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Exposé oral

Submission from Anna Tilman

Mémoire de Anna Tilman

In the Matter of

À l'égard de

Ontario Power Generation Inc., Pickering Nuclear Generating Station

Ontario Power Generation Inc., centrale nucléaire de Pickering

Request for a ten-year renewal of its Nuclear Power Reactor Operating Licence for the Pickering Nuclear Generating Station

Demande de renouvellement, pour une période de dix ans, de son permis d'exploitation d'un réacteur nucléaire de puissance à la centrale nucléaire de Pickering

Commission Public Hearing – Part 2

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Submission to the Canadian Nuclear Safety Commission (CNSC)

with respect to

Ontario Power Generation's (OPG's) Application for Renewal of its Operating Licence for the Pickering Nuclear Generating Station for a 10-year term

May 3, 2018

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Table of Contents

Executive Summary

Ontario Power Generation (OPG) is applying to the Canadian Nuclear Safety Commission (CNSC) for a 10-year operating licence for the Pickering Nuclear Generation Station (PNGS) from 2018 to 2028.

This proposed licence period would include three major and distinct stages: the continuing operation of PNGS Units 1 and 4 and 5-8 until the proposed shutdown at the end of 2024; a "stabilization" stage of three to four years; and a safe-storage period starting in 2028. Decommissioning operations would commence at that time under a new licence.

The proposed closure date represents a significant change from previous forecasts as to when commercial operation of the Pickering station would cease. In fact, in 2010, OPG announced that the Pickering station would continue operation until 2020, at which time the station would shut down. However, in January 2016, OPG was requested by the Province of Ontario to plan for safe and reliable continued operation beyond 2020. In response, on June 28, 2017, OPG informed the CNSC that all Pickering units would cease commercial operation on December 31, 2024. Following the permanent shutdown of the units, the station would be transitioned to a safe storage state.[1]

The current PNGS five-year licence expires on August 31, 2018. In 2014, OPG was granted permission by the CNSC to remove the "Hold Point" associated with the Licence Condition of the Station that required no Pickering unit pressure tubes to be operated beyond the limit of 210,000 Equivalent Full Power Hours (EFPH). The EFPH levels in Pickering B's Units 5-8 were projected to surpass that limit during the licence period. Consequently, the EFPH limit was raised to 247,000 EFPH.

The 247,000 limit was already taking a step into uncharted waters, and OPG is now seeking permission to extend it even further to 295,000 EFPH.

There are very serious issues with respect to OPG's licence application, especially the 10-year length they are requesting. This will extend the life of pressure tubes well into unknown territory, and cause inordinate delay and uncertainty as to the date when commercial operations of PGNS will finally terminate.

With respect to the activities proposed in OPG's licence request, there are serious issues with each stage, i.e., continued operation, stabilization (post-shut-down defueling and dewatering), and safe storage. The merging of all these stages into a single 10-year licence severely restricts the opportunity for public scrutiny, and also greatly diminishes the accountability of both OPG and the CNSC to Canadians.

The implications of extending the end-of-life of critical components of these reactors are enormous. For example, the rupture of any the pressure tubes in these units could have catastrophic consequences for millions of people.

In its licence application, OPG is asking to continue operations to the end of 2024, and possibly longer given that a further extension could be requested by OPG as indicated by the CNSC in its

[1] CNSC staff submission CMD18-H6 p.1

submission documents. This would mean that the lifetime of these tubes could be extended beyond 2024 to some undetermined date. So in a very short period, the shutdown date has gone from 2020 to 2024 and perhaps beyond, with no assurance as to the safety of critical components of these reactors, or for that matter that the work required extending the end-of-life limits is safe or even possible.

The issue of public safety is paramount. The Pickering station is a mere 32 kilometres from downtown Toronto, Canada's most populous city. Approximately 6 million people reside in the Greater Toronto Area alone. A catastrophic accident would impact a great many more. To presume that such an accident cannot happen at Pickering, the oldest operating nuclear power station in Canada, is the height of folly and courts disaster.

It is unconscionable that the Provincial Government, the CNSC, and OPG give their unqualified support for continuing operations at Pickering when it means taking unwarranted safety risks, potentially jeopardizing the health and well-being of so many, for the sake of eking out the last vestiges of electric power at any cost from a nuclear station that has exceeded its designed lifetime and could have a catastrophic accident at any time.

Considering the age of the station, the numerous problems encountered by the station for decades, some very serious, its location in a highly populated region, and the shortcomings of its emergency and evacuation plans, and many other issues, to continue operating Pickering B for a period of time well beyond that for which it was designed poses enormous risks to public safety that no regulator should accept.

In light of all the problems that have already been encountered at Pickering, and the horrific meltdowns at Chernobyl and Fukushima, it is most disconcerting and regrettable that the Province of Ontario's energy policy continues to rely so heavily on nuclear power rather than giving priority to conservation, efficiency and renewable energy, which are far less costly, very much cleaner and very much safer.

The PGNS currently generates approximately 14% of Ontario's electricity. There are alternative sources of electricity that could fill that gap, if needed. For example, the Province could purchase power from Hydro-Québec as an interim measure to fill a potential gap that would result from shutting down Pickering by the year 2020.

Therefore, it is our position that the Commission must reject OPG's licence request. Instead, we recommend that the Commission give OPG an interim licence for a two-three year period maximum, with clear direction that commercial operations would be shut down by 2020-2021 and that OPG would work on the ensuing activities, i.e., stabilization activities, safe storage, and a detailed decommissioning plan.

Furthermore, in the interests of the Canadian public, transparency and trust, it is critical that the CNSC, as the nuclear regulator, conduct public hearings on these outstanding and highly important matters.

Introductory Comments

In 2010, OPG announced that it would not refurbish Pickering B, and planned to end commercial operation of the Pickering Nuclear Generating Station (PNGS) by the end of 2020. However, in January 2016, OPG was requested by the Province of Ontario to plan for safe and reliable continued operation beyond 2020. In response, on June 28, 2017, OPG informed the CNSC that all Pickering units would cease commercial operation on December 31, 2024. Following the permanent shutdown of the units, the station will be transitioned to a safe storage state.

Ontario Power Generation (OPG) is now applying for a ten-year operating licence for the Pickering A and B stations. It is our position that CNSC should not grant the ten-year operating licence requested by OPG. Given the age of the station, the numerous problems encountered for decades, some of them very serious, its close location to a highly populated region, safety issues concerned with aging reactor components, and shortcomings of current emergency and evacuation plans, to continue operating Pickering beyond 2018, and as proposed by OPG for six more years at least, poses enormous risks to public safety that no regulator should accept.

As indicated in the submissions from CNSC staff and OPG, the current end-of-life limits of the reactor components, and in particular, the pressure tubes of Pickering B's Units 5-8 as estimated by OPG would be reached by 2020-2021. In order to continue operations to the end of 2024, the lifetime of these tubes would need to be extended beyond the current limits. This is courting disaster. There is absolutely no evidence or assurance that an increase in full power hours of about 20% would be safe, or even possible, not only for the safe operation of the units, but also for the workers involved. If any one pressure tube were to rupture, it could have catastrophic consequences for millions of people.

Many years ago, the Provincial Government cited economic reasons for not restarting Pickering A's units 2 and 3, and for not refurbishing Pickering B's four units. There are just as many, if not more, economic reasons for not extending the operation of Pickering well beyond its current operating limits, which do not necessarily provide any guarantee of safety.

