



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

September 10, 2018

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

**SUBJECT: JAMES A. FITZPATRICK NUCLEAR POWER PLANT – ISSUANCE OF RELIEF
FROM THE REQUIREMENTS OF THE ASME CODE N-702 FOR PLANT
NOZZLE-TO-VESSEL WELDS AND INNER RADII EXAMINATIONS
(EPID L-2017-LLR-0093)**

Dear Mr. Hanson:

By letter dated September 29, 2017, as supplemented by letter dated March 2, 2018, Exelon Generation Company, LLC (the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for relief from certain American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI requirements regarding the fifth 10-year inservice inspection program 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)(1), the licensee requested to use the proposed alternatives on the basis that the alternatives provide an acceptable level of quality and safety.

This alternative is requested for the duration of the FitzPatrick fifth 10-year inservice inspection interval beginning on August 1, 2017, and scheduled to end on June 15, 2027, and also for the remaining term of the FitzPatrick Renewed Operating License, which expires on October 17, 2034. Conditions are defined in NRC Regulatory Guide 1.147, Revision 17.

The NRC staff has reviewed the subject request and 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)(1).

B. Hanson

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If you have any questions, please contact the Project Manager, Tanya Hood, at 301-415-1387 or Tanya.Hood@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "James G. Danna". The signature is fluid and cursive, with a large initial "J" and a long, sweeping underline.

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

Docket No. 50-333

Enclosure:
Safety Evaluation

cc: Listserv



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

RELIEF REQUEST NO. 15R-05, TO UTILIZE ASME CODE CASE N-702

EXELON FITZPATRICK, LLC AND EXELON GENERATION COMPANY, LLC

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

DOCKET NO. 50-333

1.0 INTRODUCTION

By letter dated September 29, 2017,¹ as supplemented by letter dated March 2, 2018,² Exelon Generation Company, LLC (Exelon, the licensee) submitted Relief Request 15R-05 to the U.S. Nuclear Regulatory Commission (NRC or the Commission) for relief from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (B&PV Code), Section XI, Table IWB-2500-1, regarding the fifth 10-year inservice inspection (ISI) program at the James A. FitzPatrick Nuclear Power Plant (FitzPatrick). This alternative is requested for the duration of the FitzPatrick fifth 10-year inservice inspection interval beginning on August 1, 2017, and scheduled to end on June 15, 2027, and also for the remaining term of the FitzPatrick Renewed Operating License, which expires on October 17, 2034.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1), the licensee proposes to use the inspection requirements documented in ASME Code Case N-702, "Alternative Requirements for Boiling Water Reactor (BWR) Nozzle Inner Radius and Nozzle-to-Shell Welds, Section XI, Division 1." For the VT-1 visual examinations allowed by ASME Code Case N-702, the licensee proposes to use ASME Code Case N-648-1, "Alternative Requirements for Inner Radius Examination of Class 1 Reactor Vessel Nozzles, Section XI, Division 1," with associated required conditions specified in Regulatory Guide (RG) 1.147, Revision 17, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," dated August 2014.³ The regulation at 10 CFR 50.55a(z)(1) requires the licensee to demonstrate that the proposed alternative provides an acceptable level of quality and safety.

2.0 REGULATORY REQUIREMENTS

Section 50.55a(g) of 10 CFR states, in part, that ISI of certain ASME Code Class 1, 2, and 3 systems and components be performed in accordance with Section XI of the ASME Code, except the design and access provisions and the preservice examination requirements, and

¹ Agencywide Documents Access and Management System (ADAMS) Accession No. ML17275A208

² ADAMS Accession No. ML18064A278

³ ADAMS Accession No. ML13339A689

applicable addenda incorporated by reference in the regulations, as a way to detect anomaly and degradation indications so that structural integrity of these components can be maintained.

Section 50.55a(z) of 10 CFR states, in part, that alternatives to the requirements of paragraphs (b) through (h) of 10 CFR 50.55a, or portions thereof, must be submitted and authorized by the NRC prior to implementation. The applicant or licensee must demonstrate that: (1) the proposed alternative would provide 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.

The regulations require that inservice examination of components and system pressure tests conducted during the successive 120-month inspection intervals (following the initial 120-month inspection interval) must comply with the requirements in the latest edition and addenda of the ASME Code, which was incorporated by reference in 10 CFR 50.55a(a) 12 months before the start of the 120-month interval (or the optional ASME Code Cases listed in RG 1.147, Revision 17, subject to the conditions listed in 50.55a(b)). The applicable ASME Code of record for the fifth 10-year ISI interval for FitzPatrick is ASME Code, Section XI, 2007 Edition through the 2008 Addenda.

