UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

December 21, 2018

Mr. Bryan C. Hanson
Senior Vice President
Exelon Generation Company, LLC
President and Chief Nuclear Officer
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3 – ISSUANCE OF RELIEF REQUEST RE: USE OF ASME CODE CASE N-513-3 IN LIEU OF SPECIFIC ASME CODE REQUIREMENTS (EPID L-2018-LLR-0040)

Dear Mr. Hanson

By application dated March 26, 2018 (Agencywide Documents Access and Management System Accession No. ML18086B110), Exelon Generation Company, LLC (the licensee) submitted two relief requests (I5R-07 and I5R-08) to the U.S. Nuclear Regulatory Commission (NRC) for proposed alternatives to the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, for the Peach Bottom Atomic Power Station (Peach Bottom), Units 2 and 3. Relief Request I5R-08 proposed an alternative to allow the licensee to use ASME Code Case N-513-3, "Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping Section XI, Division 1," in lieu of specified ASME Code requirements. (By letter dated December 10, 2018 (ADAMS Accession No. ML18327A062), the NRC authorized the proposed alternative, Relief Request I5R-07.)

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(2), the licensee requested to use the alternative on the basis that complying with the specified requirement would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety.

The NRC staff has reviewed the subject request and finds that the proposed alternative provides a reasonable assurance of structural integrity of the moderate energy piping systems included in ASME Code Case N-513-3. The NRC staff finds that complying with the requirements of the ASME Code, Section XI, would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes, as set forth in the enclosed safety evaluation, that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2). Therefore, the NRC authorizes the use of Relief Request I5R-08 to use ASME Code Case N-513-3 at Peach Bottom, Units 2 and 3, for the fifth 10-year inservice inspection interval.

All other requirements of the ASME Code, Section XI, for which relief has not been specifically requested and authorized by the NRC staff remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

If you have any questions please contact the Peach Bottom Project Manager, Jennifer Tobin, at 301-415-2328 or Jennifer.Tobin@nrc.gov.

Sincerely,

James G. Danna Digitally signed by James G. Danna
Date: 2018.12.21 10:50:26 -05'00'

James G. Danna, Chief
Plant Licensing Branch 1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-277 and 50-278

Enclosure:
Safety Evaluation

cc: Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST I5R-08, REGARDING ALTERNATIVE REPAIR

FOR HIGH PRESSURE SERVICE WATER SYSTEM PIPING

EXELON GENERATION COMPANY, LLC

PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3

DOCKET NOS. 50-277 AND 50-278

1.0 INTRODUCTION

By application dated March 26, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18086B110), Exelon Generation Company, LLC (the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for a proposed alternative, Relief Request I5R-08, to the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, for the Peach Bottom Atomic Power Station (Peach Bottom), Units 2 and 3. The proposed alternative would allow the licensee to use ASME Code Case N-513-3, "Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping Section XI, Division 1," in lieu of specified ASME Code requirements.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(2), the licensee requested to use the alternative ASME Code Case N-513-3 to temporarily accept degraded piping on the basis that complying with the specified ASME Code requirement to repair the degraded piping would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety.

2.0 REGULATORY EVALUATION

The licensee's request proposes an alternative to the requirements of the ASME Code, Section XI, Article IWD-3000.

Adherence to Section XI of the ASME Code is mandated by 10 CFR 50.55a(g)(4), which states, in part, that ASME Code Class 1, 2, and 3 components (including supports) will meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI.

Section 50.55a(z) to 10 CFR states, in part, that alternatives to the requirements of 10 CFR 50.55a(g) may be used when authorized by the NRC if the licensee demonstrates that: (1) the proposed alternative provides an acceptable level of quality and safety, or (2) compliance with the specified requirements would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request the use of an alternative, and the NRC to authorize the proposed alternative.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Components Affected

The affected components at Peach Bottom, Units 2 and 3, are ASME Code Class 2 and 3 moderate energy piping systems, as described in Code Case N-513-3, Section 1, "Scope," whose maximum operating temperature does not exceed 200 degrees Fahrenheit (°F) and whose operating pressure does not exceed 275 pounds per square inch gauge (psig).

3.2 ASME Code Requirements

IWD-3120 of ASME Section XI requires that flaws exceeding the defined acceptance criteria be corrected by repair/replacement activities or evaluated and accepted by analytical evaluation. IWD-3130 of ASME Section XI requires that relevant conditions be subject to supplemental examination, corrective measures or repair/replacement activities, or evaluation and acceptance by analytical evaluation.

