



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

September 25, 2026

Mr. Christopher H. Mudrick Sr.
Senior Vice President
and Chief Nuclear Officer
Constellation Energy Generation, LLC
President Constellation Nuclear
200 Energy Way
Kennett Square, PA 19348

SUBJECT: JAMES A. FITZPATRICK NUCLEAR POWER PLANT; LASALLE COUNTY
STATION, UNITS 1 AND 2; AND LIMERICK GENERATING STATION, UNITS 1
AND 2 – ALTERNATIVE REQUEST FOR REPAIR OF WATER LEVEL
INSTRUMENTATION PARTIAL PENETRATION NOZZLES
(EPID L-2026-LLR-0035)

Dear Mr. Mudrick:

By letter dated May 14, 2026 (Agencywide Documents Access and Management System Accession No. ML26134A125), Constellation Energy Generation, LLC (CEG, the licensee) submitted requests James A. FitzPatrick Nuclear Power Plant (FitzPatrick), LaSalle County Station (LaSalle), Units 1 and 2, and Limerick Generating Station (Limerick), Units 1 and 2 (collectively, the CEG facilities) for the use of an alternative to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (ASME BPV Code), Section XI requirements for the inservice inspections (ISI) programs at the CEG facilities.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee submitted for U.S. Nuclear Regulatory Commission (NRC) review and approval a Relief Request for the alternative repair of the reactor vessel water level instrument nozzles for one cycle of operation on the basis that performing an ASME Code required repair would result in a hardship without a compensating increase in quality and safety.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that CEG has adequately addressed the requirements in 10 CFR 50.55a(z)(2). Therefore, the NRC staff approves the use of the proposed alternative at FitzPatrick; LaSalle, Units 1 and 2; and Limerick, Units 1 and 2. For each facility, this approval is for the ISI Code of Record Interval End Date, as specified in Table 2 of this safety evaluation.

All other ASME BPV Code, section XI, requirements for which relief was not specifically requested and approved remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact the Senior Project Manager, Scott Wall, at 301-415-2855 or e-mail at Scott.Wall@nrc.gov.

Sincerely,

ILKA
BERRIOS

Digitally signed by ILKA
BERRIOS
Date: 2026.09.25
11:19:48 -04'00'

Ilka Berrios, Chief
Plant Licensing Branch III
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-333, 50-373, 50-374,
50-352, and 50-353

Enclosure:
Safety Evaluation

cc: Listserv

SUBJECT: JAMES A. FITZPATRICK NUCLEAR POWER PLANT; LASALLE COUNTY STATION, UNITS 1 AND 2; AND LIMERICK GENERATING STATION, UNITS 1 AND 2 – ALTERNATIVE REQUEST FOR REPAIR OF WATER LEVEL INSTRUMENTATION PARTIAL PENETRATION NOZZLES (EPID L-2026-LLR-0035) DATED September 25, 2026

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ADAMS Accession Nos.:

Package: ML26252A297

Letter: ML26252A293

e-Concurrence Case: 20260910-02342



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

ALTERNATIVE REPAIR OF REACTOR VESSEL INSTRUMENT NOZZLES

FOR ONE CYCLE OF OPERATION

CONSTELLATION ENERGY GENERATION, LLC

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

LASALLE COUNTY STATION, UNITS 1 AND 2

LIMERICK GENERATING STATION, UNITS 1 AND 2

DOCKET NOS. 50-333, 50-373, 50-374, 50-352, AND 50-353

1.0 INTRODUCTION

By letter dated May 14, 2026 (Agencywide Documents Access and Management System Accession No. ML26134A125), Constellation Energy Generation, LLC (CEG, the licensee) submitted requests James A. FitzPatrick Nuclear Power Plant (FitzPatrick), LaSalle County Station (LaSalle), Units 1 and 2, and Limerick Generating Station (Limerick), Units 1 and 2 (collectively, the CEG facilities) for the use of an alternative to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (ASME BPV Code), Section XI requirements for the inservice inspections (ISI) programs at the CEG facilities.

Specifically, 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 performing an ASME Code required repair would result in a hardship without a compensating increase in quality and safety. The proposed alternative would allow the use of a half-nozzle repair technique for water level instrumentation (WLI) partial penetration nozzles on the reactor pressure vessel (RPV) as an alternative to the repair requirements in the ASME BPV Code. The proposed alternative is applicable for the Inservice Inspection (ISI) Code of Record Interval at the CEG facilities (see Table 2 in Section 3.1.2 of this safety evaluation (SE)).

2.0 REGULATORY EVALUATION

The regulations in 10 CFR 50.55a(g)(4) state, in part, that ASME BPV Code Class 1, 2, and 3 components (including supports) must meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in Section XI of the applicable editions and addenda of the ASME Code to the extent practical within the limitations of design, geometry, and materials of construction of the components.

