From:	Sreenivas, V
To:	Loomis, Thomas R:(GenCo-Nuc) (thomas.loomis@exeloncorp.com)
Cc:	Widrevitz, Dan
Subject:	RE: Limerick 1 and 2: Request for Information for Relief Request I4R-24 Associated with Residual Heat Removal Heat Exchanger Category C-A and C-B Examinations
Date:	Thursday, February 11, 2021 4:16:00 PM

Further to clarification call held with the technical reviewers on February 11, 2021, please be advised to submit the responses to these RAIs by April 7th, 2021.

REQUEST FOR ADDITIONAL INFORMATION
OFFICE OF NUCLEAR REACTOR REGULATION

Final Issue Date: February 11, 2021

Relief Request I4R-24 Associated with Residual Heat Removal Heat Exchanger Category C-A and C-B Examinations

Exelon Generation Co., LLC

Dockets: 05000352-BWR-Limerick 1,05000353-BWR-Limerick 2

EPIDS: L-2020-LLR-0122

Questions

Question Number: 227

By letter dated September 4, 2020 (ADAMS Accession No. 20252A135), Exelon Generation Company, LLC (Exelon, the licensee), submitted to the United States Nuclear Regulatory Commission (NRC), a proposed alternative to the inservice inspection (ISI) requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) for the residual heat removal heat exchanger Category C-A and C-B examinations of the Limerick Generating Station (Limerick), Units 1 and 2.

Specifically, pursuant to Title 10 of the Code of Federal Regulations (10 CFR), Part 50, Paragraph 50.55a(z)(1), the licensee proposed to increase the ISI interval for the subject components to the end of the current operating license, from the current ASME Code Section, Section XI requirement of 10 years. 10 CFR 50.55a(z)(1) requires the licensee to demonstrate that the proposed alternative provides an acceptable level of quality and safety. The NRC staff (the staff) needs to issue requests for additional information (RAIs) to complete its review of the licensee's proposed alternative.

Issue

The applicant relies substantially on the EPRI analysis, documented in Reference 1 to the application, *Technical Bases for Examination Requirements for Class 2 BWR Heat Exchanger Nozzle-to-Shell Welds; Nozzle Inside Radius Sections; and Vessel Head, Shell, and Tubesheet-to-Shell Welds 3002018473*, to justify the acceptability of their relief request. This document is currently available via the EPRI website. However, the NRC staff must rely on docketed information in coming to regulatory conclusions. The staff have reviewed this reference and are unable to complete their review without the report being docketed.

In addition, Reference 1 cites "*Heat Exchanger—Residual Heat Removal—Data Sheet." GE Document No. 21A9227AB, Rev. 2, General Electric*," (Reference 64 to the EPRI analysis), as part of the basis for selecting transients to model as part of the analysis. The staff require this reference to confirm the

appropriateness of the transient selection in the EPRI analysis.

Request

Submit the following references:

1. *Technical Bases for Examination Requirements for Class 2 BWR Heat Exchanger Nozzle-to-Shell Welds; Nozzle Inside Radius Sections; and Vessel Head, Shell, and Tubesheet-to-Shell Welds 3002018473*

2. *Heat Exchanger—Residual Heat Removal—Data Sheet." GE Document No. 21A9227AB, Rev. 2. General Electric*,

Question Number: 228

Issue

The applicant relies substantially on the EPRI analysis, documented in Reference 1 to the application, to justify the acceptability of their relief request. Reference 1, Section 5.2 states that emergency and faulted conditions were not analyzed. As these events were not analyzed, the staff must confirm that such events have not occurred since the installation of the subject components.

Request

Confirm that no emergency or faulted conditions have occurred since the installation of the subject components. Alternatively justify how any that occurrences that have occurred are still be bounded by the analysis in Reference 1.

