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Written submission from International Institute of Concern For Public Health

Mémoire de International Institute of Concern For Public Health

In the Matter of the

À l'égard de l'

Ontario Power Generation Inc.

Ontario Power Generation Inc.

Request by Ontario Power Generation Inc. to request to remove the hold point associated with Licence Condition 16.3 of the Pickering Nuclear Generating Station Power Reactor Operating Licence

Demande par Ontario Power Generation Inc. visant à supprimer le point d'arrêt associé à la condition 16.3 du permis d'exploitation de la centrale nucléaire de Pickering

Commission Public Hearing

Audience publique de la Commission

May 7, 2014

Le 7 mai 2014

Canada

INTERNATIONAL INSTITUTE OF CONCERN FOR PUBLIC HEALTH

April 22, 2014

Louise Levert, Secretariat
Canadian Nuclear Safety Commission (CNSC)
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Ottawa, ON K1P 5S9
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Re: Submission to the CNSC Public Hearing on Ontario Power Generation's (OPG's) request to remove the Hold Point associated with Licence Condition 16.3 of the Pickering Nuclear Generating Station (PGNS) Operating Licence (PROL) to allow the reactors to operate beyond 210,000 hours. [Ref. 2014-H-01]

Dear Ms Levert:

On behalf of the International Institute of Concern for Public Health (IICPH), please accept this written submission as IICPH's intervention in response to a Canadian Nuclear Safety Commission ("Commission") notice dated February 10, 2014 with respect to the public hearing on the matter noted above to be held May 7, 2014.

IICPH intervened at the Public Hearing that was held May 29, 30 2013 in Pickering, Ontario with respect to OPG's licence application to renew for a 5-year term and merge the operating licences for Pickering A and B. At that time we clearly stated our concern regarding the safety of extending the end-of-life limits of the pressure tubes in Pickering B's Units 5-8.

This submission reviews the safety concerns outlined in our previous submission on overriding the end-of-limits life of the pressure tubes and adds to that additional issues that have emerged from the documentation submitted by OPG [CMD 14-H2.1] and CNSC staff [CMD 14-H2] in March 2014 .

Sincerely,

Anna Tilman

Anna Tilman, Vice-President, IICPH

INTERNATONAL INSTITUTE OF CONCERN FOR PUBLIC HEALTH

Submission to the Canadian Nuclear Safety Commission (CNSC)

with respect to

Ontario Power Generation's (OPG's) Request to Remove the Hold Point associated with Licence Condition 16.3 of the Pickering Nuclear Generating Station Reactor Operating Licence

April 22, 2014

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Executive Summary

Ontario Power Generation (OPG) is requesting that the Canadian Nuclear Safety Commission (CNSC) remove the Hold Point currently associated with the Licence Condition of the Pickering Nuclear Power Generation Station (PNGS). This requires that no Pickering unit pressure tubes be operated beyond their designed end-of-life of 210,000 Effective Full Power Hours (EFPH) hours unless and until the Commission authorizes removal of the Hold Point.

The end-of-life limits of the pressure tubes in Pickering B's Units 5-8 will be reached sequentially between 2014 and early 2016. The rupture of any these pressure tubes could have catastrophic consequences for millions of people. In order to continue operations to the end of 2020, as OPG intends, the lifetime of these tubes will be extended well beyond their designed safe operating limits. The work required to increase the end-of-life limits of these tubes has never been done. There is no assurance that this work 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 courting 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 costly risks, 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.

Considering the age of the station, the numerous problems that have been encountered for decades, some of them very serious, its close location to a highly populated region, and the inadequacy of its emergency and evacuation plans, to continue operating Pickering B beyond the upper end-of-life limit of its pressure tubes poses enormous risks to public safety that no regulator should accept.

Furthermore, the documentation submitted by OPG [CMD 14-H2.1] and CNSC staff [CMD 14-H2] and the Commission Update on Pressure Tube Fitness for Service in March 2014 do not provide any compelling evidence at all that would justify removing the Hold Point.

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 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, it is our position that the Commission must reject OPG's request, and require OPG to shut down each reactor unit of Pickering B when it reaches the end of life of its pressure tubes.

A. Pickering

Background and Overview of OPG's Request

The Pickering Nuclear Generating Station (PNGS), one of the world's largest nuclear generating facilities, consists of consists of two stations, Pickering A, Canada's oldest commercial nuclear station, and Pickering B, each with 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 during 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. They have not produced power since 1997.