Beyond economic costs, the issue of public safety is paramount. The Pickering station is a mere 32 kilometres from downtown Toronto, Canada's most populous city. Approximately 6 million people reside in the Greater Toronto Area alone. A catastrophic accident would impact a great many more. To presume that such an accident cannot happen at Pickering, the oldest operating nuclear power station in Canada, is the height of folly.

It is unconscionable that the Provincial Government, the CNSC, and OPG would give their unqualified support for continuing operations at Pickering when it means taking unwarranted risks at exorbitant expense, and jeopardizing the health and well-being of so many, for the sake of eking out the last vestiges of electric power from a nuclear station that has exceeded its designed lifetime, and could have a catastrophic accident at any time.

Despite the serious issues already encountered at Pickering, and the horrific meltdowns at Chernobyl and Fukushima, it is most disconcerting that Ontario's energy policy continues to rely on nuclear power rather than giving priority to conservation, efficiency and renewable energy, which are far less costly, very much cleaner and very much safer.

Therefore, we are recommending that the Commission reject OPG's application for a 10-year licence renewal of the PNGS. Instead, we request that CNSC issue a temporary licence to OPG with explicit instructions to commence preparation for closure of operations immediately.

In addition, we are requesting that the Commission direct OPG to commence developing an accelerated decommissioning plan for the Pickering reactors this year and that this plan be subject to public scrutiny and consultation.

Pickering - Overview

The Pickering Nuclear Generating Station (PNGS), one of the world's largest nuclear generating facilities, operated by Ontario Power Generation (OPG), consists of consists of two stations, namely Pickering A, Canada's oldest commercial nuclear station, and Pickering B, each of which has four nuclear power reactor units.

The four reactors in Pickering A (Units 1-4) came on line during 1971-3, while the four reactors in Pickering B (Units 5-8) were brought on line from 1983-5. Currently, and for several years past, six units are operating; Units 1 and 4 in Pickering A and all four units at Pickering B. Units 2 and 3 of Pickering A are shut down and have not produced power since 1997.

On February 16, 2010, OPG announced that it would not refurbish Pickering B, and that Pickering B would enter its final decade of operation and cease operation by the end of 2020. In June 2010 the Pickering A Power Reactor Operating Licence (PROL) was renewed for a three-year period to coincide with the Pickering B PROL renewal date and thus merging the licences for A and B into a one-site licence. This licence was to focus on "the end-of-life of the facility, decommissioning (including a comprehensive plan on strategies for decommissioning), and aging management".[2]

During the licence period, from 2013-2018, and until the "intended" date of closure of commercial operations of the PNGS of 2020, Pickering B would need to operate beyond the fuel channel life of 210,000 Equivalent Full Power Hours (EFPH). OPG was required to submit to the CNSC three detailed plans to guide operations from the end of its commercial operation to a safe-storage state and the eventual decommissioning and site restoration. These plans included an integrated implementation Plan (IIP); a Continued Operations Plan (COP) for Pickering B; and a Sustainable Operations Plan (SOP) for Pickering A and B. In addition, a Preliminary Decommissioning Plan (PDP) was required.

The purpose of the IIP was to specify the work required to operate Pickering B beyond the pressure tube design life of 210,000 EFPH to 247,000 EFPH, from approximately 2015 to 2020. In the absence of refurbishment there was the distinct possibility that some units could significantly exceed the 210,000 limit and potentially reach 247,000 EFPH by 2020.

The extension of the designed life for the pressure tubes is acknowledged by OPG to be the most critical uncertainty, and the most significant potential life-limiting issue with respect to demonstrating Fitness for Service of the pressure tubes for the continued operation of

[2] CMD 13 H-2 CNSC Staff Submission January 2013, p. 5, 87

Pickering B.[3] This is a view with which we totally concur, and it is the essence of our main objection to allowing OPG to proceed with this life extension of the pressure tubes, let alone an even greater one.

Safety Issues

The four reactors at Pickering A, being the first commercial CANDU units, lacked some safety features that were incorporated into later CANDUs. In particular and very importantly, the units were designed to have only one fast-acting shutdown system that could shut down the reactor in two seconds, and one slow-acting system which required more than 10 seconds to be effective.

The slow-acting system was thought to be an adequate second shutdown method. All subsequent CANDU reactors were built with a second, independent, fast shutdown system that injects a neutron-absorbing liquid to halt the nuclear reaction in the core. The Pickering reactors are still the only ones in the western world with only one fast emergency shutdown system.

In addition, all eight reactors at Pickering share the same safety and support systems. They also share the same containment system, which consists of eight individual reactor buildings, one vacuum building and one pressure relief duct which connects them. The system is designed to absorb the stored energy and radioactive decay heat from one reactor for one hour after shutdown.

While the Pickering containment system is large compared to light water reactors, which may offer a safety advantage, this advantage is offset by the shared nature of the system. The emergency coolant injection system is also shared by all eight reactors. The storage tank and pumphouse, which were built during the construction of the Pickering B station, can provide emergency coolant for only <u>one</u> accident at <u>one</u> reactor.[4]

To ensure the safe operation of Units 1 and 4, both the Interstation Transfer Bus (ISTB) and Emergency Boiler Water Supply (EBWS) from Pickering 5-8 are required. The ISTB is intended to serve as a back-up supply of Class III power from Pickering 5-8 to Pickering 1-4 following a postulated Secondary Side Pipe Break (SSPB) in the Pickering 1-4 Powerhouse, while the EBWS is designed to provide long term, back-up cooling water to the boilers of the Pickering 1-4 units from Pickering 5-8 in the event of a loss of feedwater to the boilers of Units 1 and 4.[5]

The sharing of safety and support systems is unique for multi-unit nuclear stations and a serious safety concern with respect to the PNGS. Multiple-reactor accidents cannot be dealt with by this system.

Units 2 and 3 were never returned to power, primarily because of costs and safety issues. Instead, they were transitioned from the shut-down (or “lay-up state”) to the safe storage state in September 2010.

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[3] Letter from OPG, August 31, 2012 to CNSC re Submission of additional Information on the COP CD # P-CORR-00531-0379

[4] http://www.parl.gc.ca/Content/SEN/Committee/371/enrg/rep/repintjun01part1-e.htm

[5] Communication from OPG April 26, 2018

The safe storage state means that these reactors are shut down permanently, and are defueled with all inventory and energy sources removed. However, the conditions of safe storage include maintaining those systems in service in order to support the “safe” operations of the other two units of Pickering A. In other words, while these units are shut down in terms of delivering power, because of the connection of the shared safety-shut-down system at Pickering, no unit can be decommissioned without jeopardizing the safety of the other units. Thus, these two units can only be decommissioned when the other two units are shut down.

In addition, two units of Pickering B need to continue operating in order to support the safe operation of Pickering Units 1 and 4. In the case where a unit in Pickering B is shut down for a lengthy period, (for example, Unit 7), what consideration has been given to the possibility of an “unplanned” shutdown in two or more of the other units (5, 6 and 8)?

Pickering’s Legacy

In order to examine OPG’s licence application and its plans for the PNGS, it is worth briefly reviewing the history of the station and the problems encountered very early in its operations. This is also important because, according to OPG’s plans, the oldest station, Unit 1, and second oldest, Unit 4, are expected to outlive all of Pickering B Units. This is only because Units 1 and 4 have been re-tubed, whereas none of Pickering B’s units have been, nor will they be, even though they are over 30 years old, and fast approaching their end of life.