The regulations in 10 CFR 50.55a(z) state, in part, that alternatives to the requirements in paragraphs (b) through (h) of 10 CFR 50.55a may be 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.

The NRC Regulatory Guide (RG) 1.147, Revision 21, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," dated March 2024 (ML23291A003), identifies ASME BPV Code cases that the NRC has approved for use as a voluntary alternative to the mandatory ASME BPV Code, Section XI, provisions that are incorporated by reference into 10 CFR 50.55a.

RG 1.262, Revision 0, "ASME Code Cases Approved for Use Without Conditions," dated July 2025 (ML25091A013), lists ASME Code cases that the NRC has determined to be acceptable for use without conditions.

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 NRC to authorize the alternative requested by the licensee.

3.0 TECHNICAL EVALUATION

The information provided by the licensee in support of the request for an alternative to ASME Code requirements, as incorporated by reference in 10 CFR 50.55a, has been evaluated and the bases for NRC staff's conclusion are documented below.

3.1 Licensee's Alternative

3.1.1 ASME Code Components Affected

The affected components are reactor pressure vessel (RPV) water level instrumentation (WLI) partial penetration nozzles as shown in Table 1 below:

Table 1: Subject Affected Components

PLANT	RPV MATERIAL (CLAD WITH STAINLESS STEEL)	NOZZLE NUMBER PER UNIT (NOTE 1)	NOZZLE MATERIAL	J-GROOVE WELD MATERIAL
FitzPatrick	SA-533 Grade B Class 1, modified by ASME Code Case 1339-2	N11A, N11B, N12A, N12B, N16A, N16B	SB-166 (Alloy 600)	Alloy 82/182
LaSalle	SA-533 Grade B Class 1	N12A, N12B, N12C, N12D, N13A, N13B, N14A, N14B, N14C, N14D	SB-166 (Alloy 600)	Alloy 82/182
Limerick	SA-533 Grade B Class 1	N11A, N11B, N12A, N12B,	SB-166 (Alloy 600)	Alloy 82/182

		N12C, N12D, N16A, N16B, N16C, N16D (Unit 1 only)		
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Note 1 - Limerick Generating Station, Unit 2 nozzle N16D has previously implemented the repair.

The licensee stated that a total of 45 intergranular stress corrosion cracking (IGSCC) susceptible WLI nozzles are included in the subject relief request (i.e., proposed alternative). The subject nozzles are classified as the ASME Code, Class 1 component. The examination is specified under the ASME Code, Section XI, Subarticle IWB-2500, Table IWB-2500-1, Examination Category B-P, Item Number B15.10 and B15.20.

3.1.2 Applicable Code Editions and Addenda

The application identified the currently applicable editions and addenda of the ASME BPV Code, Section XI, for each plant, as shown in Table 2 below. In addition, Table 2 shows the associated ISI interval, including the start and end dates, for each plant. The application also identified the applicable construction code for each plant, as shown in Table 3 below.

Table 2: Current ASME BPV Code, Section XI, Code of Record

PLANT	ISI INTERVAL	ASME BPV CODE, SECTION XI	ISI INTERVAL START DATE	ISI INTERVAL END DATE	Code of Record Interval End Date (Note 1)
FitzPatrick	6 th	2021 Edition	6/16/2027	6/15/2039	6/15/2051
LaSalle	5 th	2021 Edition	10/1/2027	9/30/2039	9/30/2051
Limerick	5 th	2021 Edition	2/1/2027	1/31/2039	1/31/2051

Note 1 – Per 10 CFR 50.55a(y), the Code of Record Interval is two consecutive ISI intervals.

Table 3: Applicable ASME Construction Code

PLANT	CONSTRUCTION CODE: ASME BPV CODE
FitzPatrick	Section III 1965 Edition, through Winter 1966 Addenda
LaSalle	Section III 1968 Edition, through Summer 1970 Addenda, except Paragraph N-355
Limerick	Section III 1968 Edition, through Summer 1969 Addenda, except that Article 4 of the Winter 1969 Addenda applies

The NRC staff noted that 10 CFR 50.55a(y), “Code of record interval”, subparagraph (2) states that “...[f]or licensees with codes of record of ASME BPV Code, Section XI, 2017 Edition and OM [Operation and Maintenance] Code, 2017 Edition, or later, as incorporated by reference in paragraph (a) of this section [10 CFR 50.55a] the code of record interval is two consecutive inservice inspection or inservice examination and test intervals...”