On February 16, 2010, Ontario Power Generation (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 December 2012, OPG applied for a licence to continue operating the merged operations at Pickering A and B for a five-year period from 2013 to 2018. This would mean that from 2014 until the intended date of closure of commercial operations of the PNGS, Pickering B would need to operate its four reactor units beyond the fuel channel design life of 210,000 Effective Full Power Hours (EFPH).

A Public Hearing was held on OPG's licence application on May 29, 30 2013. In the Record of Proceedings issued by the Canadian Nuclear Safety Commission on August 9, 2013, the Commission issued a five year Power Reactor Operating Licence for the Pickering Nuclear Generating Station (PNGS) to (OPG) with a Hold Point related to pressure tube life.

This Hold Point, as established in the Pickering NGS PROL 48.00/2018 and Licence Conditions Handbook (LCH), LCH-PNGS-R000, requires that no Pickering unit pressure tubes be operated beyond 210,000 Effective Full Power Hours (EFPH) unless and until the Commission approves removal of the Hold Point.

OPG was also directed by the Commission to complete certain activities related to Probabilistic Safety Assessments before the removal of the Hold Point could be approved. These activities included:

- The revised Probabilistic Safety Analysis (PSA) for Pickering A that meets the requirements of CNSC Regulatory Standard S-294;
- An updated PSA for both Pickering A and B that takes into account the enhancements required under the Fukushima Action Plan; and
- A whole-site PSA or a methodology for a whole-site PSA, specific to the Pickering NGS site.

In addition, the Commission requested OPG to provide an action plan to address any identified issues that could arise should OPG exceed its targeted safety goals. The Commission noted that OPG will be considering filtered containment as part of its analysis of future enhancements to protect containment as part of its Fukushima Action Items. The Commission directed OPG to report on its analysis and the way forward on this issue at the time of its request to remove the Hold Point to proceed beyond 210,000 EFPH. [P.5-6]

Other requirements included the production of an emergency management public information document by the end of June 2014, to be distributed to all households in the Pickering area. This was not a condition of removing the Hold Point.

Pickering B - Issues

The four reactors at the Pickering B nuclear station have been in operation for 27-30 years. None of these reactors can be operated safely after 2015. To extend the life of these reactors, at a minimum, the pressure tubes (PTs) would need to be replaced. With the decision not to refurbish these units, OPG is counting on extending their life beyond their designed end-of-life period. This is extremely dangerous. The assumption that this can be done is built 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 the most that can and should be expected of them.

By OPG's own standards, the Pickering B reactors are close to the limit of tolerable large accidental radioactive release risk.

Furthermore, OPG has yet to provide the safety studies to demonstrate that it could operate the Pickering B reactors until 2018, let alone to the end of 2020. Instead, they are asking for permission to provide studies later to CNSC staff without public scrutiny.

Extending Pickering to 2020 - OPG's Plan

Relevant to the topic at hand, it is important to review OPG's plan concerning future operations at Pickering and its request within that plan to remove the Hold Point for the continued operation of Pickering as described in its submission at the licensing hearing in May 2013. Specifically[1]:

- Pickering Units 5-8 will enter the continued operations phase between 2014 and 2016, at which time the pressure tubes will reach their assumed design life, and will be operated until the end of 2020 **or** until a limit of 247,000 EFPH is 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 end of their assumed design life by 2020, but will nevertheless be shut down at the end of 2020.
- Unit 7 is to be "load-managed" by shutting it down for an extended outage, in order to conserve operating hours, and to ensure that there are at least two units from Pickering Units 5-8 running in order to support the safe operation of Pickering Units 1 and 4.
- After the last shutdown, Pickering will apply a deferred decommissioning strategy with a 30-year safe storage period.

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

The following table shows the timelines for OPGs End-of-Life (EOL) Projections for Pickering B ("Q" refers to the quarter of the year):[2]

OPG's Pickering End-of-Life Projections

Pickering B Unit	Projected EOL Dates based on design life of PT 210k EPFH	Expected Shutdown Date based on 240k EPFH	Shutdown Date based on 247k EPFH
5	Q1 2015	Q1 2019	Q1 2020
6	Q2 2014	Q2 2018	Q2 2019
7	Q2 2015	Q3 2020 (load-managed)	Q3 2021
8	Q2 2016	Q3 2020	Q3 2021

Comments/Questions on OPG's Plan

At the public hearing on relicensing the Pickering A and B, a number of issues were raised by IICPH on the plan presented by OPG. These issues have not been addressed. For example,