Our concerns relate to the safety of the station overall, and whether it is really Fit for Service, as OPG and CNSC contend it is. But the record and history of Pickering are far from reassuring.

The Pickering nuclear station, as noted, is just 32 kilometres northeast of downtown Toronto, and close to approximately six million people in the Greater Toronto Area. It is adjacent to Highway 401, one of the busiest and most heavily congested highways in the world. No other nuclear station in the world is that close to such a highly populated area. In fact, today, no new nuclear plant would be allowed to be sited in such close proximity to such a highly populated area.

During only twelve years of operation, several incidents, some of which were very serious, occurred at Pickering A. On August 1 1983, Unit 2 was shut down following a metre-long rupture in one of its pressure tubes due to embrittlement caused by hydrogen absorption into the tube alloy. The remaining three units were shut down in succession. All four units underwent “retubing” (the replacement of pressure tubes), a process that extended to 1993.

In 1997, due to safety concerns, all four Pickering A reactors were shut down. Only Units 4 and 1 were brought back into service, in 2003 and 2005 respectively. The Provincial Government decided against repairing Units 2 and 3, due to costs and safety concerns.

Extending Pickering to 2020 - OPG’s Plan in 2013

The plan for the continued operation and shutdown of Pickering, as described in OPG’s submission for renewal of the operating licence for PNGS for 2013-2018 was as follows[6]:

[6] CMD 13 H-2.1 OPG Submission February 2013 p.11,12

- Pickering Units 5-8 would enter the continued operations phase between 2014 and 2016, and continue operating until the end of 2020 **or** until the limit of 247,000 EFPH was reached. This limit is projected to be reached in 2021 for the final unit.
- Since the pressure tubes of Units 1 and 4 were replaced in the 1980's, they will not reach the EFPH limit by 2020, but are to be shut down at the end of 2020.
- At least two units from Pickering Units 5-8 must be operating in order to support the safe operation of Pickering Units 1 and 4.
- After the last shutdown, Pickering would apply a deferred decommissioning strategy with a 30-year safe storage period.

In its 2013 re-licencing application submission, OPG indicated that the technical basis for supporting the life extension of Pickering B pressure tubes to at least 247,000 EFPH was provided in the latest "Fuel Channel Aging and Life Cycle Management and Plan" report which was submitted to CNSC staff in December 2012.

The CNSC Staff Document CMD 13-H2 provided the following tables on the timelines for its End-of-Life (EOL) Projections for Pickering A and B ("Q" refers to the quarter of the year):[7]

Table 1: OPG's Pickering A End-of-Life (EOL) Projections

Pickering A (PNGS-B 240k EFPH)	**Projected Shutdown Date**	**EFPH for Pressure Tubes (PT) (k EFPH)**
Unit 1	Q3 2020	162
Unit 4	Q3 2020	134

Table 2: OPG's Pickering B End-of-Life (EOL) Projections

Pickering B Unit	**Projected EOL Dates based on design life of PT 210k EPFH**	**Shutdown Date based on 247k EPFH**
5	Q1 2015	Q1 2020
6	Q2 2014	Q2 2019
7	Q2 2015	Q3 2021
8	Q2 2016	Q3 2021

The four reactors at the Pickering B nuclear station have been in operation for over 30 years. To extend the life of these reactors, at a minimum, the pressure tubes (PTs) would need to be replaced. With the decision made not to refurbish these units and thus not replace the PTs, OPG was granted permission by the CNSC to extend the operation of these units from 210 k EFPH to 247k EFPH for its current licence. As noted in Table 2, this maximum level would be reached first for Unit 6, in the second quarter of the year 2019. The other three units would be at that level within less than one year (unit 5) or more than two years (Units 7 and 8).

[7] CNSC Staff Document CMD 13-H2 February 2013 p. 87, 88

As the current operating licence is expiring in 2018, the continuing operation of Pickering would require another operating licence to cover the period from 2018 to the closure of operations. The current licence and hearing material for that licence included the expectation that commercial operations of the Pickering station would be shut down at the end of 2020. However, this no longer seems to be the case, at least not on the part of OPG, the Province and the CNSC.

Instead, in its 10-year licence application for 2018-2028, OPG is requesting that the EFPH limit for Units 5-8 be increased once more to 295 k EFPH to allow for continued operation until closure in 2024. There is even a possibility of a further delay in closure beyond 2024.

This is extremely dangerous. The assumption that this can be done is based on models that have not been properly verified. In fact, it is well recognized that the PTs in CANDU reactors are particularly prone to diametrical creep and sag due to heat from the irradiated fuel and the weight of the rods, and that a 30-year lifetime is a reasonable expectation.

By OPG's own standards, the Pickering B reactors are close to the limit of tolerable large accidental radioactive release risk. There are additional risks from operating the two Pickering A reactors, Units 1 and 4, to the end of 2020 let alone 2024 or beyond, even though the pressure tubes have been replaced.

Aging Issues of CANDU Reactors

A. Fuel Channels

The aging of fuel channels (calandria and pressure tubes) is considered to be the single greatest cause of declining performance in CANDU reactors. Over time, fuel channels are subject to deterioration and embrittlement, which could lead to rupturing.

The fuel channel components most affected by degradation are pressure tubes. Problems with pressure tubes have plagued CANDUs since the mid-70s, including leakages at the pressure tube rolled joints, neutron-induced creep, embrittlement and blister formation due to excessive hydrogen pickup, fretting and corrosion. Such problems have made it necessary to replace some of the tubes, causing lengthy outages.

As these reactors age fuel channels become more vulnerable to such problems, resulting in an increased potential for cracks to develop. If not detected or repaired (if that is even possible), this could lead to a Loss of Coolant Accident (LOCA) in the Heat Transport System (HTS).

Aging issues in fuel channels are particularly critical in light of OPG's application for a ten-year operating licence, not only because of the current age of Units 5-8, but also because the licence renewal application includes extending the end-of-life of the fuel channel components from the current limit of 247,000 Equivalent Full Power Hours (EFPH) to 295,000 EFPH.

The following sections describe specific aging issues with respect to fuel channel components, specifically Pressure Tubes, Calandria Tubes, Spacers (i.e., the Annular Gas System), and Feeder Pipes.

a) Pressure Tubes

Each of the 380 fuel channels in Pickering B's reactors consists of an outer calandria tube and an inner pressure tube. The principal function of pressure tubes is to support and locate the fuel in the reactor core, and allow for slightly alkaline heavy water coolant to be pumped at high pressure through the fuel in order to remove the heat created by the fission process.

Pressure tubes are prone to aging problems from a number of factors, such as the weight of the fuel bundles, the high temperatures, pressures and radiation fields (neutron flux) in the reactor core, the absorption of hydrogen, the embrittlement of their metal walls (zirconium alloy), corrosion and deterioration.[8]

These stressors change the dimensions and material properties of pressure tubes. Over time, the tubes increase in diameter (known as diametrical creep) and length, causing their walls to thin out and sag and potentially come into contact with the outer calandria tube, which increases the likelihood that they will rupture. As a result, their useful life and the maximum power a reactor can provide are limited.

