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

March 19, 2015

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, AND QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2 - RELIEF FROM THE REQUIREMENTS OF THE ASME CODE (TAC NOS. MF3799, MF3800, MF3801, AND MF3802)

Dear Mr. Hanson

By application dated March 28, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14090A140), as supplemented by letters dated October 29, 2014, and February 5, 2015, (ADAMS Accession No. ML14303A463 and ML15036A487, respectively), Exelon Generation Company, LLC (Exelon or the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for the use of alternatives to certain American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, requirements at Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3, and Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(ii) (retitled paragraph 50.55a(z)(2) by 79 FR 65776, dated November 5, 2014), the licensee requested to use an 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 high pressure service water at PBAPS, and residual heat removal service water piping at QCNPS. 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).

If you have any questions please contact the Senior Project Manager, Joel S. Wiebe at 301-415-6606 or via e-mail at Joel.Wiebe @nrc.gov.

Sincerely,

Travis L. Tate, Chief
Plant Licensing III-2 and
Planning and Analysis Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No(s). 50-277, 50-278, 50-254, and 50-265

Enclosure:
Safety Evaluation

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST I4R-55, REVISION 2, REGARDING

ALTERNATIVE REPAIR FOR HIGH PRESSURE SERVICE WATER SYSTEM PIPING

EXELON GENERATION COMPANY

PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3

DOCKET NOS. 50-277 AND 50-278

RELIEF REQUEST I5R-12, REVISION 2, REGARDING

ALTERNATIVE REPAIR FOR RESIDUAL HEAT REMOVAL SERVICE WATER PIPING

EXELON GENERATION COMPANY

QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2

DOCKET NOS. 50-254 AND 50-265

1.0 INTRODUCTION

By application dated March 28, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14090A140) with supplements dated October 29, 2014, and February 5, 2015, (ADAMS Accession No. ML14303A463 and ML15036A487, respectively), Exelon Generation Company, LLC (Exelon or the licensee) submitted a request to the U. S. Nuclear Regulatory Commission (NRC) for relief from certain requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, at the Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3, and Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2. The licensee submitted contingency relief request (RR) I4R-55, Revision 2, for PBAPS, and I5R-12, Revision 2, for QCNPS. The RRs will be used to, under certain conditions, temporarily accept flaws in high pressure service water (HPSW) system piping at PBAPS, and residual heat removal service water (RHRSW) system piping at QCNPS.

Specifically, pursuant to Title 10 of the Code of Federal Regulations (10 CFR) Section 50.55a(a)(3)(ii) (retitled paragraph 50.55a(z)(2) by 79 FR 65776, dated November 5, 2014), the licensee requested the temporary use of modified 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," to temporary: accept degraded piping on the basis that complying with the specified

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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

Article IWD-3120(b) of the ASME Code, Section XI, requires that unacceptable flaws in ASME Code Class 3 components be corrected by repair or replacement activity, or be accepted by supplemental examination and flaw evaluation to the extent necessary, to meet the acceptance standards in ASME Code, Section XI, Article IWD-3000, which refers to the requirements of IWC-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 pre-service examination requirements, set forth in the ASME Code, Section XI.

Sections 50.55a(a)(3) and (a)(3)(ii) to 10 CFR (retitled paragraph 50.55a(z)(2) by 79 FR 65776, dated November 5, 2014), states, in part, that alternatives to the requirements of paragraph (g) of 10 CFR 50.55a 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 requirement at PBNPS, Units 2 and 3, and QCNPS, Units 1 and 2.

3.0 TECHNICAL EVALUATION

3.1 The Licensee's Request for Alternative

The affected component at PBAPS, Units 2 and 3, are ASME Code Class 3 HPSW system piping. The main segments of the HPSW system piping range from 14 inches to 18 inches nominal pipe size (NPS), each with a wall thickness of 0.375 inches. The 18-inch piping is connected to 24-inch piping. Exelon stated that Code Case N-513-3 is not needed for the 24-inch piping as it is only present immediately prior to the discharge pond. The HPSW system piping also has smaller branches and drains and vents that range from 1/2-inch to 3-inch NPS.

The HPSW piping design pressure and temperature are 450 pounds per square inch gauge (psig) and 100 degree Fahrenheit, respectively. HPSW is normally in standby mode with a pressure generally less than 50 psig. The HPSW system supports shutdown cooling and generally operates at a pressure of approximately 295 psig. The highest expected normal operating pressure occurs when placing a second HPSW pump in service prior to valving in the second residual heat removal (RHR) heat exchanger in that loop. This results in a calculated pressure less than 375 psig. Exelon noted that the time during which HPSW piping experiences pressure between 275 and 375 psig is limited. Exelon reported that during a 2-year fuel cycle period, HPSW system pressure reached between 275 and 375 psig for a maximum of 526 hours for any train (3 percent of the total time).