> 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. However, this report has not yet been made available for public review, so its validity cannot be properly, objectively and independently assessed.
>
> Why is Unit 7 selected to be load-managed? Are there problems with that Unit that should be clearly identified?
>
> Two units from Pickering 5-8 must continue operating in order to support the safe operation of Pickering Units 1 and 4. But if Unit 7 is shut down for a time, what consideration has been given to the possibility of an "unplanned" shutdown in two or more of the other units (5, 6 and 8)?
>
> The operating licence OPG has received would expire in 2018. The continuing operation of Pickering would require another licence at that time to cover the period to the closure of operations. This presents a regulatory gap in OPGs plans, as it is tacitly assumed that Pickering's operating licence would be renewed, regardless of any issues that might arise that could make the renewal impossible.

B. Aging Issues – Creep, Sagging, Corroding and Cracking

The aging issues outlined in this section are critical to OPG's request to remove the Hold Point. This section reviews critical factors that could lead to cracks developing in pressure tubes, which in turn would result in loss of coolant which could cause a meltdown.

a) Fuel Channels

The 380 fuel channels in each of the Pickering B reactors each consists of an outer calandria tube and an inner pressure tube. The principal function of pressure tubes (PTs) is to support

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

and locate the fuel in the reactor core, and allow slightly alkaline heavy water coolant to be pumped at high pressure through the fuel, to remove the heat created by the fission process.

b) Pressure Tubes

Pressure tubes (PTs) are prone to aging problems from the weight of the fuel bundles, the high temperatures, pressures and radiation fields in the reactor core, and from corrosion. Over time, the tubes increase in diameter (known as diametrical creep) and length, causing the walls of the pressure tubes to thin out. This makes them sag, mainly because of the applied stress from the weight of the fuel and coolant contained within them. When they sag, they can come into contact with the outer calandria tube. This increases the chance of rupture of the PT, due to embrittlement of their metal walls by corrosion and the absorption of hydrogen.[3]

The design analyses of PTs take into account the dimensional changes of pressure tubes from the effects of creep and growth over a thirty-year period, which is their design life. But there is a point of no return. With the inevitable deterioration of the PTs, which leads to the degradation of the Heat Transport System (HTS) of the reactor, the safety margins of the operation of the reactor are compromised. This is why the tubes need to be replaced by the end of their designed life.

c) Formation of Hydrides and Hydrogen Embrittlement

The concentration of hydrogen (also referred to as deuterium uptake) in a PT has the greatest influence on toughness. It increases with the length of operation of the reactor unit.

A percentage (approximately 5–20%) of hydrogen diffuses into the zirconium alloy cladding of the CANDU pressure tubes forming zirconium hydrides. The hydrides mechanically weaken the cladding because they have lower hardness, ductility and density than zirconium or its alloys. Therefore hydrogen accumulation results in the formation of blisters and cracks. This process is known as hydrogen embrittlement.

This embrittlement can result in short-term loss of toughness, but it also causes a stable, time-dependent crack growth mechanism called delayed hydride cracking (DHC). During DHC, hydrides migrate to stress regions and promote crack growth. When a critical condition is reached, probably related to size, there is a fracture, the crack extends and the process is repeated. DHC has caused several failures in pressure tube components.

[Time-dependent cracking was also 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 from tube straightening.]

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

The rolled joints at the end of pressure tube are particularly susceptible to enhanced deuterium pickup. The primary cause may be corrosion in the crevices between the pressure tube and the end fitting. [4]

d) Feeder Pipes

Feeder pipes, which are connected to both ends of a fuel channel, carry the 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.

Wall thinning is particularly widespread in CANDU outlet feeders, and has become a very serious issue for OPG's aging reactors. Pickering A reactors are especially susceptible to wall thinning of the feeder pipes, due to the aggressive use of decontamination reagents in the mid 1980's, and because they were made from carbon steel containing less than optimum chromium. This corrosion is most likely to occur at tight bends in the carbon steel piping, which carry high temperature water at high flow velocities. This condition is present at the first elbow of every outlet feeder pipe in CANDU reactors.[5]

The wall thickness at a feeder pipe bend is subject to considerable variability, making it necessary to do measurements in a number of different places to determine when feeder thinning occurs at this critical location.

