Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

CMD 21-H112.1A
CMD 21-H114.1A

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Supplementary Information

Written submission from Ontario Power Generation

In the Matter of

Request for authorization to return Pickering Nuclear Generating Station (NGS) Units 6-7-8 and Darlington NGS Units 1 and 4 to service

Public Hearing - Hearing in writing based on written submissions

November 2021

Renseignements supplémentaires

Mémoire d' Ontario Power Generation

À l'égard de

Demande pour obtenir l'autorisation de remettre en service les tranches 6-7-8 de la centrale nucléaire de Pickering et les tranches 1 et 4 de la centrale nucléaire de Darlington

Audience Publique - Audience fondée sur des mémoires

Novembre 2021

Canada

OPG Document: CD# NK38-CORR-00531-22869

As discussed in the previous hearings in early October, the case for allowing Darlington to restart from a forced outage is compelling. However the information presented in this submission is un-convincing in a few areas:

1. Enclosure 1 is a statistical assessment of the possible numbers of flaws in the ROI of Darlington Unit 1 and 4. The claim is the made that "*Enclosure 1 quantitatively demonstrates that no flaws which pose any challenge to pressure tube fitness for service are present in the ROI*". Claiming without any qualifiers that this analysis concludes that there is zero risk of challenging Fitness for Service seems like a stretch for a statistical analysis done at 95% confidence level.
    a. Repeat comment from last hearing: a base case which blends Darlington data (where the use of a fuel carrier greatly reduces the risk of flaws in the ROI) with Pickering B data will present a risk for Pickering B which is shifted in the non-conservative direction.
    b. Insufficient justification for blending Darlington flaw data with Pickering flaw data is presented since the fuel and fuel channel designs for the two stations are significantly different.

OPG's response:

OPG's justification for demonstrating a low number of flaws in the region of interest is based on the understanding of flaw formation and the physical limitations in forming flaws in these regions, due to the presence of the fuel carrier, at Darlington and the shield plug location at Pickering. The inspection data performed has continued to show that the flaw population in the area of interest remains low. The statistical analysis is provided as supplementary information which postulates the probability of a flaw in the uninspected population. Since there are no observations of dispositionable flaws that cannot be attributed to known fuelling events, in any unit, there is no evidence that the units and stations are behaving differently from one another in this regard and this is considered the most appropriate basis for the analysis and chosen as the Base Case.

In addition to the sensitivity analysis provided in N-CORR-00531-22916, since Darlington and Bruce Power reactors have similar fuel bundle configurations and have similar fuelling machine designs with the use of fuel carriers, pressure tube flaw inspection results can be pooled as shown below in the additional Sensitivity Case C. This shows that the expected number of flaws in each of the uninspected tube populations in the region of interest is approximately 0.4 flaws for Darlington units 1 and 4.

Mean Results for 50mm inboard of Burnish Mark - 360 Degree Region of Interest Using a Zero Event Geometric Distribution

					Base Case	Sensitivity Case A	Sensitivity Case B	Sensitivity Case C
Unit	**Station**	**Number of FL Inspections**	**Total Channels**	**Uninspected Channels**	**All OPG data**	**PNGS A/B unit data, DNGS separate**	**All OPG and BP data**	**DNGS and BP data**
D1	DN	70	480	410	0.5	1.2	0.3	0.4
D4	DN	61	480	419	0.6	1.3	0.3	0.4

2. Enclosure 2 seems like a long (mathematical) way of saying that "FC failure is within the design basis so we don't need to worry about it". This argument has not been given much weight historically since it removes all the redundant lines of defence and relies entirely on containing the activity released by the failure.

OPG's response:

The purpose of Enclosure 2 in NK38-CORR-00531-22869 is to highlight that in the very unlikely event of a pressure tube leak or failure, the overall risk associated with a pressure tube failure is extremely low, and to provide an indication of the robustness of the defense in depth of plant design and operation.

In an unlikely event of pressure tube leak or failure leading to loss of coolant inventory, there are several redundant lines of defence that will prevent progression to severe core damage and release of activity. For example, make-up to the primary heat transport system will take place from emergency coolant injection system or from the emergency water supply system (at Pickering) or from the emergency water system (at Darlington). In addition, OPG has Emergency Mitigating Equipment (EME) that can also be used to provide make-up to several heat sinks. Any release of radioactivity will be contained within the negative pressure containment system and if needed will be filtered via Emergency Filtered Venting System. It should be noted that aforementioned lines of defences are accounted for in the safety analysis, i.e., the analysis does not remove all redundant lines of defence.

