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

December 10, 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-513-4 IN LIEU OF SPECIFIC ASME CODE REQUIREMENTS (EPID L-2018-LLR-0039)

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 a request to the U.S. Nuclear Regulatory Commission (NRC) for a proposed alternative, Relief Request I5R-07, to the requirements of Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 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-513-4, "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 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 513-4. 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-07 to use ASME Code Case N 513-4 at Peach Bottom, Units 2 and 3, for the fifth 10-year inservice inspection interval, or until such time as the NRC approves ASME Code Case N-513-4 for general use through revision of Regulatory Guide 1.147, Revision 18, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1."

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 a 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, 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

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST I5R-07, 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 (Exelon, the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for a proposed alternative, Relief Request I5R-07, to the requirements of Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 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-513-4, "Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping Section XI, Division 1" (Code Case N-513-4), 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 Code Case N-513-4 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 ASME Code, Section XI, Articles IWC-3000 and 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 Background

The affected components at Peach Bottom, Units 2 and 3, are ASME Code Class 2 and 3 moderate energy piping systems, as described in ASME Code Case N-513-4, Section 1, "Scope," whose maximum operating temperature does not exceed 200 degrees Fahrenheit and whose operating pressure does not exceed 275 pounds per square inch gauge.

3.2 ASME Code Requirements

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

The licensee stated that Code Case N-513-3 (currently approved for use in Regulatory Guide (RG) 1.147, Revision 18, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," dated March 2017 (ADAMS Accession No. ML16321A336), contains limitations regarding the evaluation of flaws in certain locations of moderate energy piping components. Many of these limitations have been addressed in Code Case N-513-4. Moderately degraded piping could require a plant shutdown within the required action statement timeframes to repair observed degradation. The licensee stated that plant shutdown activities result in additional radiological dose and plant risk that would be inappropriate when a degraded condition is demonstrated to retain adequate margin to complete the component's function.

The licensee's proposed alternative is to use Code Case N-513-4 for the evaluation and temporary acceptance of flaws in moderate energy Class 2 and 3 piping in lieu of specified ASME Code, Section XI requirements. In addition, the licensee's proposed alternative includes the determination of an allowable leakage rate by dividing the critical leakage rate by a safety factor of four.

3.5 Licensee's Basis for Proposed Alternative

The licensee stated that limitations in Code Case N-513-3 related to its use on piping components such as elbows, bent pipe, reducers, expanders, and branch tees and external tubing or piping attached to heat exchangers, have been addressed in Code Case N-513-4.

The licensee provided a high level overview of the differences between Code Case N-513-3 and Code Case N-513-4, as listed below:

1. Revised the maximum allowable time of use from no longer than 26 months to the next refueling outage.

2. Added applicability to piping elbows, bent pipe, reducers, expanders, and branch tees where the flaw is located more than $(R_0t)^{1/2}$ from the centerline of the attaching circumferential piping weld.

3. Expanded use to external tubing or piping attached to heat exchangers.

4. Revised to limit the use to liquid systems.

5. Revised to clarify treatment of service level load combinations.

6. Revised to address treatment of flaws in austenitic pipe flux welds.

7. Revised to require minimum wall thickness acceptance criteria to consider longitudinal stress, in addition to hoop stress.

8. Made other minor editorial changes to improve the clarity of the Code case.

As part of a previous NRC-approved alternative dated September 6, 2016 (ADAMS Accession No. ML16230A237), for the Exelon fleet of nuclear power plants to use Code Case N-513-4, the licensee provided a technical basis document for Code Case N-513-4, "Proceedings of the ASME 2014 Pressure Vessels & Piping Conference, PVP2014, July 20-24, 2014, Anaheim, California, USA, PVP2014-28355, Technical Basis for Proposed Fourth Revision to ASME Code Case N-513." Exelon's prior alternative submittal included Peach Bottom and is dated January 28, 2016 (ADAMS Accession No. ML16029A003).

The licensee stated that the effects of leakage may impact the operability determination or the plant flooding analyses specified in paragraph 1(f) of Code Case N-513-4. For a leaking flaw, the licensee stated that the allowable leakage rate will be determined by dividing the critical leakage rate by a safety factor of four. The critical leakage rate is determined as the limiting leakage rate that can be tolerated and may be based on the allowable loss of inventory or the maximum leakage that can be tolerated relative to room flooding, among others. The licensee contends that applying a safety factor of four to the critical leakage rate provides quantitative measurable limits that ensure the operability of the system and early identification of issues that could erode defense-in-depth and lead to adverse consequences.

The licensee stated that Code Case N-513-4 utilizes technical evaluation approaches that are based on principles in other Code documents already acceptable to the NRC. The licensee also stated that application of this Code case in concert with safety factors on leakage limits will maintain acceptable structural and leakage integrity, while minimizing plant risk and personnel exposure by minimizing the number of plant transients that could be incurred if a degradation condition is required to be repaired based on ASME Code, Section XI acceptance criteria only.

