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Oral presentation

Written submission from Canadians for Nuclear Energy

In the Matter of the

Ontario Power Generation Inc.

Application to extend the operation of Pickering Nuclear Generating Station Units 5 to 8 until December 31, 2026

Commission Public Hearing

June 2024

Exposé oral

Mémoire de Canadians for Nuclear Energy

À l'égard d'

Ontario Power Generation Inc.

Demande visant à prolonger l'exploitation des tranches 5 à 8 de la centrale nucléaire de Pickering jusqu'au 31 décembre 2026

Audience publique de la Commission

Juin 2024

Submission by:
Canadians For Nuclear Energy
to the CSNC 2024

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1.0 Introduction

C4NE is a grassroots non-profit organization composed of Canadian scientists, medical doctors, engineers, energy workers, policy experts, and citizens who believe that nuclear energy must be part of Canada's path forward on climate change. As a group of dedicated and interested individuals, we support the growth and continued operation of nuclear power plants to supply our nation with the needed electrical power today and into the future.

This need has never been greater with growing demand beyond the capacity of hydroelectric generation and augmented by wind and solar generation. Nuclear power generation offers a safe, reliable, and cost-effective way of meeting our electrical power going forward.

1.1 The Case for Pickering Nuclear Generating Station

The Ontario Power Generation Pickering Nuclear Generating Station (PNGS) is one of the stalwarts of the Ontario nuclear fleet. Over the last two decades it has demonstrated a consistent increase in both reliability and performance. With refurbishment of the reactor components, controls, and systems, it is more than capable of not only continuing to operate for several more decades, but at even higher levels of reliability and performance. The record of accomplishment of this process is readily observed with Bruce Units 1 and 2, which have the highest capacity factors in the fleet after a similar extensive refurbishment as what will be performed at Pickering.

Our team fully supports the continued operation of the Pickering Nuclear Generating Station. We have been instrumental in building the case to keep the Pickering nuclear station running to the Ontario government and, of course, to Ontario Power Generation.

We believe a strong case can be made for the continued operation of the Pickering Nuclear Generating Station through to the end of 2026. Our assessment of several factors supports this conclusion. These factors are anticipated EFPH levels and peak Heq concentrations (section 5.0), pressure tube condition changes encompassing fuel channel sag, radial and axial growth (elongation) as well as annulus spacer positions. All having an impact on the fitness of the fuel channel for continued service affected by sag. We discuss each below.

1.2 The CANDU Reactor: An Overview

The heart of the reactor is the calandria, a large, horizontal, cylindrical, atmospherically pressurized, vessel filled with a heavy water moderator with helium gas as the “cover gas” above the moderator. The two exposed vertical faces, the end shield tube sheets, are perforated by the fuel channels. The calandria structure itself consists of the calandria tubes, pressure tubes and fuel bundles; connected at each end of the pressure tube by an end fitting joining the fuel channel to the heavy water primary heat transport system through feeder pipes, running from each end fitting up to the primary heat transport headers, and in turn delivering the high temperature heavy water to the steam generators.

The primary heat transport system is a closed loop system, using heavy water. The steam generator circuit is light water heated to steam in the steam generators to drive the turbines, rotating the generator to create electrical output.

As stated in the operating license amendment application, the fuel channel calandria tubes, pressure tubes and feeders are areas of concern, thus a major focus as to their fitness for service in enabling the continued operation of these reactors. Inside the steam generator, the boiler tubes are also regularly inspected during maintenance outages and cleaned or plugged as necessary to ensure continued safe operation.

2.0 Fitness for Service (FFS)

How is fitness for continued service determined at Pickering NGS? A multi-step process is followed with several specific areas of focus:

2.1 Update the Fuel Channels Pressure Tubes Periodic Inspection Plan (PIP)

Update the Fuel Channels Pressure Tubes Periodic Inspection Plan (PIP) including who will be responsible for completing this task at the Pickering NGS Units 5-8 in preparation for an extended operating period up to the end of 2026.