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

In a technical presentation by CNSC at an IAEA workshop on the topic of flow accelerated corrosion (FAC) of feeder pipes, the authors stated:

> "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."[6]

C. Worker Health and Safety

The currently allowed "safe" level of exposure to ionizing radiation (in millisiverts, mSv) for the public is 1 mSv/year, and for nuclear energy workers it is 100 mSv over 5 years with a maximum of 50 mSv in one year. In special circumstances, an effective public dose of 5 mSv/year may be

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[4] http://www-pub.iaea.org/MTCD/publications/PDF/te_1649_web.pdf

[5] http://www.energyquest4nanticoke.ca/green1.htm

[6] *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

permitted. These limits have been set by the International Commission on Radiological Protection (ICRP) and are used by the CNSC and OPG. They are derived from models based on assumptions and value judgements as to what are deemed to be "acceptable" risks. From a health perspective, any level of exposure to ionizing radiation can cause harm.[7]

Maintenance and repair work, including testing and measurement of components by Nuclear Energy Workers and contract workers, needs to be carried out routinely on pressure tubes, feeder pipes, garter springs, etc., above all in cases where there are notable problems, such as leaks. As the components age, even more of this work is necessary. By allowing Pickering B to continue to operate, and exceed the designed end-of-life of the pressure tubes, it will be all the more necessary to increase the frequency of monitoring, inspecting, and repairing the components of the fuel channels for deuterium uptake, corrosion, leaks, and cracks, etc.

Planned outages will be required in order to do this work. This work could very well result in higher exposure of workers to all forms of ionizing radiation and also other hazardous substances. Any work of this nature can lead to accidents, some very serious, placing front-line nuclear workers and contract workers at great risk.

Comments

None of the documents of March 2014, or of those submitted during the licensing hearings in May 2013, discuss the frequency of repair and testing that is being done under normal operations, or what would be expected if these plants approach, and are even allowed to exceed the end-of-life limits of the pressure tubes. There is no reference made to the radiation doses to which workers are exposed in undertaking these tasks.

This type of work is probably the most dangerous type involved in a nuclear facility, except of course in the case of a serious accident, and could very well have long-term effects on workers and their families.

This is an unconscionable burden to place on a particular segment of society. It is only made possible by setting an inordinately high "allowable" radiation dose for nuclear energy workers, and by refusing to consider the harm done to both contract workers and long-term employees by their exposure to ionizing radiation. This exposure is just as harmful to nuclear energy workers as anyone else, and they should be afforded at the very least the same level of protection as the general public.

OPG has not even provided estimates as to what such levels of exposure are during routine operations and what additional exposure they may suffer as a result of allowing pressure tubes to operate beyond EOL. Without this information, CNSC is not in a position to approve removal of the Hold Point.

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[7] BEIR VII report: http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/beir_vii_final.pdf

D. Submissions by OPG and CNSC staff

In its submission to the Commission, CMD 14-H2.1 March 2014, pertaining to the hearing, OPG stated that:

- The plant is demonstrated to be safe and can be safely operated beyond 210,000 EFPH of operation,
- All the requirements for the removal of the Hold Point have been met, and
- The Commission has sufficient information to consider the removal of the Hold Point associated with Licence Condition 16.3 of the Pickering NGS Operating Licence.

Thus, OPG is requesting the Commission to approve the removal of the regulatory Hold Point to allow the Pickering Units 5 to 8 reactors to operate beyond 210,000 EFPH.

OPG also noted that a decision by the Commission is required no later than the end of May 2014 before Pickering Unit 6 reaches 210,000 EFPH of operation in June 2014.

The CNSC staff document (CMD 14-H2) concluded that "OPG has satisfactorily met the necessary pre-requisites and additional requirements associated with the Licence Condition 16.3 of PROL 48.00/2018 and recommend that the Commission remove the hold point."

In the following section, we are posing questions and commenting on specific elements of these reports.

Comments/Questions

No specific data has been provided in the OPG or CNSC staff documents related to the pressure tubes. For example, the current EFPH for Pickering units 5-8 are not provided. No information is provided on the concentration of hydrogen in the tubes.

No reference or mention has been made as to the margin of error or confidence level in the determination of the end-of-life (EOL) limit of 210 000 EPFH for the pressure tubes. Every engineering specification and measurement or calculation by models must include margins of error. No value can ever be considered to be exact.

The documents do not specify what the increased level of EFPH is expected to be. However, according to the documents at the licensing hearing of May 2013, OPG proposed increasing the EFPH to 247,000, which is approximately 18% above the EOL. Presuming this to be the case, it is absolutely essential to know *a priori* the margin of error of the designed limit of the pressure tubes.

