aging facility data at the Kinectrics Inc. laboratory and the related testing and inspections of the aged samples as an acceptable alternative to in-situ visual inspections of Fiberglass Reinforced Plastic required under N285.5-08 (Update No. 1) (CNSC letter 6657479).

OPG has committed to provide the CNSC with OPG's Transition Plan identifying the compliance date and describing the plan and key transition dates for implementation of the 2022 edition of CSA Standard N285.5 by March 28, 2024.

CVC Related to CSA N287.7-17

CNSC staff have accepted the Pickering NGS-A and B PIP and Leakage Rate Test Requirements documents, which were updated for the purpose of transitioning from N287.7-08 to N287.7-17 (e-Doc 6653986). In CNSC letter e-Doc 6752746, CNSC staff conditionally accepted the updated PIP document NA44-PIP-03643.2-00002 "Pickering Nuclear GS - PRD and VB Periodic Inspection Program" (see CNSC letter for terms of conditions).

In CNSC letter e-doc 5839771, CNSC staff provided its consent for OPG to increase the inspection and testing interval for the vacuum building, the dousing system and pressure relief duct at Pickering NGS from 10 years to 12 years.

OPG shall perform a test to measure the leakage rate, at full design pressure, of the operating reactor buildings and inspect the reactor building concrete structures and components of all units once every six years.

The leakage rate test schedule for Pickering NGS-A units is as follows:

- Unit 1, completed November 2022
- Unit 4, completed May 2023

The leakage rate test schedule for Pickering NGS-B units is as follows:

- Unit 5, completed April 2022
- Unit 6, completed April 2023
- Unit 7, completed April 2019
- Unit 8, completed May 2021

In-Service Inspection of Safety-Related Structures (CSA N291)

For safety-significant safety-related structure(s) OPG shall implement and maintain an in-service inspection program(s) in accordance with industry best practices.

The licensee shall have adequate knowledge of the current state of safety-related structures to ensure that they are capable of operating within their design intent and perform required safety functions if called upon.

The licensee shall develop, implement and maintain in-service inspection program(s) and LCMPs for BOP safety-related structures, excluding concrete containment structures in accordance with CSA N291 *Requirements for safety-related structures for CANDU nuclear power plants*, keeping with industry best practices.

OPG shall comply with CSA N291-08 with the understanding that OPG meets the intent of CSA N291-08 Clause 4.3(d) through the actions completed in the Integrated Implementation Plan (IIP) under LC 15.1. In that regards, OPG has completed an inspection of non-containment safety-related civil structure developed a risk-based approach for aging management of non-containment safety-related civil structures. This approach has been accepted by CNSC staff and incorporated into N-PROC-MP-0060.

The in-service inspection program(s) developed to satisfy this licence requirement will ensure safety-related structures are monitored for credible degradation.

In-Service Inspection of Balance of Plant Systems and Components

For safety-significant BOP pressure retaining systems and components OPG shall implement and maintain an in-service inspection program(s) in accordance with industry best practices.

The licensee shall have adequate knowledge of the current state of BOP pressure retaining systems, components to ensure that they are capable of operating within their design intent and perform the required safety functions if called upon.

The licensee shall develop, implement and maintain in-service inspection program(s) and LCMPs for safety-significant BOP pressure retaining systems and components, keeping with industry best practices.

The in-service inspection program(s) developed to satisfy this licence requirement will ensure balance-of-plant (BOP) safety-significant pressure retaining systems and components are monitored for credible degradation.

Under normal operation and upset conditions, the plant safety analyses may take direct and/or indirect credit for the operation of some of the BOP SSCs, which are outside the scope of CSA N285.4, CSA N285.5 and CSA N287.7 standards and not inspected in accordance with these standards. The condition of these SSCs may have an indirect, but significant, impact on nuclear safety if they are permitted to degrade over time.