3.3 Applicable ASME Code Edition and Addenda

The Code of record for the fifth 10-year inservice inspection (ISI) interval at Peach Bottom, Units 2 and 3, is the ASME Code, Section XI, 2013 Edition. The fifth 10-year ISI interval is scheduled to begin on January 1, 2019, and end on December 31, 2028.

3.4 Licensee's Proposed Alternative

In lieu of repairing or replacing degraded piping in accordance with the ASME Code, Section XI, the licensee requested to apply modified Code Case N-513-3 to temporarily accept flaws in the ASME Code Class 3 high pressure service water (HPSW) system piping with a maximum operating pressure of 375 psig. The scope of Code Case N-513-3 is limited to piping with a maximum operating pressure of 275 psig. In addition, the licensee's proposed alternative includes a 5 gallon per minute (gpm) leakage limit. The licensee stated that the proposed alternative will be applied to HPSW piping with corrosion degradation only if ASME code repairs cannot be reasonably completed within the technical specification time limit.

The licensee stated that the analytical methods in Code Case N-513-3 are based on the ASME Section XI, Appendix C, "Evaluation of Flaws in Piping," with supplemental guidance in the Code case specific to through-wall flaws. The licensee noted that the ASME Section XI piping flaw evaluation methods do not place pressure or temperature limits for evaluation of flaws in piping. The licensee stated that the Code case analytical methods account for flaw length, depth, pipe material toughness, applied stresses, and use of safety factors. The licensee stated that there is no technical basis for limiting the use of the Code case to components operating at

275 psig or less. The licensee referenced the technical basis document, "Technical Basis for N-513-3 Scope Expansion to Higher Pressure," which it submitted in support of a similar proposed alternative for the fourth 10-year ISI interval at Peach Bottom, Units 2 and 3. The technical basis document is included in Enclosure 3 to Reference 4 (ADAMS Accession No. ML15036A487) of the licensee's March 26, 2018, letter.

3.5 Licensee's Basis for Proposed Alternative

The licensee's technical basis document referenced above compares using the evaluation methods in Code Case N-513-3 to evaluate flaws in piping operating at 275 psig and 375 psig. The technical basis document also compares jet thrust force in piping operating at 375 psig vs. 275 psig for given through-wall hole diameters. The licensee stated that it was determined that the Code case allowable flaw sizes by both the linear elastic fracture mechanics (LEFM) and branch reinforcement methods used in ASME Code Case N-513-3 were smaller at a pressure of 375 psig than those calculated using a pressure of 275 psig. The effects of jet thrust force were evaluated, and it was determined there was little difference in force for a 0.56-inch (in.) diameter flaw size at 275 psig vs. 375 psig. The study also determined that jet thrust force increases with increasing leakage rate and that it is appropriate to limit the application of this relief request to 375 psig.

ASME Code Case N-513-3 requires that the owner demonstrate system operability due to leakage. The licensee stated that the Code case does not demonstrate the consequences of leakage, so the owner is required to demonstrate leakage consequence/operability per operability procedures. The licensee stated that the scope of an operability evaluation needs to be sufficient to address the capability of the system, structure, and components to perform its specified safety function(s) from both the ASME Code Case N-513-3 structural perspective and leakage perspective.

As part of the proposed alternative, the licensee stated that it will apply a 5 gpm leakage limit to limit the effects of jet thrust force, even though its structural evaluation of the subject piping and leakage effects would allow a much higher leakage rate than 5 gpm. The licensee stated that any leakage, if present, will be limited to the leakage allowed by the evaluation or 5 gpm, whichever is lower.

The licensee noted that each residual heat removal (RHR) heat exchanger contains a tube-to-shell differential pressure alarm, which is the first indication that there is an internal leak resulting in cross-contamination from the RHR system to the HPSW system. Additionally, there are radiation monitors installed downstream of the HPSW system that indicate if there is cross-system leakage. Between these alarms and established operations and chemistry procedures, the systems are maintained such that unacceptable RHR system leakage into the HPSW system does not occur. The licensee explained that piping through-wall leaks in an operating HPSW train would not contain unacceptable levels of radionuclides due to the actions described above to address system cross-contamination and maintaining the HPSW system at a higher operating pressure than the RHR system. These actions assure any HPSW piping through-wall leaks would not result in an increase in the probability of release of radionuclides to the environment.