2.2 Fitness for Service of Fuel Channels

Monitoring of fuel channels for fitness of service is accomplished by establishing a basis for continued monitoring of Pickering NGS Units 5 to 8 for the extended operating period up to the end of 2026. This includes demonstration of a sufficient margin on the FFS limits of the pressure tubes, calandria tubes and garter springs (annulus spacers) during the continued operational life of the plant.

2.3 Spacer Fitness for Service

Annulus spacers are a critical component of the fuel channel and are routinely inspected for their location on the pressure tubes. Since annulus spacers are an internal component of the fuel channel; placed on the pressure tube in four specific locations to provide support for the pressure tube within the calandria tube; during inspections they are located and, if necessary, repositioned to their correct locations using tooling described in section 7.2.4

2.4 Fitness for Service of Feeders

Establish a basis for continued demonstration of fitness for the service of feeders at Pickering NGS Units 5 to 8 to extend the operating period up to the end of 2026. Fitness for service of feeders includes that the predicted feeder condition, with identified and planned mitigations, is acceptable for the intended period of operation.

2.5 Fitness for Service of Steam Generators

Establish a basis for continued demonstration of fitness for service of steam generators of Pickering NGS Units 5 to 8 for the extended operating period up to the end of 2026. Fitness for service of steam generators includes demonstrating that predicted steam generator condition, with identified and planned mitigations, is acceptable for the intended operation.

2.6 Fitness for Service of Reactor Components and Structures

Establish a basis for continued demonstration of fitness for service of reactor components and structures for Pickering NGS Units 5 to 8 for the extended operating period up to the end of 2026. This includes a demonstration that predicted reactor components and structures condition, with identified and planned mitigations, is acceptable for the intended operation. This also includes the required inspection activities to update the Calandria Tube – Liquid Injection Shutdown System (CT-LISS) nozzle gap assessments and identification of mitigation strategies if CT-LISS contact is predicted within the extended operating period.

2.7 Governance Implementation / Effectiveness Issues

Install an enhancement to the Emergency Water Supply Reactor Building Water Level Measurement to install 67138-LT566/LIA566 for Pickering NGS Units 5 to 8.

2.8 Safety Analysis to Support the Extended Operating Period

Update the Heat Transport System aging safety analysis models and perform the required safety analysis of events most impacted by aging (Small Break Loss of Coolant Accident, Loss of Flow and Neutron Overpower) to support continued operation for Pickering NGS Units 5 to 8 up to the end of 2026.

2.9 Safety-Related Structures (Non-Containment) for Nuclear Power Plants

Complete PSR2-B review of the aging management strategy for non-Containment safety-related structures. The purpose of the review is to confirm that the bases for the associated Aging Management Plan and PIP Program remain valid for the extended operation and to determine if any follow-up actions are necessary for extended operation of Pickering NGS Units 5 to 8 up to the end of 2026.

2.10 Fire Protection – National Building Code of Canada (NBCC) and National Fire Code of Canada (NFCC)

Apply NBCC 2015 Part 3 for future construction or modification related to fire protection, occupant safety and accessibility. Update current applicable governance documents to include, when appropriate, the new requirements, codes or standards identified in NFCC 2015 and develop strategy for appropriate and practicable operational and programmatic changes.

2.11 Safety-Related Structures (Non-Containment) for Nuclear Power Plants

Reassess Pickering NGS EQAs to support extended operation of Pickering NGS Units 5 to 8 to the end of 2026.

3.0 Pressure Tube Condition Changes

As pressure tubes age, they not only pick up hydrogen but also change dimensionally. The pressure tube dimensional changes are diameter expansion (3.1), wall thinning (3.2), axial elongation (3.3), and sag (3.4).

Pressure tube dimensional changes are induced by stress (pressure), irradiation (fast neutron, flux $>$1 MeV), and temperature. Deformation is proportional to these parameters. The axial elongation stress component is the end stress due to internal pressure. The diametral expansion stress component is the circumferential stress due to internal pressure.