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 LICENSEE'S EVALUATION

3.1 Background

For all reactor pressure vessel (RPV) nozzle-to-vessel shell welds and nozzle inner radii, ASME Code, Section XI requires 100 percent inspection during each 10-year ISI interval. However, ASME Code Case N-702 provides an alternative, which reduces the inspection of RPV nozzle-to-vessel shell welds and nozzle inner radii areas from 100 percent to 25 percent of the nozzles for each nozzle type during each 10-year interval. This ASME Code Case was conditionally approved in RG 1.147, Revision 17. For application of ASME Code Case N-702, the licensee is required to address the conditions specified in RG 1.147, Revision 17, for ASME Code Case N-702:

The applicability of Code Case N-702 must be shown by demonstrating that the criteria in Section 5.0 of NRC Safety Evaluation regarding BWRVIP-108 dated December 18, 2007^[4] or Section 5.0 of NRC Safety Evaluation regarding BWRVIP-241 dated April 19, 2013^[5] are met. The evaluation demonstrating the applicability of the Code Case shall be reviewed and approved by the NRC prior to the application of the Code Case.

BWRVIP-108, "BWR Vessel and Internals Project, Technical Basis for the Reduction of Inspection Requirements for the Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Blend Radii," dated November 25, 2002,⁶ and BWRVIP-241, "BWR Vessel and Internals Project, Probabilistic Fracture Mechanics [PFM] Evaluation for the Boiling Water Reactor

⁴ ADAMS Accession No. ML073600374

⁵ ADAMS Accession No. ML13071A240

⁶ ADAMS Accession No. ML023330203

Nozzle-to-Vessel Shell Welds and Nozzle Blend Radii,” dated April 26, 2011,⁷ contain PFM analysis results supporting ASME Code Case N-702. Both reports are for 40 years of operation. BWRVIP-241 contains additional PFM results supporting revision of the evaluation criteria under “Conditions and Limitations” in the safety evaluation (SE) for BWRVIP-108. The SE for BWRVIP-241 accepted the revised criteria.

The NRC staff issued a revised SE dated April 26, 2017,⁸ for license renewal for BWRVIP-241, Appendix A, “BWR Nozzle Radii and Nozzle-to-Vessel Welds Demonstration of Compliance with the Technical Information Requirements of the License Renewal Rule (10 CFR 54.21).” This license renewal Appendix A extends the applicability of the BWRVP-108 and BWRVIP-241 methodologies, and, therefore, ASME Code Case N-702, from 40 years to the period of extended operation.

ASME Code Case N-702 allows that VT-1 visual examination may be performed in lieu of volumetric examination for Examination Item Number B3.100 nozzle inner radius sections. ASME Code Case N-648-1, as conditionally accepted by RG 1.147, Revision 17, requires that nozzle inner radius examinations must use the allowable flaw length criteria of ASME B&PV Code Table IWB-3512-1 with limiting assumptions on the flaw aspect ratio.

3.2 ASME Code Component Affected

The affected components belong to Examination Category B-D, “Full Penetration Welded Nozzles in Vessels,” under Examination Item Number B3.90, “Nozzle-to-Vessel Welds,” and B3.100, “Nozzle Inside Radius Section.”

Table 1			
RPV Nozzle-to-Vessel Welds and Inner Radii Subject to this Request			
Identification Number	Description	Total Number	Minimum Number to be Examined
N1	Recirculation Outlet	2	1
N2	Recirculation Inlet	10	3
N3	Main Steam Outlet	4	1
N5	Core Spray	2	1
N-TH-A/C	Closure Head Instrumentation	2	1
N-TH-B	Closure Head Vent	1	1
N8	Jet Pump Instrumentation	2	1

3.3 Applicable Code Edition and Addenda

This request applies to the fifth 10-year ISI interval and the remaining term of the FitzPatrick renewed operating license in which FitzPatrick adopted the 2007 Edition through the 2008 Addenda of ASME Code Section XI as the Code of Record.

⁷ ADAMS Accession No. ML111190077

⁸ ADAMS Accession No. ML17114A096

3.4 Applicable Code Requirements

ASME Section XI, Table IWB-2500-1, Examination Category B-D, requires a volumetric examination of all nozzles with full penetration welds to the vessel shell (or head) and integrally cast nozzles each 10-year interval.

3.5 Licensee's Proposed Alternative

The licensee proposed to implement ASME Code Case N-702 and reduce the ASME Code required volumetric examinations for all RPV nozzle-to-shell welds and inner radii to a minimum of 25 percent of the nozzle inner radii and nozzle-to-shell welds, including at least one nozzle from each system and nominal pipe size during each inspection interval. The required examination volume for the reduced set of nozzles remains at 100 percent of that depicted in Figures IWB-2500-7 (a) through (d), as applicable in the ASME Code.