There is considerable variation amongst pressure tubes in each unit. For example, the concentration of hydrogen in each tube, very critical for maintaining the integrity of the pressure tubes, can vary considerably. No consideration has been given to addressing this variation. This is a vital issue, given that one of the aging mechanisms for pressure tubes, namely deuterium ingress and fracture toughness, was supposedly a reason for the Hold Point. In fact, at the public hearing to renew the operating licence of Pickering May 2013, OPG stated that the average concentration of deuterium (hydrogen) in the Pickering units was 53 ppm, and by 2020 it would reach 80 ppm. The CSA standard is 100 ppm. However, the uptake in deuterium has been observed to vary significantly between tubes, by as much as a factor of three (AECL Report No. 00-311---200-005, July 2005). So the behaviour of pressure tubes over time will vary. It just takes one crack in one tube to cause a serious problem.

OPG states that “the vast majority of time the reactors are either at full power operation or shutdown, at which time fracture toughness behaviour is not an issue.” [p.7]. There is no evidence to support this claim. Furthermore, this statement does not clearly specify the power level at which each of these units are expected to be operating for the proposed extended time period.

Unit 6 is presumably reaching the EOL level in June of 2014, just one month or so following the Public Hearing of May 7 2014. OPG plans to continue operating this unit for another five years and fully expects the Hold Point to be removed. Based on typical operating practices at 80% of full power, this unit will have reached about 245 000 EFPH by 2019. There is absolutely no analysis or supporting evidence given that would confirm that such an increase is even technically possible, or above all, even safe.

The reason that end-of-life limits are set for equipment, such as pressure tubes, is that it has been determined, when they were manufactured, that they could be only safely expected to last so long. But there have been serious problems with pressure tubes at Pickering well before the EOL. So any guidance, methodology or criteria or probability assessments aimed at increasing margins in pressure tube Leak Before Break (LLB), as indicated in CMDs 14-H2.1 and14-H2 to allow exceeding these limits cannot be verified by past experience and are therefore unacceptable.

There is no outside third party independent review of this information.

There is no discussion regarding exposure of workers doing repair, maintenance and measurement work on the pressure tubes. We are asking specifically:

What are the doses received by workers doing this type of work?

Are the workers allowed to exceed the annual limit of 20 mSv/Year?

What action is taken if a worker receives in excess of 50mSv/year, a “permissible dose” under certain circumstances?

What follow-up is provided by OPG to track the health of the workers?

CNSC staff report CMD 14-2

The report stated that of all aging and degradation mechanisms affecting pressure tubes, it only required additional information on deuterium uptake and its effect on fracture toughness, which may affect the integrity of pressure tubes during a very limited period of reactor operation – specifically, power transitions between shut down to full power and vice versa.

It then discusses two methods that are in place to prevent pressure tube rupture, namely, leak-before-break and fracture protection (delayed hydride cracking as a result of deuterium uptake).

Leak Before Break (LBB): Pressure tubes and their ancillary components typically have flaws (scratches, dents) from loading into reactors, radiation, etc. Problems develop if a flaw becomes larger. The concept behind LLB, according to the Commission Report, is to be able to detect a growing flaw and fix it before it becomes unstable.

The Commission Document on Fitness for Service states that the goal of an LBB evaluation is to "demonstrate with a high degree of reliability, that in an unlikely event of a pressure tube leak, the operator can safely bring the reactor to a safe shutdown without failure of a pressure tube". [p. 20]

Accordingly, OPG developed new methodologies and probabilistic engineering models to detect leaks.

Questions/Comments:

How does one "demonstrate ability to detect a leak"? Is the leak detection methodology that good? Is it foolproof? Is it always possible to detect leaks? Are there times when leak detection methodology is not available? Precisely how do these new methodologies consider longer lifetime operation of pressure tubes?

While CNSC staff and OPG have confidence in such methodologies that ensure "fitness for service", there is no example cited which refers to the particular situation at Pickering, namely, exceeding end-of-life limits of Pickering B's pressure tubes. Nor is there any explanation as to how this situation has been accounted for in the predictive models.

Fracture Protection: The report notes that "Fracture Protection ensured that hydrides in the pressure tubes have not increased to a level which can render the pressure tubes too brittle to prevent cracks. These cracks could form while the primary heat transport system pressure is being increased to or decreased from the normal operating Pressure" (p.5) The report then refers to OPG's development of methodologies and models to conservatively assess the fitness for service of the pressure tubes. OPG has also committed to more research on enhancing understanding of the linkage between hydride formation and its effect on fracture toughness.

