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CMD 22-H2.1C

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Supplementary Information

Written submission from New Brunswick Power Corporation on the Request for Ruling filed by the 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

Renseignements supplémentaires

Mémoire de la Société d'Énergie du Nouveau-Brunswick au sujet de la demande de décision déposée par PEACE-NB

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

Énergie NB Power

Point Lepreau Nuclear Generating Station
PO Box 600, Lepreau, NB
E5J 2S6

TU 06374
PICA 22-3000

May 26, 2022

Mr. Denis Saumure, Commission Registrar
Commission Registry
Canadian Nuclear Safety Commission
P.O. Box 1046, Station B
Ottawa, Ontario
K1P 5S9

Dear Mr. Saumure:

Subject: Response to Requests for Ruling Per CMD 22-H2.139B

The purpose of this letter is to provide a response to two specific requests for ruling as presented in CMD 22-H2.139B during the 2022 licence renewal hearings for Point Lepreau Nuclear Generating Station. Each individual request is presented in italics followed by NB Power's response in normal font. Please note that definitions for terms used in this letter are provided (Attachment 1).

Probabilistic safety assessment (PSA) was described well in CMD-16-M46 (e-Doc 5051883) as presented to the Commission during a meeting of the Commission held on August 17, 2016. CMD-16-M46 described PSA as "one of the many tools used to evaluate risk at a nuclear power plant (NPP). While the design basis and safety operating limits for NPPs are based on deterministic safety analysis, a PSA can add important safety insights to enhance safety. The main regulatory role of PSAs has been to assist in integrated safety reviews or periodic safety reviews as part of the process to identify and prioritize safety improvements." Section 2 of CMD-16-M46 provides further information about PSAs and how they are used in the Canadian and international nuclear regulatory framework.

Internationally, it is well recognized by expert PSA practitioners that it is not the calculated risk estimate that is of primary importance to a nuclear power plant, but rather it is in the act of performing a PSA where practitioners can identify potential plant vulnerabilities and then decide how large a plant modification should be to meet safety objectives, if necessary. In this context, the margin between the calculated risk estimate from PSA and a defined quantitative safety goal (or objective) can be thought of as a "measuring stick" in prioritizing potential safety improvements and identifying how large an improvement should be made.

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In the context of overall plant safety management and evaluation of plant safety, the Canadian Nuclear Safety Commission (CNSC) staff groups 72 safety items into 14 safety and control areas (SCAs). PSA is one of the 72 safety items to be considered in the evaluation of plant safety. For NB Power, PSA is utilized to "risk-inform" decision-making in addition to any number of those other 71 items that may be applicable to the issue under consideration. For example, deterministic safety analyses, design analyses and/or engineering assessments also often provide input to decision making in addition to probabilistic safety assessments.

NB Power Specific Responses to Requests for Ruling

Ruling #1 *We request a ruling that the Commission acknowledge there was a change in the PSA based Seismic Margin large release limit from .4g to .344g in the 2017 licencing hearings.*

Historical Perspectives

In the early days of the Point Lepreau PSA development (2002), there were large uncertainties in the industry associated with the numerical results of seismic PSAs. According to USNRC nuclear regulatory document NUREG/CR-4334, An Approach to the Quantification of Seismic Margins in Nuclear Power Plants, the uncertainties are so large that they cannot be used as the basis for decision making. Contributors to the uncertainties include items such as:

- inadequate knowledge of the site-specific seismic hazard,
- inadequate database of fragilities estimates (i.e., strength estimates of structures, systems and components to withstand an earthquake).

According to NUREG 1407, Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities, emphasis should be placed on the identification of dominant sequences that could lead to core damage rather than a numerical estimate of the frequency of occurrence.

Therefore, NB Power selected the Probabilistic Safety Assessment (PSA) based seismic margin assessment, as recommended by the USNRC Policy Issue SECY-93-087, Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs.

For the first PSA-based seismic margin assessment completed in 2008, the proposed Point Lepreau safety objective was set at 0.3g peak ground acceleration (expressed as 95% confidence that the failure probability at a particular earthquake level is 5% or less—also referred to as High Confidence Low Probability of Failure or HCLPF). This safety objective was consistent with international practice for establishing a review level earthquake that is 1.5 times greater than the plant design basis earthquake of 0.2g peak ground acceleration. For example, NUREG-1407 states, "It is the staff's judgment that the use of a 0.3g review level earthquake for most of the nuclear power plant sites in the Central and Eastern United States (east of the Rocky Mountains) would serve to meet the objective of the IPEEE." The use of the word "most" in the above statement leaves the door open for individual nuclear power plants to use a different review level earthquake if seismic hazard assessments indicate doing so is warranted.