[8] http://www-pub.iaea.org/MTCD/publications/PDF/te_1037_prn.pdf

i) Fracture Toughness - Formation of Hydrides and Hydrogen Embrittlement

The concentration of hydrogen (also referred to as deuterium uptake expressed as H_{eq} in parts per million (ppm)) has the greatest influence on the reduction of fracture toughness of a PT, and is the dominant contributor to the failure of pressure tubes.[9]

As the operation time of a reactor increases, so does the concentration of hydrogen. The accumulation of hydrogen results in the formation of blisters and cracks, a process referred to as hydrogen embrittlement. This can result in a short-term loss of toughness, and cause a stable, time-dependent crack growth mechanism called Delayed Hydride Cracking (DHC). This is most pronounced during the reactor's transition states between shut down to full power and vice versa.

During DHC, hydrides migrate to stress regions and promote crack growth. When a critical condition is reached, probably related to crack size, a fracture develops, the crack extends further, and the process is repeated on newly exposed metal.

Approximately 5–20% of hydrogen uptake occurs in the zirconium alloy cladding of the CANDU pressure tubes, resulting in the formation of zirconium hydrides which mechanically weakens the cladding. DHC has caused several failures in pressure tube components.

Time-dependent cracking has also been discovered during the storage at room temperature of Zr-2.5Nb fuel cladding before irradiation. High residual stresses from welding were an important factor in these fractures. Similar stresses were also responsible for cracking in Zr-2.5Nb pressure tubes. The source of these stresses was either the process used to join the pressure tube to the ends of its fuel channel or tube straightening.

ii) Deuterium Ingress and Corrosion

During "hot" operating conditions, pressure tubes react with the heavy water coolant, absorbing deuterium in two main locations, the inside surface of the main body of the pressure tube and the end fittings where the ingress of hydrogen is much more rapid than in the body of the tube.

Pressure tube material has a limited solubility for hydrogen, referred to as terminal solid solubility (TSS) that increases with increasing temperature. If sufficient quantities of deuterium are absorbed and the TSS is exceeded, zirconium hydrides are formed. These hydrides weaken the cladding of the pressure tubes by decreasing its hardness, ductility and density, making them susceptible to DHC, which could lead to pressure tube failures.

The concentration of deuterium increases along the main body of the pressure tube and peaks near the outlet end. The rolled joints at the ends of the pressure tubes (i.e., the inlet and outlet sections) are particularly susceptible to enhanced deuterium pickup. The primary cause may be corrosion in the crevices between the pressure tube and the end-fittings.[10]

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[9] CMD 15-H2 Aging Management p. 49-53: CNSC Commission Public Hearing Part 2 – Licence renewal re Bruce Power CNSC staff February 27, 2015

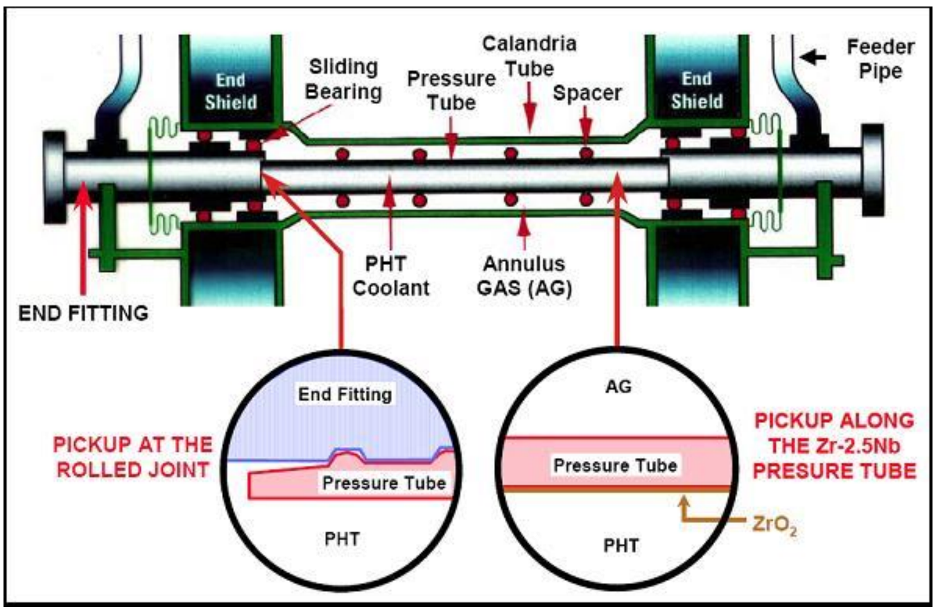
[10] CNSC Submission CMD 18-H6 p. 161-2; http://www-pub.iaea.org/MTCD/publications/PDF/te_1649_web.pdf

There is considerable variation amongst the pressure tubes in each unit. For example, the concentration of hydrogen and the rate of deuterium ingress for pressure tubes in different units can vary over time by as much as a factor of three.[11] As has been noted, not only does the uptake of deuterium vary significantly between tubes, it also varies along the length of the tube, the highest being at the end of a tube close to the rolled joint.

This is a critical matter. In fact, reduced fracture toughness caused by deuterium ingress was a reason given by the CNSC for instituting a Hold Point in OPG's previous licence renewal request.

At the public hearing for the relicensing of Pickering in May 2013, OPG stated that the average concentration of deuterium (hydrogen) in the Pickering units was 53 ppm, and by 2020 would reach 80 ppm. Using an "average" concentration for deuterium is misleading and totally inappropriate, because it is the highest peak in concentration where a crack is most likely to occur.[12] It just takes one crack in one tube to cause a serious problem.

Sources of Deuterium Uptake [13]



iii) Material Wear and Fretting

Pressure tubes sustain varying degrees of mechanical wear caused by the passage of fuel bundles. Repeated rubbing against pads bearing fuel bundles, and small pieces of trapped debris, can lead to fretting flaws and crevice corrosion. These local stress concentrators, under certain conditions, can act as initiation sites for DHC.

Pressure tube oxide spalling (i.e., flakes of material broken off by corrosion) can be caused by fretting. Because oxide thickness provides a measure of hydrogen pick-up, oxide spalling could

[11] AECL Report No. 00-311---200-005, July 2005

[12] Note: The CSA limit for Heq at that time was 100 ppm and has since been raised to 120 ppm.

[13] CNSC staff report CMD18-M4 January 23 2018 p. 46

affect this measurement and lead to uncertainties as to the hydrogen pick-up level that has occurred.

The design analyses of these tubes must take into account the dimensional changes of pressure tubes from the effects of creep and growth over their intended design life. With the inevitable deterioration of the pressure tubes, resulting in the degradation of the Heat Transport System (HTS), the safety margins of the operation of the reactor are compromised.

b) Calandria tubes

The main integrity issue for calandria tubes is irradiation-enhanced deformation which causes elongation, localized deformation and sagging between spacers. This could make it difficult for fuel bundles to pass through the sagged calandria tube during replacement. This could lead to fretting damage of the calandria tubes and compromise integrity.

The deformation and sagging of pressure tubes could also result in contact between the hot pressure tube with the cooler calandria tube, referred to as PT-CT contact. This in turn may result in the formation of a brittle hydride blister which could crack and potentially lead to pressure tube rupture at the contact location.