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-513-4 in Regulatory Guide (RG) 1.147 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

The NRC staff evaluated the adequacy of the proposed alternative in maintaining the structural integrity of piping components identified in Code Case N-513-4. Code Case N-513-3, which is conditionally approved for use in RG 1.147, provides alternative evaluation criteria for temporary acceptance of flaws, including through-wall flaws, in moderate energy Class 2 and 3 piping. However, Code Case N-513-3 contains limitations that the licensee considers restrictive and that could result in an unnecessary plant shutdown. Code Case N-513-3 is limited to straight pipe with provisions for flaws that extend for a short distance at the pipe to fitting weld into the fitting. Evaluation criteria for flaws in elbows, bent pipe, reducers, expanders, branch tees, and heat exchangers are not included within the scope of N-513-3. Code Case N-513-4 addresses these limitations. Given that the previous revision of this Code case (Code Case N-513-3) is conditionally approved for use in RG 1.147, Revision 18, the staff focused its review on the differences between Code Case N-513-3 and Code Case N-513-4. The significant changes in N-513-4 include: (1) revised temporary acceptance period; (2) added flaw evaluation criteria for elbows, bent pipe, reducers/expanders, and branch tees; (3) expanded applicability to heat exchanger tubing or piping; (4) limited use to liquid systems; (5) clarified treatment of service load combinations; (6) revised treatment of flaws in austenitic pipe flux welds; (7) revised minimum wall thickness acceptance criteria to consider longitudinal stress in addition to hoop stress; and (8) revised leakage monitoring requirements. The NRC staff also evaluated the licensee's proposed limitation on the leakage rate and its hardship justification.

The NRC staff notes that many requirements specified in Code Case N-513-4 are not discussed in this safety evaluation, but they should not be considered as less important. As part of the NRC-approved proposed alternative, all requirements in the Code case must be followed except those identified modifications. Any exceptions or restrictions to the Code case that are approved in this safety evaluation also need to be followed.

4.1 Temporary Acceptance Period

Code Case N-513-3 specifies a temporary acceptance period of a maximum of 26 months. Code Case N-513-3 is accepted for use in RG 1.147, Revision 18, with the following condition: "The repair or replacement activity temporarily deferred under the provisions of this Code Case shall be performed during the next scheduled outage." Code Case N-513-4 includes wording that limits the use of the Code case to the next refueling outage. The NRC staff finds that Code Case N-513-4 appropriately addresses the NRC condition on Code Case N-513-3, and is, therefore, acceptable.

4.2 Flaw Evaluation Criteria for Elbows, Bent Pipe, Reducers/Expanders, and Branch Tees

Evaluation and acceptance criteria have been added to Code Case N-513-4 for flaws in elbows, bent pipe, reducers, expanders, and branch tees using a simplified approach that is based on

the Second International Piping Integrity Research Group (IPIRG-2) program reported in NUREG/CR-6444, BMI-2192, "Fracture Behavior of Circumferentially Surface-Cracked Elbows," dated March 1996.

The flaw evaluation methodology approach in Code Case N-513-4 for piping components is conducted in straight pipe by scaling hoop and axial stresses using ASME piping design code stress indices and stress intensification factors to account for the stress variations caused by the geometric differences. Equations used in the Code case are consistent with the piping design-by-rule approach in ASME Code, Section III, NC/ND-3600. NUREG/CR-6444 shows that this approach is conservative for calculating stresses used in flaw evaluations in piping elbows and bent pipe. The Code case also applies this methodology to reducers, expanders, and branch tees.

The NRC staff finds that the flaw evaluation and acceptance criteria in Code Case N-513-4 for elbows, bent pipe, reducers, expanders, and branch tees is acceptable because the flaw evaluation methods in the Code case are consistent with the ASME Code, Section XI, and ASME Code, Section III design-by-rule approach. Further, the staff finds that the alternative provides a conservative approach, as confirmed by comparing the failure moments predicted using this approach to the measured failure moments from the elbow mockup tests for through-wall circumferential flaws conducted as part of the IPIRG-2 program.

4.3 Flaw Evaluation in Heat Exchanger Tubing or Piping

Code Case N-513-4 has been revised to include heat exchanger external tubing or piping, provided that the flaw is characterized in accordance with Section 2(a) of the Code case and leakage is monitored. Section 2(a) requires that the flaw geometry be characterized by volumetric inspection or physical measurement.

The NRC staff determined that the flaw evaluation criteria in Code Case N-513-4 for straight or bent piping, as appropriate, can be applied to heat exchanger external tubing or piping. The NRC staff determined the methods for evaluating flaws in straight pipe are acceptable since they are currently allowed in Code Case N-513-3. For bent pipe, the acceptability is described in Section 3.2.2 above. Therefore, the NRC staff finds inclusion of heat exchanger external tubing or piping in the Code case to be acceptable because only heat exchanger tubing flaws that are accessible for characterization and leakage monitoring may be evaluated in accordance with the Code case, and the Code case provides acceptable methods for the evaluation of flaws.

4.4 Limit Use to Liquid Systems

Use of Code Case N-513-4 is specifically limited to liquid systems. The NRC staff finds this change acceptable since Code Case N-513 is not intended to apply to air or other compressible fluid systems.