Exelon performs quarterly inservice testing (IST) for each HPSW pump for approximately one hour at a pressure of approximately 295 psig; the routine system testing is performed monthly. Exelon reported that the IST of HPSW pumps results in 20 combined hours at a pressure between 275 and 375 psig for both units over a 2 year fuel cycle.

The affected components at QCNPS, Units 1 and 2, are ASME Code Class 3 RHRSW system piping. The main segments of the RHRSW system consist of piping that is 12 inches and 16 inches NPS, each with a wall thickness of 0.375 inches. The RHRSW system has smaller branches and drains and vents that range from 1/2 inches to 4 inches NPS.

The RHRSW system design pressure and temperature are 350 psig and 150 °F, respectively. RHRSW is normally in standby mode with a pressure generally less than 50 psig. The maximum system operating pressure is limited by the RHRSW relief valve that is set at 350 psig. RHRSW system operating temperature is dependent upon river temperature and does not have a specified maximum operating temperature. The RHRSW system supports shutdown cooling during which it operates at or below a pressure of 350 psig. Exelon noted that the time during which RHRSW piping experiences pressure between 275 and 375 psig is limited. Exelon reported that during a 2-year fuel cycle period, the RHRSW system pressure reached between 275 and 375 psig for a maximum of 697 hours for any train (3.81 % of the total time).

Exelon performs quarterly ISTs for each RHRSW pump for approximately 3 hours at a pressure greater than 275 psig. Exelon reported that the IST of RHRSW pumps results in approximately 96 combined hours at a pressure between 275 and 375 psig for both units over a 2 year fuel cycle.

Applicable Code Edition and Addenda

Plant	Interval	Edition	Start	End
Peach Bottom Units 2 and 3	Fourth	2001 Edition through 2003 Addenda	November 5, 2008	November 4, 2018
Quad Cities Units 1 and 2	Fifth	2007 Edition through 2008 Addenda	April 2, 2013	April 1, 2023

Applicable Code Requirement:

ASME Code, Section XI, IWD-3120(b), requires that components exceeding the acceptance standards of IWD-3400 be subject to supplemental examination or to a repair/replacement activity.

Exelon requested relief from the requirements of the ASME Code, Section XI, to perform repair or replacement activities for degraded HPSW and RHRSW piping. Exelon stated that the repair of degraded pipe could have a detrimental overall risk impact by requiring a plant shutdown, thus requiring use of a system that is in standby during normal operation within the required action statement timeframes. Plant shutdown activities result in additional dose and plant risk that would be inappropriate when a degraded condition is demonstrated to retain adequate margin to complete the component mission. Exelon further stated that the use of an acceptable

alternative analysis to permit the affected pipe remain in service in lieu of immediate repair will afford additional extent of condition examinations on the affected piping while allowing time for safe and orderly long term repair actions, if necessary.

In lieu of repairing or replacing degraded piping in accordance with ASME Code, Section XI, IWD-3120(b), Exelon requested to apply modified Code Case N-513-3 to temporarily accept flaws in the HPSW and RHRSW system piping having a maximum operating pressure of 375 psig. Code Case N-513-3 is applicable to moderate energy piping which is limited to a maximum operating pressure of 275 psi.

Exelon evaluated the effects of a pressure of 375 psi on the HPSW and RHRSW piping and applicability of the code case. As a comparison, Exelon determined that there was little difference in jet thrust force for a postulated 0.56-inch diameter flaw size at 275 psig versus 375 psig. Exelon also calculated the allowable flaw sizes for the operating pressure of 275 and 375 psig. Exelon's calculation determined that the higher the operating pressure the smaller the allowable flaw sizes for specific pipe diameters.

Exelon performed Operability Evaluations by investigating the consequence of leakage from the postulated flaw size based on the current licensing basis of each plant, including technical specifications (TSs) and Updated Final Safety Analysis Reports, to establish the conditions and performance requirements to be met for determining operability, as necessary. Exelon stated that the scope of an Operability Evaluation needs to be sufficient to address the capability of the system, structure, and component to perform its specified safety function(s) considering both Code Case N-513-3 structural requirements and system performance with the identified leakage.

Exelon noted that each 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 or RHRSW systems. Additionally, there are radiation monitors installed downstream of the HPSW/RHRSW systems 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 or RHRSW system does not occur. Exelon explained that piping through-wall leaks in an operating HPSW or RHRSW train would not contain unacceptable levels of radionuclides due to the actions described above to address system cross contamination and maintaining the HPSW or RHRSW system at a higher operating pressure than the RHR system. These actions assure any HPSW or RHRSW piping through-wall leaks would not result in an increase in the probability of release of radionuclides to the environment.