These programs shall incorporate the inspection requirements for SSCs important to safety based upon industry best practices appropriate to the design and operation of the SSCs.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CSA	N285.4	Periodic Inspection of CANDU Nuclear Power Plant Components	2014 and Update No. 1 (May 2016)
CSA	N285.5	Periodic Inspection of CANDU Nuclear Power Plant Containment Components	2013
CSA	N287.1	General requirements for concrete containment structures for nuclear power plants	2014
CSA	N287.2	Material requirements for concrete containment structures for CANDU nuclear power plants	2008
CSA	N287.3	Design requirements for concrete containment structures for nuclear power plants	2014
CSA	N287.4	Construction, fabrication, and installation requirements for concrete containment structures for CANDU nuclear power plants	2008
CSA	N287.5	Examination and testing requirements for concrete containment structures for nuclear power plants	2011
CSA	N287.8	Aging Management for Concrete Containment Structures for Nuclear Power Plants	2015
CSA	N285.7	Periodic Inspection of CANDU Nuclear Power Plants Balance of Plant Systems and Components	2015
CSA	N291	Requirements for safety-related structures for CANDU nuclear power plants	2015
CNSC	REGDOC-1.1.3	Licence Application Guide: Licence to Operate a Nuclear Power Plant	2017

Maintenance

The scope of the maintenance program covers all SSCs within the bounds of the nuclear power plant, which includes activities for monitoring, inspecting, testing, assessing, calibrating, servicing, overhauling, repairing, and parts replacing. The type of maintenance activity and frequency applied to each SSC should be commensurate with importance to safety, design function and required performance.

Aging Management

For balance of plant pressure boundary component inspection programs non-destructive examination (NDE) procedures used in the Components and Equipment Surveillance sub-program should be developed and implemented using a level of rigour consistent with the safety significance of systems and components and the nature of the degradation. For NDE procedures necessary to carry out inspections in

the BOP programs, guidance may be obtained from NDE requirements for the PIP program addressed in CSA N285.4.

Periodic Inspection and Testing

Periodic Inspection Programs

OPG should review the compliance matrices for periodic inspection programs on an annual basis to confirm the programs reflect current practices.

Balance of Plant Pressure Retaining Components

Given the limited planned operating time remaining for the Pickering NGS it would be impractical for OPG to develop and implement a CSA N285.7-15 compliant periodic inspection program for balance of plant pressure boundary components. However, the licensee should be capable of demonstrating that existing inspection programs meet the objectives of the CSA standard.

6.2 Fitness for Service Program for Fuel Channels in Extended Operation

Licence Condition 6.2:

The licensee shall implement and maintain an enhanced fitness for service program for fuel channels in extended operation.

Preamble:

The fitness for service program requirements in Section 6.1 have been demonstrated to be effective for operation of pressure tubes for the original target operating life of 210,000 EFPH. However, many of the model and evaluation processes used to assess pressure tube fitness for service in CSA Standard N285.8 require further development for levels of hydrogen equivalent concentration (Heq) that may be experienced when extending the operation of pressure tubes beyond 210,000 EFPH.

Heq is a key input parameter to the models used to assess crack initiation, crack growth, fracture toughness and fracture initiation toughness. Recent operational experience has indicated that the Heq in regions of the pressure tube near the inlet and outlet rolled joints (referred to as regions of interest or ROIs) in some pressure tubes in extended operation in other CANDU Units have exceeded the values that were estimated prior to 2021 for the end-of-life conditions. Furthermore, the validity of the existing crack initiation, crack growth and fracture toughness models requires confirmation for the Heq levels in the ROIs. OPG has undertaken a R&D program to extend the Heq limits for the models used to demonstrate pressure tube fitness for service.

The enhanced fitness for service program incorporates alternate criteria to evaluate the impact of pressure tube aging on safe operation, modified reporting criteria and focused R&D activities to expand pressure tube fitness for service models to higher Heq limits.