To supplement the selection of the safety objective for Point Lepreau, the safety objective of 0.3g was compared to the available seismic hazard information at that time which showed that a 0.3g earthquake has an average frequency of less than one in 10,000 years. It is to be noted that the initial PSA-based seismic margin assessment methodology prepared in 2002 for Point Lepreau only referred to the one review level earthquake of 0.3g.

Normally, as per international guidelines, this is the same safety goal that would be applied to the assessment of seismic capacity for severe core damage and a large radiological release. There is typically only one review level earthquake defined for a seismic margin assessment. Refer to item #123 of the Record of Decision for the 2017 Point Lepreau License Renewal Hearing (e-Doc 5333540).

However, as indicated by NB Power during the May 10, 2017 licence renewal hearing (see page 262 of the hearing transcript) given the plant refurbishment outage, which began in 2008, provided a unique one-time opportunity to make significant plant changes, NB Power exceeded the international guidelines and adopted a "stretch" safety goal of 0.4g HCLPF for prevention of large radiological releases while maintaining 0.3g HCLPF for severe core damage. There was no international guidance or regulatory requirement to have a large release safety goal that was higher than the safety goal for severe core damage. Also, refer to items #124 and 134 of the Record of Decision for the 2017 Point Lepreau License Renewal Hearing (e-Doc 5333540). NB Power's adoption of 0.4g HCLPF as a safety goal for large releases essentially applied two review level earthquakes to the assessment and exceeded regulatory requirements. The results of the first PSA-based seismic margin assessment in 2008 resulted in seismic capacities of 0.34g HCLPF for severe core damage and 0.42g HCLPF for large release outside containment. This met the Point Lepreau safety objectives for plant refurbishment.

During the performance of the first PSA-based seismic margin assessment, to meet the above safety goals adopted by NB Power the following seismic upgrades were identified and implemented during plant refurbishment from 2008 to 2012:

- Diesel tank fuel oil day tank supports
- Uninterruptible power supply battery supports
- Main control room lighting safety chains to prevent falling
- Deaerator tank sliding saddle support
- Dousing header frame support
- Lube oil tanks bracing and anchorage
- Large transformer restraints inside the Turbine Building
- Instrument air compressors anchorage
- Key safety system panels were linked together in the control equipment room to prevent "pounding" together during a seismic event and anchoring improvement
- Upgrades to the secondary control area operator trailer
- Containment isolation valves PV29/30 seismic support

Given public concerns being expressed regarding the events at Fukushima Daiichi during the Part 2 Commission hearings held in 2011 for Point Lepreau's 2012 licence renewal, NB Power committed on December 9, 2011 (e-Doc 3856297) to perform a seismic hazard assessment to augment the NB Power long-term Fukushima action plan. This commitment was later

reflected as a Commission request in item #10 of the record of decision for 2012 licence renewal (e-Doc 3875798). The request was for NB Power to also share the "results" of the assessment as part of its public information program. NB Power posted the results on its website as a summary of the work to provide context on its interpretation and meaning (Seismic Hazard Assessment (nbpower.com)).

A study of historical earthquakes (i.e., a paleoseismology study) was performed as an input to the seismic hazard assessment, the latter being completed in May 2015. The seismic hazard assessment was then used as an input to further seismic analysis to determine what the safety-related buildings on site would experience. This was determined to be 0.344g peak ground acceleration corresponding to an earthquake occurrence frequency of one in 10,000 years.

Therefore, 0.344g was adopted as the new and only review level earthquake for the revised PSA-based seismic margin assessment methodology. To re-align with international guidance, safety goals for both severe core damage and large release were assigned at the single review level earthquake of 0.344g (refer to item #123 of the Record of Decision for the 2017 License Renewal – e-Doc 5333540). In this particular case, the safety goal was met for both severe core damage and large release outside containment, and no plant modifications were required as a result of the revised assessment.