ASME Code Case N-702 stipulates that a VT-1 examination may be used in lieu of the volumetric examination for the inner radii. The licensee stated that if a VT-1 visual examination is performed, it will be consistent with ASME Code Case N-648-1 and the associated required conditions specified in RG 1.147, Revision 17.

3.6 Licensee's Basis for Alternative

The alternative is based on the PFM results documented in the BWRVIP-241 report. The licensee proposed that it met the evaluation criteria in the SE for BWRVIP-241 as follows:

(1) Max RPV Heatup/Cooldown Rate

The maximum RPV heatup/cooldown rate is limited to $< 115^{\circ}\text{F}$ (degrees Fahrenheit)/hour.

FitzPatrick Technical Specification Surveillance Requirement 3.4.9.1 reactor coolant system heatup and cooldown rates are $\leq 100^{\circ}\text{F}$ in any one hour period and thus meet the requirement of Condition 1.

(2) Recirculation Inlet (N2) Nozzles

$(pr/t)/C_{RPV} < 1.15$, where

p = RPV normal operating pressure (psi),

r = RPV inner radius (inch),

t = RPV wall thickness (inch), and

C_{i-RPV} = Inlet RPV constant

$C_{i-RPV} = 19332$.

The FitzPatrick result based on the input parameters for this nozzle per the licensee submittal is $(pr/t)/C_{RPV} = 0.86 [(1040)(110.375)/6.875]/19332$, thus meeting the requirements of Condition 2.

(3) Recirculation Inlet (N2) Nozzles

$$[p(r_o^2 + r_i^2)/(r_o^2 - r_i^2)]/C_{\text{NOZZLE}} \leq 1.47, \text{ where}$$

p = RPV normal operating pressure
r_o = nozzle outer radius (inch),
r_i = nozzle inner radius (inch), and
C_{i-NOZZLE} = Inlet nozzle constant
C_{i-NOZZLE} = 1637.

The FitzPatrick result based on the input parameters for this nozzle per the licensee submittal is $[p(r_o^2 + r_i^2)/(r_o^2 - r_i^2)]/C_{\text{i-NOZZLE}} = 1.37$ $([1040(10.22^2 + 6.19^2)/(10.22^2 - 6.188^2)]/1637)$, thus meeting the requirements of Condition 3.

(4) Recirculation Outlet (N1) Nozzles

$$(pr/t)/C_{\text{RPV}} \leq 1.15, \text{ where}$$

r = RPV inner radius (inch),
t = RPV wall thickness (inch), and
C_{o-RPV} = Outlet RPV constant
C_{o-RPV} = 16171.

The FitzPatrick result based on the input parameters for this nozzle per the licensee submittal is $(pr/t)/C_{\text{o-RPV}} = 1.03$ $([(1040)(110.375)/6.875]/16171)$, thus meeting the requirements of Condition 4.

(5) Recirculation Outlet (N1) Nozzles

$$[p(r_o^2 + r_i^2)/(r_o^2 - r_i^2)]/C_{\text{o-NOZZLE}} \leq 1.59, \text{ where}$$

r_o = nozzle outer radius (inch),
r_i = nozzle inner radius (inch), and
C_{o-NOZZLE} = Outlet nozzle constant
C_{o-NOZZLE} = 1977.

The FitzPatrick result based on the input parameters for this nozzle per the licensee submittal is $[p(r_o^2 + r_i^2)/(r_o^2 - r_i^2)]/C_{\text{o-NOZZLE}} = 1.08$ $([1040(21.66^2 + 12.69^2)/(21.66^2 - 12.69^2)]/1977)$, thus meeting the requirements of Condition 5.

3.7 Duration of the Proposed Alternative

This alternative is requested for the duration of the FitzPatrick fifth 10-year ISI interval beginning on August 1, 2017, and scheduled to end on June 15, 2027, and for the remaining term of the FitzPatrick Renewed Operating License, which expires on October 17, 2034.

4.0 NRC STAFF EVALUATION

The NRC staff reviewed the information in Relief Request 15R-05, including the supplemental information in the letter dated March 2, 2018. The NRC staff reviewed the status of the referenced BWRVIP reports and found application of the referenced BWRVIP reports to be

acceptable, provided that the NRC conditions associated with the latest safety evaluation for each BWRVIP report are implemented.

The licensee proposed an alternative to implement ASME Code Case N-702 for all FitzPatrick RPV nozzle-to-vessel shell penetration welds and nozzle inner radii using the criteria in BWRVIP-241. The applicability of the BWRVIP-241 report to an ASME Code Case N-702 alternative is demonstrated by showing that Criteria 2 through 5 within Section 5.0 of the NRC SE for BWRVIP-241 are met for the bounding nozzles, and that Criterion 1 is met for all components included in the proposed alternative.