Compliance Verification Criteria:

Applicable Heq Limits

The Heq limits of applicability for the relevant fitness for service models addressed by this licence condition are:

- Fracture toughness: 100 ppm within 1.5 meters of the front end of a pressure tube and 140 ppm for the remainder of the length of the tube
- Delayed hydride cracking, hydrided region overload and fatigue crack initiation models: 120 ppm
- Delayed hydride cracking growth rate models: 200 ppm
- Fracture initiation toughness: 120 ppm

For regions of pressure tubes with Heq levels below these values, the CVC in Section 6.1 shall apply for fitness for service evaluations. The CVC in this section apply on an interim basis for the ROIs where these Heq values may be exceeded.

Based upon available information, the ROIs adopted for the interim evaluations of safe operability of pressure tubes are defined as follows:

- Inlet region of interest (IROI): The region encompassing the full circumference of a pressure tube extending 20 mm axially inboard of the inlet rolled joint burnish mark.
- Outlet region of interest (OROI): The region encompassing the full circumference of a pressure tube extending 60 mm axially inboard of the outlet rolled joint burnish mark.

The definitions of the regions of interest may be modified as supported by results of the R&D program, subject to confirmation by CNSC staff. To modify the definitions, conservative bounds of the ROIs shall be established for the expected end of operational life of pressure tubes, accounting for the sensitivity of the defined regions to the influential parameters identified under the R&D program.

Research and Development Program

The licensee shall implement the research and development program described in OPG's submission (e-Doc 6840208) subject to the conditions in CNSC staff's letter (e-Doc 6956470). Progress reports on the R&D program, including modifications to the scope and schedule of the R&D program, shall be submitted to CNSC staff on six-month intervals.

Interim Approach for Assessments of the Safe Operation of Pressure Tubes

For the IROI and the OROI, OPG shall continue to demonstrate a low likelihood of the existence of flaws that would lead to crack initiation in the inspection reports submitted in accordance with Clause 12.2.6 of CSA Standard N285.4-19.

These interim approaches to assess the safe operability of pressure tubes expire on December 31, 2025. By that time, it is expected that OPG will return to the use of CVC established in Section 6.1 based on the results of the R&D program specified in e-Doc 6840208.

15 NUCLEAR FACILITY-SPECIFIC

15.1 Periodic Safety Review Integrated Implementation Plan

Licence Condition 15.1:

The licensee shall implement the Integrated Implementation Plan.

Preamble:

In support of the application (see LC G.1 for more information) for renewal of the Pickering NGS Power Reactor Operating Licence (PROL) in 2018, Ontario Power Generation (OPG) conducted a Periodic Safety Review (referred to as PSR2) in accordance with the requirements of REGDOC-2.3.3, *Periodic Safety Reviews*. The results of Pickering NGS PSR2 were documented in the PSR2 Integrated Implementation Plan (IIP). OPG was required to implement the results of the PSR2 to ensure the continued safe and reliable commercial operation of Pickering NGS to the end of 2024.

As detailed in the Commission's 2018 renewal Record of Decision, for any Pickering NGS units to operate beyond December 31, 2024, OPG is required to reassess the impact of such extended operation on the licensing basis and continued plant safety, and submit the results of such reassessment for CNSC staff acceptance in accordance with REGDOC-2.3.3. In accordance with this requirement, on December 12, 2022, OPG informed CNSC of its intention to operate Pickering NGS unit 5 to 8 beyond December 31, 2024. Subsequently, on June 16, 2023, OPG applied for authorization to operate Pickering NGS units 5-8 to December 31, 2026. In support of OPG's application, OPG conducted a PSR reassessment (referred to as PSR2-B) consistent with the requirements of REGDOC-2.3.3. LC 15.1 requires the licensee to implement the results of the PSR reassessment to ensure the continued safe and reliable commercial operation of the Pickering NGS units 5-8 to the end of 2026. The results of the Pickering NGS PSR reassessment are documented in the PSR2-B IIP.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
P-REP-03680-00031	Pickering NGS Periodic Safety Review 2 (PSR2) Integrated Implementation Plan	Yes
P-REP-03680-00052	Pickering NGS Periodic Safety Review 2-B (PSR2-B) Integrated Implementation Plan	Yes
P-INS-03680-00001	Pickering IIP Administration	Yes