3.6 Duration of Proposed Alternative

The licensee stated that the duration of the proposed alternative is the fifth 10-year ISI interval at Peach Bottom, Units 2 and 3, which is scheduled to begin on January 1, 2019, and end on

December 31, 2028, or such time as the NRC approves Code Case N-513-3 in Regulatory Guide (RG) 1.147, "Inservice Inspection of Code Case Acceptability, ASME Section XI, Division 1," or other document. The licensee stated that if a flaw is evaluated near the end of the interval, and the next refueling outage is in the subsequent interval, the flaw may remain in service until the next refueling outage.

4.0 NRC STAFF EVALUATION

Structural Integrity Analysis

Using the Code Case N-513-3 method, the licensee calculated the design minimum wall thickness, allowable flaw sizes, and cover thickness requirements for various pipe sizes under operating pressures of 275 psig and 375 psig.

Paragraph 3.2(b) of Code Case N-513-3 states that for nonplanar flaws, the pipe is acceptable when the remaining pipe thickness is greater than or equal to the minimum wall thickness. The licensee calculated the minimum wall thickness of 6-inch (in.), 12-in., and 24-in. pipe using Equation 4 of the Code case. The result shows that the increase in minimum required wall thickness would be 0.02 in. for the 6-in. pipe, 0.04 in. for the 12-in. pipe, and 0.08 in. for the 24-in. pipe, based on a pressure of 375 psig in lieu of 275 psig. The largest increase in minimum wall thickness in the calculations performed by the licensee is for 24-in. pipe, which would require a relatively small increase in additional wall thickness. The NRC staff notes that Equation 4 of the Code case is consistent with the method used to determine minimum wall thickness in accordance with the ASME Code, Section III, Subsections NC and ND. Based on the above, the NRC staff finds that the methods described in the relief request are consistent with the Code case and are acceptable to determine the minimum wall thickness at 375 psig for flaw evaluations conducted in accordance with Code Case N-513-3.

Code Case N-513-3, paragraph 3.2(c), permits through-wall openings along a portion of pipe, with a thinned wall to be evaluated by the branch reinforcement method. The licensee calculated and plotted the required remaining ligament average thickness (Equation 9 of the Code case) vs. the adjusted diameter of the leaking hole (Equation 8 of the Code case) for 275 psig and 375 psig. The plot provided by the licensee shows that the change in the average cover thickness (remaining ligament average thickness) as a function of the adjusted diameter, for 375 psig vs. 275 psig is relatively low. For typical modeled openings less than 1 inch, the licensee stated that the change in required cover thickness is less than 0.010 in. The NRC staff notes that the branch reinforcement method described in paragraph 3.2 (c) is based on branch reinforcement opening design requirements in the ASME Code, Section III. Based on the above, the NRC staff finds that the proposed alternative is consistent with the methods described in paragraph 3.2(c) and is acceptable to determine flaws in pipe operating at pressures up to 375 psig, because the change in required average cover thickness at 375 psig vs. 275 psig is small, and the branch reinforcement methodologies in paragraph 3.2(c) are based on branch reinforcement design requirements in the ASME Code, Section III.

The licensee provided a plot of the jet force (pound-force (lbf)) for various through-wall hole diameters up to 1.5 in at 275 psig and 375 psig. The plot shows that the difference in jet force between 275 psig and 375 psig for hole diameters up to 0.5 in. is small. For a 0.5-in. diameter hole, the NRC staff calculated a jet force of 187.5 lbf at 375 psig vs. 137.5 lbf at 275 psig. A significant change in jet force is only seen in through-wall holes considerably larger than 0.5 in. The licensee calculated a leakage rate of 90 gallons per minute (gpm) for a 0.5-in. diameter hole at 375 psig.

Code Case N-513-3 does not contain leakage limits for components with through-wall flaws. The NRC staff notes that at 375 psig, leakage rates could increase significantly in a relatively short period of time. A larger diameter hole results in additional jet thrust forces and leakage, which can impact system operability and surrounding equipment due to flooding or cooling water spray. The proposed alternative limits the leak rate to no more than 5 gpm for the subject piping. The NRC staff finds that this leakage limit will provide additional restriction on the flaw size in the subject pipes because a relatively small through-wall flaw could easily exceed 5 gpm at a pipe system pressure of 375 psig. The NRC staff finds that the licensee's approach of applying a leakage limit of 5 gpm is acceptable because it will provide sufficient time for corrective measures to be taken before significant increases in leakage erodes defense-in-depth, which could lead to adverse consequences.

