DRAFT REQUEST FOR ADDITIONAL INFORMATION

PROPOSED ALTERNATE FOR EXAMINATION OF STEAM GENERATOR WELDS

ENERGY HARBOR NUCLEAR GENERATION LLC

ENERGY HARBOR NUCLEAR CORP.

DAVIS-BESSE NUCLEAR POWER STATION, UNIT NO. 1

DOCKET NO. 50-346

By application dated September 13, 2021 (ADAMS Accession No. ML21256A119), Energy Harbor Nuclear Corp. (the licensee) submitted a request for a proposed alternative to certain requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a, "Codes and standards," for Davis-Besse Nuclear Power Station, Unit No. 1. Specifically, in accordance with 10 CFR 50.55a(z)(1), the application requests U.S. Nuclear Regulatory Commission (NRC) approval to increase the inservice inspection (ISI) interval for the steam generator (SG) welds and nozzle inner radii from 10 years to 30 years. These ISI requirements are specified in the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (ASME Code), Section XI, as incorporated by reference in 10 CFR 50.55a.

The proposed alternative is based on the methodology described in the Electric Power Research Institute (EPRI) Report No. 3002015906, "Technical Bases for Inspection Requirements for PWR [Pressurized-Water Reactor] Steam Generator Class 1 Nozzle-to-Vessel Welds and Class 1 and Class 2 Vessel Head, Shell, Tubesheet-to-Head, and Tubesheet-to-Shell Welds," 2019 (ADAMS Accession No. ML20225A141), and the EPRI Report No. 3002014590, "Technical Bases for Inspection Requirements for PWR Steam Generator Feedwater and Main Steam Nozzle-to-Shell Welds and Nozzle Inside Radius Sections," April 2019 (ADAMS Accession No. ML19347B107) (collectively, the EPRI Reports). The NRC staff is reviewing the application and has determined that the additional information below is required to complete the review.

Regulatory Basis

The requirements for the 10-year ISI intervals after the first ISI interval are established by 10 CFR 50.55a(g)(4)(ii), and require licensees to comply with the ASME Code requirements incorporated by reference in 10 CFR 50.55a(a) 18 months prior to the start of the ISI interval. In accordance with 10 CFR 50.55a(z)(1), the NRC staff may authorize an alternative to an ASME Code, Section XI, requirement established through 10 CFR 50.55a(g)(4)(ii) if the licensee demonstrates that the proposed alternative provides an acceptable level of quality and safety.

Request for Additional Information (RAI)-1

The application does not provide sufficient information regarding the welds and nozzles for the Davis-Besse replacement SGs that are included in the proposed alternative.

Request

A. Discuss whether the replacement SGs are completely new or are hybrid replacements that include components from the original SGs (e.g., welds or nozzles). If the replacement SGs are hybrid SGs, identify the SG welds and nozzles included in the proposed alternative that

are from the original SGs and justify why the transient cycles used in the fatigue crack growth calculations for such welds are acceptable.

B. Discuss the material specifications of the SG welds included in the proposed alternative.
C. Discuss which welding process (e.g., gas tungsten arc welding, shield metal arc welding) was used to fabricate the SG welds included in the proposed alternative.
D. Discuss whether repairs were made on the subject SG welds and nozzles during fabrication of the replacement SGs. If repairs were made, discuss whether the weld residual stress analyses considered and modeled the repaired flaw in the weld residual analyses or explain why this was not necessary.

RAI-2

Figure 1-2 in Attachment 1 to the proposed alternative shows cladding on SG welds for Item No. B2.40 of the ASME Code, Section XI, Table IWB-2500-1. However, Figures 1-3 and 1-4 in Attachment 1 do not show cladding on the SG welds and nozzles for Item Nos. C1.30, C2.21 and C2.22 of the ASME Code, Section XI, Table IWC-2500-1.

Request

A. Confirm that cladding is not applied to SG welds and nozzles for Item Nos. C1.30, C2.21 and C2.22. Discuss the susceptibility to corrosion in the components without cladding.
B. Discuss whether the effect of cladding on SG welds covered under Item No. B2.40 is included in the plant-specific analyses (e.g., in the weld residual stress calculation).