Question Number: 229

Issue

The applicant relies substantially on the EPRI analysis, documented in Reference 1 to the application, to justify the acceptability of their relief request. In Reference 1, Section 8.2.2.2 (and other locations within the report) a postulated 5.2% through-wall flaw is presented as part of the deterministic fracture mechanics evaluation. This does not appear consistent with ASME Code, Section XI, Table IWC-3510-1 from which the value is derived.

Request

1. Clarify how 5.2% is the appropriate depth per this table as that value is indicated for vessels equal to or greater than 4 inches in thickness while the subject components are noted as varying between 0.75 to 1.315 inches for the shell and 1.5 to 2.4 inches for the nozzles.
2. If 5.2% is not the appropriate depth, provide updated results utilizing an appropriate depth.

Question Number: 230

Issue

The applicant relies substantially on the EPRI analysis, documented in Reference 1 to the application, to justify the acceptability of their relief request. Reference 1, Section 8.3.2.2 references data from the Pressure Vessel Research Users Facility (PVRUF) and compares it to simulation results from *Flaw Size and Distribution and Flaw Existence Frequencies in Nuclear Piping* (described in EPRI report references 87-89, hereafter denoted as Chapman simulation). The EPRI analysis selected the PVRUF flaw distribution as "bounding" for the purpose of the EPRI analysis. The EPRI analysis does not make a clear case for the applicability of the relatively old thick section results from PVRUF as to how they relate to the thinner Class 2 subject components. In addition, PVRUF data concerns components examined under ASME Boiler and Pressure Vessel Code, Section XI, Appendix VIII requirements under which the subject components are required to be examined. This may unduly skew the certainty of the current state of the subject components relative to the assumptions in the analysis.

The EPRI analysis includes a sensitivity study on this topic in Section 8.3.4.3.3 comparing the PVRUF based distribution to simulated flaw distributions drawn from the Chapman simulation. The referenced papers include reference to PVRUF and "unpublished probabilities for piping welds" to justify their work. The simulated flaw distributions do not appear to have clearly described validation work demonstrating their applicability to the subject components. The staff notes that the Chapman references discuss the importance thickness of component has in properly simulating flaw distributions.

Without a clearly validated basis for use of these distributions the staff cannot make a clear determination of the applicability and utility of the use of such as it relates to the subject components. The flaw distributions in the subject components will be affected by many factors including thickness, relative modernity of construction, type of welding process, etc. which have not been addressed under the presumption that PVRUF results will be bounding. The staff do not find this sufficient to draw clear conclusions from.

Request

The staff requests that the applicant justify the sufficiency of the PVRUF data to their application accounting for:

1. Differences in geometry relative to PVRUF/References 87-89,
2. Manufacturing processes applied to current heat exchangers,
3. Examinations due to the subject components not being inspected under ASME BPV, Section XI, Appendix VIII requirements.

Question Number: 231

Issue

The applicant relies substantially on the EPRI analysis, documented in Reference 1 to the application, to justify the acceptability of their relief request. Reference 1, Section 8.3.2.2, states that 0.001 flaws were assumed per nozzle inside radius section consistent with"*BWRVIP-108: BWR Vessels and Internals Project, Technical Basis for the Reduction of Inspection Requirements for the Boiling Water Reactor Nozzle-to-Shell Welds and Nozzle Blend Radii*" (Reference 5 of the EPRI analysis) as approved by the NRC staff (documented in Reference 6 of the EPRI analysis). *BWRVIP-108* was approved by the NRC based on a supplement with an assumed flaw population of 0.1 flaws per nozzle inner radii (Reference 6 of the EPRI analysis). As the EPRI analysis is not bounded by the BWRVIP-108 approval, the staff cannot make a determination based citation of BWRVIP-108.

Request

Justify the use of 0.001 flaws per nozzle inside radius independently of the approved BWRVIP-108 report cited above (e.g. conduct a sensitivity study, recalculate using 0.1 flaws per nozzle, or otherwise address this gap between the analysis and the cited NRC approved methodology.)