The channel sag stress component is the weight of the fuel and the channel. Inner core high power channels deform more than outer-core low-power channels due to irradiation variations across the reactor core. The middle of a pressure tube deforms more than the outside ends due to the radiation variations along the channel (See section 2.1, Pressure Tube in the reference document). Deformation is a constant volume phenomenon, thus wall thinning occurs due to volumetric conservation because of elongation and diametral expansion. Pressure tube dimensional changes can limit the life of the fuel channels.

The maximum pressure tube axial elongation is estimated at 7 to 8 inches after 30 years of operation. The yearly elongation is approximately 0.25 inches per year of operation. Elongation varies due to fast neutron, flux, and material property variations. This variability produces a maximum differential elongation between channels of about 1 to 1.25 inches after 30 years.

3.1 Pressure Tube Diametric Expansion

The maximum diametric expansion of the pressure tube is estimated to be 6% after 30 years of operation. The initial 4.070-inch pressure tube inside diameter becomes 4.310 inches after 30 years.

Flow bypass may be a problem late in life. Flow bypass occurs when coolant bypasses the fuel and flows around the fuel as the pressure tube inside diameter increases. If the fuel is not cooled properly it may overheat.

Nip-up of the annulus spacer between the pressure tube and the calandria tube may also be a problem late in life as the pressure tube outside diameter increases. During nip-up, the annulus spacers are pinched between the pressure and calandria tube, causing a local increase in calandria tube stresses.

Solutions include:
Derate the reactor late in life to reduce fuel overheating.

Install the pressure tube with the back end at the inlet to reduce diametric expansion to 5.1%. This modification delays the problem for five additional years. The back end of the pressure tube is the end that comes out of the extrusion last during manufacture. This end has a higher yield strength, but lower fracture toughness compared to the front end.

Install CANFLEX fuel bundles (43 elements (two sizes) instead of 37 elements (one size)) to reduce the peak element rating without derating the reactor.

Design the annulus spacer with a smaller coil diameter. Determine the max stresses in the calandria tube and pressure tube at the end of life and show that nip-up is not a problem.

3.2 Wall Thinning

Wall Thinning (Per page 55 of the application) due to irradiation effects occurs from the fuel, coolant loading, and temperature, causing axial and diametral expansion of the pressure tubes (PT). A reduced wall thickness results in an increase in stress impacting the acceptability of small flaws in the PT inner wall. The maximum wall thinning typically coincides with the highest flux and temperature in the PT. (Figure 12)