This degradation mechanism is particularly important for units operating with loose-fitting spacers (also known as loose-fitting garter springs), such as Pickering Units 5-8. These spacers can shift under normal operating conditions, thereby increasing the unsupported span length of the fuel channel which can lead to PT-CT contact.[14]

Another issue that particularly applies to Pickering Units 5-8 relates to the irradiation-induced dimensional changes in the calandria tubes, which results in a narrowing of the gap between the calandria tube and the liquid injection shutdown system nozzle.. Contact between these two components could affect the ability of the nozzle to operate as expected, and also affect the structural integrity of the calandria tube.[15]

c) Feeder Pipes

Feeder pipes, which are connected to both ends of a fuel channel, carry heavy water coolant to and from the steam generators. These pipes are bent, highly radioactive, have a very small diameter, and are very difficult to monitor. Over time, they are subject to severe degradation due to pipe cracking and wall thinning. This is particularly widespread in CANDU outlet feeders, and is a very serious issue for aging reactors.

The wall thickness at a feeder pipe bend is subject to considerable variability, making it necessary to take repeated measurements in a number of different places to determine whether thinning has made the feeders unfit for service.

For example, the discovery of wall thinning in Unit 1's feeder pipes was found unexpectedly and only after Unit 1's fuel channels were declared fit for service, which made it necessary to shut down Unit 4, the only Pickering A unit on line at that time.

[14] CNSC Submission CMD 18-H6 p. 162
[15] Ibid p. 163

As acknowledged by the CNSC in a technical presentation at an IAEA workshop on the corrosion of feeder pipes, the authors stated:[16]

> "The limited knowledge regarding the causes of the degradation may lead to susceptible areas that are not inspected. Accordingly, regulatory staff has insisted that inspection planning and structural integrity assessments should take into account of these limitations in a conservative way. In practical terms, this means that regulatory staff allows a utility to continue operating degraded feeder pipes only when they provide a conservative engineering evaluation of the observed degradation, and commit to an expanded inspection scope to identify other feeders with similar or potentially more severe degradation."

Due to the well-recognized issues of degradation and deterioration of these pipes, OPG updates its Life Cycle Management Plan (LCMP) for feeders annually and conducts inspections and measurements on feeder thickness. While no feeders were replaced during the current licence period this does not alleviate concerns as to the effects of further aging of these components, even though the CNSC staff have concluded that "OPG's strategies outlined in the LCMP are appropriate to manage the expected aging of the Pickering feeders over the proposed operation period."[17]

d) Spacers

The integrity of annulus spacers (loose and tight-fitting), which are used to separate each pressure tube from the surrounding calandria tube, is primarily affected by neutron irradiation, imposed loads, rolling wear, and deuterium (hydrogen) uptake during operation.

The movement of both loose-fitting and tight-fitting annulus spacers can increase the risk of contact of the pressure tube with the calandria tube. In the presence of sufficiently high hydrogen concentrations in the pressure tubes, this can result in hydride blister formation on the outside of the pressure tube. With prolonged contact, hydride blisters may become large enough to initiate DHC and thereby compromise the integrity of the pressure tube.

B. Steam Generators

Steam generators incorporate thin-walled pipes (also called tubes) in which coolant from the reactor core circulates to transfer heat to the turbine side of the station. These tubes constitute one of the primary barriers between the radioactive and non-radioactive sides of the plant. If a tube bursts while a plant is operating, radioactivity from the primary coolant system could escape directly to the atmosphere in the form of steam. For this reason, the integrity of the tubing is essential in preventing the leakage of radioactivity into the environment.

Steam generators are very sensitive to corrosion induced by chemical attack, and particularly to attack from deposits left by the concentration of boiler water contaminants. Problems with steam generators also include clogging of the pipes due to mineral deposits, 'fretting' or

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[16] *Abstract of the technical presentation by CNSC presented at:* IAEA workshop Moscow, Russia April 21-23, 2009 *Prepared by* John C. Jin and Raoul Awad, CNSC
http://nuclearsafety.gc.ca/eng/readingroom/technical_papers_presentations_and_articles/2009/apr09.cfm

[17] CMD 18-H6 p. 74

breakage of the internal pipes due to excessive vibration, and stress corrosion cracking of the metal that can result in the release of radioactive water. Even with water chemistry improvements, inspections, and cleaning programs, problems with steam generators are known to persist.[18]

Prolonged operation with degraded steam generators will ultimately increase radiation exposure and result in extended outages due to the increasing need for extensive tube inspection and repair.

EFPH Values for Units 5-8

The following table illustrates the current EFPH values (as of the end of 2017) and the H_{eq} concentrations in parts per million (ppm) at the inlet and outlet for the rolled joints for Pickering units 5-8: [19]

Table 3: EFPHs - 2017

Unit	EFPH	H_{eq} Inlet Rolled Joint (ppm)	H_{eq} Outlet Rolled Joint (ppm)
P5	229,124	51	78
P6	236,883	49	75
P7	228,008	51	78
P8	215,905	50	76

OPG expects that the Heq levels will not exceed the current Heq limit of 120 ppm for these units during its requested licence period. However, it is not clear whether the Heq values in Table 3 produced by OPG are averages. To adequately ensure safety, they must be peak values.

The CNSC requires that licensees demonstrate performance of 100 % of pressure tubes over the future period. Fitness-for-Service assessments are based on results from periodic inspections which include 30% of the pressure tubes. The remaining pressure tubes are subjected to risk assessment models (e.g. LBB and fracture protection).[20] However, no information has been provided by OPG as to how many pressure tubes have been tested (i.e., burst tests) at various Heq concentrations or at what frequency.

Furthermore, the expected EFPH for each of these units over the proposed extended time period has not been specified.

Unit 6 surpassed the initial EOL level of 120,000 EFPH in June of 2014. Based on operating at approximately 80-85% of full power, this unit is expected to reach approximately 245,000 EFPH

[18] Babcock and Wilcox, the manufacturers of the Steam Generators for Darlington, Bruce and Pickering http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/31/018/31018404.pdf; https://canteach.candu.org/Content%20Library/NJC-1-4-10.pdf; and http://www.power-eng.com/articles/print/volume-100/issue-1/features/steam-generator-replacement-overview.htm

[19] Information on EFPHs and Heq values were obtained directly from OPG upon request.

[20] CNSC Commission Meeting CMD 18-M4 slide 28.

by 2019 (refer to Table 2, p. 5). By extending operations to the end of 2020, its EFPH would exceed the current 247,000 limit.

Four more years of operation of this unit at near full power would bring its EFPH to about 290,000 EFPH. Units 5 and 7 and 8 would also surpass the 247,000 EFPH limit in that timeframe. Thus, OPG had to request an increase in the EFPH limit to 295,000 EFPH to allow these units, in particular, Unit 6, to continue operating until 2024, and is presuming that the CNSC will grant its request.

In its presentation in Part 1 of the public hearing held April 4 2018, CNSC stated that: [21]

> **"OPG must notify the CNSC no later than December 31, 2022, in case it intends to operate any reactor unit beyond December 31, 2024".**

Does this mean that once again OPG can extend operations of its reactors, even beyond 2024? Is there no certainty as to <u>when</u> these units will be shut down?

Reactor Operating Time-Metrics

Many of the aging mechanisms affecting fuel channel components are driven by thermal conditions, i.e. high temperatures, and thus depend on the time that a reactor is at its operating temperature, that is the "hot hours", whether or not the reactor is producing power. The metric "Hot Hours" includes all periods when the Heat Transport System exceeds ≈200°C. Since Pressure Tubes corrode at these temperatures, Hot Hours is therefore a useful metric for assessing H_{eq} levels.