Code Case N-513-3, paragraph 3.2(d), permits through-wall openings along a portion of pipe with a thinned wall to be evaluated as two independent planar through-wall flaws, one oriented in the axial direction and the other oriented in the circumferential direction. Following the Code case guidance, the licensee performed an LEFM evaluation for 6-in., 12-in., and 24-in. pipe to determine maximum allowable flaw sizes at 275 psig and 375 psig. The evaluation methods provided in the Code case are based on the ASME Code, Section XI, Appendix C. As expected, the maximum permitted flaw size decreased for evaluations performed at the higher pressure of 375 psig, and the most notable change was for flaws in the axial direction due to the hoop stress, which for a given pressure is twice that of axial stress. The decrease in allowable flaw size calculated by the licensee is small when compared to the pipe size. The NRC staff determines that the LEFM methods used in the Code case are consistent with the ASME Code, Section XI, which are not limited by pressure. Based on the above, the NRC staff finds that the methods described in paragraph 3.2(d), as described by the licensee in the relief request, are acceptable to determine acceptable flaw sizes in pipe operating at pressures up to 375 psig.

Peach Bottom, Units 2 and 3, have differential pressure alarms and radiation monitors that can detect leakage that could result in cross-contamination from the RHR system to the HPSW system. These alarms, coupled with established operations and chemistry procedures, will provide appropriate monitoring of the piping systems for cross-contamination and prevent release of radionuclides to the environment. Therefore, the NRC staff finds acceptable that the licensee has established defense-in-depth measures to protect the HPSW system when the relief request is used to disposition a flaw in the HPSW pipe.

In order to temporarily accept a degraded pipe to remain in service, Code Case N-513-3 requires a licensee to perform flaw characterization, flaw evaluation, periodic monitoring, and extent of condition examinations. The NRC staff focused its review of the proposed alternative as it relates to flaw evaluation and periodic monitoring, which could be impacted by the 100 psig increase in maximum operating pressure. The NRC staff finds that flaw characterization and extent of conditions examinations are not impacted by the increase in pressure because they do not contain any aspects that are dependent on operating pressure. The increase in operating pressure could impact the flaw evaluation and determination of structural integrity. It could also impact the frequency of periodic monitoring due to shorter times needed to increase leakage significantly due to an approximately 36 percent increase in maximum operating pressure beyond the current permissible limit of 275 psig.

Hardship Justification

The NRC staff finds that shutting down a unit to repair the HPSW piping during normal operation would increase the potential of an unnecessary transient, resulting in undue hardship. The NRC staff determines that no significant compensating increase in the level of quality and safety would be gained by performing an ASME Code repair if degradation occurs during normal operation.

Technical Summary

Code Case N-513-3 is acceptable to the NRC for generic use by licensees with one condition, as listed in RG 1.147, Revision 18. The condition in RG 1.147 states, "The repair or replacement activity temporarily deferred under the provisions of this Code Case shall be performed during the next scheduled outage." The licensee's proposed alternative meets this condition. The license intends to utilize Code Case N-513-3 on HPSW piping up to a maximum of 375 psig operating pressure. The scope of Code Case N-513-3 limits its use to systems operating at a pressure no greater that 275 psig and a temperature no greater than 200 °F. The licensee intends to follow the Code case except for the 100 psig increase in maximum operating pressure to 375 psig.

5.0 CONCLUSION

As set forth above, the NRC staff finds that the proposed alternative provides a reasonable assurance of structural integrity of the subject components, and that complying with IWD-3130 of the ASME Code, Section XI, would result in a hardship or unusual difficulty, without a compensating increase in the level of quality and safety. Accordingly, the staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2). Therefore, the NRC authorizes the use of Relief Request I5R-08 to use ASME Code Case N-513-3 at Peach Bottom, Units 2 and 3, for the fifth 10-year ISI interval.

All other requirements of the ASME Code, Section XI, for which relief has not been specifically requested and authorized by NRC staff remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: R. Davis

Date: December 21, 2018

SUBJECT: PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3 – ISSUANCE OF RELIEF REQUEST RE: USE OF ASME CODE CASE N-513-3 IN LIEU OF SPECIFIC ASME CODE REQUIREMENTS (EPID L-2018-LLR-0040) DATED DECEMBER 21, 2018

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