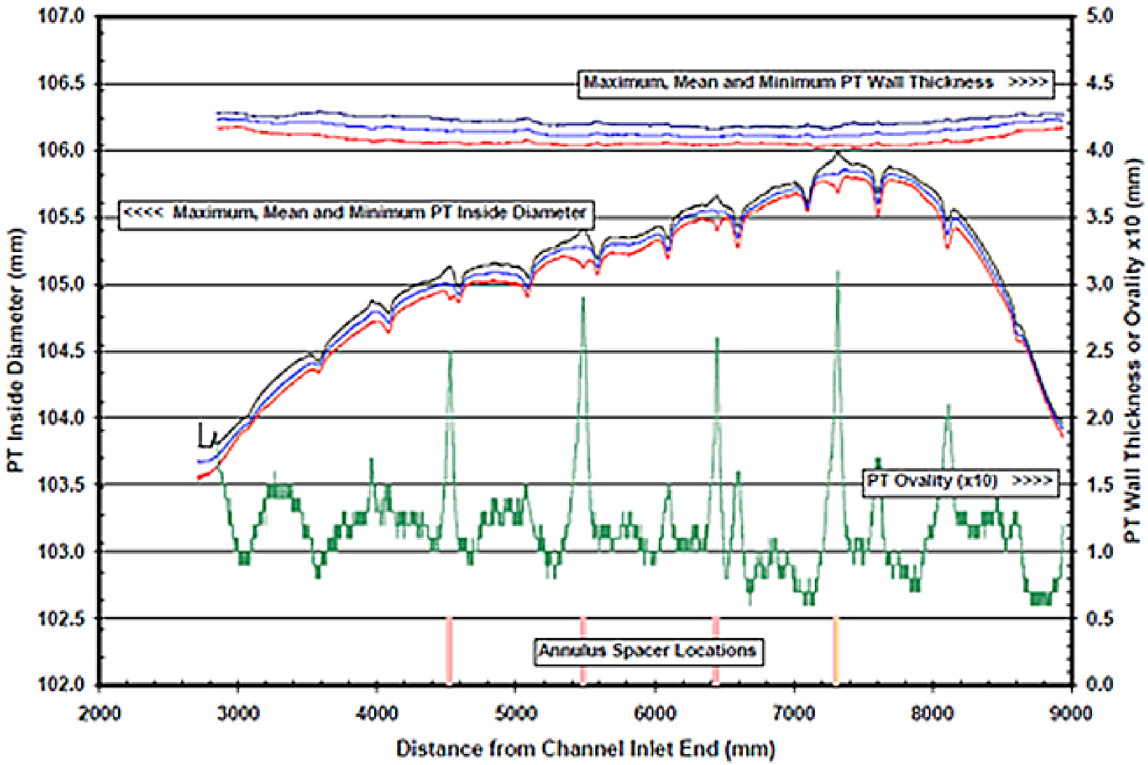

FIGURE 12 – EXAMPLE OF INNER DIAMETER, OVALITY AND WALL THICKNESS PROFILES ALONG THE LENGTH OF A TYPICAL CANDU PRESSURE TUBE

Based on extensive inspection data used to model and project into the future, wall thinning will not exceed the minimum wall thickness specified in the design. This ensures the PT will continue to perform its design function to contain the heat transport system and cool the fuel.

3.3 Elongation

Pressure tube axial elongation (per pages 56-57 of the application) involves the axial growth of the pressure tube (PT) under the operating environment of elevated temperatures, pressures, and neutron flux. Pressure tube elongation is accommodated by allowing the fuel channel assembly to slide axially on the journal bearings at each end of the calandria vessel. (Figure 13)

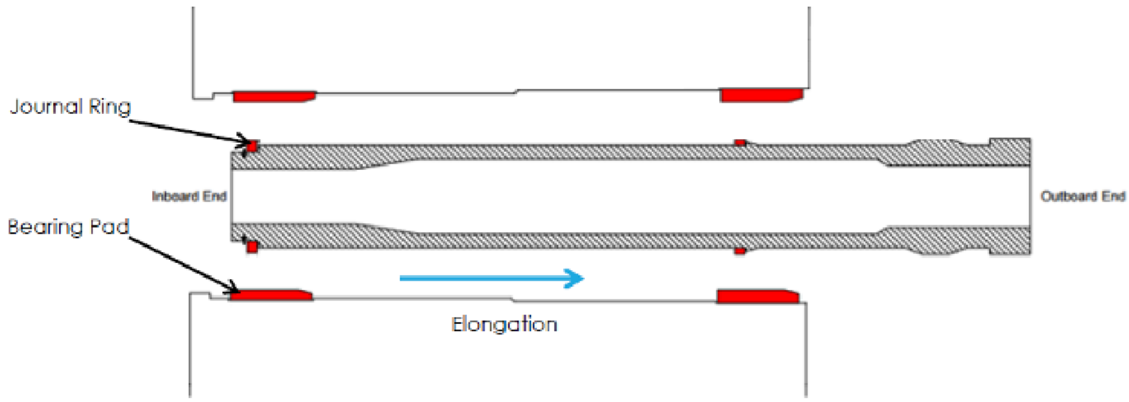

FIGURE 13 – FUEL CHANNEL ELONGATION BEARING AND JOURNAL RING

During the initial installation of the fuel channels (FC), a subassembly; (a pressure tube rolled into an end fitting in the Components Building Clean Room); is inserted into the east reactor face lattice site and into the calandria tube (CT). This is known as the first end (fixed end) of the FC.

