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

CORRECTION TO SAFETY EVALUATION BY

THE OFFICE OF NUCLEAR REACTOR REGULATION

PROPOSED ALTERNATIVE TO UTILIZE ASME CODE CASE N-789-1

EXELON FITZPATRICK, LLC

EXELON GENERATION COMPANY, LLC

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

DOCKET NO. 50-333

1.0 INTRODUCTION

By letter dated May 4, 2017 (Agencywide Documents Access and Management System Accession No. ML17124A303), Exelon Generation Company, LLC (Exelon, the licensee) requested relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, IWA-4000, for the repair of Class 2 and 3 moderate energy carbon steel raw water service system piping at the James A. Fitzpatrick Nuclear Power Plant (FitzPatrick).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee proposed an alternative to use ASME Code Case N-789-1, "Alternative Requirements for Pad Reinforcement of Class 2 and 3 Moderate-Energy Carbon Steel Piping for Raw Water Service, Section XI, Division 1," for the repair of the cooling water system piping on the basis that complying with the specified ASME Code requirement to repair the subject piping would result in hardship and/or unusual difficulty without a compensating increase in the level of quality and safety.

2.0 REGULATORY EVALUATION

Article IWA-4400 of the ASME Code, Section XI, requires that unacceptable flaws in ASME Code Class 2 and 3 components be corrected by repair or replacement activity or be accepted by supplemental examination and flaw 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 preservice examination requirements, set forth in the ASME Code, Section XI.

Enclosure

The regulation in 10 CFR 50.55a(z) 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, and the Commission to authorize, the alternative requested by the licensee.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Components Affected

The affected components are ASME Code Class 2 and 3 moderate energy, carbon steel, raw water piping systems. Raw water is defined as water such as river, lake, well, or brackish/salt water used in plant equipment, area coolers, and heat exchangers. Moderate energy is defined as less than or equal to 200 degrees Fahrenheit (°F) (93 degrees Celsius (°C)) and less than or equal to 275 pounds per square inch gauge (psig) (1.9 MPa) maximum operating conditions.

3.2 ASME Code Edition and Addenda

The applicable Code of record for the fifth 10-year inservice inspection interval (ISI) at FitzPatrick is ASME Code Section XI, 2007 Edition through the 2018 Addenda.

3.3 ASME Code Requirements

ASME Code, Section XI, IWA-4000 provides requirements for welding, brazing, metal removal, and installation of repair/replacement activities.

3.4 Licensee's Reason for Request

In accordance with 10 CFR 50.55a(z)(2), Exelon requested a proposed alternative from the requirement for replacement or internal weld repair of wall thinning conditions resulting from degradation in Class 2 and 3 moderate energy carbon steel raw water piping systems in accordance with IWA-4000. Such degradation may be the result of mechanisms such as erosion, corrosion, cavitation, and pitting, but excluded are conditions involving flow-accelerated corrosion, corrosion-assisted cracking, or any other form of cracking. IWA-4000 requires repair or replacement in accordance with the owner's requirements and the original or later Construction Code. Other alternative repair or evaluation methods are not always practicable because of wall thinness and/or moisture issues. The primary reason for this request is to permit installation of a technically sound temporary repair to provide adequate time for evaluation, design, material procurement, planning, and scheduling of appropriate, permanent repair or replacement of the defective piping, considering the impact on system availability, maintenance rule applicability, and availability of replacement materials.

Performing Code repair/replacement in lieu of implementing this relief request would, in some cases, necessitate extending technical specification actions to install a permanent repair/replacement, putting the plant at higher safety risks compared with the short time necessary to install a technically sound pad repair. Use of N-789-1 may avoid a plant shutdown in situations where it may be necessary to shut the plant down for a Code repair/replacement

activity. This could result in an unnecessary plant transient and the loss of safety system availability, as compared to maintaining the plant online.

Use of Code Case N-789-1 during refueling outages will enable a greater number of scheduled corrosion inspections during the outages. The ability to install non-intrusive repair pads rather than scheduling contingency plans for piping replacement will enable longer corrosion inspection windows, increased scope of inspection, and improved overall plant safety.

3.5 Licensee's Proposed Alternative and Basis for Use

In accordance with 10 CFR 50.55a(z)(2), Exelon proposed to implement the requirements of ASME Code Case N-789-1 ("Alternative Requirements for Pad Reinforcement of Class 2 and 3 Moderate-Energy Carbon Steel Piping for Raw Water Service, Section XI, Division 1") as a temporary method to repair degradation in Class 2 and 3 moderate energy raw water piping systems resulting from mechanisms such as erosion, corrosion, cavitation, or pitting, but excluding conditions involving flow-accelerated corrosion, corrosion-assisted cracking, or any other form of cracking. These types of defects are typically identified by small leaks in the piping system or by preemptive non-Code required examinations performed to monitor the degradation mechanisms.