3.1.3 Applicable Code Requirements

The licensee has requested an alternative to the following ASME BPV Code, Section XI, requirements:

Flaw Removal

- Paragraph IWA-4412 states "Defect removal shall be accomplished in accordance with the requirements of IWA-4420."
- Subparagraph IWA-4611.1(a) states "Defects shall be removed in accordance with IWA-4422.1. A defect is considered removed when it has been reduced to an acceptable size."
- Subarticle IWA-5250(a)(3) states "Components requiring corrective action shall have repair/replacement activities performed in accordance with Article IWA-4000 or corrective measures performed where the relevant condition can be corrected without a repair/replacement activity."
- Subarticle N-528 of the ASME Code Section III 1965 Edition up to and including the Summer 1970 Addenda, or Subarticle NB-4453 of the ASME Code Section III 1971 Edition up to and including the 2021 Edition, requires repair of weld defects, including complete and satisfactory removal of defects detected visually, by examinations, or by leakage tests.
- Subarticle N-532 of the ASME Code Section III 1965 Edition up to and including the Summer 1970 Addenda, or Subarticle NB-4620 of the ASME Code Section III 1971 Edition up to and including the 2021 Edition, contains requirements for post weld heat treatment.

Flaw Evaluation

- Subparagraph IWB-3142.1(b) states "A component whose visual examination detects the relevant conditions described in the standards of Table IWB-3410-1 shall be unacceptable for continued service, unless the component meets the requirements of IWB-3142.2, IWB 3142.3, or IWB-3142.4."
- Subarticle IWA-3300(a) states, in part, "Flaws detected by the preservice and inservice examinations shall be sized ... "
- Subarticle IWA-3300(b) states, in part, "Flaws shall be characterized in accordance with IWA 3310 through IWA-3390, as applicable ... "
- Subarticle IWB-3420 states "Each detected flaw or group of flaws shall be characterized by the rules of IWA-3300 to establish the dimensions of the flaws. These dimensions shall be used in conjunction with the acceptance standards of IWB-3500."
- Subparagraph IWB-3522.1 states, in part, "A component whose visual examination (IWA-5240) detects any of the following relevant conditions shall meet IWB-3142 and IWA-5250: ... "

- Subarticle IWB-3600(b) states, in part, "For purposes of analytical evaluation, the depth of flaws in clad components and piping items shall be defined in accordance with Figure IWB 3600-1 as follows: ... "

ASME Code Case N-749-x, as approved or conditionally approved by the NRC in the latest revision of RG 1.147 or RG 1.262, allows for the use of elastic-plastic fracture mechanics (EPFM) methods in lieu of IWB-3600 and IWB-3610 acceptance criteria to evaluate flaws in ferritic steel components operating in the upper shelf temperature range.

3.1.4. Reason for Request

By letter dated August 12, 2021 (ML21224A123), the licensee submitted a similar relief request for the alternative repair of RPV WLI nozzles for a one-cycle operation at the CEG boiling water reactor (BWR) fleet, including FitzPatrick, LaSalle, and Limerick units. By letter dated April 15, 2022 (ML22094A001), the NRC staff approved the use of that relief request (refer to as the 2021 relief request) for specific 10-year ISI interval at these three nuclear plants. The NRC approved the use of the 2021 relief request for the fifth ISI interval at FitzPatrick and for the fourth ISI interval at LaSalle and Limerick. However, in 2027, these three nuclear plants will enter new ISI intervals that are not covered by the 2021 relief request. FitzPatrick will be starting the sixth ISI interval on June 16, 2027. LaSalle and Limerick will be starting their fifth ISI intervals on October 1, 2027, and February 1, 2027, respectively. In addition, these three nuclear plants will be using the latest NRC-approved 2021 edition of the ASME Code that was not covered in the 2021 relief request. To adopt these changes, the licensee submitted the current relief request on a contingency basis so that it can repair subject nozzles in the new ISI intervals, if a repair is needed.

3.1.5 Proposed Alternative

In lieu of the ASME Code requirements, the licensee proposed the following alternatives to repair the RPV WLI nozzles for one cycle of operation:

- As an alternative to flaw removal or reduction in size to meet the applicable acceptance standards per Paragraphs IWA-4412 and IWA-4611, the licensee proposed to implement an outside diameter (OD) repair of the RPV WLI nozzles using an OD weld pad and half nozzle.
- As an alternative to performing the non-destructive examination (NDE) required to characterize the flaw under Subarticles IWB-3420 and IWB-3600(b) in the WLI weld or nozzle, the licensee proposed analyzing a maximum postulated flaw that bounds the range of flaw sizes that could exist in the original J-groove weld and nozzle.
- As an alternative to the requirements of post-weld heat treatment required by the Construction Code, the licensee proposed to install a welded pad in accordance ASME Code Case N-638-x, N 839-x, N-888-x or similar code case, as approved or conditionally approved by the NRC in the latest revision of RG 1.147 or RG 1.262.