When the end fitting (EF) is correctly axially positioned in the east reactor face fuel channel (FC) the positioning assembly (PA) hardware is installed. The hardware yokes are placed around the end fitting and locked in position on the PA stud by the locking nut, thereby holding the east end fitting in its correct axial position to prevent elongation in that direction.

The west, (second end), end fitting is then installed, and the PT is roll expanded into the end fitting. The positioning assembly hardware is installed on the west end fitting and left in the unlocked position leaving the second end free to allow fuel channel elongation and thermal expansion during operation.

All Pickering NGS-B Units 5 to 8 fuel channels were "reconfigured" in the mid-2000s to allow growth in the opposite direction (i.e., unlock the east fixed end and lock the west free end) to ensure the end fittings do not extend over the lattice tube bearings.

Fuel channels must remain "on bearing" which is the acceptable design configuration. Each fuel channel may have a different elongation rate due to the differences in channel power/flux and effects of microstructural variations between pressure tubes.

To support understanding of each fuel channel's elongation rate, measurements are performed at each outage to determine the growth of the channels over the operating period. These elongation rates also provide the projected time when the fuel channel will remain on bearing. Maintenance activities include fuel channel shifting by either pushing or pulling the fuel channel to allow additional bearing travel on the free end. On-going maintenance and elongation measurements continue to be performed to ensure the fuel channels remain on bearing until the projected unit EFPH limit is reached.

OPG addresses the topic of elongation only briefly in the application because it is their view that this will not impact the ability of the units to operate through to the end of 2026 nor 305,000 EFPH.

3.4 Sag

Pressure tube sag (per pages 51 and 55 of the application) occurs in the high temperature and high flux environment due to the weight loading of the pressure tube (PT), calandria (CT), fuel, and coolant. Sag of the channel can affect passage of the fuel as well as inspection and maintenance tooling through the center of the core and reduced gap between the PT and CT. See page 56 (Section 4.1.3.2.12) of Pickering Nuclear Generating Station - Power Reactor Operating Licence Amendment Application.

Sag of the fuel channel assembly (PT and CT) can also reduce the gap between the CT and other reactor vessel internal core components; e.g., Liquid Injection Shutdown System (LISS) nozzles that inject large volumes of gadolinium nitrate in the unlikely case where a rapid shutdown of the reactor is required).

LISS is an important safety feature of CANDU reactors, and its proper functioning is essential for ensuring the safe operation of these nuclear power plants. This safety system is designed to rapidly cool the reactor core in case of a coolant accident. It consists of a network of 6 horizontal tubes, called LISS nozzles, that are installed at two elevations beneath the calandria tubes (CTs) with 3 nozzles between rows F and G and 3 nozzles between rows Q and R. If a loss of coolant accident occurs, the LISS is activated and injects a large amount of liquid neutron poison into the reactor core, quickly shutting down the nuclear reaction and cooling the fuel. The LISS nozzles are positioned perpendicular to the CTs, allowing for efficient distribution of the neutron poison throughout the reactor core.

OPG has performed repeat inspections and maintenance to ensure there remains a gap between the CT and LISS nozzles. Further mitigating actions and maintenance through repeat gap inspections, increasing the gap between the components or removal of the affected fuel channel(s), are planned in the upcoming outages to support fitness-for-service to the projected unit EFPH.

There continues to be extensive monitoring of the pressure tube sag measurements to provide information about fuel or tooling passage concerns. Based on the measurements and projections of unit EFPH, there is no risk of exceeding the fuel or tool passage limits.

The focus is on the amount of sag. If left unchecked, it can result in the CT contacting the LISS nozzles as they are positioned in the calandria as described in The Pickering Nuclear Generating Station Power Reactor Operating Licence Amendment Application: 4.1.2.3 Safety Enhancements (Page 32/33):

Calandria Tube-Liquid Injection Shutdown System (CT-LISS) De-tensioning: The Unit 6 De-tensioning device installation project was completed to keep the CT and LISS nozzles within an allowable gap, and Pickering NGS is committed to ensuring the required gap tolerance is maintained to support FFS. Detailed inspections of the CT and LISS nozzles were completed during the 2023 Unit 6 outage and the gaps between CT and LISS nozzles were adjusted. The need for reassessment in the next Pickering NGS Unit 6 planned maintenance outage will be confirmed once the assessment is complete.

