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Supplementary Information

Written submission from CNSC Staff on the Request for Ruling filed by the PEACE-NB

Renseignements supplémentaires

Mémoire du personnel de la CCSN au sujet de la demande de décision déposée par PEACE-NB

In the Matter of the

New Brunswick Power Corporation, Point Lepreau Nuclear Generating Station

Application for the renewal of NB Power's licence for the Point Lepreau Nuclear Generating Station

Commission Public Hearing
Part 2

May 10 to 12, 2022

À l'égard de

Société d'Énergie du Nouveau-Brunswick, centrale nucléaire de Point Lepreau

Demande de renouvellement du permis d'Énergie NB pour la centrale nucléaire de Point Lepreau

Audience publique de la Commission
Partie 2

10 au 12 mai 2022

Canada

CNSC Staff Response to the Request for Ruling Filed by PEACE-NB (CMD 22-H2.139B) in the Matter of NB Power's Request to Renew the Power Reactor Operating licence for the Point Lepreau Nuclear Generating Station

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1. Introduction

On May 12, 2022, PEACE NB submitted a request for ruling to the CNSC [1], in accordance with Rule 20(3) of the *Canadian Nuclear Safety Commission Rules of Procedure* (the "Rules") in the matter of NB Power's request to renew the power reactor operating licence for the Point Lepreau Nuclear Generating Station (NGS).

In the submission PEACE NB requested the following:

- **Ruling #1:** Request that the Commission acknowledge there was a change in the Probabilistic Safety Assessment (PSA) based Seismic Margin large release limit from 0.4g to 0.344g in the 2017 licensing hearings.
- **Ruling #2:** Request that the Commission instructs NB Power to perform upgrades until they meet the previous 0.4g limit for large release as part of their continuous improvement program within the next 5 years.

2. Regulatory requirements

a) **Analysis methods for Seismic Events:**
CNSC Regulatory Document, REGDOC-2.4.2 *Probabilistic Safety Assessment (PSA) for Reactor Facilities* [2] allows for alternative analysis methods for external events. The licensees may elect to use any method, that has prior acceptance by CNSC staff.

b) **Acceptance criteria:**
There are no regulatory requirements specifying the High Confidence of Low Probability of Failure (HCLPF) limit for the Seismic Margin Assessment (SMA) or PSA Based SMA. This is also confirmed in Paragraph 134 of the 2011 Record of Decision [3] which stated:

> *the Commission states that, while NB Power demonstrated during the 2011 hearing that a large release of fission products from the PLNGS would be prevented at 0.4g, this was not, and is not, a licensing requirement.*

The criteria used by CNSC staff to review licensees' results are based on the comparison against the defined Review Level Earthquake (RLE). The guidance provided in CSA N289.1 [4] refers to a margin factor of 1.5 above the Design Basis Earthquake (DBE). The Point Lepreau NGS DBE is 0.2g (peak ground acceleration) and the PSA-Based SMA Plant HCLPF for Core Damage Frequency (CDF) and Large Release Frequency (LRF) should show a margin equal to or higher than a factor of 1.5 above the DBE. The 1.5 factor is included in CSA N289.1 as guidance [4].

For comparison purposes with international practices, the Western European Nuclear Regulators' Association guidance document [5] allows the use of RLE of 0.1g for existing reactors. The guidance reads as follows:

> *The exceedance frequencies of design basis events shall be low enough to ensure a high degree of protection with respect to natural hazards. A common target value of frequency, not higher than 10^{-4} per annum, shall be used for each design basis event. Where it is not possible to calculate these probabilities with an acceptable degree of certainty, an event shall be chosen and justified to reach an equivalent level of safety. For the specific case of seismic loading, as a minimum, a horizontal peak ground acceleration value of*

0.1 g (where 'g' is the acceleration due to gravity) shall be applied, even if its exceedance frequency would be below the common target value.

3. Technical Background on the Analysis Methods of Seismic Events

Existing reactors were built with considerations for a DBE, selected according to codes and standards available at the time. From a safety perspective, the analysis uses different assessment methods to consider whether there are any safety margins above the adopted DBE that are required to prevent cliff edge effects.

The first assessment method was deterministic in nature and is known as "Seismic Margin Assessment" (SMA). This method looks at a success path comprised of an equipment list that is credited to mitigate a seismic event and identifies the component or system with the lowest seismic capacity as the Plant Level High Confidence of Low Probability of Failure (HCLPF). This method has shortcomings as it does not consider other types of system failures, human errors, and systems' unavailabilities due to testing and maintenance activities.

