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

November 10, 2015

Mr. Bryan C. Hanson
President and Chief Nuclear Officer
Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3 - SAFETY EVALUATION OF RELIEF REQUEST I4R-56 ASSOCIATED WITH THE COMMON EMERGENCY SERVICE WATER SYSTEM PIPING (CAC NOS. MF6551 AND MF6552)

Dear Mr. Hanson:

By letter dated July 29, 2015, as supplemented by letters dated August 13, 2015, and September 11, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML15210A750, ML15225A592, and ML15254A545, respectively), Exelon Generation Company, LLC (Exelon, 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 (ASME) *Boiler and Pressure Vessel Code* (Code) Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," Code Case N-513-3, "Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping," as conditioned in Regulatory Guide 1.147, Revision 17, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," for Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3. Specifically, in Relief Request I4R-56, the licensee proposed the deferral of the repair of a through-wall leak in a section of piping in the emergency service water (ESW) system until the fall 2016 refueling outage for PBAPS, Unit 2. The affected section of piping is common to both units. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee requested to use the proposed 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 relief request applies to the fourth 10-year inservice inspection interval at PBAPS, Units 2 and 3.

The NRC staff completed its review of the relief request and provided verbal authorization of the proposed alternative in a conference call with Exelon on September 17, 2015. The NRC staff issued a summary of the conference call on September 18, 2015 (ADAMS Accession No. ML15260A503). The NRC Office of Nuclear Reactor Regulation principal staff members who participated in the conference call with Mr. David Helker and other members of the Exelon staff included:

Mr. David W. Alley	Chief, Component Performance, Non-Destructive Examination and Testing Branch Division of Engineering

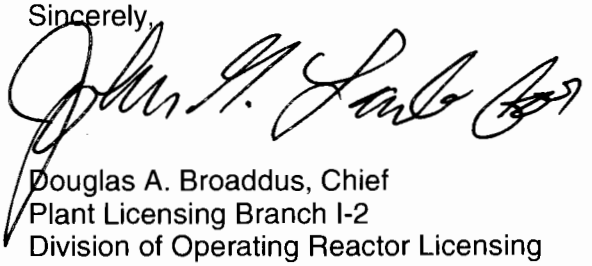
Mr. Robert H. Davis	Senior Materials Engineer, Component Performance, Non-Destructive Examination, and Testing Branch Division of Engineering
Mr. Douglas A. Broaddus	Chief, Plant Licensing Branch I-2 Division of Operating Reactor Licensing
Mr. Richard B. Ennis	Senior Project Manager, Plant Licensing Branch I-2 Division of Operating Reactor Licensing

The enclosed Safety Evaluation (SE) documents the basis on which the NRC staff verbally authorized the proposed alternative. As discussed in the SE, the NRC staff concluded that the proposed alternative provides reasonable assurance of the structural integrity of the ESW system. The NRC staff finds that complying with the requirements of ASME Code, Section XI, Code Case N-513-3, would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concluded that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2). Therefore, the NRC authorized the use of Relief Request I4R-56 at PBAPS, Units 2 and 3, through the end of the next Unit 2 refueling outage scheduled to begin October 2016, or until the system leak rate exceeds 5 gallons per minute, whichever occurs first.

All other requirements of the ASME Code, Section XI, and Code Case N-513-3 for which relief has not been specifically requested and authorized by the NRC staff remain applicable, including a third party review by the Authorized Nuclear Inservice Inspector.

If you have any questions concerning this matter, please contact the Limerick Project Manager, Mr. Richard Ennis, at (301) 415-1420 or Rick.Ennis@nrc.gov.