For additional details on the licensee's request, please refer to the documents located at the ADAMS Accession No. identified above.

3.1.6 Duration of Proposed Alternative

The licensee requested the proposed alternative to perform these repairs through the ISI code of record interval end date, as specified in Table 2 in Section 3.1.2 of this SE. The licensee further requested that each repair following the proposed alternative be approved for the duration of the operating cycle in which the indication is identified in the RPV WLI nozzles.

The licensee stated that it will submit a separate proposed alternative to justify continued use of the nozzle repair beyond the first cycle. The licensee further stated that it will submit the separate proposed alternative for permanent acceptance, which will contain the appropriate analyses and justification for the remainder of the plant operating life, before the end of the next upcoming operating cycle after the repair is made.

3.2 Staff Evaluation

3.2.1 Evaluation Approach

In the submittal, the licensee qualitatively discussed the design, growth of remnant flaw(s), corrosion issues, and loose parts associated with the proposed nozzle repair. However, the submittal does not contain quantitative analyses to support the proposed alternative to the ASME Code, Section XI. The licensee instead does commit to submitting analyses within 14 days following the end of the refueling outage as stated in Attachment 1 of the submittal. The NRC staff noted that the licensee submitted the proposed alternative as contingency planning in case a WLI nozzle needs to be repaired in the future. As such, the staff recognizes that the submittal does not contain analyses for the actual nozzle repair.

The NRC staff approved similar alternatives for repairs of RPV WLI nozzles for one cycle of operation at the licensee's BWR fleet as shown in the following NRC SEs.

- By letter dated January 30, 2013 (ML13016A454), the staff approved relief request I4R-19 for Quad Cities Unit 2 which the licensee submitted on April 6, 2012 (ML12100A012) with supplements dated April 11, 2012 (ML12103A009), April 12, 2012 (ML12104A021, ML12104A067, and ML12104A068), April 13, 2012 (ML12107A361), and April 14, 2012 (ML12107A362, ML12108A028, and ML121080063).
- By letter dated August 14, 2017 (ML17208A090), the staff approved relief request I4R-17 for Limerick Unit 2 which the licensee submitted on May 15, 2017 (ML17135A423) with a supplement dated May 16, 2017 (ML17137A068).
- By letter dated April 23, 2021 (ML21110A680), the staff approved relief request I5R-14 for Peach Bottom Unit 2 which the licensee submitted on November 4, 2020 (ML20309B020) with a supplement dated November 24, 2020 (Package ML20329A344).
- By letter dated April 15, 2022 (ML22094A001), the staff approved the 10 CFR 50.55a relief request for Clinton, Unit 1 (Clinton); Dresden, Units 2 and 3 (Dresden); FitzPatrick; LaSalle; Limerick; Nine Mile Point, Units 1 and 2 (Nine Mile Point); Peach Bottom, Units 2 and 3 (Peach Bottom); and Quad Cities, Units 1 and 2 (Quad Cities). The licensee submitted the 10 CFR 50.55a relief request on August 12, 2021 (ML21224A123) with a supplement dated February 2, 2022 (ML22033A134) for contingency purposes.

The NRC staff noted that the licensee has repaired three WLI nozzles using the NRC-authorized alternatives at Quad Cities, Peach Bottom and Limerick since 2012. The repaired nozzles have performed their intended functions for more than one cycle of operation.

To evaluate the acceptability of the current submittal, the NRC staff reviewed analyses associated with the above previously submitted relief requests to determine whether the framework/structure of those analyses are applicable to and support the current proposed alternative. The staff's objective is to determine whether the methodology of these analyses ensures that the key parameters are considered and addressed if a nozzle repair at FitzPatrick, LaSalle, and Limerick is necessary such that the licensee will demonstrate structural integrity for the duration of the operating cycle in which the indication is identified.

In each of the topics below, the NRC staff evaluated the licensee's technical basis described in the current submittal and the analyses of the previously NRC-authorized alternatives.

3.2.2 Repair Procedures

The licensee proposed to apply a welded pad on the OD of the RPV at the WLI nozzle location using IGSCC-resistant nickel alloy filler metal (e.g., 52M). The new weld pad will be welded using the machine gas tungsten arc welding (GTAW) or manual shielded metal arc welding (SMAW) ambient temperature temper bead (ATTB) welding processes. The licensee proposed to attach an IGSCC-resistant nozzle to the new weld pad with a partial penetration weld using a non-temper bead manual welding process and IGSCC-resistant nickel alloy filler metal. The repaired nozzle configuration is presented in Attachment 2 of the submittal.