Comments

A commitment to do more research when we are talking about serious immediate risks is not something to be praised. The CANDU Owners Group (COG) has been conducting research on pressure tubes and the problems related to them for thirty years. What does OPG intend to come up with between now and the end of June for Pickering B? Clearly the research so far has not been able to solve all of the problems. Perhaps some of the problems cannot be solved!

At the licensing hearings for the PNGS in May 2013, OPG acknowledged that the extension of the designed life for the pressure tubes is the most critical activity, and the most significant potential life-limiting issue with respect to demonstrating the Fitness for Service of the pressure tubes for the continued operation of Pickering B.[8] This is a view with which we totally concur.

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

E. Compliant Probabilistic Risk Assessments (PRAs)

Conditions for removing the Hold Point were for OPG to provide CNSC with a Revised Probabilistic Safety Analysis (PSA) for Pickering A that meets the requirements of CNSC Regulatory Standard S-294; an updated PSA for Pickering A and B that takes into account enhancements required under the Fukushima Action Plan (FAP); and a whole-site PSA or methodology for a whole-site PSA specific to the PNGS.

Accordingly, OPG states that the Pickering A PSA has been completed, and that all values meet or are better than the CNSC safety goal limits for Severe Core Damage Frequency (SCDF) of 1 x 10^{-4} per reactor year and the Large Release Frequency (LRF) of 1 X 10^{-5} per reactor year.

In terms of the FAP, the enhancements that were incorporated related specifically to those hazards that contributed to SCDF and LRF.

As to a whole-site PSA, OPG has come up with a methodology – at a concept level. Thus, OPG considers it has met all the conditions to remove the Hold Point and the CNSC staff is also satisfied.

Comments

While the CNSC staff find this satisfactory, we do not. Mainly, it seems absurd at this stage that the only thing that OPG can produce for a multi-unit PSA is a conceptual methodology. Will the concept take shape by the end of June? After all, that is when the critical risk really commences.

As to the other PSAs, we always need to question the risks to the public that are considered acceptable. Is any risk to the health and property of millions of people acceptable?

According to the PRAs for Pickering A and B (2009 and 2012): "the risk of operation of the Pickering station to the population living and working in the vicinity is significantly lower than other risks to which they are normally exposed."[9] What other risk are they exposed to that could harm the health and property of millions of people?

There is no safe level of exposure to ionizing radiation. Any level of exposure can cause harm to the very seed of life. This may or may not manifest itself in present generations, or specific individuals, but the effects of ionizing radiation will be carried through to future generations in all living matter, and such serious lasting harm is unacceptable. Any arguments, such as those advanced by OPG or CNSC staff, that deny the capacity of ionizing radiation to do critical harm to the fundamental basis of life are completely specious.

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

[9] CMD 13-H2.1 p. 32,33

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. And 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.

Finally, 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. As CNSC staff have admitted, their probabilistic risk models have no predictive value.

Following the accident at the American Three Mile Island nuclear station in 1979, an all-party committee of the Ontario Legislature (the Select Committee on Hydro Affairs) investigated Ontario's nuclear policies. In its 1980 report to the legislature, the committee concluded that:

> "Accidents, mistakes and malfunctions do occur in [CANDU] nuclear plants: equipment fails; instrumentation gives improper readings; operators and maintainers make errors and fail to follow instructions; designs are inadequate; events that are considered `incredible' happen...no matter how careful we are, we must anticipate the unexpected."

F. Emergency Preparedness

If a severe worst-case scenario accident were to happen at Pickering today, are the essential emergency planning and preparations in place? Are the public alarm systems adequate and properly functioning? Are evacuations plans able to handle the removal of so many people to safe sheltered areas in time? Are there adequate provisions to provide safe food, drinking water, and medical assistance trained to treat the sick, those exposed to large amounts of ionizing radiation and to assist with the evacuation of large populations?

A review of the current emergency plans does not indicate any of these plans or provisions to be remotely adequate. It does not take large accidents seriously. Nuclear accidents are not even considered within the top ten emergency risks in Durham Region despite its ten operating reactors. The potential impacts of a severe accident on millions of people across the Greater Toronto Area (GTA) are not taken seriously.