Sincerely,



Douglas A. Broaddus, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-277 and 50-278

Enclosure:
Safety Evaluation

cc w/enclosure: Distribution via Listserv

UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST I4R-56 ASSOCIATED WITH THE COMMON

EMERGENCY SERVICE WATER SYSTEM PIPING

EXELON GENERATION COMPANY

PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3

DOCKET NOS. 50-277 AND 50-278

1.0 INTRODUCTION

By letter dated July 29, 2015, as supplemented by letters dated August 13, 2015, and September 11, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML15210A750, ML15225A592, and ML15254A545, respectively), Exelon Generation Company, LLC (Exelon, 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 (ASME) *Boiler and Pressure Vessel Code* (Code), Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," Code Case N-513-3, "Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping, Section XI, Division 1," as conditioned in Regulatory Guide (RG) 1.147, Revision 17, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," for Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3. Specifically, in Relief Request I4R-56, the licensee proposed the deferral of the repair of a through-wall leak in a section of piping in the emergency service water (ESW) system until the fall 2016 refueling outage for PBAPS, Unit 2. The affected section of piping is common to both units. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee requested to use the proposed 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 relief request applies to the fourth 10-year inservice inspection interval at PBAPS, Units 2 and 3.

On September 17, 2015, the NRC staff authorized the use of Relief Request I4R-56 at PBAPS, Units 2 and 3 (ADAMS Accession No. ML15260A503), for the current Unit 2 operating cycle, through the end of the Unit 2 refueling outage scheduled to begin in October 2016, or until system leakage exceeds 5 gallons per minute (gpm), whichever occurs earlier.

2.0 REGULATORY EVALUATION

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. The regulation in 10 CFR 50.55a(g)(4)(ii) permits the use of Code Cases listed in RG 1.147, Revision 17, when using Section XI.

The regulation in 10 CFR 50.55a(z) states, in part, that alternatives to the requirements of paragraph (b) through (h) 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 PBAPS, Units 2 and 3.

3.0 TECHNICAL EVALUATION

3.1 Proposed Relief Request I4R-56

ASME Code Component(s) Affected

ASME Code Class 3 ESW system piping common to PBAPS, Units 2 and 3.

The affected section of piping is 12-inch nominal pipe size, 0.375-inch wall thickness, American Society for Testing Materials A106 Grade B material, classified as ASME Code Class 3, with a design pressure of 150 pounds per square inch gauge (psig) at 100 degrees Fahrenheit (°F). The maximum operating pressure is 58 psig, and the maximum operating temperature is 92 °F. The standby operating pressure is 45 psig.

Applicable Code Edition and Addenda

The original Construction Code for the affected ESW piping is the 1967 Edition of American National Standards Institute (ANSI) B31.1, "Power Piping Code."

The applicable Code of Record for the fourth 10-year inservice inspection interval at PBAPS, Units 2 and 3, which began on November 5, 2008, and concludes on November 4, 2018, is the 2001 Edition with 2003 Addenda of ASME Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components."

Applicable Code Requirement

ASME Section XI 2001 Edition through 2003 Addenda, Subsection IWA-4000, "Repair/Replacement Activities," allows the use of Code Cases.

The licensee proposes to use an alternative to ASME Code Case N-513-3 as conditioned by RG 1.147. Section 2(h) of Code Case N-513-3 requires that repair or replacement be performed

no later than when the predicted flaw size exceeds the acceptance criteria, or the next scheduled outage, whichever occurs first. RG 1.147 also specifies, as a condition for use, that when using Code Case N-513-3, repair or replacement activities temporarily deferred under the provisions of this Code Case shall be performed during the next scheduled outage.

Proposed Alternative

The licensee is proposing to defer replacement of an ESW system pipe spool containing a pinhole leak until the Unit 2 refueling outage in October 2016, in lieu of adhering to the requirements of Code Case N-513-3, as conditioned by RG 1.147, which requires the repair to be performed during the upcoming Unit 3 refueling outage in September 2015. The licensee also proposes, as part of its alternative, to set a 5 gpm leakage limit as part of its relief request. The licensee is proposing its alternative in accordance with 10 CFR 50.55a(z)(2) on the basis that a Unit 2 shutdown during the Unit 3 refueling outage would result in a hardship without a compensating increase in the level of quality or safety. Specifically, the licensee stated that it would result in an unnecessary Unit 2 transient, additional personnel radiological exposure, and a potential adverse effect on electrical grid stability.

With the exception of deferring the repair of the piping section until the Unit 2 refueling outage in October 2016, the licensee stated that it will adhere to all of the requirements listed in Code Case N-513-3.