Licensing Basis Publications

Org	Document #	Title	Version	Effective Date
CNSC	REGDOC-2.3.3	Periodic Safety Reviews	2015	2018-09-01

All commitments included in the PSR2 IIP in support of commercial operation to the end of 2024 have been closed by CNSC staff, as of June 2021.

All commitments included in the PSR2-B IIP in support of commercial operation of Pickering NGS units 5-8 to the end of 2026 are to be completed by OPG by December 31, 2024.

Among the high-ranked PSR2-B IIP committed actions are the following:

- Updating the life cycle management plans (LCMPs) for the major components (fuel channels, feeders, steam generators, and reactor components and structures) with the basis for the continued demonstration of fitness for service for the extended operating period to the end of 2026.
- Demonstrate Fitness-for-Service for Zr-Nb-Cu and Inconel X-750 Pickering Units 5 to 8 Spacers.
- Updating the safety analyses impacted by aging.
- Update the periodic inspection plan (PIP) for fuel channels.
- Re-assess Environmental Qualification Assessment (EQAs) for environmental qualified life-limited components.
- Development of an implementation plan for developing inputs to satisfy the methodology in the Non-Mandatory Annex G of CSA N285.8-15, Update #1 to perform uncertainty analyses in probabilistic evaluations.

OPG instruction P-INS-03680-00001, *Pickering IIP Administration* was developed by OPG and reviewed by CNSC staff for matters such as IIP management, change control, completion and closure of actions, reporting, roles and responsibilities, and communication with CNSC.

Detailed criteria for implementing the results of the PSR reassessment (PSR2-B) are as follows:

1. The licensee shall progress to completion the actions identified during the PSR reassessment and documented in the P-REP-03680-0052, *Pickering NGS Periodic Safety Review 2-B (PSR2-B) Integrated Implementation Plan*.
2. In each calendar year, and as per P-INS-03680-00001, *Pickering IIP Administration*, the licensee shall submit a quarterly progress report on the IIP implementation, no later than fifteen calendar days from the end of the quarter.
3. The licensee quarterly progress reports on the IIP implementation should contain, as a minimum, the following:
    a. Summary of changes in the IIP Administration, IIP Change Control, Action completion and closure targets;
    b. A list of actions completed since the last quarter, emphasizing physical improvements;

c. A list of actions to be completed in the subsequent four quarters, emphasizing physical improvements;

d. Intent and non-intent changes effected; and

e. Requests for closure of completed actions.

4. For each calendar year, and as per P-INS-03680-00001, *Pickering IIP Administration*, the licensee shall submit an annual report on the state of the IIP execution, no later than February 28 of the following year.

5. The licensee annual status report on the IIP implementation shall contain, as a minimum, the following:

   a. Summary of changes in the IIP Administration, IIP Change Control, Action completion and closure targets;

   b. Update of the information included in Appendix B of P-REP-03680-00052, *Pickering NGS Periodic Safety Review 2-B (PSR2-B) Integrated Implementation Plan*, reflecting most current information;

   c. Actions completed since the last annual report, emphasizing physical improvements;

   d. Actions to be completed in the subsequent year, emphasizing physical improvements;

   e. Intent and non-intent changes effected during the reporting year;

   f. Request for closure of completed Resolution Statements during the year; and

   g. Changes to the IIP pending CNSC acceptance/concurrence.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CSA	N290.18	Periodic safety review for nuclear power plants	2017
IAEA	Specific Safety Guide No. SSG-25	Periodic Safety Review for Nuclear Power Plants	2013

15.3 Removed

15.4 End of Commercial Operations

Licence Condition 15.4:

The licensee shall implement and maintain plans for end of commercial operations of all Pickering units.