The alternative repair technique described in Code Case N-789-1 involves the application of a metal reinforcing pad welded to the exterior of the piping system, which reinforces the weakened area and restores pressure integrity. This repair technique will be utilized when it is determined that this temporary repair method is suitable for the particular defect or degradation being resolved.

Code Case N-789-1 requires that the cause of the degradation be determined and that the extent and rate of degradation in the piping be evaluated to ensure that there are no other unacceptable locations within the surrounding area that could affect the integrity of the repaired piping. The area of evaluation will be dependent on the degradation mechanism present. A baseline thickness examination will be performed for a completed structural pad, attachment welds, and surrounding area, followed by monthly thickness monitoring for the first 3 months, with subsequent frequency based on the results of this monitoring, but at a minimum of quarterly. Areas containing pressure pads shall be visually observed at least once per month to monitor for evidence of leakage. If the areas containing pressure pads are not accessible for direct observation, then monitoring will be accomplished by visual assessment of surrounding areas or ground surface areas above pressure pads on buried piping or monitoring of leakage collection systems, if available.

For the pressure pad design, the higher of two times the actual measured corrosion rate, or four times the estimated maximum corrosion rate, for the system will be used. If the actual measured corrosion rate in the degraded location is unavailable, the estimated maximum corrosion rate for the system assumed in the design will be calculated based on the same degradation mechanism as the degraded location.

Paragraph 3.2(i) of the Code Case includes an incorrect reference to NC-2650 for the flexibility analysis associated with Class 2 designs. The correct reference should be NC-3650. Exelon will comply with NC-3650.

The repair will be considered to have a maximum service life of the time until the next refueling outage when a permanent repair or replacement must be performed. Additional requirements for design of reinforcement pads, installation, examination, pressure testing, and inservice monitoring are provided in Code Case N-789-1.

Based on the above justification, the use of Code Case N-789-1 as a proposed alternative to the requirements of ASME Section XI will provide an acceptable level of quality and safety that does not impose an undue hardship. All other ASME Section XI requirements for which relief was not specifically requested and authorized by the NRC staff will remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Code Case N-789-1 has not been incorporated into NRC Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," and thus, is not available for application at nuclear power plants without specific NRC approval. Therefore, Exelon requests use of this alternative repair technique described in the Code Case by this relief request.

3.6 Duration of Proposed Alternative

The proposed alternative is for use of the Code Case for the remainder of the 10-year inspection interval as specified in Section 2.0 of the licensee's May 4, 2017, letter. When Code Case N-789-1 is approved for use by the NRC, this relief request will no longer be applied, and the Code Case, including Regulatory Guide 1.147 conditions, will be used in lieu of this relief request. Any reinforcing pads installed before the end of the 10-year ISI interval will be removed during the next refueling outage, even if that refueling outage occurs after the end of the 10-year interval.

3.7 NRC Staff Evaluation of the Alternative

The NRC staff evaluated the adequacy of the proposed alternative in maintaining the structural integrity of the repaired subject piping. The staff focused on the following key elements of the proposed alternative to use Code Case N-789-1: (1) general requirements, (2) initial evaluation, (3) design requirements, (4) water-back application, (5) installation, (6) examination, (7) pressure testing, (8) inservice monitoring, and (9) hardship justification.

The NRC staff notes that many requirements specified in Code Case N-789-1 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. Any exceptions to the Code Case that are approved in this safety evaluation also need to be followed.

3.7.1 General Requirements

The NRC staff notes that the proposed alternative requires the reinforcing pad be applied in accordance with a repair/replacement plan satisfying the requirements of the ASME Code, IWA-4150. The design, materials, and installation requirements of the Construction Code and IWA-4000, except as stated in the Code Case, must be satisfied.

Code Case N-789-1 includes the following limitations: (1) the repair cannot be applied if the minimum required thickness of reinforcing pad necessary to satisfy the requirements of Section 3 of the Code Case is greater than the nominal thickness for the size and schedule of the piping; (2) additional reinforcement or repair on top of an existing reinforcing pad is

prohibited; (3) reinforcing pads, including those installed during a refueling outage, shall not remain in service beyond the end of the next refueling outage; and (4) the repair is only applicable to piping not required to be ultrasonically examined for ISI.

The NRC staff finds that the proposed general requirements, including limitations, are appropriate and, therefore, acceptable.