EFPHs, which include only the time during which power is produced, captures only those periods when fuel is undergoing fission, and is useful for tracking degradation due to neutron damage (e.g., pressure tube elongation).[22]

While cumulative EFPHs are commonly used by CNSC and nuclear operators, the accumulated "Hot Hours", which are greater than EFPHs, may be more relevant in assessing the safety of fuel channel components, particularly as this metric includes all of the time that the components are subjected to thermal effects. In fact, many references in the literature pertaining to aging effects on CANDUs refer to hot hours, not EFPH.[23]

The difference between EFPHs and Hot Hours on an annual basis may be relatively small (e.g. 5% or so). But over time this difference can become significant in assessing the effects of aging, especially with respect to pressure tubes.

In addition to these metrics, the term "total on line", which is the total number of hours during which a unit is operating with at least one main generator connected to the grid, is also used.[24] This metric is comparable to the EFPH metric. But the calculated accumulated TOL for Units 5-8 to the end of 2017 are higher than the EFPH values provided in Table 3 by approximately 7,000-

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[21] CNSC staff presentation April 4, 2018 CMD 18-H6.A p. 21

[22] CNSC Commission Meeting January 23, 2018 CMD 18-M4 p. 15

[23] AECL: Corrosion and Hydrogen Ingress of Pressure Tubes https://www.nrc.gov/docs/ML0300/ML030020286.pdf; Canadian Nuclear Laboratories, http://pubs.cnl.ca/doi/full/10.12943/CNR.2016.00007

[24] IAEA Power Reactors Information System (PRIS) refers to TOL.

8,000 hours, as indicated in the table in the Appendix. This difference calls into question the accuracy of the EFPH values, which is absolutely critical for this licence application. In other words, is EFPH alone the critical metric to use in licensing these reactors?

Comments

OPG's plan to operate Pickering Units 5-8, with a limit of 295,000 EFPH is based on its confidence that the fuel channel components, in particular, pressure tubes, will remain fit for service at that level.

Based on the inherent and growing danger that the deterioration of these components presents as they age, continually increasing the permissible life of the PTs from 210,000 EFPH to 247,000 EFPH in 2013 and then to 295,000 EFPH for the proposed licence period of PNGS, and perhaps even beyond, is unsound, potentially unsafe, irresponsible, and unacceptable.

CNSC's mandate to protect public safety requires that it not allow the Pickering station to continue to operate under these dangerous conditions.

Even though the CNSC is very aware of problems caused by the aging of these components, it is still giving its unconditional support for continuing to operate Pickering for (at least) six more years beyond the end of its current licence period, and perhaps longer.

Probability Risk Assessments - Methodology

The probabilistic models used by CNSC to determine the probability of an accident at a nuclear power plant are not mathematically or scientifically valid for a great many reasons. First of all, a mathematical model is only valid, and can only give reliable results, if it is both complete and accurate. This means that it must take into account everything that might affect every number it is calculating, and must represent every last one of these essential factors accurately enough to give accurate final results. It is a well-known principle of mathematics (and computer science) that the final result of a computation is only as accurate as the least accurate number that went into it.

It is completely impossible to foresee everything that could cause a serious nuclear accident, let alone take it into account in a mathematical model. There's no telling what human errors might occur, such as the one that caused the accident at Chernobyl. And the reactors at Fukushima were able to withstand an earthquake as large as the one that actually occurred; but the resulting tsunami was larger than anyone foresaw, so adequate provision was not made for it. Just one oversight like this is enough to make any model that calculates the probability of a nuclear accident completely worthless, and it is impossible to avoid all oversights of this kind.

Furthermore, it is impossible to determine accurately the probabilities of all the accident scenarios that are foreseen. Just as logic and experience are the sole basis for all genuine science, so logic and experience are the only basis for determining probabilities.

There is no logical basis for determining the probability of any particular kind of human error, or a tsunami such as the one at Fukushima, or many other chance occurrences that might cause a serious nuclear accident. We can never have long enough experience with nuclear accidents (without being destroyed by them first) to determine such probabilities on the basis of experience. So there is simply no way to determine them accurately at all.

Even if we could accurately determine the probability of a serious nuclear accident at one of the proposed nuclear power plants, it would provide no guarantee of safety, no matter how small it was. Probabilistic predictions are only reliable when they are applied to a large number of cases. In a single case anything can happen at any time, even when it's highly improbable.

Models and Tests

The methodologies used to assess Fitness for Service for major components (i.e., fuel channels, feeders, and steam generators/pre-heaters) are addressed under Life Cycle Management Plans (LCMPs). These plans cover Leak-Before-Break (LBB) assessments and Research and Development, including fracture protection models, and burst tests. LCMPs also include technical information, regulatory requirements, maintenance activities and fuel channel mitigation activities to ensure that the components are fit for service. Bruce Power has revised and updated its LCMP for the major components in preparation for the work planned in its licence renewal.

Two fracture toughness models are used as key inputs into the LBB and fracture protection assessments to guard against through-wall crack penetration in order to demonstrate the safe operation of pressure tubes.[25]

Leak-Before-Break evaluations are intended to ensure that if a crack develops in a pressure tube, the consequential leak can be detected in time to shut down the reactor and cool and depressurize the primary heat transport system before the pressure tube ruptures.

Fracture protection models and tests are intended to establish the pressure and temperature limits required to prevent the fracture of tubes by delayed hydride cracking (DHC), in particular the time periods where DHC is most likely to occur. i.e. during transition periods while the primary heat transport system pressure is being increased to or decreased from the normal operating pressure during reactor start-up and shutdown,

What guarantee is there that these models are reliable enough to provide the needed assurance that leaks or cracks will not develop, especially over the extensive, untested time periods that these tubes will be in use?

There is none, in reality, unless every tube is tested regularly. No model can accurately take into account the variability in the behaviour of those tubes under the thermal conditions that they are subject to, especially over extensive periods.

Accidents, mistakes and malfunctions can and do occur in [CANDU] nuclear plants. Equipment fails; instrumentation and monitoring can give erroneous readings; operators can make errors; instructions may not always be followed; designs may be inadequate. Events that are considered “incredible” or “unlikely” can and do happen. No matter how careful we are, we must anticipate the unexpected. Nothing is foolproof.

This is why we take great exception to the use of the term “unlikely” in dismissing the possibility that an accident will occur. For example, CNSC’s submission states:[26]

> **a) *Pressure tube leak-before-break***
>
> Leak-before-break (LBB) assessments are used to demonstrate that in the unlikely event of a leak from a pressure tube, the consequential leak will be detected in time to shut down the reactor and cool and depressurize the primary heat transport system before the pressure tube ruptures. This evaluation produces an estimated conditional probability of LBB given a through-wall crack, and is compared against the acceptance criteria (expressed as an allowable conditional probability of ruptures per through wall crack over the evaluation period).
>
> **b) *With respect to emergency planning***
>
> CNSC staff will continue to monitor the new developments and improvements including OPG’s development of a new public education campaign to provide guidance in the unlikely event of a nuclear emergency and how to prepare prior to an emergency.