The ASME Code, Section XI, IWA-4412 and IWA-4611 require the removal of or reduction in size of defects. The licensee proposed that the original partial penetration J-groove weld and a remnant of the original nozzle will remain in place. The defect on the nozzles will not be removed; therefore, the licensee requested an alternative from these Code requirements.

The ASME Code, Section XI, Subarticles IWB-3400 and IWB-3600 require a flaw characterized by volumetric examination to support the required flaw evaluation. The NRC staff noted that a performance demonstration initiative (PDI) qualified technique does not exist to perform ultrasonic testing (UT) of the J-groove weld or nozzle that can be used to accurately characterize the location, orientation, or size of a flaw. As such, the licensee stated that it will evaluate a postulated maximum postulated flaw in the original J-groove weld to demonstrate the acceptability of leaving the defective original J-groove weld and remnant nozzle for one cycle.

The licensee stated that it will perform a UT examination on the existing J-groove weld in accordance with BWRVIP-03, "Reactor Pressure Vessel and Internals Examination Guidelines," Revision 21 or later. The licensee stated that the current RPV outside diameter volumetric examination technique has been demonstrated to only interrogate the partial penetration J-groove weld and the surrounding RPV low alloy steel material. This examination technique provides crack detection, length sizing, and depth sizing of flaws that initiate within the partial penetration J-groove weld material and low alloy steel material.

The licensee stated that it will replace the existing nozzle assembly with a nozzle penetration that is resistant to IGSCC and examine the new IGSCC-resistant weld pad in accordance with ASME Code Case N-638-x, N-839-x, N-888-x or similar code case, as approved or conditionally approved by the NRC in the latest revision of RG 1.147 or RG 1.262 to verify that no

unacceptable indications (cracking or fabrication) in the newly installed weld pad or original base metal material exist.

The licensee stated that it will perform an extent of condition. For accessible nozzles with the same design as the repaired nozzle, the licensee will perform a bare metal VT-2 visual examination at the normal operating pressure. The licensee will look for evidence of through-wall leakage, degradation due to corrosion of a pressure retaining boundary, and evidence of pressure/flow loss or flow impairment.

The NRC staff determined that the proposed repair procedure in Attachment 2 to the submittal is consistent with the repair procedure that the staff previously approved for the 2021 fleet relief request. The staff noted that the industry has gained experience from performing nozzle repairs at various BWR plants for many years. This is evident in the repair procedure in the current submittal which provides enhanced and improved procedure as compared to the repair procedure in Quad Cities Unit 2 relief request I4R-19, Limerick Unit 2 relief request I4R-17, Peach Bottom Unit 2 relief request I5R-14.

The NRC staff finds the proposed repair procedure has been demonstrated to be effective and ensures structural integrity and leak tightness of the repaired nozzle. Additionally, the new IGSCC-resistant weld pad will be examined in accordance relevant ASME Code Case, as approved or conditionally approved by the NRC in the latest revision of RG 1.147 or RG 1.262 to verify that no unacceptable indications (cracking or fabrication) in the newly installed weld pad or original base metal material exist. Therefore, the NRC staff finds that the proposed repair procedure in the current submittal is acceptable.

3.2.3 Design Analysis

In the current submittal, the licensee stated that it will perform a design analysis in accordance with the design requirements of the construction code. The new design will be reconciled to the original construction code and addresses all applicable loads to ensure all Code requirements are met. The licensee explained that as required by the design specification, the nozzle repair is required to satisfy the design requirements of the ASME Code, Section III. The licensee further stated that the analysis per the ASME Code, Section III will take no credit for the original J-groove weld and nozzle material. The Code requirements for weld sizing provide design margin against ejection which will ensure that the repair is acceptable for one cycle.

The submittal does not contain a design analysis although the licensee stated that it will submit a one-cycle evaluation of the repair as part of its commitment in Attachment 1 to the submittal. As such, the NRC staff reviewed the design analysis in the previously NRC-approved Quad Cities Unit 2 relief request I4R-19 (Package ML121080063) to determine whether the framework/structure of this analysis are applicable to and support the current proposed alternative. The Quad Cities design analysis includes all required design loads (e.g., pressure, deadweight, thermal, seismic and transients). The resultant stresses meet the allowable stress of the ASME Code, Section III and, therefore, the adequate design margin is maintained.

The NRC staff determined that the framework/structure for the design analysis, similar to that for Quad Cities Unit 2 relief request I4R-19, ensures that the key parameters (e.g., the nozzle material, the RPV wall thickness, weld size, operating conditions) are considered and addressed if nozzle repair at FitzPatrick, LaSalle, and Limerick is necessary. Additionally, the staff determined that framework/structure for the design analysis is intended to ensure the

repaired component will perform its intended function under design conditions by demonstrating that the stress requirements of the ASME Code, Section III, NB-3000 will have been satisfied.