As a mitigation mechanism, OPG has implemented an inspection and adjustment procedure to deal with this, where the gap is measured and then the position of the nozzle is adjusted to maintain the proper distance (gap). OPG is confident that this procedure will enable them to get to 305,000 EFPH**.**

4.0 Fuel Channel Status Considerations

4.1 Advanced Inspection Maintenance Services (AIMS)

This OPG department is responsible to continually monitor, inspect, and test the fuel channels, feeders, and boilers (steam generators) for operation suitability through many diverse systems and tools to ensure that the data collected will support assessments made from it.

Founded in 1972 at OPG's predecessor company, Ontario Hydro, this department has approximately 400 employees and performs inspections on the reactors and steam generators using the following tools and others:

4.2 Fuel Channel Inspections

The AIMS department has many tools available to perform testing and inspections of the fuel channel assemblies. These include Advanced Nondestructive Evaluation (ANDE) (4.2.1), along with seven other tools (4.2.2 through (4.2.8) listed below not used at PNGS though noteworthy.

4.2.1 Advanced Nondestructive Evaluation (ANDE) and its application for pressure tube inspections in OPG reactors

Jarron, D. (Ontario Power Generation, Ajax, Ontario (Canada)); Trelinski, M. (Ontario Power Generation, Ajax, Ontario (Canada)); Kretz, S. (Ontario Power Generation, Ajax, Ontario (Canada)), E-mail: don.jarron@opg.com, E-mail: mike.trelinski@opg.com, E-mail: steve.kretz@opg.com

Periodic and in-service inspections of CANDU fuel channels are essential for the proper assessment of the structural integrity of these vital components. The arrival of new delivery devices for fuel channel inspections (Universal Delivery Machine) has driven new methods for gathering and analyzing NDE data.

The Advanced Non-Destructive Examination (ANDE) system has been designed and field implemented as a high-speed data acquisition system to meet the requirements of the CSA N285.4 code. It was built from the solid foundation of CIGAR (Channel Inspection and Gauging Apparatus) experience and uses innovative hardware and software to attain high-speed data collection enabling quick inspection of many fuel channels.

The capabilities of the ANDE inspection system include surface and volumetric inspection of pressure tube by ultrasonics; Flaw characterization by ultrasonics; Pressure tube diameter measurements; Pressure tube thickness measurements; Garter Spring location by Eddy Current; Garter Spring location by ultrasonics; Pressure tube sag measurement. In addition to the above, selected flaws/areas of a pressure tube can be replicated using a two plate ANDE replica tool.

At the heart of the inspection system is a set of twelve ultrasonic probes positioned in such a way that the inspected areas are examined from various angles and directions and by various ultrasonic wave modes (shear and longitudinal). High frequency ultrasound used for the examinations allows for reliable detection of small flaws. Separate sensors have been installed on the inspection head for Garter Spring location and sag measurements. (author)

4.2.2 Bruce Reactor Inspection Maintenance System (BRIMS)

The second of its kind – to Bruce Power on February 24, 2017. Known as BRIMS II, this highly engineered reactor inspection delivery tool system will meet its scheduled delivery date.

4.2.3 Channel Inspection and Gauging Apparatus (CIGAR)

Performs full volumetric inspections of the fuel channel, including gap, sag, replica, and visual camera inspection.

4.2.4 Spacer Location and Repositioning Tool (SLAR)

Used with annulus spacer (garter springs) inspections. Used to locate and reposition garter springs to prevent pressure tube to calandria tube contact (PT-CT contact) and subsequent blister cracking.

4.2.5 Universal Delivery Machine (UDM)

Developed in 2001, providing a common delivery mechanism for fuel channel inspection tooling.