[25] The models include a statistical model for the upper shelf temperature region and a cohesive-zone model for the transition temperature region.

[26] CMD18-H-6 p. 71, 164; p.103

Emergency Preparedness - Readiness

There are 10 nuclear reactors in Durham Region, 6 reactors at the Pickering Station and 4 reactors at the Darlington station. These stations are approximately 40 km from each other. The Pickering units are approaching their end of life. OPG is refurbishing the 4 reactors at Darlington. This is a lot of nuclear activity in a highly populated geographical area.

OPG has indicated that "Polling results support that the public knows what to do in the unlikely event of a nuclear emergency."[27] If nuclear disasters are perceived as "unlikely", then that could well lower the level of planning and preparedness below what is required to adequately meet such a disaster.

The Pickering Station lies within a highly populated area. The population of the Pickering region alone is expected to increase from approximately 94,000 currently to 190,000 by 2031. Similarly, rapid growth is happening in the Greater Toronto Region within 50 km of the Pickering Station. Many residents, both present and future, may be totally unaware of how close they are to the Pickering plant.

Rather than dismissing nuclear emergencies as "unlikely", we must prepare for a worst-case scenario accident. If a severe worst-case scenario accident were to happen at either the Pickering or Darlington stations, today or at any time in the future, are essential emergency planning and preparations in place?

Are there enough well-trained personnel on hand to ensure that there is rapid response to an emergency and to assist with the evacuation of large populations?

Are the public alarm systems adequate and properly functioning?

What actions are planned to protect farmland and livestock?

What special considerations have been given to evacuating children, the sick, the elderly, and those with disabilities?

Are there adequate provisions to provide safe food, drinking water, and medical assistance for the sick, and above all, those exposed to large amounts of ionizing radiation?

Will workers at the Pickering and Darlington stations be required to take heroic actions to to mitigate damage to a reactor?

Is the planned management of a disaster well-coordinated?

Emergency Planning Zones

Emergency planning zones are geographic areas that require detailed preparations in the event of a nuclear accident. With respect to Pickering, the zones are as follows:

The Contiguous Zone –This zone includes the area immediately surrounding the station out to a radius of 3 km. Dominant features within this zone include portions of Highway 401 and Lake Ontario, and surrounding industrial and farming activities. Priority evacuations would be undertaken within this area.

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[27] OPG CMD18-H6.1A p. 20

The Primary Zone –This area includes a radius of 10 km around the station and includes the Contiguous Zone. Detailed planning and preparedness for measures against exposure to a radioactive emission is required for this area, which has large population centres. The primary zone is divided into Response Sectors.

The Secondary Zone – This zone includes the Contiguous and Primary Zones, and the area within a 50 km radius around the station. The planning and preparation for this area includes implementing ingestion control measures, such as monitoring the food chain for contamination, and banning consumption of contaminated food items. This zone encompasses areas of Durham Region, the City of Toronto, York Region, the City of Kawartha Lakes, and the counties of Northumberland and Peterborough within a 50-km radius of the PNGS.

Is the delineation of these zones appropriate in the event of a major accident? For example, are some households potentially cut off because they may be living on the periphery of a zone?

Changes in wind patterns and weather conditions could affect the dispersion and deposition of radiation and thus affect the delineation of these zones. Are there plans to broaden and/or alter these zones as needed?

Evacuation and Sheltering

Are evacuation plans able to handle the removal of so many people to safe sheltered areas quickly enough, especially if there is an early release (first 24 hours) of radionuclides?

Are the plans to deal with adverse weather and road conditions, especially during winter, reliable enough to allow for mass evacuation?

How will such heavy traffic be handled safely?

What consideration has been given as to the impact of weather, road conditions, etc., in the event of mass evacuation?

How will changes in wind etc. be taken into account for evacuation? (e.g., , The citizens of Iitate, 40 km from Fukushima, were outside the 20 km evacuation zone, and had to be belatedly evacuated due to radioactive deposition from a change in wind.)

Are there sufficient and appropriate safe sheltering buildings that offer protection against external radiation? Note: Buildings constructed of wood or metal are "not generally suitable for use as protective shelters against external radiation, and buildings that cannot be made substantially airtight are not effective in protecting against any exposures."[28]

Evacuation Time Estimate Study:

In 2008, OPG estimated that the Primary Zone could be evacuated in approximately 5 to 6.5 hours, depending on weather and time of day. This study provided for approximately 250,000 people and 115,000 vehicles to be evacuated. The maximum evacuation time was projected to

[28] http://www.icrp.org/docs/ICRP_TG_Emergencies_draft_42_194_08.pdf

be 9 hours in 2025. This time was considered to be much less than the shortest time it would take for an offsite radiation release from a severe accident at the Pickering site.[29]

A 2016 evacuation study for Pickering, based on the methodology used in a 2015 study for Darlington, resulted in a worst-case evacuation time estimate of 8 hours 40 minutes for the Pickering Primary Zone. The total population in that zone is estimated to be 280,590.

The Darlington study used 2011 census data and took into account the roadway infrastructure network, traffic management studies, mobilization time, voluntary evacuation, school population, special events, weather, time-of-day, week, year, as well as evacuations of people who live beyond the 10 km zones.[30]

A new 20 km Contingency Planning Zone (CPZ) has been introduced in the Pickering Nuclear Emergency Response Plan (PNERP). OPG is currently reviewing the requirements of this new zone with respect to updates of evacuation time estimates, and estimates of the number of evacuees.[31]

A catastrophic accident would involve a great many people from a much larger area. Massive traffic congestion compounded with adverse weather conditions would make roads almost impassable. Finding protective shelters would be difficult. So much is left to individuals to look after, including basic needs such as food and water. Medical assistance and care would be essential. The most vulnerable would be the least protected. Confusion and chaos would reign.

Potassium Iodide (KI) Pills

OPG is working with the Region of Durham, City of Toronto, and the Office of the Fire Marshall and Emergency Management on the predistribution of KI pills to all residents, businesses, and institutions within the primary zone. In addition, KI pills are available to residents within the 10 to 50 km radius (secondary zone), and stockpiles of tablets will be available for distribution by public authorities in an emergency, should they ever be required.

These requirements are intended to ensure that KI is already on hand in the case of a nuclear accident. This is because the timeliness of ingestion of KI in the event of radioactive emissions is critical. Health Canada advises that KI is most effective to reduce the amount of radioactive iodine picked up by thyroid glands if ingested just prior to or at the time of the first emission of radioactive iodine from a nuclear accident, as its effectiveness diminishes very rapidly after that. Protecting against radioactive iodine exposure is very important in cases of early releases.

Will the distribution of KI pills be able to cover the number and ranges of people most likely to be affected by exposure to radiation, especially children, in the brief time period for which the pills are most effective?

It is important to stress that KI pills only deal with one radionuclide. There is no antidote for the other radionuclides that would be released in the event of a large accident (e.g., Cs-137,

[29] CNSC CMD 13-H2.1, p. 65, CMD 12-H13.2 p.62

[30] Durham Nuclear Emergency Response Plan July 2017, p, 22, 25, 26 https://www.durham.ca/en/living-here/resources/Documents/EmergencyPreparedness/DurhamNuclearEmergencyResponsePlan.pdf

[31] OPG CMD 18-H6-1 p. 33

Strontium-90). So KI pills must not be seen as a panacea, or as offering protection against all radiation exposure.