In its February 5, 2015, letter, Exelon stated that it will apply a 5 gallon per minute (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. Exelon stated that any leakage, if present, will be limited to the leakage allowed by the evaluation or 5 gpm, whichever is lower.

The proposed alternative will be applicable for the remainder of each plant's 10-year inservice inspection (ISI) interval as specified above. Exelon stated that an ASME Code, Section XI, compliant repair or replacement will be completed prior to exceeding the allowable period

defined in Code Case N-513-3, Section 1(e), and Regulatory Guide (RG) 1.147, or the next refueling outage, whichever comes first.

3.2 NRC Staff Evaluation

The NRC notes that to temporary 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. In addition, RG 1.147, Revision 17, imposes on the code case a condition which requires that the repair or replacement activity temporarily deferred under the provisions of this code case be performed during the next scheduled outage.

Structural Integrity Analysis

Using the Code Case N-513-3 method, Exelon calculated the allowable flaw sizes for various pipe sizes under operating pressure of 275 and 375 psig. Exelon's calculation shows that the allowable flaw sizes at a pressure of 375 psig are smaller than at 275 psig. When a flaw exceeds the allowable size, the degraded pipe does not satisfy the acceptance criteria of the code case. This means that the RRs are no longer applicable and the licensee is required to take actions in accordance with the ASME Code requirement.

Exelon also calculated the openings that would bound the leaking flaw size at the 275 and 375 psig conditions based on remaining ligament average thickness equation in Code Case N-513-3. The NRC staff notes that the differences in the openings are small between the 275 and 375 psig conditions.

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. In its March 28, 2014, letter, Exelon concluded that as the operating pressure increases from 275 to 375 psig, minimum required wall thickness increases. A higher minimum required wall thickness at 375 psig is appropriate because a thicker wall is needed to ensure the structural integrity at a higher operating pressure than at a lower pressure.

In its February 5, 2015, letter, Exelon limits the leak rate to be 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 beyond this leakage, the licensee is required to take actions in accordance with the ASME Code requirement.

In its March 28, 2014, letter, Exelon stated that if a leak or thinned area below minimum wall thickness is identified while the plant is operating, the PBAPS Technical Specification 3.7.1, and the QCNPS TS 3.7.1, allows 7 days for restoration unless the condition can be declared operable but degraded using an evaluation method acceptable to the NRC.

The NRC staff finds that the licensee has demonstrated by stress analyses, based on the requirements of Code Case N-513-3, that an operating pressure of 375 psig will not significantly challenge the structural integrity of the subject piping. In addition, the limiting condition of operation in the plant's TSs provides additional layer of protection for the safe operation of the plant with degraded piping.

Flooding Analysis

In its October 29, 2014, letter, Exelon stated that for PBAPS, the HPSW system normally operates at approximately 4900 gpm with a design requirement of 4500 gpm. This provides a margin of 400 gpm in case of a leak so that HPSW piping will maintain its intended function.

For QCNPS, the RHRSW pumps are tested to ensure that a total flow rate of 3883 gpm is produced. Each RHRSW pump is verified to produce up to 4100 gpm as part of a biennial performance test. This provides a margin of 217 gpm in case of a leak so that RHRSW piping will maintain its intended function.

In its October 29, 2014, letter, Exelon considered the design basis flooding analysis for each potential leak and evaluated potential leakage using its Operability Evaluation process. The original RR specified that the leakage is limited to the maximum allowed by evaluation or 100 gpm. However, by letter dated February 5, 2015, Exelon revised the RR to require a 5 gpm maximum limit in order to add additional margin in application of this RR.

In its October 29, 2014, letter, Exelon noted that the need to evaluate the impact of water jet impinging on adjacent equipment is appropriate whether the system in which the leak is occurring is safety-related or nonsafety-related because safety-related components could be adjacent to nonsafety-related leaking pipes. Exelon explained that its flooding analysis will consider functionality of electrical equipment based on ability to resist water intrusion or actions must be taken to prevent wetting of the equipment. Exelon will also address the ability of the adjacent area to remove the water volume. As required by its procedure OP-AA-108-115, "Operability Determinations," Exelon will address all postulated negative effects of leakage regardless of pressure and conclude there are no unacceptable resultant conditions; otherwise, the leakage would be deemed unacceptable.