4.2.6 Rapid Delivery Machine (RDM)

An automated machine used to execute fuel channel inspections in future outages at the Darlington nuclear station. The project will help replace manual inspection techniques, resulting in shorter outages and improving employee safety.

4.2.7 Terminal Solid Solubility (TSS)

A system tool measures fuel channel pressure tube hydrogen level. (Discontinued)

4.2.8 Circumferential Wet Scrape Tool (CWEST*)

Considerable work has been done to predict the hydrogen concentration over the operating life of fuel channels, but sampling is still required to provide complete assurance. This is done by taking a “scrape” from the tube at specific locations during outages. The high radiation fields and inaccessibility of the pressure tubes make sampling difficult, and any tool used must be accurate, reliable, deployable, and fail-safe.

4.3 Pressure Tube Hydrogen Absorption Measurements

Hydrogen can build up within the zirconium alloys used in the pressure tubes and can lead to changes in the alloy’s physical properties. Operators must keep an eye on this build-up to ensure the safety of their assets and satisfy the regulator's requirements.

5.0 Hydrogen equivalent (Heq) and Equivalent Full Power Hours (EFPH)

5.1 Heq

During operation, the exposure of the pressure tubes to heat, pressure, and neutron flux results in the zirconium alloy absorbing hydrogen atoms, changing the metallurgical composition of the alloy as they become part of it. A virgin pressure tube is very ductile, meaning it is not prone to fracture under stress but rather deformation. As the concentration of hydrogen in the alloy increases, this drives embrittlement of the material, in turn reducing the ductility and, if permitted to get to a sufficiently elevated level, would lead to a tendency to fracture under stress.

The cap placed on the hydrogen equivalent concentration in the pressure tubes at Pickering and Darlington is 120 ppm (parts per million).

5.2 EFPH

The aging of the pressure tubes is monitored through the number of hours the unit is operated at the equivalent of 100% full power.

Since a nuclear unit is not always at 100% full power, there needs to be an adjustment mechanism utilized for when the unit is operated at less than that state. The overall figure determined through this process is then reflected as EFPH.

EFPH is designed to be predictive, that is, hydrogen uptake (Heq) should track with EFPH, providing some crude modeling guidelines as to the aging of the pressure tubes in each unit and how much longer they will remain fit for service.

In application, the relationship between Heq and EFPH is not fixed and is influenced by the level of neutron flux in the core. This is well-demonstrated by looking at the Bruce units, running in various stages of derate since the 90's. Despite the hours being equivalence-adjusted to reflect this, it is clear that Heq remains notably lower than the levels found at Darlington due to the reduced flux in the cores.

This observation also extends to Pickering. It is apparent that despite the Pickering B units having some of the highest full power equivalent hours, the hydrogen uptake levels, as shown by peak Heq, are lower than for other power reactors as shown next in 5.2.1.

5.2.1 Table[1]

C. Current and predicted status of key parameters and models for pressure tubes in Canadian power reactor

	Status as of January 1, 2020			Future situation			
Unit	**EFPH**	**Peak Heq concentration, ppm**	**Existing fracture toughness model valid?**	**Key date**	**Anticipated EFPH**	**Predicted maximum Heq conc., ppm**	**Existing fracture toughness model valid?**
Pickering Unit 1	151,116	67.4	Yes	Dec 2024	192,100	88.2	No[1]
Pickering Unit 4	122,911	55.7	Yes	Dec 2024	167,500	68.3	Yes
Pickering Unit 5	243,485	84.3	Yes	Dec 2024	287,500	97.4	Yes
Pickering Unit 6	250,731	77.6	Yes	Dec 2024	295,000	90.7	Yes
Pickering Unit 7	242,546	81.1	Yes	Dec 2024	287,000	94.2	Yes
Pickering Unit 8	229,586	74.2	Yes	Dec 2024	274,500	87.3	Yes

1. The current fracture toughness model has been restricted to 80 ppm Heq for front end pressure tube material per CSA N285.8-15, *Technical Requirements for In-Service Evaluation of Zirconium Alloy Pressure Tubes in CANDU Reactors*, Update #1. Pickering Unit 1 contains 50% of tubes oriented with front end material at the outlet location.