As the disaster at Fukushima has vividly demonstrated, not taking catastrophic accidents seriously led to a lack of emergency preparedness, which contributed to an even greater tragedy to so many people. The institutional thinking so prevalent in the industry, that accidents are so unlikely prevails even today. As stated by Toshimitsu Homma of the Japan Atomic Energy Agency, IAEA Regulator`s Conference in Ottawa, April 2013

> “There was an implicit assumption that such a severe accident could not happen and thus insufficient attention was paid to such an accident by authorities.”

Of all nuclear stations in Ontario, Pickering is at the greatest risk of an accident. With several million people at risk, the possibility of a serious accident cannot and must not be so summarily dismissed. After all, the empirical probability of a meltdown is once a decade somewhere in the world and emergency planning must take this into account. Unlike other severe industrial accidents, a nuclear meltdown is mass destruction for generations. This means that emergency planning and preparedness needs to include provisions to protect the people, the land, the food, the water, after a nuclear plant accident. It must have a robust public alarm system to warn residents of an accident, an evacuation and relocation plan, and measures to prevent the ingestion of radionuclides from air, food, and water. No nuclear facility should be allowed to operate without a coordinated, well-organized emergency plan that takes into account the worst possible accidents.

Following is a brief examination of the current emergency plan system, with comments addressing the shortfalls and recommendations for CNSC as requirements for emergency planning and preparedness.

Public Alerting System

Under the 2009 Provincial Nuclear Emergency Response Master Plan (PNERP), OPG is required to provide resources and assistance to Durham Region Municipality to enable it to establish and maintain a public alerting system.

Within the 3 km zone around PNGS, the public alerting system is required to provide, within 15 minutes, warning to "practically 100% of the people, indoors or outdoors, and irrespective of the time of day or year."[10] Specific requirements are also in place for the 10 km zone (Primary Zone).

But the alarming system falls short of what should be required For example;

- The Pickering alerting system is only now being completed for 3 km, but not for the 10 km zone, despite the fact that the plant has been operating for decades.
- Reaching “practically 100% of the people” is not reaching all the people. Who are left out –those with restricted mobility, the elderly, the sick?

[10] CMS 13-H2.1 p. 62

- Testing of the 3km outdoor public alerting system (9 sirens) in place around Pickering in 2012 demonstrated that the sirens did not practically cover 100% of the 3km area.
- In regards to indoor alerting, an auto-dialer system currently in place meets the PNERP requirement for the 3km zone, but not the 15 minute standard for the 3km to 10km zone.

At a meeting in September 2011, CNSC Commission Tribunal members expressed concern that not all provincial requirements for nuclear emergency public alerting were met.[11]

Evacuation

OPG has estimated that the Primary Zone (10 km around Pickering) can be evacuated within 6 to 7.5 hours, depending on weather and time of day. This study (in 2008) accounted for approximately 250,000 people evacuating and 115,000 vehicles. The maximum evacuation time of the 10 km zone was projected at 9 hours in 2025.[12]

In the event of evacuation orders, most people are expected to make their own arrangements. For those who can`t, Seneca College and York University in Toronto will have evacuation/reception centres. In the event that decontamination is required, because of the population density, most people are expected to "self decontaminate, if required".

These evacuation scenarios and plans are totally inadequate and unrealistic in so many ways, from the 10 km zone to be evacuated, to the estimates by OPG as to the number of people, vehicles and the projected time, let alone adverse weather conditions.

A catastrophic accident would involve so many more people and from an area so much a larger. The congestion on the roads would make them impassable. Bad weather conditions would have a massive effect on traffic. The destinations for shelter are completely inadequate. Individuals are left to look after their own basic needs, including food and water. Medical assistance and care would be essential. The most vulnerable would be the least protected. And confusion would reign.

As has been noted in this Submission, OPG has been directed by the Commission to ensure the production of an emergency management public information document to be distributed to all households in the Pickering area, summarizing the integrated emergency response plan of all involved organizations, and their key roles and responsibilities. The document would also include information on the distribution of potassium iodide (KI) tablets. This document is not a requirement for removing the Hold Point.

OPG has produced a document, using input from selected focus groups in Darlington and Pickering. Based on what they heard, they are making it a "simple package" [CMD 14-H2.1 p. 17, 18]. The question of the distribution of KI tablets –whether or when or to whom, is not clear.

Without knowing the contents of this pamphlet, one can only comment on the reductionist thinking about emergency planning in general and how very primitive the concepts remain.