The NRC staff finds that Exelon has a procedure to evaluate the impact of the leakage on other safety-related or nonsafety-related components as part of flooding analysis. In addition, Exelon will implement a leak rate limit of 5 gpm which is conservative in comparison to the leak rate that is permitted by the structural and flooding analysis detailed above. Therefore, the NRC staff finds that Exelon's flooding analysis described above is acceptable.

Monitoring

Exelon has not requested deviations from inspection requirements of Code Case N-513-3. In its October 29, 2014, letter, Exelon noted that Code Case N-513-3 cannot be applied to inaccessible pipe locations because nondestructive examination data is required to evaluate a flaw. Exelon clarified that any location where the code case will be applied will be accessible for required examination and monitoring in accordance with the code case. Insulated piping is considered accessible for examination; however, buried piping is not considered accessible for application of Code Case N-513-3 unless uncovered for a specific purpose such as follow-up inspection due to other inspection processes such as guided wave ultrasonic examination. Paragraph 5(a) of the code case requires augmented examination of susceptible and accessible piping locations to determine extent of condition of the affected system. In its letter dated October 29, 2014, Exelon stated that it intends to comply with this code case requirement.

The NRC staff notes that the subject nuclear units have differential pressure alarms and radiation monitors that can detect leakage from the subject piping. These alarms and established operations and chemistry procedures will provide appropriate monitoring of the piping systems for leakage. The NRC staff finds that Exelon's monitoring of potential flaws is acceptable because monitoring will follow the requirements of Code Case N-513-3.

Hardship Justification

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

Generic Implication

The NRC staff is concerned that authorization of the proposed alternative may establish precedent for the use of Code Case N-513-3 at a pressure above the current limit of 275 psig for moderate energy piping at various plants. The NRC staff believes that establishing such a precedent may have far reaching consequences, some of which may be adverse. In its October 29, 2014, letter, Exelon stated that the proposed RRs are: (a) only applicable to the boiling-water reactor (BWR) Mark I containment plants without isolation condensers, i.e., at PBAPS and QCNPS, and (b) only applicable to one specific system at each subject plant that occasionally operates at a pressure greater than that allowed by Code Case N-513-3. In addition, the corrosion of a raw water system such as the subject piping is a well-understood degradation mechanism.

The NRC staff has determined that the RRs are limited in scope because: (1) it is applicable only to the HPSW and RHRSW system piping with plant-specific conditions that are unique to PBAPS and QCNPS, and (2) Exelon has shown that the duration during which the pressure in the subject pipes exceeds 275 psig is limited.

In summary, the NRC staff finds that applying Code Case N-513-3 to HPSW and RHRSW piping that experience a maximum operating pressure of 375 psig is acceptable because: (1) Exelon has demonstrated that the 375 psig pressure will not significantly affect the structural integrity of the subject pipes, (2) PBAPS and QCNPS have detection systems to alert operators potential leakage in the subject piping, (3) Exelon has procedures to perform the flooding analysis, (4) Exelon will follow the monitoring requirements of Code Case N-513-3, (5) the proposed alternative is applicable to plant-specific and system-specific piping at PBAPS and QCNPS, and (6) Exelon will implement a stringent allowable leak rate limit of 5 gpm for the subject piping.

4.0 CONCLUSION

As set forth above, the NRC staff finds that the proposed alternative provides a reasonable assurance of structural integrity of the HPSW at PBAPS and RHRSW piping at QCNPS. The NRC staff finds that complying with the requirements of 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 that the licensee has adequately addressed all of the

regulatory requirements set forth in 10 CFR 50.55a(a)(3)(ii) (retitled paragraph 50.55a(z)(2) by 79 FR 65776, dated November 5, 2014).

Therefore, the NRC authorizes the use of RR I4R-55, Revision 2, at PBAPS, Units 2 and 3, until the end of the fourth ISI interval, the acceptance criteria of Code Case N-513-3 are exceeded, or the leak rate exceeds the allowable, whichever occurs first.

The NRC also authorizes the use of RR I5R-12, Revision 2, at QCNPS, Units 1 and 2, until the end of the fifth ISI, the acceptance criteria of Code Case N-513-3 are exceeded, or the leak rate exceeds the allowable, whichever occurs first.

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 In-service Inspector.

Principal Contributor: John Tsao

Date of issuance: March 19, 2015

If you have any questions, please contact the Senior Project Manager, Joel S. Wiebe at 301-415-6606 or via e-mail at Joel.Wiebe@nrc.gov.

Sincerely,

/RA/

Travis L. Tate, Chief
Plant Licensing III-2 and
Planning and Analysis Branch
Division of Operating Reactor Licensing
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Docket No(s). 50-277, 50-278, 50-254, and 50-265

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