3.7.2 Initial Evaluation

The NRC staff finds that the proposed initial evaluation in Code Case N-789-1 is acceptable because: (1) prior to installing the reinforcing pad, the proposed alternative requires that the base metal be ultrasonically examined to determine the cause and rate of degradation; (2) if the cause of damage is determined to be flow-accelerated corrosion, corrosion-assisted cracking, or any other form of cracking, the licensee will not use this Code Case to repair the subject piping; and (3) the proposed alternative requires an inspection be performed to determine the condition of the subject piping.

3.7.3 Design Requirements

The licensee stated that paragraph 3.2(i) of Code Case N-789-1 includes an incorrect reference to NC-2650 for the flexibility analysis associated with Class 2 designs. The correct reference should be NC-3650, and the licensee stated that it will comply with NC-3650. The NRC staff finds that the reference to NC-2650 in paragraph 3.2(i) of Code Case N-789-1 is incorrect; the correct reference is NC-3650, as stated by the licensee. Therefore, the staff finds the licensee's use of NC-3650 in lieu of NC-2650 to be acceptable.

The NRC staff finds that the reinforcing pads will be designed in accordance with the applicable requirements of the Construction Code or the ASME Code, Section III (NC-3100; ND-3100; NC-3600; and ND-3600, including Appendix II). The NRC staff notes that the proposed alternative clearly defines the pressure pads and structural pads such that each type of pad will be applied for specific pipe degradation and purpose.

The NRC staff notes that Code Case N-789-1, paragraph 3.1(a)(1), specifies that a pressure pad is designed with a corrosion rate of either two times the actual measured corrosion rate in that location or four times the estimated maximum corrosion rate for the system. The licensee stated that if the actual measured corrosion rate in the degraded location is unavailable, the estimated maximum corrosion rate for the system assumed in the design will be calculated based on the same degradation mechanism as the degraded location.

For the structural pad, the corrosion rate will be based on paragraph 3.2(f) in the Code Case, which requires that the predicted maximum degradation of the reinforced piping until the next refueling outage be included in the design. The predicted degradation of the piping will be based on in-situ inspection of, and established data for, similar base metals in similar environments. The proposed alternative requires that if the reinforcing pad is predicted to become exposed to the raw water, the predicted degradation of the reinforcing pad shall be based upon established data for base metals or weld metals with similar chemical composition to that used for the reinforcing pad.

The NRC staff notes that the Code Case does not provide a specific corrosion rate determination for the structural pad. It is not clear to the staff that the corrosion rate used in the structural pad design would be bounding other than by the fact that the structural pad will be

designed for the duration until the next refueling outage. As a compensatory measure, the proposed alternative does require inservice monitoring to ensure the structural integrity of the repaired pipe using a structural pad. In addition, the proposed repair is limited to a maximum duration of one operating cycle. This relatively short duration of application should limit the degradation. However, should the actual corrosion rate exceed the projected corrosion rate during the operating cycle, and a leak develop at or around the installed pad, the proposed inservice monitoring will be able to detect such leakage, and the operator will be able to take corrective action.

The NRC staff notes that by the next refueling outage, the structural pad will be designed with partial penetration attachment welds that extend for a distance in each direction beyond the area predicted to infringe upon the required thickness. Final configuration of the structural pad (including attachment welds) will permit the examinations and evaluations required herein, including any required preservice or inservice examinations of encompassed or adjacent welds. The proposed alternative requires that the thickness of the reinforcing pad be sufficient to maintain required thickness until the next refueling outage.

Despite some concern about the corrosion rate used in the structural pad design, the NRC staff finds that the proposed alternative will provide reasonable assurance of the structural integrity and leakage integrity of the repaired piping until the next refueling outage because: (1) the structural pad will be designed to maintain required thickness until the next refueling outage, and (2) the proposed alternative requires periodic inservice monitoring as discussed further in this safety evaluation. Therefore, the NRC staff finds the aforementioned design requirements to be acceptable.

3.7.4 Water-Backed Applications

The proposed alternative requires the use of the shielded metal arc welding process with low-hydrogen electrodes for the attachment welds on water-backed piping. The proposed alternative further requires precaution be taken when welding a reinforcing pad to a leaking area. For piping materials other than P-No. 1, Group 1, the proposed alternative requires a surface examination that is to be performed no sooner than 48 hours after completion of welding. The NRC staff notes that waiting 48 hours after welding ensures that if delayed hydrogen cracking were to occur, it would be detected during the surface examination. Therefore, the NRC staff finds the proposed requirements for water-backed application to be acceptable.