The Planning Regime

Approximately 54 agencies are involved in emergency planning, including OPG, Durham Region, the Province of Ontario (via the Provincial Nuclear Emergency Response Plan (PNERP)), the municipalities, CNSC, Health Canada, etc.

In the event of an accident, OPG will notify the Province, CNSC, and the local municipalities and be responsible for mitigating any effects within its boundaries. The province under PNERP will notify the public about action to be taken, which will include issuing emergency bulletins to the public on sheltering, KI pill ingestion, and/or evacuation.

The CNSC requires major licensed facilities such as nuclear power plants to have effective emergency preparedness programs and associated emergency response plans. These licensees are required to conduct appropriate training, drills and regular exercises with all affected stakeholders to validate their emergency preparedness program.[32]

Carrying out evacuation and finding sheltering requires the highest level of coordination, organization, and personnel. All the agencies involved in emergency planning must be well coordinated under strong oversight. A state of preparedness and readiness must be maintained at all times.

Unlike other severe industrial accidents, a nuclear meltdown can cause mass destruction for generations. This means that emergency planning and preparedness needs to include provisions to protect people, land, food, and water after a nuclear accident. There must be a reliable public alarm system, an evacuation and relocation plan, and measures to prevent the ingestion of radionuclides from air, food, and water.

Extensive community outreach and education sessions on nuclear emergency plans for large releases and severe accidents are required and must be conducted routinely.

As the disaster at Fukushima has vividly demonstrated, not taking the possibility of catastrophic accidents seriously leads to a lack of emergency preparedness, which has tragic results for a great many people. Given that there are 10 operating nuclear reactors in the Durham Region, the potential impacts that a catastrophic nuclear accident could have on millions of people across Durham Region, the Greater Toronto Area (GTA), and beyond must be seriously addressed.

The empirical probability of a meltdown is once a decade somewhere in the world and emergency planning must take this into account. No nuclear facility should be allowed to operate without a coordinated, well-organized emergency plan that takes into account the worst possible accidents.

CNSC has a responsibility as a regulator to ensure that such a plan is in place before granting an operating licence to OPG for the Pickering Station.

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[32] CNSC Study p. 32

Recommendations and Conclusions

To extend the life of the station by exceeding the designed end-of-life of Units 5-8 for six years and possibly more, as OPG has requested, may not even be possible let alone safe. There is a point in time where trying to repair equipment that is worn out and unsafe is throwing good money after bad. A decision is typically made to “retire” equipment rather than go through uncertain expenditures in trying to repair it, to gain uncertain additional life at the risk of public safety. That is certainly the case for Pickering.

The experience with Pickering to date is not very comforting. It has been beset with numerous accidents. It is situated in a densely populated area. No proof has been given that extending its operating life is safe.

The possibility of accidents, especially very serious ones, must be the foremost concern for any nuclear facility. However, there is clearly an intrinsic bias on the part of the nuclear industry, the Provincial Government and the CNSC to treat the possibility of such accidents as “unlikely”. This “denial syndrome” seemingly underpins their refusal to accept that Pickering is in a precarious state and must be shut down sooner rather than later.

OPG’s plans to operate Pickering Units 5-8 to a closure date of 2024 and to a limit of 295,000 EFPH is premised on the fuel channels remaining fit for service for that period, or even longer. There is absolutely no scientific basis for such confidence. The past record of incidents and the problems with fuel channels in CANDUs place such confidence in very serious question.

In the interests of public safety, the time has come to shut down all units of the Pickering station rather than risk an accident which could be devastating for so many, both now and for all generations to come.

The propping up of the nuclear industry blocks far more affordable, safer and cleaner alternative sources of energy for residents of Ontario. Conservation measures, renewable power sources and alternative sources of electricity, could easily fill the gap that would result by the closure of Pickering.

As stated in this submission, we have serious concerns with respect to the 10-year licence period requested by OPG and supported by the CNSC staff. With all the stages planned during this licence period, from operation to preparation for decommissioning, a single licence of this length is an intolerable barrier to public scrutiny of these activities and is completely unacceptable.

Therefore, we urge CNSC to reject OPG’s request, and instead, recommend that:

> CNSC provide explicit instructions to OPG to prepare for the shutdown of the Pickering station by 2020 -1 at the latest, and issue an operating licence specifically for that period.
>
> During this time, preparations for safe storage and decommissioning would be underway. Therefore, we recommend that the CNSC engage the public in sessions, meetings and further hearings as these stages take place.
>
> OPG must have a complete decommissioning plan prepared which would be subject to due public process and consultation under a separate licence issued by the CNSC.

Appendix: Time on Line (TOL) Pickering Units 5-8[33]

Year	Annual	Total TOL	Annual	Total TOL	Annual	Total TOL	Annual	Total TOL
Unit	Unit 5	Unit 5	Unit 6	Unit 6	Unit 7	Unit 7	Unit 8	Unit 8
1983	6968		856					
1984	7035	14003	7636	8492	861	861		
1985	6989	20992	6540	15032	8227	9088		
1986	8057	29049	6763	21795	7002	16090	8086	8086
1987	7148	36197	7791	29586	8642	24732	7585	15671
1988	8683	44880	8775	38361	8519	33251	7296	22967
1989	6862	51742	7794	46155	6939	40190	8569	31536
1990	7821	59563	7017	53172	7420	47610	6743	38279
1991	5724	65287	8721	61893	8436	56046	8759	47038
1992	2621	67908	7936	69829	7349	63395	8280	55318
1993	8307	76215	5506	75335	8760	72155	7233	62551
1994	6196	82411	8036	83371	7386	79541	8579	71130
1995	7008	89419	6962	90333	8140	87681	8066	79196
1996	6429	95848	5707	96040	4416	92097	2597	81793
1997	7908	103756	6841	102881	6208	98305	995	82788
1998	7296	111052	6384	109265	6495	104800	7009	89797
1999	5302	116354	6863	116128	8751	113551	7077	96874
2000	5457	121811	6449	122577	4445	117996	5508	102382
2001	5986	127797	5286	127863	7968	125964	6999	109381
2002	5565	133362	7985	135848	8538	134502	7244	116625
2003	6566	139928	6566	142414	3811	138313	8026	124651
2004	8264	148192	5597	148011	6127	144440	5182	129833
2005	4818	153010	5596	153607	8658	153098	8431	138264
2006	8113	161123	7635	161242	5311	158409	5853	144117
2007	5637	166760	6588	167830	7540	165949	8015	152132
2008	8357	175117	8521	176351	3084	169033	6116	158248
2009	6631	181748	7051	183402	8492	177525	8520	166768
2010	7645	189393	7659	191061	5895	183420	6427	173195
2011	4258	193651	6334	197395	8673	192093	8345	181540
2012	8725	202376	8550	205945	5965	198058	5967	187507
2013	5371	207747	6047	211992	8760	206818	7979	195486
2014	8760	216507	8397	220389	5489	212307	5223	200709
2015	5865	222372	6064	226453	8336	220643	8440	209149
2016	8784	231156	8259	234712	5574	226217	4367	213516
2017	**5841**	**236997**	**8686**	**243398**	**7512**	**233729**	**7787**	**221303**
EFPH -2017 (OPG)		**229124**		**236883**		**228008**		**215905**

[33] https://www.iaea.org/PRIS/CountryStatistics/ReactorDetails.aspx?current=33