Enclosure 2 was provided to support a risk-informed basis for unit restart. Furthermore, OPG's significant investment of effort and resources to inspections, assessments, research and development demonstrate that OPG does not espouse the idea that pressure tube fitness for service is of low concern due to existence of several other lines of defense.

3. Enclosure 3 provides an estimated frequency of occurrence of two independent, concurrent pressure tube (PT) failures. As expected, the frequency is the square of the frequency for a single PT failure. What is not assessed anywhere is the more difficult question of whether a PT failure (which can be a violent event resulting in calandria tube failure and end fitting ejection) can cause a second neighbouring weakened PT to fail. Consequential failures from a design-basis event are not allowed.

OPG's response:

Enclosure 3 provides an estimated frequency of occurrence of two independent, concurrent pressure tube failures in OPG operated reactors. This estimate is based on existing deterministic and probabilistic analyses. The conclusion confirms that the likelihood of independent, concurrent failure of two pressure tubes is very unlikely.

Furthermore, the risk of pressure tube and consequential failure of adjacent tubes is not expected to increase in light of this recent OPEX from Bruce Power.

4. The results of full scale fuel channel burst tests at Stern Laboratories in the 1990's are not addressed in the deterministic safety assessment. The test rig contained an arrary of neighbouring simulated fuel channels and the results demonstrated that the only observable damage was collapse of the calandria tubes onto their pressure tubes with

resultant compressive loading on the inner pressure tubes. The magnitude of a fuel channel failure.at power will be limited by potential crack arrest due to the high fracture toughness at upper shelf conditions.

OPG's response:

The subject Stern Laboratories tests were associated with the Generic Action Item (GAI) 95G02 which was closed by the CNSC in 2008 (N-CORR-00531-04215) after OPG addressed all closure criteria. Relevant updates to the Pickering and Darlington Safety Reports were also implemented in conjunction with the closure of this GAI. The results of the tests were further applied in the ongoing validation of applicable safety analysis codes.

OPG CMD Doc # CMD 21-H112.1 - Pickering 6-7-8 Restart

This document is virtually identical to OPG Document:CD# NK38-CORR-00531-22869 (reviewed above).

The comments on the Darlington CMD apply to the Pickering 5-8 CMD also

OPG's response:

Acknowledged. Kindly see OPG's responses above as they are applicable to Pickering CMD.

CNSC Staff CMD: 21-H112, 21-H114

This CMD is quite short and agrees with OPG's contention that its Darlington and Pickering units meet Condition b of the Order.

Specific Comments:

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1. This CNSC decision is based to a surprising extent on the ability of the plant to suffer a major FC failure and mitigate the impacts through other plant design features, in other words, "FC failure is a design basis event" (see Section 3.3 of the CMD)

OPG's response:

See OPG response to Comment # 2 above.

2. Insufficient supporting justification is presented for reducing the ROI to 60 mm inboard of the burnish mark from the previous value of 75 mm. While this may indeed be a reasonable change, the documentation does not provide any supporting justification.

OPG's response:

Justification to reduce the region of interest is due to the fact that OPG has historically and continues to scrape at 50mm inboard of the burnish mark. OPG has performed rolled joint scrape exceeding the CSA N285.4 requirements and has not observed [Heq] inboard of the burnish mark as high as observed in the Bruce Power Unit 3 or 6 OPEX. Similarly, removed tubes from OPG's reactors have not exhibited [Heq] of similar magnitude. On-going scrape campaigns and removed pressure tubes for material surveillance will continue to monitor the region of interest for any future increase in [Heq].

3. The logic by which a flaw observed in a channel was dispositioned as “not plausible as a future flaw” was not explained in the CMD. Rather it referenced an OPG document as the source for this conclusion.

OPG’s response:

Flaws which have occurred in the region of interest at Pickering were attributed to a procedurally driven event which allowed fuel to remain in cross flow for an extended period of time. Due to an operational procedure change, fuel bundles are time restricted in crossflow conditions and no flaws have been observed since this change in procedure. This is now precluded in other pressure tubes.