Basis for Use

On May 3, 2015, the licensee detected a pinhole leak in a section of 12-inch ESW system piping. The leak is located very close to the ceiling of the Unit 2 reactor building sump room, directly below the Unit 2 reactor building closed cooling water room floor. This section of piping is part of the main ESW header that provides ESW flow to the Unit 2 emergency core cooling system (ECCS) coolers. However, it is physically connected to common piping, which also provides flow to the Unit 3 ECCS room coolers and to the common emergency diesel generators. Isolating the leak location during the Unit 3 outage would result in a technical specification required shutdown of Unit 2 (i.e., would result in a dual unit shutdown). The licensee evaluated this location for repair by branch connection, weld overlay, and pipe sleeve. The licensee determined that none of those options could be performed due to the proximity of the leak to the structural penetration that the pipe passes through.

The ESW system consists of two independent loops (A and B), with one 100 percent capacity pump per loop. Due to through-valve leakage of valve MO-2-33-2972, the leaking piping section cannot be isolated for replacement without a Unit 2 shutdown. Code Case N-513-3, as conditioned by RG 1.147, allows for the continued operation of Class 3 moderate energy piping systems with through-wall flaws under certain conditions, such as those present in the PBAPS, Unit 2 and 3, ESW system. However, repair or replacement activities deferred under the provisions of Code Case N-513-3, as conditioned by RG 1.147, must be performed during the next scheduled outage.

The leakage rate at the time of discovery was identified as 0.0048 gpm. Based on the leakage rate and the known system standby operation pressure of 45 psig, the licensee computed the size of the pinhole orifice to be approximately 0.0064-inch. Based on the computed pinhole orifice size, the licensee anticipated that the leakage during system operation would increase to

0.009 gpm. The highest identified leakage through the flaw during re-inspections at both standby and operating conditions was 0.0117 gpm.

The licensee stated that based on a review of historical PBAPS-specific corrosion data, it determined the corrosion rate for the flaw to be 12 mils per year (mpy) (1 mil = 0.001-inch) in each direction, or a total growth of the flaw or 24 mpy. Based on the corrosion rate, the licensee determined that the through-wall flaw is expected to increase by 34 mils before the start of the Unit 2 outage, for a final hole diameter of 0.0404-inch. The licensee calculated an expected leakage rate of 0.373 gpm at system operational pressure for a hole diameter of 0.0404-inch.

The licensee stated that the minimum required system flow rate at a maximum river temperature of 92 °F is 3133 gpm. Recent testing performed by the licensee has shown a measured flow rate of 3,824 gpm for the "A" ESW pump and 3,851 gpm for the "B" ESW pump. Given that the minimum required system flow rate is 3,133 gpm, there is a resulting margin of a 691 gpm when compared to the measured pump flow rate with one pump running. The licensee stated that a 3113 gpm flow rate is based on the worst-case accident scenario for each heat exchanger and is representative of ESW system balanced flow with 100 percent flow to the Unit 2 and Unit 3 ECCS unit coolers and the diesel generator coolers. The licensee further stated that a 3,113 gpm flow rate is sufficient to mitigate the consequences of a design-basis accident on one unit, while bringing the other unit to a safe shutdown condition. The licensee proposed, as part of its alternative, to set a maximum allowable leakage rate of 5 gpm.

The licensee calculated a minimum required pipe wall thickness of 0.063-inch. Non-destructive examination utilizing ultrasonic testing (UT) was performed in the area of the pinhole, and it was determined that an area 0.75-inch in diameter around the pinhole was below the minimum required wall thickness. UT examinations also identified that an area of 4.6-inch x 5.30-inch around the flaw was less than 87.5 percent (i.e., 0.328-inch) of nominal wall thickness (i.e., 0.375-inch). Based on the flaw characterization, the licensee determined that the most likely failure mode is under-deposit corrosion influenced by microbial activity.

