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

April 15, 2022

Mr. David P. Rhoades
Senior Vice President
Constellation Energy Generation, LLC
President and Chief Nuclear Officer
Constellation Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: CLINTON POWER STATION, UNIT NO. 1; DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3; JAMES A. FITZPATRICK NUCLEAR POWER PLANT; LASALLE COUNTY STATION, UNITS 1 AND 2; LIMERICK GENERATING STATION, UNITS 1 AND 2; NINE MILE POINT NUCLEAR STATION, UNITS 1 AND 2; PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3; AND QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2 — PROPOSED ALTERNATIVE FOR REPAIR OF WATER LEVEL INSTRUMENTATION PARTIAL PENETRATION NOZZLES (EPIDS L-2021-LLR-0057 AND L-2021-LLR-0058)

Dear Mr. Rhoades:

By application dated August 12, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21224A123), Exelon Generation Company, LLC submitted a request in accordance with paragraph 50.55a(z)(2) of Title 10 of the *Code of Federal Regulations* (10 CFR) for a proposed alternative to certain requirements of 10 CFR 50.55a, "Codes and standards," for Clinton Power Station (Clinton), Unit No. 1; Dresden Nuclear Power Station (Dresden), Units 2 and 3; James A. FitzPatrick Nuclear Power Plant (FitzPatrick); LaSalle County Station (LaSalle), Units 1 and 2; Limerick Generating Station (Limerick), Units 1 and 2; Nine Mile Point Nuclear Station (Nine Mile Point), Units 1 and 2; Peach Bottom Atomic Power Station (Peach Bottom), Units 2 and 3; and Quad Cities Nuclear Power Station (Quad Cities), Units 1 and 2. On February 1, 2022 (ADAMS Accession No. ML22032A333), Exelon Generation Company, LLC was renamed Constellation Energy Generation, LLC (the licensee). By letter dated February 2, 2022 (ADAMS Accession No. ML22033A134), the licensee supplemented its application in response to a January 13, 2022, Nuclear Regulatory Commission (NRC) staff request for additional information (ADAMS Accession No. ML22020A064).

The licensee specifically requested NRC staff approval to use a half-nozzle repair technique for water level instrumentation (WLI) partial penetration nozzles on the reactor pressure vessel as an alternative to the repair requirements in Section XI of the American Society for Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPV Code). Specifically, pursuant to 10 CFR 50.55a(z)(2), the licensee requested to use the proposed alternative on the basis that complying with the specific ASME BPV Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The NRC staff has reviewed the application, as supplemented, and concludes, as set forth in the enclosed safety evaluation, that the licensee has adequately addressed the regulatory requirements set forth in 10 CFR 50.55a(z)(2). Therefore, the NRC authorizes the licensee to use the proposed alternative described in its application, as supplemented, at Clinton, Unit No. 1; Dresden, Units 2 and 3; FitzPatrick; LaSalle, Units 1 and 2; Limerick, Units 1 and 2; Nine Mile Point, Units 1 and 2; Peach Bottom, Units 2 and 3; and Quad Cities, Units 1 and 2. This authorization is for the remainder of the current 10-year inservice inspection intervals for each facility and for the upcoming sixth 10-year inservice inspection intervals at Dresden, Units 2 and 3, and Quad Cities, Units 1, and 2, as specified in the licensee's application. However, each use of the proposed alternative is limited to the duration of the operating cycle in which the degraded WLI nozzle is identified and repaired in accordance with the proposed alternative. Prior NRC approval would be required for such a repair to remain in place for longer than one operating cycle.

All other ASME BPV Code, Section XI, requirements for which an alternative 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 Blake Purnell at 301-415-1380 or via e-mail at Blake.Purnell@nrc.gov.

Sincerely,

Robert F. Kuntz

Digitally signed by Robert F. Kuntz
Date: 2022.04.15 09:15:55 -04'00'

Nancy L. Salgado, Chief
Plant Licensing Branch III
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos., 50-317, 50-318, 50-461, 50-373, 50-374, 50-352, 50-353, and 50-410

Enclosure:
Safety Evaluation

cc: ListServ

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PROPOSED ALTERNATIVE REQUEST

REPAIR OF WATER LEVEL INSTRUMENTATION PARTIAL PENETRATION NOZZLES

CLINTON POWER STATION, UNIT NO. 1

DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3

JAMES A. FITZPATRICK NUCLEAR POWER PLANT

LASALLE COUNTY STATION, UNITS 1 AND 2

LIMERICK GENERATING STATION, UNITS 1 AND 2

NINE MILE POINT NUCLEAR STATION, UNITS 1 AND 2

PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3

QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2

CONSTELLATION ENERGY GENERATION, LLC

DOCKET NOS. 50-461, 50-237, 50-249, 50-333, 50-373, 50-374, 50-352, 50-353, 50-220, 50-410, 50-277, 50-278, 50-254, AND 50-265

1.0 INTRODUCTION

By application dated August 12, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21224A123), Exelon Generation Company, LLC submitted a request in accordance with paragraph 50.55a(z)(2) of Title 10 of the *Code of Federal Regulations* (10 CFR) for a proposed alternative to certain requirements of 10 CFR 50.55a, "Codes and standards," for Clinton Power Station (Clinton), Unit No. 1; Dresden Nuclear Power Station (Dresden), Units 2 and 3; James A. FitzPatrick Nuclear Power Plant (FitzPatrick); LaSalle County Station (LaSalle), Units 1 and 2; Limerick Generating Station (Limerick), Units 1 and 2; Nine Mile Point Nuclear Station (Nine Mile Point), Units 1 and 2; Peach Bottom Atomic Power Station (Peach Bottom), Units 2 and 3; and Quad Cities Nuclear Power Station (Quad Cities), Units 1 and 2. On February 1, 2022 (ADAMS Accession No. ML22032A333), Exelon Generation Company, LLC was renamed Constellation Energy Generation, LLC (the licensee). By letter dated February 2, 2022 (ADAMS Accession No. ML22033A134), the licensee supplemented its application in response to a January 13, 2022, U.S. Nuclear Regulatory

Commission (NRC) staff request for additional information (ADAMS Accession No. ML22020A064).