RAI-3

Section 5 of the proposed alternative states that the EPRI Reports provide the technical basis for the alternative. The licensee also stated that it performed a plant-specific analyses for Davis-Besse. Section 5, page 5, of the proposed alternative states that because the sensitivity studies performed in the ERPI Reports involve preservice inspection (PSI)/ISI scenarios that are different from those at Davis-Besse, supplemental analyses were performed for the plant-specific inspection scenarios at Davis-Besse. Section 5, page 10, of the proposed alternative states that the deterministic fracture mechanics (DFM) evaluations in the EPRI Reports provide verification of the probabilistic failure mechanics results for Davis-Besse. The licensee did not submit the plant-specific analyses with the proposed alternative and did not explain how the EPRI DFM evaluations verify the probabilistic failure mechanics results for Davis-Besse.

Request

A. Submit the plant-specific analyses used to support this request.
B. Discuss how the DFM evaluation in the EPRI Reports are applicable to Davis-Besse.
C. Provide a table comparing the plant-specific and EPRI analysis inputs for the SG welds and nozzles that includes the following information: crack dimensions, material stress intensity factor (K_{IC}), stress, stress multipliers, crack growth rate, number of flaws, flaw density for the nozzle inside radii, crack size (flaw depth and length) distribution, crack model, probability of detection, ISI schedule, examination coverage, treatment of analytical uncertainty, and number of realizations.

RAI-4

Section 7 of the EPRI Reports discusses the finite element analyses (FEA) to determine stresses due to internal pressure and thermal transients for the selected SG welds and nozzle

geometries. Section 5, page 4, of the proposed alternative states that the FEA in the EPRI Reports are applicable to Davis-Besse as shown in Attachment 1 to the proposed alternative. The FEA in the EPRI Reports does not include applied seismic, deadweight, and transient loads nor loads from the main steam and reactor coolant system pipes onto the SG welds and nozzles. Attachment 1 to the proposed alternative does not provide sufficient information to show that the FEA in the EPRI Reports is applicable to Davis-Besse.

Request

A. Discuss how the finite element models for Item Nos. B2.40, C1.30, C2.21 and C.22 in the EPRI Reports are applicable to Davis-Besse.
B. Discuss whether applied seismic, deadweight, and transient loads and loads from the main steam and reactor coolant system pipes onto the SG welds and nozzles are considered in the plant-specific analyses. If the loads are not considered, provide justification for excluding these loads.

RAI-5

The EPRI Reports use probability of detection (POD) curves based on the ASME Code, Section XI, Appendix VIII. Section 5, page 9, of the proposed alternative states that Davis-Besse does not use Appendix VIII procedures for all the examination categories, so use of the Appendix VIII POD curve may not be appropriate for all of the items. However, the application does not state what POD curves were used in the Davis-Besse plant-specific analyses.

Request

A. Describe the POD curves that were used in the Davis-Besse plant-specific analyses for each examination category (e.g., POD based on the ASME Code, Section XI, Appendix VIII or ASME Code, Section V).
B. Compare the POD curves used in the plant-specific analyses to the POD curve used in the EPRI Reports and explain why they are adequate for this application.

RAI-6

The EPRI Reports show that during the beginning and ending of heatup and cooldown transients the operating temperature in the SGs could be as low as 70 degrees Fahrenheit (°F). Table 1-2 in Attachment 1 to the proposed alternative also shows 70 °F as the minimum heatup and cooldown temperature. At this low temperature, the K_{IC} value could be lower than the K_{IC} value at a higher SG operating temperature. The lower K_{IC} value is more conservative than the higher K_{IC} value to limit the acceptability of a postulated flaw. The application does not state whether the plant-specific analyses considered the impact of the lower K_{IC} value on the Davis-Besse SG welds and nozzle inside radii.

Request

Discuss the acceptability of the K_{IC} value used for the beginning and ending of heatup and cooldown transients for calculating the probability of failure and probability of leakage of the Davis-Besse SG welds and nozzle inside radii.

RAI-7

Tables E-1, E-2, and E-3 of the proposed alternative show the probability of leakage and probability of failure for Item Nos. B2.40, C1.30, C2.21 and C2.22 from year 10 to year 80. The

NRC staff noted that the probability of leakage and probability of failure in Tables E-1, E-2, and E-3 of the proposed alternative are higher than the corresponding values in the EPRI Reports. Also, different stress multipliers were used to determine the results in Tables E-1, E-2, and E-3.