The licensee performed an analysis, in accordance with Code Case N-513-3, using a flaw size (area below minimum wall thickness) of 0.75-inch in diameter and found the flaw to be acceptable, in accordance with Code Case N-513-3. Using a corrosion rate of 12 mpy in each direction, the licensee expects that the area that is below minimum wall thickness will grow by 34 mils before the scheduled Unit 2 refueling outage, which corresponds to a flaw size of 0.784-inch. The licensee also analyzed the expected additional flaw growth prior to the October 2016 Unit 2 refueling outage by using a bounding conservative flaw size of 1.5-inch in diameter. The licensee also calculated the allowable through-wall flaw lengths in accordance with Code Case N-513-3. The allowable through-wall flaw lengths calculated by the licensee are 8 inches in the axial direction and 13.5 inches in the circumferential direction.

The licensee stated that successive 30-day UT examinations have been performed of the leak location as required by Code Case N-513-3, with no detectable growth in the flaw. Augmented inspections on surrounding and similar piping as required by Code Case N-513-3 were performed by the licensee. Of the five areas inspected as extent of condition, the licensee stated that none have an expected life less than 9 years based on a low reading of 0.134-inch of pipe wall thickness.

The licensee stated that the assurance of quality and safety in the extended period of time between September 2015 and October 2016 is based on 1) the small size of the indication; 2) the results of the Code Case N-513-3 evaluation, which demonstrates structural integrity of the pipe; 3) the large capacity of the current flow margin; 4) the flaw growth analysis demonstrating that the flaw will not grow beyond and current acceptance criteria; and 5) a Code Case N-513-3 required daily leak check and UT flaw examination every 30 days.

Duration for the Proposed Alternative

The licensee requested relief though the current PBAPS, Unit 2, operating cycle and refueling outage scheduled to begin in October 2016.

3.2 NRC Staff Evaluation

The licensee is currently utilizing Code Case N-513-3, as conditioned by RG 1.147, to continue to operate Units 2 and 3 with degraded ESW system piping that contains a pinhole leak. Given that the ESW system is common to Units 2 and 3, the degraded piping must be repaired or replaced, in accordance with Code Case N-513-3 Section 2(h), as conditioned by RG 1.147, at the next scheduled outage, which is the Unit 3 outage in September 2015. As discussed above, the licensee seeks to defer replacement of the degraded pipe section until the Unit 2 scheduled refueling outage in October 2016. The licensee currently meets all requirements associated with its use of the Code Case.

To temporarily accept a degraded pipe to remain in service, Code Case N-513-3 requires the licensee to perform flaw characterization, flaw evaluation, periodic monitoring, and extent of condition examinations.

Flaw Characterization and Structural Analysis

The licensee characterized the flaw geometry in accordance with Code Case N-513-3 by UT examination. The licensee's characterization of the flaw included the flaw area and the entire circumference of the pipe at the flaw location. The licensee also performed shear wave UT of the flaw area to verify the absence of crack-like indications. The licensee calculated the minimum required wall thickness of the pipe section in accordance with Code Case N-513-3 and determined the minimum required wall thickness to be to 0.063-inch. The NRC staff reviewed the licensee's May 4, 2015, UT examination report. The report shows a 0.75-inch diameter area around the pinhole to be less than 0.063-inch. The UT report also identified that an area of 4.6-inch x 5.30-inch around the flaw was less than 87.5 percent (i.e., 0.328-inch) of nominal wall thickness (i.e., 0.375-inch). Given the licensee's characterization of the flaw, the area around the flaw and the absence of flaws in the circumference of the pipe, as well as the absence of any crack-like indications, the NRC staff finds that the most likely cause of the degradation that caused the pin-hole leak is under-deposit corrosion influenced by microbial activity.

Based on historical PBAPS corrosion data, the licensee stated that the corrosion rate for the leak was determined to be 12 mpy in each direction, or a total diameter growth of the flaw by 24 mpy. As a result, the area that is below minimum wall thickness (0.063-inch) is expected to grow by 34 mils, resulting in a flaw size of 0.784-inch by October 2016. The NRC staff reviewed the licensee's flaw evaluation included in its July 29, 2015, and September 11, 2015, letters. The licensee calculated the stress intensity factors at the system design pressure (150 psig),

assuming a conservative flaw size of 1.5-inch, which the NRC staff notes is considerably larger than the anticipated flaw size (0.784-inch) at the beginning of the Unit 2 outage in October 2016. The resulting stress intensity factor values (normal/upset and emergency/faulted conditions) for axial and circumferential flaws were well below the allowable fracture toughness of the piping material. The licensee also calculated the maximum allowable through-wall flaw size at the maximum system operation pressure of 58 psig. The licensee's evaluation shows that the maximum allowable through-wall flaw size, based on fracture toughness of the piping material, is 8 inches in the axial direction and 13.5 inches in the circumferential direction.