Preamble:

On June 28, 2017, OPG informed the CNSC that all Pickering units would cease commercial operation on December 31, 2024 (P-CORR-00531-04930, e-doc 5290277).

As a result of this announcement, CNSC staff revised regulatory expectations specific to the end of commercial operation to reflect evolving elements of the regulatory framework. Previous regulatory expectations had been developed in 2011, in the anticipation that Pickering NGS would cease commercial operation in 2020. The revised regulatory expectations are detailed in CNSC letter, e-doc 5307950, dated August 2, 2017.

This licence condition states the regulatory requirement for the licensee to implement and maintain plans for the end of commercial operation for Pickering NGS. According to the CNSC letter of August 2, 2017, these plans are to include:

- A sustainable operations plan (SOP) for the safe operation until the final permanent shutdown of each reactor, and
- A stabilization activity plan (SAP) for transitioning every shutdown reactor unit to the safe storage state.

On December 12, 2022, OPG informed the CNSC that it intended to operate Pickering NGS units 5-8 beyond December 31, 2024. (P-CORR-00531-23091, e-doc 6940452).

This licence condition also ensures that commercial operations of Pickering NGS units 1 and 4 end by December 31, 2024, and that commercial operations of Pickering NGS units 5-8 end by December 31, 2026.

As described in the Commission's 2018 renewal Record of Decision, the licencing basis assumes that all units will transition to a safe storage with surveillance state following the end of commercial operations.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
P-PLAN-09314-00003	Pickering Site Strategic Plan	No

CNSC regulatory requirements and expectations for the systematic preparation for the end of commercial operation of Pickering NGS are detailed in CNSC letter, e-doc 5307950, dated August 2, 2017.

End of Commercial Operation - General Requirements

- The licensee shall establish and implement an end of commercial operation (ECO) strategy that includes:
  - A sustainable operations plan (SOP) to manage anticipated challenges while approaching the ECO of any reactor unit to be shut down; and
  - A stabilization activity plan (SAP) to manage the transition period until all the units of Pickering NGS are placed in a Safe Storage Stage (SSS).

SOP – Specific Requirements

- The sustainable operations plan (SOP) shall be developed and implemented at least five years preceding the permanent shutdown of the first unit of Pickering NGS.
- For any subsequent Pickering NGS unit to be shut down, the SOP shall be updated using lessons learned from previous application.

SAP – Specific Requirements

- The stabilization activity plan (SAP) shall be developed at least 3 years prior to, and be implemented immediately after the permanent shutdown of the first unit of Pickering NGS.
- For any subsequent Pickering unit to be shut down, the SAP shall to be updated using lessons learned from previous application.

Annual updates to the SOP and SAP shall be submitted by December 15 of each year, and include a report on the progress and effectiveness of measures committed to in these two plans.

Pickering NGS Units 5-8 Refurbishment Project

On February 1, 2024, OPG notified the CNSC that it has elected to proceed with a project to refurbish Pickering NGS units 5-8. As soon as practicable, OPG shall provide the CNSC:

- Changes to the Pickering Site Strategic Plan, P-PLAN-09314-00003.
- A project execution plan for refurbishment.

In addition, to support refurbishment and long-term operation of Pickering NGS units 5-8, OPG shall conduct a comprehensive periodic safety review (PSR) in accordance with REGDOC-2.3.3, *Periodic Safety Reviews* to determine safety improvements to enhance the level of safety of Pickering NGS units 5-8 that is on par with modern codes and standards, regardless of any other consideration. Due to the time required for CNSC staff review and assessment of the PSR, OPG shall submit the IIP for refurbishment no later than 12 months prior to the to expiry of the current licence period.

Guidance:

Additional guidance is provided in the CNSC letter, e-doc 5307950, dated August 2, 2017.