A second method is the PSA-based SMA. This method is more effective than a deterministic SMA since it considers and provides qualitative insights regarding other types of human and equipment failures. The outcome of this method is still the Plant Level HCLPF, and it does not allow for the quantification of plant CDF and LRF.

The third, which is the most complete method is the Seismic PSA, characterizes the seismic risk by considering all types of failures (non-seismic and seismic-induced failures) by convolving these failures with the site-specific Seismic Hazard Curve. The result of this method is the quantification of the plant CDF and LRF which can then be compared to the established CDF and LRF Safety Goals.

For the Seismic PSA, the third method described above, is the preferred methodology by CNSC staff. The criteria used by CNSC staff has the established CDF and LRF safety goals of 1 in 10,000 years and 1 in 100,000 years respectively.

4. Staff response to Request for Ruling #1

4.1. PEACE NB Request

PEACE NB requested a ruling that the Commission acknowledge there was a change in the PSA based Seismic Margin large release limit from 0.4g to 0.344g in the 2017 licensing hearings [1].

Further, on page 3 of the submission, the author states:

> *NB Power updated the PSA based seismic margin analysis and methodology (which is where the limits are set) and CNSC staff approved this methodology. In this update it was found that the Large Release HCLPF of the plant decreased from .42g to .35g and as a result NB Power no longer met the stated safety limit of .4g as put forth in the 2011 hearings. In the 2017 hearings a new large release limit of .344g was presented without the change being acknowledged by either CNSC staff or NB Power to the commission members.*

4.2. Staff Analysis of PEACE NB Request

CNSC staff acknowledge NB Power's statements in CMD 11-H12.1 [6] Table, on Page 105, shows that PSA-Based SMA HCLPF limit is 0.4g for Large Releases. On the other hand, it's stated in the preceding

paragraph that for the PSA-Based SMA, the limit corresponds to the Review Level Earthquake (RLE) and is a pass or fail threshold against which the resulting plant seismic capacity is compared. These two statements are conflicting and not consistent with the CNSC staff accepted PSA-Based SMA methodology.

From CNSC staff perspective, the methodology that was accepted prior to the development of 2008 PSA Based SMA [7], has neither an indication nor a requirement of a HCLPF limit for large releases of 0.4g. This CNSC staff accepted methodology [7] which is part of REGDOC-2.4.2 (Section 3.9) is listed in the Point Lepreau NGS Licence Conditions Handbook (LCH). Furthermore, this methodology [7] states that a Plant Level HCLPF value in the range of 0.3 to 0.35g will be adopted as a safety objective. It is important to note that a safety objective set by the licensee is in no way equivalent to a safety limit imposed by the regulatory requirements, referred to as a safety goal. An objective is something that is being aimed to be achieved and a limit or goal is a threshold that should not be exceeded; in addition, the entity setting the objective is not the regulator (CNSC staff or Commission), but the licensee, in this case NB Power.

In the 2017 Record of Decision [3], the Commission previously ruled on the PSA-Based SMA 0.4g limit. In Paragraph 128 the Commission refers to the 2008 0.4g limit as “not a licensing requirement”. This is further clarified in Paragraph 132 where the Commission acknowledges that they are satisfied with the RLE safety goal of 0.3g.

Furthermore, it is important to note that NB Power and other licensees have moved from the PSA-Based SMA to a full Seismic PSA (the third method described in Section 3) which is the methodology that CNSC staff prefer. This methodology provides a better characterization of risk as it includes other types of failures and system unavailabilities in addition to the purely seismic induced failures. NB Power completed the Seismic PSA update in 2021 for Point Lepreau NGS which showed that the Large Release Frequency is 2.50E-06 occurrences/year (1 occurrence in 400,000 years) and demonstrated that they meet the CDF and LRF Safety Goals.

4.3. Staff Conclusion

While NB Power referred to the PSA-Based SMA limit in their CMD [6] as 0.4g, there was no change in the regulatory requirement nor a compromise to safety at Point Lepreau NGS. CNSC staff conclude that based on the accepted PSA-Based SMA methodology [6], there was no change in the PSA based SMA large release limit from 0.4g to 0.344g by CNSC staff, since 0.4g was not a regulatory limit and was not part of the accepted methodology, as discussed in section 2(b) *Acceptance criteria*.