5.3 Conclusions for Heq and EFPH

Hydrogen uptake, and by extension embrittlement of the alloy, work to set a limit within the "leak before break" philosophy, as primary determinants of fitness for service. However, we note that this will not be what limits the suitability for continued operation of the Pickering B pressure tubes, since all would be well below the 120 ppm limit at 305,000 equivalent full power hours. This supports the extension of the EFPH limit being requested by OPG.

[1] Regulatory Oversight Report for Nuclear Power Generating Sites: 2019 (nuclearsafety.gc.ca) https://www.nuclearsafety.gc.ca/eng/resources/publications/reports/regulatory-oversight-reports/npgs-report-2019/#appx-C

6.0 Feeder Pipe and Steam Generator Inspections

6.1 Scanning Transmission Electron Microscopy Tool (STEM)

Mass spectrometer focusing system (deflection system)

The utilization of a laser-scanning system to map the reactor face. Determines the elongation of the fuel channels in the reactor over time.[2]

6.2 Feeders

Manual inspection is performed using tooling to measure the feeder pipe wall thickness in specific areas using ultrasonic wall thickness, axial, and 6-probe tool (circumferential) measurements.

6.3 Phased Array Ultrasonic Testing (PAUT) - thinning and cracking

- Visual inspection for fretting and vibration induced failures
- Feeder Replacement
- Measure wall thickness downstream of large radius bends beyond the elbow section

6.4 Steam Generators

Inspection and Monitoring of boiler tubes and nozzle thickness:

- Bobbin Probe Eddy Current, specialized ET (x-probe) and UT
- Tube Removal and plugging
- Metallurgical Examination
- Foreign material retrieval tool.

Utilizes robotic systems that can reduce dose the technicians are exposed to by 75%.

6.5 Balance of Plant Heat Exchanger Inspection

Non-Destructive Examination (NDE) is used to inspect heat exchangers. Includes leading edge heat exchanger tubular ultrasonic testing inspection technology, along with Internal Rotary Inspection System (IRIS) and Tiny Rotating Ultrasonic Tube Inspection Equipment (TRUSTIE).

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[2] See: Pickering_2026_Licence_Reportpdf.pdf. Pickering Nuclear Generating Station Power Reactor Operating Licence Amendment Application 4.1.3.2.5 Overview of Fuel Channel Fitness for Service, page 59and 4.1.3.2.6 Condition Assessment of Fuel Channels page 54

7.0 Further Considerations

One of the key reasons for requesting the extension of the operation of Pickering B through to the end of 2026, beyond ensuring that Darlington is back to full capacity, is to avoid what is effectively the unnecessary consumption and combustion of natural gas, providing that capacity. OPG argues in their application that in continuing to operate Pickering B through to the end of 2026, considerable emissions from natural gas assets will be avoided.

Following that line of thought, Pickering units 5, 7 and 8 could conceivably be operated beyond 2026 if all are provided with the same 305,000 EFPH limit as Unit 6, avoiding more emissions still.

Anticipated EFPH for all units as of December 31st, 2026, the current date of shutdown:

- Unit 5: 297,500
- Unit 6: 305,000
- Unit 7: 298,000
- Unit 8: 283,000

Based on the proposed EFPH limit, the units could be extended thusly (days):

- Unit 5: 312
- Unit 6: 0
- Unit 7: 292
- Unit 8: 917

Two modifications to the facility during refurbishment do require complete shutdown:

1. The removal of the connections to the A units from the vacuum building
2. The deep-water inlet upgrades.

However, we project that a phased approach with units 5 and 7 operating until the fall of 2027, when a month long total outage could be used for the vacuum building (VB) disconnect and going live on the deep water inlet, provided most of the civil works could be completed ahead of time, would then allow Unit 8 to return for the winter and continue operation until Unit 6 returns to service. This has favourable optics and avoids the complete cessation of operation of the facility.

8.0 References

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