Given that CNSC staff had been well informed of the seismic work by NB Power staff, its progress, and has performed regulatory review and acceptance of the methodologies and safety goals being applied for the work, it was determined that there is no reportability required by NB Power with regards to appropriately adjusting the methodology and safety goals in light of the new and updated seismic hazard information and to align with international guidelines.

While the application for Point Lepreau's 2012 licence did identify 0.4g HCLPF as a safety limit for large radiological release for the seismic margin assessment, it is within the authority of CNSC staff to make adjustments to various aspects of the licence condition handbook as a result of CNSC-mandated improvements to the plant, its procedures and its methods. This includes the refinement of methodologies for performing analysis and applicable safety goals. It is in the domain of PSA methodology documents where safety goals are defined and accepted by CNSC staff. This is no different than for the seismic margin assessment work performed by NB Power. Consequently, probabilistic safety goals were not identified in Point Lepreau's application for 2017 licence renewal. In item #134 of the Commission's Record of Decision for 2017 Licence Renewal (e-Doc 5333540), it is clearly stated by the Commission that 0.4g "…was not, and is not, a licensing requirement. [sic]"

As part of continuous improvement efforts and although it was not required, NB Power also decided to perform a full seismic PSA in addition to updating the PSA-based seismic margin assessment. This was done to ensure that NB Power fully understood any equipment and structural limitations to mitigate a seismic event as well as quantifying and aggregating the risk contribution of a seismic event to severe core damage and large release frequencies. Those aggregated risks could then be compared to internationally accepted frequency-based safety goals for an existing nuclear power plant.

As presented to the Commission on May 10, 2017, during the 2017 licence renewal hearings (see page 263 of the hearing transcript), given NB Power has performed a full seismic probabilistic safety assessment (seismic PSA) it supersedes the seismic margin assessment and fully complies with regulatory document REGDOC-2.4.2 Probabilistic Safety Assessment (PSA) for Reactor Facilities. Also, refer to item #128 of the Record of Decision for the 2017 Point Lepreau License Renewal Hearing (e-Doc 5333540). This is because the seismic PSA provides not only additional information it also estimates plant risk that can be considered in the context of other risk sources. Seismic margin assessment results in an estimate of plant strength, not risk, therefore it is no longer essential to the plant safety case as it has been superseded by the full seismic PSA.

Current Perspectives

The safety case for Point Lepreau Nuclear Generating Station evolves with time to take into consideration new insights, knowledge, plant ageing and experience. New analyses that are performed are done so following the latest international guidelines and methods to demonstrate the design adequacy of the plant and its safety. In the case of seismic assessments, and considering NB Power's updated seismic hazard assessment, seismic analysis for Point Lepreau has evolved from a PSA-based seismic margin assessment to a full seismic PSA.

A seismic PSA provides a more holistic safety assessment in comparison to seismic margin assessments by considering more than just seismic-induced failures—it also combines those with potential random component failures and potential human errors as well as the frequencies of different earthquake magnitudes resulting in risk estimates which can then be integrated with other elements of the PSA.

Recently, the seismic PSA was updated as part of the 5-year PSA update required by regulatory document REGDOC-2.4.2. Since the seismic PSA supersedes the PSA-based seismic margin assessment:

- the PSA-based seismic margin assessment reports are no longer referenced in the Point Lepreau Licence Conditions Handbook (LCH-PR-17.00/2022-R001),
- the public PSA summary, posted on the NB Power website (Probabilistic Safety Assessment (nbpower.com)), no longer references the PSA-based seismic margin assessment in favour of reflecting the seismic PSA and the aggregated risks for all hazards to which the plant may be susceptible,
- The public PSA summary demonstrates that all safety goals for Point Lepreau continue to be met even when aggregating seismic risks.

As a result of the foregoing, NB Power contends that the request for ruling in CMD 22-H2.139B is not applicable.

Ruling #2 *We also request a ruling that the commission instruct NB Power to perform upgrades until they meet the previous .4g limit for large release as part of their continuous improvement program within the next 5 years and come back before the commission with the results.*

In view of the foregoing and that the PSA-based seismic margin assessment has been superseded by the more holistic seismic PSA, the quoted review level earthquake and its related safety goal are no longer applicable. As a result, the intervener's request should be denied. As per the public PSA summary (Probabilistic Safety Assessment (nbpower.com)), the aggregated risks for all hazard types—including seismic risk—meets all defined and accepted safety goals. As a result, no further seismic upgrades to Point Lepreau Nuclear Generating Station are warranted at the current time.