Request

A. Discuss why different stress multipliers were used to determine the results in Tables E-1, E-2, and E-3 for the subject SG welds and nozzle inner radii.
B. Identify the specific probability of leakage and probability of failure for the proposed PSI +30 ISI interval for each Item Nos. B2.40, C1.30, C2.21 and C2.22 as shown in Tables E-1, E-2, and E-3.

RAI-8

Tables 1-2, 1-3, and 1-4 in the application provide a comparison of the 60-year projected transient cycles in the plant-specific analyses and the EPRI Reports. A footnote to each table states, in part, that: "The 60-year projected cycles were determined as part of license renewal and are identified in EN-DP-00355, Determination of Allowable Operating Transient Cycles." The NRC staff noted that there are differences between the transient cycle information provided in Tables 1-2, 1-3, and 1-4 and the information provided as part of the license renewal application (ADAMS Accession Nos. ML102450572 and ML11159A132). In addition, the license renewal information was provided before the steam generators were replaced in 2014. Therefore, it is not clear how the transient cycles were projected to 60 years.

Request

A. Provide Procedure No. EN-DP-00355.
B. Discuss in detailed how the transient cycles in Tables 1-2, 1-3, and 1-4 are projected to 60 years and how this relates to the replacement SGs that were installed in 2014.
C. Tables E-1, E-2, and E-3 show failure and leakage probability values to 80 years. However, Tables 1-2, 1-3, and 1-4 show transient cycles projected to 60 years. Discuss whether the probability of failure and probability of leakage values for 80 years were calculated based on the transient cycles projected to 60 years or to 80 years.

RAI-9

Section 5, page 9, of the proposed alternative states that Table E-4 "shows that the largest variation of the R/t [radius-to-thickness] ratio between the geometry evaluated in [EPRI Report 3002014590] and those at Davis-Besse is 28 percent, which is lower than the stress multipliers applied in the sensitivity studies in Tables E-1 through E-3." However, the application does not explain why an R/t ratio difference of 28 percent is lower than the stress multipliers applied in the sensitivity studies. In addition to the geometric variation, Tables 1-2 and 1-3 of Attachment 1 to the proposed alternative indicate there are differences in transient temperatures and pressures between the generic analyses in the EPRI Reports and the operation conditions at Davis-Besse. The geometric and transient temperature and pressure differences may affect the overall stresses in the Davis-Besse SG welds and nozzles.

Request

A. Explain how the R/t ratio difference of 28 percent between the geometry evaluated in EPRI Report 3002014590 and that at Davis-Besse is lower than the stress multipliers applied in the sensitivity studies as shown in Tables E-1 through E-3.

B. Discuss the impact of the differences in temperature and pressure on the stresses in the Davis-Besse SG welds and nozzles.
C. Discuss whether a plant-specific stress analysis was performed. If not, discuss the applicability of the generic stress analyses of the EPRI Reports to the Davis-Besse SG welds and nozzle inner radii.

RAI-10

Attachment 2 to the proposed alternative presents the inspection history of the Davis-Besse SG welds and nozzles in the replacement and original SGs. The examination tables in Attachment 2 show that the examination results are all acceptable. However, the application does not explain why the inspection history of the original SGs is relevant to this application.

Request
A. Discuss how the inspection history of the original SGs was used to support this proposed alternative. Discuss whether the inspection of the original SGs was used to determine the probability of leakage and failure of the SG welds and nozzles in the replacement SGs.
B. Clarify what is meant by "acceptable" examination results (e.g., no recordable indications were detected, or indications were detected but the acceptance standards of the ASME Code were met).
C. Discuss the acceptance criteria to disposition the detected indications during the PSI and ISI and identify the provisions of the ASME Code that were used to disposition the indications.
D. Discuss which nondestructive examination method was used in the PSI and ISI of the subject SG welds and nozzle inner radii.
E. Discuss whether the flaw size used in the plant-specific analyses bounds the indications detected in the PSI and ISI.
F. Discuss whether the examination history confirms that the generic analyses in the EPRI Reports is reasonable for Davis-Besse.

RAI-11

Section 5, page 11, of the proposed alternative states that "all other inspection activities, including the system leakage test (Examination Categories B-P and C-H) will continue to be performed consistent with this request for alternative and in accordance with all other ASME Section XI requirements, providing further assurance of safety." However, the application does not identify other relevant inspections that will be performed to ensure safety.