3.2.4 Flaw Evaluation

In the submittal, the licensee stated that it will not remove the flaw in the degraded J-groove weld and the original nozzle as part of the proposed nozzle repair. As a result, the licensee is required to evaluate the flaw in the original weld and nozzle per the ASME Code, Section XI, IWB-3600. The flaw evaluation is to determine the acceptability of leaving a degraded J-groove weld at the WLI nozzle after the nozzle is repaired. As stated above, the flaw in the J-groove weld cannot be adequately sized by currently available NDE techniques. Therefore, the licensee assumed that the as-left J-groove weld includes a worst-case flaw that extends through the entire J-groove weld and Alloy 600 remnant nozzle material.

The ASME Code, Section XI, provides two flaw evaluation methods that the licensee could use. The flaw evaluation methods in the ASME Code, Section XI, IWB-3610 is based on the linear-elastic fracture mechanics (LEFM) method. ASME Code Case N-749-x provides the elastic-plastic fracture mechanics (EPFM) method as acceptable alternatives to the LEFM method for operating conditions where ferritic vessel materials are operating on the material toughness upper shelf temperature range. The licensee stated that it will perform a flaw evaluation for one cycle of operation in accordance with Subarticle IWB-3610 and ASME Code Case N-749-x or similar code case with all applicable conditions stated in the latest revision of RG 1.147 or RG 1.262.

In the current submittal, the licensee stated that the analysis inputs would include the geometry of the original and new instrument nozzles, the material properties of new and existing components, the fracture material properties, design and steady state operating conditions, and operating condition transients. The licensee will use a finite element crack model to obtain stress intensity factors. The licensee will apply steady state and transient loads to calculate crack growth. The ASME Code, Section XI flaw evaluation requires a projection of crack growth for the flaw in the J-groove weld or nozzle being abandoned in-place, and potentially into the RPV material. The licensee will analyze the flaw propagating into the RPV low alloy steel by fatigue and stress corrosion cracking.

To verify the above licensee's discussion, the NRC staff reviewed flaw evaluations in the NRC-authorized Peach Bottom Unit 2 relief request I5R-14 dated November 24, 2020 (Package ML20329A344) and Quad Cities Unit 2 relief request I4R-19 (Package ML121080063) to determine whether the framework/structure of this analysis are applicable to and support the current proposed alternative.

The flaw evaluations in Peach Bottom and Quad Cities relief requests assume the entire J-groove weld is cracked. The licensee further postulated that the preferential direction for crack propagation is radial-axial relative to the nozzle and RPV because the hoop stress is determined to be dominant at the J-groove weld location. The NRC staff determined that the direction of crack propagation is acceptable because it is based on the state of stress. The staff verified that stress intensity factors along the postulated crack front were calculated for pressure, residual stress, steady stress thermal and transient conditions as shown in the flaw evaluations of Peach Bottom and Quad Cities relief requests.

The licensee used a bounding crack growth rate data in BWRVIP-60-A, "BWR Vessel and Internals Project, Evaluation of Stress Corrosion Crack Growth in Low Alloy Steel Vessel

Materials in the BWR Environment,” (Package ML031710335) to determine cracking into the Peach Bottom’s RPV material from the service-related degradation. The NRC staff has approved generic use of BWRVIP-60-A for determining stress-corrosion cracking (SCC) in RPV low alloy steel in the BWR environment. Therefore, it is acceptable for the licensee to use BWRVIP-60-A to calculate crack growth.

In its fracture mechanics analysis for the Peach Bottom relief request I5R-15 and Quad Cities relief request I4R-19, the licensee used a finite element model to obtain the applied stresses in the RPV shell at the nozzle J-groove weld location based on bounding design basis transient conditions of normal/upset condition (heat-up/cool-down, loss-of-pump, and single relief) and emergency/faulted condition (overpressure). The finite element model included the RPV base material, remnant original Alloy 600/182 nozzle and attachment weld, stainless steel cladding, Alloy 52M weld pad, Alloy 690/52M replacement nozzle and new attachment weld. The NRC staff finds the licensee’s finite element model acceptable because appropriate materials, plant-specific configurations, and loading conditions were used.

In addition to the thermal and pressure stresses, the licensee’s flaw analysis for Peach Bottom and Quad Cities included the weld residual stress (WRS) that contributes to the crack driving force. The licensee assumed the magnitude of WRS based on room temperature yield strength of the Alloy 182 J-groove weld material which is reduced by the compressive stress in the RPV shell. The staff finds that the licensee’s WRS is adequate for this analysis because: (a) the RPV was post-weld heat treated during fabrication which reduces the WRS, and (b) the licensee’s calculation has shown that magnitude of WRS is reduced by the compressive stress in the RPV shell.