3.7.5 Installation

The NRC staff finds that the proposed alternative requires the use a qualified welding procedure in accordance with the ASME Code, Section IX, and the Construction Code, in addition to requirements specified in the Code Case. Therefore, the NRC staff finds the proposed installation requirements to be acceptable.

3.7.6 Examination

The proposed alternative requires a surface examination (liquid penetrant or magnetic particle) and volumetric examination be performed of the pad, weld, and base metal after the reinforcing pad is welded to the pipe in accordance with Section III of the ASME Code or the Construction Code. The NRC staff finds the proposed acceptance examination follows Section III of the

ASME Code and the Construction Code. Therefore, the staff finds the proposed acceptance examinations to be acceptable.

3.7.7 Pressure Testing

The proposed alternative requires that a system leakage test will be performed in accordance with IWA-5000 prior to, or as part of, returning the system to service. In addition, reinforcing pads attached to piping that have not been breached shall be equipped with pressure taps for performance of pressure testing. The NRC staff finds that the proposed pressure testing is acceptable because it is consistent with IWA-5000 of the ASME Code, Section XI.

3.7.8 Inservice Monitoring

For the structural pad, the proposed alternative requires that the pad be examined using ultrasonic or direct thickness measurement to record the thickness of the plate; the thickness at the attachment welds, including the underlying base metal; and, to the extent examinable in a 3-inch wide band, the thickness surrounding the repair as a baseline for subsequent monitoring of the repair. The licensee will monitor the structural pad monthly for the first quarter. The subsequent frequency will be based on the results of the monitoring activities, but at least quarterly.

For the pressure pad, the proposed alternative requires that the areas containing the pad be visually examined monthly for evidence of leakage. If the areas containing the pressure pad are not accessible for direct observation, the licensee will observe surrounding areas or ground surface areas above pressure pads on buried piping or leakage collection systems, if available.

The licensee stated that if the results of the monitoring program identify leakage or indicate that the structural margins required by the Code Case will not be maintained until the next refueling outage, the pad will be removed, and repair/replacement activities shall be performed prior to encroaching on the design limits.

The NRC staff finds that the proposed inservice monitoring requirements are acceptable because: (1) the frequency and the examination method are adequate to monitor the structural integrity of the pressure pad and structural pad, and (2) the acceptance criteria for the pressure pad and structural pad are clearly defined and adequate.

3.7.9 Applicable Duration

The licensee requested to use the proposed alternative for the fifth 10-year inspection interval or until such time that Code Case N-789-1 is approved for use by the NRC. The fifth 10-year ISI interval at FitzPatrick began on June 16, 2017, and is scheduled to end on June 15, 2027. The licensee clarified that any reinforcing pads installed before the end of the 10-year ISI interval will be removed during the next refueling outage, even if that refueling outage occurs after the end of the 10-year interval. Installed reinforcing pads are designed to support a maximum of one cycle of operation from one refueling outage to the next refueling outage. The NRC staff finds that installed reinforcing pads are acceptable to remain in service beyond the end date of the 10-year ISI interval if that interval end date falls midcycle and if the pad is removed in the next scheduled refueling outage.

3.7.10 Hardship Justification

The NRC staff finds that performing a plant shutdown to repair the subject piping would cycle the unit and increase the potential of an unnecessary transient, resulting in undue hardship. Additionally, performing the ASME Code repair during normal operation could necessitate extending technical specification actions, thus placing the plant at higher safety risk than warranted. Therefore, the NRC staff determines 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.

3.8 Summary

The NRC staff finds that the proposed alternative will provide reasonable assurance of the structural integrity and leaktightness of the repaired cooling water system pipe because: (1) the scope of the application is clearly defined; (2) the pressure pad and structural pad will be designed in accordance with the Construction Code and ASME Code, Section III, and specific requirements as specified in Code Case N-789-1; (3) the degraded pipe will be examined and evaluated prior to the repair; (4) acceptance examinations will be performed to verify the condition of the repair; (5) the inservice monitoring will be performed to verify the pipe wall thickness and potential degradation; and (6) pressure testing will be performed in accordance with IWA-5000 of the ASME Code, Section XI.

4.0 CONCLUSION

As set forth above, the NRC staff finds that complying with IWA-4000 of the ASME Code, Section XI, would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The staff finds that the licensee demonstrated its proposed alternative to use Code Case N-789-1 will provide reasonable assurance that the structural integrity and leakage integrity of the subject cooling water system piping will be maintained. 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). The NRC staff authorizes the proposed alternative as documented in the submittal dated May 4, 2017, for the temporary repair of Class 2 and 3 moderate energy carbon steel raw water service piping at FitzPatrick for the fifth 10-year inspection 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.

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