Request
A. Discuss any visual examinations, walkdowns, boric acid corrosion program inspections, or other inspections that may be performed to detect any potential leakage from the subject SG welds and nozzles as part of defense-in-depth measures.
B. Discuss whether the reactor coolant system leakage detection systems can detect leakage from the subject SG welds and nozzle.
C. Discuss any sensors, instrumentations, or coolant inventory calculations that could detect leakage from the subject SG welds and nozzles.

RAI-12

By letters dated January 11 and July 16, 2021 (ADAMS Accession Nos. ML20352A155 and ML21167A355, respectively), the NRC approved proposed alternatives to extend the inspection interval for SG welds and nozzle inner radii at Vogtle Electric Generating Plant, Units 1 and 2

(Vogtle), and Millstone Power Station, Unit No. 2 (Millstone), respectively. These approved alternatives were both based, in part, on the EPRI Reports and were identified as precedents in Section 7 of the proposed alternative for Davis-Besse. Vogtle, Millstone, and EPRI generally concluded that the ISI interval for SG welds and nozzles could be extended when only PSI without any other post-PSI examinations had been performed. However, in the associated NRC safety evaluations, the NRC staff found that these general conclusions were unacceptable because, in part, these general conclusions do not account for the effect of the combination of the most significant parameters or the added uncertainty of low probability events.

The Davis-Besse application does not provide sufficient information to demonstrate that the structural integrity of the subject SG welds and nozzle inner radii can be ensured for the next 30 years without further inspections because ISI is the most effective measure for detecting changes in degradation or new degradation in the subject components under service conditions. Davis-Besse has performed only PSI and a partial ISI of its replacement SGs and is proposing to extend the interval to 30 years for the subject SG components. Davis-Besse has not performed a complete ISI of all the subject SG welds and nozzles in the fourth 10-year ISI interval. The application does not identify if or when the fourth interval ISI of the subject SG components will be completed.

Section 5, page 5, of the Davis-Besse application states that the plant-specific evaluations were performed assuming PSI only. However, the application does not address the concerns previously raised by the NRC staff regarding extending the ISI interval for the subject SG components based on PSI only without any other post-PSI examinations.

<u>Request</u>

A. Identify the SG welds and nozzle inner radii, including identifications, that need to be inspected to complete the examinations required by the ASME Code, Section XI, in the fourth 10-year ISI interval.
B. Identify when Davis-Besse will complete the ISI of the subject SG welds and nozzle inner radii for the fourth 10-year ISI interval, as required by the ASME Code.
C. If the ISI will not be completed in the fourth 10-year ISI interval, justify how the structural integrity of the subject SG welds and nozzle inner radii can be maintained for 30 years without additional inspections. This justification should address the concerns the NRC staff raised in the January 11 and July 16, 2021, safety evaluations for Vogtle and Millstone, respectively.

RAI-13

Section 5, page 3, of the proposed alternative states that the licensee is “requesting and inspection alternative to the examination requirements of the ASME, Section XI, Tables IWB-2500-1 and IWC-2500-1,” for specific examination categories and item numbers. Section 5, page 3, goes on to state: “The proposed alternative is to increase the inspection interval for these item numbers for the replacement steam generators at Davis-Besse to 30 years.” The term “inspection interval” is defined in the ASME Code, Section XI, IWA-2430, as the 10-year time period in which all inspection requirements of Section XI must be met. The application needs to clearly identify the specific requirements for which the alternative is being requested.

<u>Request</u>

Clarify whether the licensee is seeking an alternative to the examination requirements of the ASME Code, Section XI, IWB-2500 and IWC-2500, for the item numbers specified in the

application or an alternative to the definition of an inspection interval in the ASME Code, Section XI, IWA-2430.

RAI-14

The application states that the 2007 Edition through 2008 Addenda of the ASME Code, Section XI, is applicable to the fourth 10-year ISI interval at Davis-Besse. The application request approval for the remainder of the fourth interval through the sixth interval. However, the application does not identify the Edition and Addenda of Section XI that will be applicable to the fifth and sixth ISI intervals. The NRC staff understands that the licensee cannot provide this information for the sixth interval at this time.

Request
Identify the specific Edition and Addenda of the ASME Code, Section XI, that will apply to the fifth 10-year ISI interval at Davis-Besse, including the start and end dates for the interval. For the fifth interval, identify the specific provisions of Section XI for which the proposed alternative will be used (e.g., see Section 3 of the proposed alternative request).