The NRC staff confirms that Criterion 1 is satisfied because FitzPatrick Technical Specification Surveillance Requirement 3.4.9.1 limits the maximum heatup/cool-down rate to less than or equal to 100°F/hour, well below the 115 °F/hour criterion limit.

For Criteria 2 to 5, the licensee provided plant-specific data and its evaluation of the driving force factors, or ratios, using the criteria established in Section 5.0 of the BWRVIP-241 SE. The NRC staff reviewed the licensee's calculations and confirms that they show that Criteria 2 to 5 are satisfied. Therefore, the BWRVIP-241 report is applicable, and the basis for using ASME Code Case N-702 is demonstrated for the FitzPatrick RPV nozzle-to-vessel welds and inner radii listed in Table 1 above.

By e-mail dated February 2, 2018,⁹ the NRC staff issued a request for additional information (RAI) requesting the licensee to report the probability of failure (PoF) values for low temperature overpressure (LTOP) and normal operation or discuss how the PoF values for LTOP are more limiting than those for normal operation. In its RAI response dated March 2, 2018, the licensee provided a plant-specific PFM analysis to supplement the criteria of ASME Code Case N-702 in order to demonstrate that the PoF remains acceptable over the period of extended operation.

The evaluation concluded the maximum PoF for an LTOP event is 3.0×10^{-9} per year, and the maximum PoF for normal operation is less than 8.0×10^{-9} per year. These PoFs are approximately 3 orders of magnitude lower than the acceptance criterion of 5×10^{-6} per year. Based on its review, the NRC staff finds the licensee's evaluation acceptable because the PoF due to either LTOP or normal operation is less than the NRC safety goal of 5×10^{-6} per year.

For the Examination Item Number B3.100 nozzle inner radius sections, the NRC staff finds the licensee's proposal to perform VT-1 visual examination in lieu of ultrasonic examination to be acceptable since the licensee will comply with ASME Code Case N-648-1, with associated required conditions specified in RG 1.147, Revision 17.

This alternative is requested for the duration of the FitzPatrick fifth 10-year ISI interval beginning on August 1, 2017, and scheduled to end on June 15, 2027, and for the remaining term of the FitzPatrick renewed operating license, which expires on October 17, 2034. The ASME Code Case N-702 examination requirements shall be met during this entire timeframe. Specifically, a minimum of 25 percent of nozzle inner radii and nozzle-to-shell welds, including at least one nozzle from each system and nominal pipe size, as identified in Relief Request I5R-05, will be examined during each 120-month ISI inspection interval in accordance with the conditions for the implementation of ASME Code Case N-702. These conditions are defined in RG 1.147, Revision 17. The licensee shall adhere to these requirements during both of the remaining

⁹ ADAMS Accession No. ML18033A139

FitzPatrick 10-year ISI program intervals, which span the balance of the FitzPatrick period of extended operation.

As part of its review, the NRC staff considered the duration of the request (i.e., for the remainder of the licensee's current license). The NRC staff finds the duration of the request to be acceptable because the request lies within the licensee's current license; the request is limited to demonstrating that the conditions placed on NRC approved ASME Code Case N-702 are met, and none of the inputs or calculations required to meet the NRC conditions change with time.

5.0 CONCLUSION

As set forth above, the NRC staff determines that for Relief Request 15R-05, the proposed alternative provides an acceptable 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)(1) for Relief Request 15R-05. Therefore, the NRC staff authorizes the use of the alternative request for FitzPatrick for the fifth 10-year ISI interval and the remaining term of the FitzPatrick Renewed Operating License for ASME Category B-D, Item Numbers B3.90 and B3.100, until October 17, 2034.

The NRC staff notes that if the licensee intends to take exceptions to, or deviations from, the NRC staff-approved BWRVIP inspection guidelines, this will require the licensee to revise and resubmit this relief request. The licensee shall obtain NRC staff approval for such exceptions prior to implementing the revised inspection guidelines for FitzPatrick pursuant to 10 CFR 50.55a(z).

All other requirements of the ASME Code, Section XI, for which an alternative has not been specifically requested remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector. Any ASME Code, Section XI RVI components that are not included in this relief request will continue to be inspected in accordance with the ASME Code, Section XI requirements.

Principal Contributor: C. Fairbanks

Date: September 10, 2018

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FROM THE REQUIREMENTS OF THE ASME CODE N-702 FOR PLANT
NOZZLE-TO-VESSEL WELDS AND INNER RADII EXAMINATIONS
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