Question Number: 232

Issue

The applicant relies substantially on the EPRI analysis, documented in Reference 1 to the application, to justify the acceptability of their relief request. Reference 1, Table 8-10 indicates that scenario number 3 has a lower probability of leakage than all other cases for BHX-VC-P1A and BHX-TS-P3A and a risk equal to or lower than most other cases for BHX-NS-P6A. Many of the other scenarios have more inspections, including some with complete overlap of the ISI regime included in scenario 3. It appears from the results presented that more ISI can increase risk in the simulations. This is not isolated to scenario 3 but is most prominently demonstrated in the results reported for this scenario (e.g. scenario 4 has a higher risk than scenario 2 for BHX-VC-P1A and BHX-TS-P3A). These results appear counter-intuitive to the staff.

Request

Clarify how increased ISI can lead to increased probability of leakage in the EPRI analysis model even when one case completely overlaps another (Case 3 and Case 7 for example).

Question Number: 233

Issue

The applicant relies substantially on the EPRI analysis, documented in Reference 1 to the application, to justify the acceptability of their relief request. Reference 1, Section 8.3.2.3 presents a probability of detection curve (POD) used in the analyses. This POD curve is based on results utilizing ASME BPV Appendix VIII, Supplement 4. The requirements for the subject components do not include application of Appendix VIII. Consequently, the examinations performed to date, and the examinations modeled in the EPRI analysis, may not have the resolution or reliability assumed by the EPRI analysis. It would be possible that flaws of interest within the EPRI analysis model may not be identified with the same likelihood in the subject components as presumed by the EPRI analysis and consequently result in nonconservative results of said analysis.

The staff noted that the EPRI analysis purported that pre-service inspections would be sufficient. The staff consider that PSI and ISI are synergistic (not duplicative) in providing confidence in the material state of a subject component; the staff do not consider the application of PSI alone a sufficient basis to approve this application. Consequently, the manner in which in-service inspection is conducted remains important to enabling the staff to determine the adequacy of the application.

Request

Provide a basis for the adequacy of the proposed POD used in the EPRI analysis as it relates to the subject components and inspection modelling for the subject components.

Question Number: 234

Issue

The applicant relies substantially on the EPRI analysis, documented in Reference 1 to the application, to justify the acceptability of their relief request. Reference 1, Section 8.3.3.2 contains a discussion concerning the verification and validation (V&V) of the **PROMISE** software. The results presented in the EPRI analysis, Table 8-7 are identical to those previously reported for **PROMISE** Version 1.0. The applicable analysis done for the subject components is indicated as having been completed using **PROMISE** Version 2.0. It is unclear to the staff as to whether the V&V results have been reconfirmed for **PROMISE** Version 2.0.

Request

Confirm whether the V&V was recalculated using the Version 2.0 confirming that previous results for **PROMISE** Version 1.0 are consistent with results from Version 2.0.

Question Number: 235

Issue

The applicant relies substantially on the EPRI analysis, documented in Reference 1 to the application, to justify the acceptability of their relief request. Reference 1 contains no evidence demonstrating the degree of convergence of the simulations. As convergence can be dependent on analysis parameters, like-to-like simulation specific results are necessary to confirm convergence.

Request

Clarify how it was determined that the appropriate number of realizations was chosen in Reference 1, and that the simulation output was sufficiently converged.

Question Number: 236

Issue

The applicant notes, in Section 7.0 of the submittal that "Low safety significant (LSS) components, typically including the BWR heat exchanger components in the scope of this evaluation, are exempt from the volumetric, surface, and VT-1 and VT-3 visual examination requirements of Section XI." It is not the staff's understanding that the Limerick, Units 1 and 2 heat exchangers are of low safety significance for the purposes of this application. The relative risk significance of a component is important in considering the necessary level of assurance the staff require to approve this submittal.

Request

Clarify whether the Limerick, Units 1 and 2, subject components are required or utilized for any upset, emergency, or faulted plant responses (service levels B-D). Specifically, clarify if the applicant considers the subject components to be of low safety significance and the basis for such determination.

If you have any questions, please contact me at v.sreenivas@nrc.gov