CNSC staff also conclude that the selection of RLE follows the CSA N289.1 [4] and international practice. The selection of RLE of 0.344g was derived from the 2015 site-specific Probabilistic Seismic Hazard Assessment (PSHA) [8] which was reviewed and accepted by CNSC staff and clarified by the Commission in the 2017 Record of Decision [3].

5. Staff response to Request for Ruling #2

5.1. PEACE NB Request

PEACE NB requested a ruling that the Commission instruct NB Power to perform upgrades until they meet the previous 0.4g limit for large release as part of their continuous improvement program within the next 5 years.

5.2. Staff Analysis of PEACE NB Request

CNSC staff reviewed previous submissions, related to PSA-based SMA from NB Power. In the 2008 submission, the RLE selected in 2008 study which corresponds to 0.3g, produced a CDF HCLPF of 0.34g, and a LRF HCLPF of 0.42g. Similarly, from the 2016 submission in which the RLE is derived from the 2016 site-specific PSHA, which was higher than the 2008 RLE submission as 0.344g. The PSA-based SMA results were CDF HCLPF of 0.344 g and LRF HCLPF of 0.35g.

Based on the information above, from the 2008 and 2016 CDF results, CNSC staff concludes they both met or exceeded the RLE value. It is worthy to note that there is no regulatory imposed limit of 0.4g as reported in the request for ruling, CMD 22-H2.139B [1].

5.3. Staff Conclusion

The Point Lepreau NGS DBE is 0.2g (peak ground acceleration) and the PSA-Based SMA Plant HCLPF for CDF and LRF showed there is a margin higher than a factor of 1.5 above the DBE. This 1.5 factor aligns with CSA N289.1 guidance [4]. From a nuclear safety perspective, NB Power's results demonstrate adequate safety margins above the adopted DBE (0.2g x 1.5 factor which is equal to 0.3g) that is required to prevent cliff edge effects.

In addition, it is important to emphasize that the RLE is an earthquake ground motion that needs to be sufficiently larger than the DBE. This challenges the capacity of the plant structures, systems and components so that a plant-level HCLPF capacity can be determined. Plant level HCLPF is one of the outcomes of a SMA/SPSA and as such cannot be a limit pre-set prior to performing the assessment.

CNSC staff conclude that PEACE NB's request to the Commission to instruct NB Power to perform upgrades until they meet the 0.4g limit for large releases has no basis since NB Power's Seismic PSA remains within the regulatory requirements and there is no regulatory limit of 0.4g.

References

[1]. PEACE NB, "*Request for Ruling in the matter of NB Power's request to renew the operating licence for the Point Lepreau nuclear generating station*", CMD 22-H2.139B, May 12, 2022, e-Doc#: 6795085

[2]. Canadian Nuclear Safety Commission (CNSC): "*Probabilistic Safety Assessment for Nuclear Power Plants*", Regulatory document REGDOC 2.4.2, CNSC (May 2014).

[3]. Record of Decision in the matter of NB Power's application to renew the nuclear power reactor operating licence for the Point Lepreau nuclear generating station", June 26, 2017, e-Doc# 5333679

[4]. Canadian Standard Association (CSA Group): "*General Requirements for seismic design and qualification of nuclear power plants*", CSA N289.1-18, May 2018

[5]. Western European Nuclear Regulators' Association (WENRA), "Guidance Document Issue T: Natural Hazards Guidance on Seismic Events", October 2016.

[6]. Written submission from New Brunswick Power Nuclear, "Application to renew the Power Reactor Operating licence for the Point Lepreau Generating Station", CMD 11-H12.1, September 6, 2011, e-Doc#: 3794617

[7]. NB Power, "*Methodology for PSA Based Seismic Margin Assessment*", 87RF-0.3612-0001-001-AB-A 00, August 2002, e-Doc 3734748

[8]. NB Power, "*Probabilistic Seismic Hazard Assessment (PSHA)"*, April 2015, e-Doc#: 4767253

List of acronyms

CDF	Core Damage Frequency
CMD	Commission Member Document
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standard Association
DBE	Design Basis Earthquake
HCLPF	High Confidence of Low Probability of Failure
LCH	Licence Conditions Handbook
LRF	Large Release Frequency
NB	New Brunswick
NGS	Nuclear Generating Station
PSA	Probabilistic Safety Assessment
PSHA	Probabilistic Seismic Hazard Assessment
RLE	Review Level Earthquake
SMA	Seismic Margin Assessment
SPSA	Seismic Probabilistic Safety Assessment