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[11] http://nuclearsafety.gc.ca/eng/mediacentre/updates/2012/March-20-2012-spotlight-ontario.cfm

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

CNSC has a responsibility as a regulator to ensure that emergency planning is in order and is vastly improved over the current situation, which is highly inadequate. This is especially troublesome if the Hold Point is removed, allowing units 5-8 to exceed end-of-life limits of their pressure tubes.

It is well past the time to give a "light touch" to emergency planning. We are offering, once again, the following recommendations for emergency planning requirements.

Recommendations to CNSC on Emergency Planning Requirements

- The inadequacy of alarm warning systems must be immediately addressed. The number, location and capacity of evacuation zones must be assessed and intensified. Assistance for evacuation must be provided.
- The nuclear emergency plans of each municipality in Durham Region and the surrounding GTA must be expeditiously reviewed for consistency against the most recent Provincial Nuclear Emergency Plan.
- Immediate and extensive improvements of communications infrastructure for all zones as an immediate priority are needed.
- The capacity of Emergency Measures Ontario to conduct its responsibilities in the case of a nuclear emergency must be expeditiously reviewed and publicly reported.
- Extensive community outreach and education sessions on nuclear emergency plans for large releases and severe accidents should be required, and conducted with increased frequency, and the results made public in the community.
- Transparent and explicit messaging to schools, senior's residences and health facilities must be distributed and posted, with regular communication exercises to ensure that family members are aware of nuclear emergency plans.
- Areas in need of improvement in nuclear emergency planning for severe accidents should be tracked and reported publicly in the community.

G. Conclusion

To extend the life of the station by exceeding the designed end-of-life of Units 5-8 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. At this point a decision is typically made to "retire" the 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 propping up of the nuclear industry, at the expense of Ontario taxpayers, is a barrier to far more affordable, safer and cleaner alternative sources of energy, and has made Ontario reliant on continuing a nuclear path. That is a great disservice to the people of Ontario.

Accidents, including 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 refuse to seriously consider the possibility of accidents. This "denial syndrome" is behind their refusal to accept that Pickering is in a precarious state.

The experience with Pickering to date is not very comforting at all. It has been beset with numerous accidents, and it is situated in a densely populated area. As of June 2014, just weeks from this public hearing, Unit 6 will already be in a state where the pressure tubes have reached end-of-life. No proof has been given that extending the life is safe. This has only been stated without any scientific basis, in OPG and CNSC staff documents. Keeping Pickering operating until the end of 2020, as OPG plans, beyond the end-of-life of pressure tubes of the units in Pickering B, places the public at enormous risk. The time has come to shut it down rather than risk an accident which could be so devastating for so many, both now and for all generations to come.

It is abundantly clear that the lessons of Fukushima have not been applied. This is very disturbing, especially when the Fukushima accident happened just over three years ago, and its effects will be felt (like those of Chernobyl) indefinitely into the future. Fukushima has provided the strongest and most recent demonstration that a nuclear power station can cause devastating harm. To presume that "it can't happen here" is the height of arrogance and ignorance. It can happen anywhere, at any time, for countless reasons, which can't all be foreseen or prevented. It has also demonstrated how important it is to have well-defined emergency plans in place, especially for a multi-unit facility such as the PNGS in a highly populated area.

Ignoring the potential risks of a major accident is contrary to the precautionary principle, which requires a project to err on the side of caution, especially where there is a large degree of uncertainty, or the risk of very great harm. To risk the mass destruction of people, property, and the natural environment that a serious accident at Pickering would cause, is completely unacceptable.

OPG's plans to operate Pickering units 5-8 beyond the assumed fuel channel design life of 210,000 EFPH is based on its "high confidence" that the fuel channels will remain fit for service well beyond the proposed license period. There is absolutely no scientific basis for such confidence. If anything, the past record of incidents and the problems with fuel channels in CANDUs place such confidence in very serious question.

Based on the acknowledged weaknesses in CANDU's PTs, and the inherent danger that the deterioration of these tubes presents as they age, continuing to use the PTs beyond their designed limit of 210,000 EFPH is completely unacceptable.

Since Pickering cannot operate without creating this unacceptable risk, which is greater and greater as its plants are pushed beyond their designed lifetimes, public safety requires that it be shut down.

In conclusion, we find that removing the Hold Point placed on Pickering would be completely reckless and irresponsible. Therefore, we urge CNSC to reject OPG's request, and instead, issue explicit instructions to OPG prepare for the closure of Pickering B, at the very least by the time that the pressure tubes reach their designed end-of-life, from 2014-2016.