4.5 Treatment of Service Load Combinations

Modifications in Code Case N-513-4 now make clear that all service load combinations must be considered in flaw evaluations to determine the most limiting condition. Although previously implied in Code Case N-513-3, Code Case N-513-4 makes this requirement clear. Therefore, the NRC staff finds this change acceptable.

4.6 Treatment of Flaws in Austenitic Pipe Flux Welds

Paragraph 3.1(b) of N-513-4 contains modifications that include a reference to ASME Code, Section XI, Appendix C, C-6320, to address flaws in austenitic stainless steel pipe flux welds. The ASME Code, Section XI, Appendix C, C-6000, permits the use of elastic-plastic fracture mechanics criteria in lieu of limit load criteria to analyze flaws in stainless steel pipe flux welds. Equation 1 of the Code case was also revised to be consistent with ASME Code, Section XI, Appendix C, C-6320, so the equation can be used for flaws in austenitic stainless steel pipe flux welds. The NRC staff finds this acceptable because the modification to the Code case includes the appropriate methods for the evaluation of stainless steel pipe flux welds in accordance with ASME Code, Section XI.

4.7 Minimum Wall Thickness Acceptance Criteria to Consider Longitudinal Stress

Although it is unlikely that a longitudinal stress-based minimum wall thickness would be limiting when compared to a hoop stress-based minimum wall thickness, Code Case N-513-4 includes revisions that require consideration of longitudinal stress in the calculation of minimum wall thickness. Previous versions of the Code case only required the use of hoop stress. The NRC staff finds this acceptable because it will ensure that the more limiting of the longitudinal or hoop stress is used to determine minimum wall thickness.

4.8 Leakage Monitoring for Through-Wall Flaws

Code Case N-513-3 required through-wall leakage to be observed by daily walkdowns to confirm the analysis conditions used in the evaluation remain valid. Code Case N-513-4 modifies this requirement by continuing to require that leakage be monitored daily but allows other techniques to be used to monitor leakage such as the use of visual equipment or leakage detection systems to determine if leakage rates are changing. The NRC staff finds this change acceptable because the Code case continues to require through-wall leaks to be monitored daily, and the expanded allowable monitoring methods should have no adverse impact.

4.9 Leakage Rate

Code Case N-513-3, paragraph 1(d), states, "The provisions of this Case demonstrate the integrity of the item and not the consequences of leakage. It is the responsibility of the Owner to demonstrate system operability considering effects of leakage." Code Case N-513-4 modified the last sentence, now located in paragraph (f), to state, "It is the responsibility of the Owner to consider effects of leakage in demonstrating system operability and performing plant flooding analyses."

The licensee stated that the allowable leakage rate will be determined by dividing the critical leakage rate by a safety factor of four. The critical leakage rate is determined as the limiting leakage rate that can be tolerated and may be based on the allowable loss of inventory or the maximum leakage that can be tolerated relative to room flooding, among other factors. The licensee contends that applying a safety factor of four to the critical leakage rate provides quantitative measurable limits that ensure the operability of the system and early identification of issues that could erode defense-in-depth and lead to adverse consequences.

Code Cases N-513-3 and N-513-4 do not contain leakage limits for components with through-wall flaws. The NRC staff finds that the licensee's approach of applying a safety factor of four to the critical leakage rate is acceptable because it will provide sufficient time

for corrective measures to be taken before significant increases in leakage erode defense-in-depth, which could lead to adverse consequences.

4.10 Hardship Justification

The NRC staff finds that Code-repairing the subject pipe immediately upon discovery requires a plant shutdown that would cycle the unit and increase the potential of an unnecessary transient, resulting in undue hardship. Additionally, performing certain ASME Code repair during normal operation would challenge the technical specification completion time and place the plant at higher safety risk than warranted. Therefore, the NRC staff determined that compliance with the specified ASME Code repair requirements would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety.

4.11 Summary

The NRC staff finds that the proposed alternative will provide reasonable assurance of the structural integrity because: (1) Code Case N-513-4 addresses the NRC condition in RG 1.147 for Code Case N-513-3; (2) flaw evaluations in component types added to Code Case N-513-4 are based on acceptable methodologies; and (3) the method for determining the allowable leakage rate is adequate to provide early identification of a significant increase in leakage. In addition, complying with ASME Code, Section XI requirements would result in in hardship or unusual difficulty, without a compensating increase in the level of quality and safety.

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 IWC-3120, IWC-3130, IWD-3120, and 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-07 to use Code Case N-513-4 at Peach Bottom, Units 2 and 3, for the fifth 10-year ISI interval, or until such time as the NRC approves Code Case N-513-4 for general use through revision of RG 1.147. If the proposed alternative is applied to a flaw near the end of the authorized 10-year ISI interval and the next refueling outage is in the subsequent interval, the licensee is authorized to continue to apply the proposed alternative to the flaw until the next refueling outage.

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 a third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: R. Davis

Date December 10, 2018

SUBJECT: PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3 – ISSUANCE OF RELIEF REQUEST RE: USE OF ASME CODE CASE N-513-4 IN LIEU OF SPECIFIC ASME CODE REQUIREMENTS (EPID L-2018-LLR-0039) DATED DECEMBER 10, 2018

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