In its fracture mechanics analysis for Peach Bottom relief request I5R-14, the licensee used the screening criteria in ASME Code Case N-749 with the condition in RG 1.147, Revision 19, to determine acceptability of flaw in the RPV shell when the RPV base metal reference temperature is in the upper shelf range. The screening criteria provide guidance on the use of LEFM method and EPFM method. The NRC staff verified that the flaw evaluation performed for Peach Bottom relief request satisfied the ASME Code required acceptance criteria for LEFM and EPFM.

The staff determined that the framework/structure for the flaw evaluation, similar to that for Peach Bottom relief request I5R-14 and Quad Cities relief request I4R-19, ensures that the key parameters (e.g., the material properties, operating conditions, and repaired nozzle configuration) are considered and addressed if nozzle repair at FitzPatrick, LaSalle, and Limerick is necessary. Therefore, in combination of the proposed repair procedures as discussed in Attachment 2 to the submittal and the licensee’s previous flaw evaluation, the NRC staff determined that the framework/structure of the flaw evaluation is intended to ensure the structural integrity of the repaired WLI nozzle will be maintained and is acceptable for one cycle of operation.

3.2.5 Corrosion Evaluation

In the submittal, the licensee stated that it will evaluate corrosion as a potential material degradation due to the repair of the RPV WLI nozzle. The licensee stated that the RPV nozzle repair will change the penetration configuration which may cause potential corrosion because (1) the proposed repair will expose the RPV nozzle penetration to water conditions, (2) the repair includes a new Alloy 690 nozzle as part of the pressure boundary, (3) the repair includes

a new Alloy 52M weld pad and partial penetration J-groove weld as part of the pressure boundary, and (4) the pipe coupling and weld to the nozzle may be dissimilar metals.

The licensee stated that it will consider general corrosion, crevice corrosion, galvanic corrosion, and stress corrosion cracking. The licensee further stated that it will use conservative corrosion rates based on established industry experience and testing. Design inputs will include the geometry of the repair, the material properties of the new and existing components, the water chemistry of wetted components, galvanic interactions, and operating conditions. The licensee will review the implementation of the on-line noble metal chemical addition with hydrogen water chemistry to mitigate corrosion for applicable nozzles. The licensee explained that the reactor water chemistry of FitzPatrick, LaSalle, and Limerick meet the requirements of the latest approved revision of BWRVIP-190, Revision 2, "BWRVIP Water Chemistry Guidelines." The licensee stated that acceptance for potential material loss due to the postulated corrosion mechanisms will be based on the ASME Code, Section XI and Section III analyses. The licensee will submit its corrosion evaluation as part of its regulatory commitment as discussed further in the SE.

The NRC staff reviewed the corrosion evaluations in the licensee's supplement dated April 12, 2012 (ML12104A068 proprietary) for Quad Cities Relief request I4R-19 and supplement dated May 16, 2017 (ML17137A068 publicly available; ML17137A069 proprietary) for Limerick Relief Request I4R-17. The staff determined that the results of the corrosion evaluations in these NRC-authorized relief requests demonstrate that the corrosion of the RPV shell would be minimal for one cycle of operation.

The NRC staff determined that the framework/structure for the corrosion evaluation, similar to that for Quad Cities relief request I4R-19 and Limerick Relief Request I4R-17, ensures that the key parameters (e.g., material properties, water chemistry of the RPV and operating conditions) are considered and addressed if nozzle repair at FitzPatrick, LaSalle, and Limerick is necessary. Therefore, the staff also determined that it is reasonable that the (a) potential corrosion will be minimal for one cycle of operation at FitzPatrick, LaSalle, and Limerick, (b) potential corrosion will not significantly affect the structural integrity of the repaired nozzle at FitzPatrick, LaSalle, and Limerick. Regardless, the NRC staff noted that the licensee will need to perform a corrosion evaluation that assesses the plant-specific conditions at FitzPatrick, LaSalle, and Limerick if a WLI nozzle repair is necessary.

3.2.6 Loose Parts Evaluations

In the submittal, the licensee stated that it will complete a lost-parts evaluation consistent with existing loose part evaluation procedures to assess the potential for nozzle segments to enter the RPV during operation. The licensee further stated that it will assess the potential and impact for the original J-groove weld material and remnant nozzle to enter the RPV during operation. The licensee will also evaluate the potential impact of loose parts on the fuel and the potential impact on internal RPV components. Interfacing systems, flow blockage, and adverse chemical reactions will be considered in the licensee's evaluation. The NRC staff noted that as part of the repair procedure, the licensee will insert a temporary plug at the inside RPV opening of the instrument line to mitigate any loose parts falling inside the RPV.