The NRC staff finds that the licensee has demonstrated by structural analysis, based on the requirements of Code Case N-513-3, that a flaw considerably larger than the projected flaw size at the beginning of the Unit 2 scheduled refueling outage will not challenge the structural integrity of the degraded ESW piping section. In addition, the 5 gpm leakage limit imposed by the licensee provides an additional layer of protection for the safe operation of the plant with the section of degraded pipe.

Flooding Analysis

In the licensee's July 29, 2015, letter, it stated that a combined minimum ESW cooling water flow of 3,133 gpm is sufficient to mitigate the consequences of a design-basis accident on one unit, while bringing the other unit to a safe shutdown condition. Recent testing of "A" and "B" ESW pumps shows a measured flow rate of 3,824 gpm and 3,851 gpm, respectively. The margin provided is 691 gpm and is sustainably larger than the maximum allowable leakage rate of 5 gpm set by the licensee. This substantial margin provides a considerable amount of time for the licensee to take corrective actions, should leakage increase beyond 5 gpm, which would require a plant shutdown.

The licensee stated in its August 13, 2015, letter, that its flooding analysis determined that at a 5 gpm leakage rate, it would take approximately 19 hours for the water to reach a level at which safety-related equipment may begin to be affected. The licensee also stated that the Unit 2 reactor building sump room is equipped with two 100 gpm sump pumps, which have alarm indications that notify the control room of high sump levels.

The NRC staff finds that the licensee has appropriately taken into consideration the impact of the leakage on system operation. The NRC staff also finds that the licensee has appropriately taken into consideration the impact of flooding on safety-related components as part of flooding analysis. Therefore, the NRC staff finds that the licensee's analysis on the impact of leakage on system operation and its flooding analysis are acceptable.

Inspections

As required by N-513-3, Section 2(f), the licensee has conducted daily walkdowns to verify that the analysis conditions used in the evaluation remain valid. Section 2(e) of the Code Case requires periodic inspections of no more than 30-day intervals shall be used to determine if the flaw is growing. The licensee is currently conducting these inspections and will continue to perform them until the October 2016, Unit 2, refueling outage. Daily visual inspections, as well subsequent 30-day UT examinations performed by the licensee on June 1, June 29, and July 27, 2015, showed that there has been no measurable increase in the flaw size or leak rate. The NRC staff reviewed the aforementioned 30-day UT examination reports and verified that the

report results show no measurable increase in the degraded area of the pipe. The staff finds that the licensee's inspection program for the degraded pipe has satisfied, and will continue to satisfy, the requirements of Code Case N-513-3 and is, therefore, acceptable.

Hardship Justification

The NRC staff finds that shutting down Unit 2 during the upcoming Unit 3 refueling outage would result in additional radiological exposure to personnel and an unnecessary plant transient, resulting in undue hardship. The NRC staff has determined that no compensating increase in the level of quality and safety would be gained by performing an ASME Code repair during the Unit 3 refueling outage in September 2015, in lieu of performing the repair during the Unit 2 scheduled refueling outage in October 2016.

4.0 CONCLUSION

As set forth above, the NRC staff finds that the proposed alternative provides a reasonable assurance of structural integrity of the ESW system at PBAPS, Units 2 and 3. The NRC staff finds that complying with the requirements of ASME Code, Section XI, Code Case N-513-3, Section 2(h), 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(z)(2).

Therefore, the NRC authorizes the use of Relief Request I4R-56 at PBAPS, Units 2 and 3, until the end of the next Unit 2 refueling outage scheduled to begin October 2016, or until the leak rate exceeds 5 gpm, whichever occurs first.

All other requirements of the ASME Code, Section XI, and Code Case N-513-3 for which relief has not been specifically requested and authorized by the NRC staff remain applicable, including a third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: Robert Davis

Date: November 10, 2015