If you require further information or clarification, please contact Jason Nouwens, Director of Regulatory and External Affairs at (506) 659-6687 or e-mail at JNouwens@nbpower.com.

Sincerely,

Mark Power
Site Vice President

MP/JN/dsm

cc: Louise Levert, Anu Bulkan, Interventions (CNSC)
CNSC Site Office
cnsc.licensee-titulaires.ccsn@canada.ca
forms-formulaires@cnsc-ccsn.gc.ca
Brett Plummer, Nick Reicker, Scott Demmons, Amanda Gardner, Alex Bardsley, Kathleen Duguay, Jenn Lennox, Will Higgins, Derek Mullin, Andre Jean, Daniel Basque (NBP)

Attachment 1 – Definitions and Terms

Probabilistic Safety Assessment (PSA)

A comprehensive and integrated assessment of the safety of a facility. The safety assessment considers the probability, progression and consequences of equipment failures or transient conditions to derive numerical estimates that provide a consistent measure of the safety of the facility, as follows:

- a Level 1 PSA identifies and quantifies the sequences of events that may lead to the loss of core structural integrity and massive fuel failures
- a Level 2 PSA starts from the Level 1 results, analyzes the containment behaviour, evaluates the radionuclides released from the failed fuel and quantifies the releases to the environment
- a Level 3 PSA starts from the Level 2 results, analyzes the distribution of radionuclides in the environment and evaluates the resulting effect on public health

This term is the one commonly used in Canada; however, the terms probabilistic risk assessment and probabilistic risk analysis are also used sometimes [source: CNSC REGDOC-3.6 Glossary of CNSC Terminology].

Review Level Earthquake

An engineering representation of earthquake ground motion chosen to have a lower probability of occurrence exceedance than the design basis earthquake (DBE) [source: Canadian Standard CSA N289.3-10 Design procedures for seismic qualification of nuclear power plants, as referenced in the Point Lepreau Licence Conditions Handbook (LCH-PR-17.00/2022-R001)].

Safety Objective/Safety Goal

The objective of protecting reactor facility staff, the public and the environment from harm, by establishing and maintaining effective defences against the release of radiological hazards. For example, a nuclear power plant's probabilistic safety goals can be expressed in terms of the frequency of severe core damage or of radionuclide releases [source: CNSC REGDOC-3.6].

Seismic Capacity

The highest seismic level for which required adequacy has been verified, expressed in terms of the input or response parameter at which the structure or the component is verified to perform its required safety function with high confidence of low probability of failure. [source: Canadian Standard CSA N289.1-08 General requirements for seismic design and qualification of CANDU nuclear power plants, as referenced in the Point Lepreau Licence Conditions Handbook (LCH-PR-17.00/2022-R001)].

Seismic Hazard

The scientific calculation of an earthquake ground motion for defined levels of probability [source: Canadian Standard CSA N289.1-08 as referenced in the Point Lepreau Licence Conditions Handbook (LCH-PR-17.00/2022-R001)].

Seismic Margin Assessment

An assessment performed to demonstrate sufficient margin over the design earthquake level to ensure plant safety and to find any weaknesses that might limit the plant capacity to safely shut down after a seismic event exceeding the design earthquake level [source: Canadian Standard CSA N289.1-08 as referenced in the Point Lepreau Licence Conditions Handbook (LCH-PR-17.00/2022-R001)].

PSA-Based Seismic Margin Assessment

A hybrid approach of seismic margin assessment and seismic probabilistic safety assessment can identify safety significant accident sequences to quantify seismic capacities and the seismic margin at the system level and plant level. It represents a semi-probabilistic simplification of the full seismic probabilistic safety assessment method [source: interpreted from IAEA Safety Reports Series No. 103, Methodologies for Seismic Safety Evaluation of Existing Nuclear Installation].

Seismic Probabilistic Safety Assessment (Seismic PSA)

An assessment performed to determine the probability distribution of the frequency of occurrence of adverse consequences due to the potential effects of earthquakes [source: Canadian Standard CSA N289.1-08 as referenced in the Point Lepreau Licence Conditions Handbook (LCH-PR-17.00/2022-R001)].