The NRC staff reviewed the licensee's loose parts evaluation associated with the 2021 fleet relief request (ML22033A134), Peach Bottom relief request I5R-14 (ML20309B020), and Limerick relief request I4R-17 (ML17135423). The staff determined that the framework/structure for the loose parts evaluation, similar to those relief requests, ensures that the key parameters

(e.g., nozzle and weld fragments, impact on the fuel bundles and RPV internal components) are considered and addressed if nozzle repair at FitzPatrick, LaSalle, and Limerick is necessary. The staff determined that the approach for a loose parts evaluation in the current submittal is consistent with the loose parts evaluation of the previously NRC-approved relief requests. Therefore, the NRC staff finds that the current submittal has addressed the need for a loose parts evaluation satisfactorily if a WLI nozzle repair is necessary at FitzPatrick, LaSalle, and Limerick

3.2.7 Hardship

The licensee explained that performing a repair in accordance with the ASME Code would require a full core offload to access the repair locations. This would result in significant risk associated with the inclusion of loose parts and foreign material falling into the RPV, and significant increase in radiological exposure. The NRC staff recognizes that core offload is a complex effort and noted that there have been cases of damage such as scratches on the surface of the vessel inside surface wall based on industry operating experience. The staff also recognizes that radiological dose for the plant personnel would be a concern when performing a full core offload. Therefore, the NRC staff finds that an ASME Code repair, when compared to the repair technique for the instrument nozzles proposed by the licensee, would result in hardship for the licensee without a compensating increase in quality and safety.

3.2.8 Duration of the Alternative Repair

The licensee requested the proposed alternative to repair the WLI nozzles through the Inservice Inspection Code of Record Interval End Date as specified in Table 2 of this safety evaluation.

Additionally, in Section 6 of Attachment 2 to the submittal, the licensee stated that the alternative repair is requested for the duration of the operating cycle in which the indication is identified. The NRC staff noted that because the current proposed alternative is only applicable for one-operating cycles, the licensee would be required to submit a separate alternative request in accordance with 10 CFR 50.55a to justify continued use of the nozzle repair beyond the first operating cycle but prior to the end of the next upcoming operating cycle.

The NRC staff reviewed the licensee's proposed repair against the requirements of the Inservice Inspection Code of Record for each plant, and finds the proposal is acceptable, given the licensee's hardship. Further, the NRC staff's technical review finds the licensee's proposed repair will ensure structural integrity for the duration of the operating cycle in which the indication is identified.

3.2.9 Regulatory Commitment

In Attachment 1 to the submittal, the licensee made the following regulatory commitment:

The final one-cycle flaw analytical evaluation, evaluation of repair, and corrosion evaluation will be submitted within 14 days following the end of the refueling outage in which the flaw is identified.

The NRC staff noted that the evaluations that the licensee committed to submit within the specified timeframe would support the NRC staff's oversight responsibilities.

3.2.10 Technical Conclusion

The NRC staff determined that the framework/structure for various analyses, similar to that for the analyses in previously NRC-authorized relief requests, ensures that the key parameters are considered and addressed if nozzle repair at FitzPatrick, LaSalle, and Limerick is necessary. Based on the above evaluation, the NRC staff finds that the proposed alternative in the current submittal provides reasonable assurance that the structural integrity of the RPV WLI nozzle, if repaired, will be maintained for the duration of the operating cycle in which an indication is identified.

4.0 ENVIRONMENTAL CONSIDERATION

This authorized alternative relates to 10 CFR 50.55a action. The NRC staff finds that the action does not have a significant effect on the human environment and that special circumstances are not present that would preclude reliance on the categorical exclusion. Accordingly, this action meets the eligibility criteria for categorical exclusion set forth in paragraph (a)(16) of 10 CFR 51.22, "Categorical exclusions." Pursuant to 10 CFR 51.22, no environmental impact statement or environmental assessment need be prepared in connection with the action.

5.0 CONCLUSION

As set forth above, the NRC staff determined that the licensee's proposed alternative to eliminate certain documentation requirements for pressure retaining bolting provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all the regulatory requirements set forth in 10 CFR 50.55a(z)(1).

As set forth above, the NRC staff determines that the licensee's proposed alternative will provide reasonable assurance that the structural integrity of the RPV WLI nozzle, if repaired, will be maintained for the duration of the operating cycle in which the indication is identified. Accordingly, the NRC staff concludes that the licensee has adequately addressed all the regulatory requirements set forth in 10 CFR 50.55a(z)(2).

The NRC staff, therefore, authorizes the use of the proposed alternative at the CEG facilities for the ISI Code of Record Interval End Date, as specified in Table 2 of this SE.

All other ASME BPV Code, section XI, requirements for which relief was not specifically requested and approved remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Date: September 25, 2026