The licensee specifically requested NRC staff approval to use 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 Section XI of the American Society for Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPV Code). Specifically, pursuant to 10 CFR 50.55a(z)(2), the licensee requested to use the proposed alternative on the basis that complying with the specific ASME BPV Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

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, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the applicable editions and addenda of the ASME BPV 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(g)(4)(ii) require, in part, that inservice examination of components and system pressure tests conducted during successive 10-year inservice inspection (ISI) intervals (i.e., after the initial 10-year interval) must comply with the latest edition and addenda of the ASME BPV Code (or the optional Code Cases) incorporated by reference in 10 CFR 50.55a(a) 18 months before the start of the 10-year ISI interval subject to the conditions listed in 10 CFR 50.55a(b).

Regulatory Guide (RG) 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," lists the Code Cases that the NRC has approved or conditionally approved for use as voluntary alternatives to the mandatory ASME BPV Code, Section XI, provision that are incorporated by reference in 10 CFR 50.55a. RG 1.147, Revision 20 (ADAMS Accession No. ML21181A222), is the most recent revision of RG 1.147 incorporated by reference in 10 CFR 50.55a(a)(3)(ii). Because the status of Code Cases continually changes, the NRC staff periodically updates 10 CFR 50.55a and RG 1.147 to accommodate new Code Cases and any revisions of existing Code Cases. The regulations in 10 CFR 50.55a(b)(5) state:

> Licensees may apply the ASME BPV Code Cases listed in NRC Regulatory Guide 1.147, as incorporated by reference in paragraph (a)(3)(ii) of this section, without prior NRC approval, subject to the following:
>
> (i) *ISI Code Case condition: Applying Code Cases.* When a licensee initially applies a listed Code Case, the licensee must apply the most recent version of that Code Case incorporated by reference in paragraph (a) of this section.
>
> (ii) *ISI Code Case condition: Applying different revisions of Code Cases.* If a licensee has previously applied a Code Case and a later version of the Code Case is incorporated by reference in paragraph (a) of this section, the licensee may continue to apply, to the end of the current 120-month interval, the previous version of the Code Case, as authorized, or may apply the later version of the Code Case, including any NRC-specified

conditions placed on its use. Licensees who choose to continue use of the Code Case during subsequent 120-month ISI program intervals will be required to implement the latest version incorporated by reference into this section as listed in Tables 1 and 2 of NRC Regulatory Guide 1.147, as incorporated by reference in paragraph (a)(3)(ii) of this section.

(iii) *ISI Code Case condition: Applying annulled Code Cases.* Application of an annulled Code Case is prohibited unless a licensee previously applied the listed Code Case prior to it being listed as annulled in NRC Regulatory Guide 1.147. If a licensee has applied a listed Code Case that is later listed as annulled in NRC Regulatory Guide 1.147, the licensee may continue to apply the Code Case to the end of the current 120-month interval.

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.

Based on the above, the NRC staff finds that regulatory authority exists for the licensee to request and the NRC staff to authorize the use of the proposed alternative.

3.0 TECHNICAL EVALUATION

3.1 Licensee's Request

3.1.1 ASME BPV Code Components Affected

The affected components are the ASME BPV Code Class 1, WLI partial penetration nozzles with associated J-grove welds attached to the RPV. The WLI nozzles are part of Examination Category B-P, Item No. B15.10 in Table IWB-2500-1 of the ASME BPV Code, Section XI. The specific nozzle identifications for each of the subject RPVs and materials are provided in Section 5 of the relief request.

3.1.2 Applicable Code Edition and Addenda

In its application, the licensee identified the currently applicable editions and addenda of the ASME BPV Code, Section XI, for each plant in its application, as shown in Table 1 below. In addition, the table shows the current 10-year 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 2 below.

Table 1: Current ASME BPV Code, Section XI, Code of Record

PLANT	ISI INTERVAL	ASME BPV CODE, SECTION XI	START	END
Clinton, Unit No. 1	4th	2013 Edition	7/1/2020	6/30/2030
Dresden, Units 2 and 3	5th	2007 Edition, through 2008 Addenda	1/20/2013	1/19/2023
	6th	2017 Edition	1/20/2023	1/19/2033

PLANT	ISI INTERVAL	ASME BPV CODE, SECTION XI	START	END
FitzPatrick	5th	2007 Edition, through 2008 Addenda	8/1/2017	6/15/2027
LaSalle, Units 1 and 2	4th	2007 Edition, through 2008 Addenda	10/1/2017	9/30/2027
Limerick, Units 1 and 2	4th	2007 Edition, through 2008 Addenda	2/1/2017	1/31/2027
Nine Mile Point, Unit 1	5th	2013 Edition	8/23/2019	8/22/2029
Nine Mile Point, Unit 2	4th	2013 Edition	10/6/2018	8/22/2028
Peach Bottom, Units 2 and 3	5th	2013 Edition	1/1/2019	12/31/2028
Quad Cities, Units 1 and 2	5th	2007 Edition, through 2008 Addenda	4/2/2013	4/1/2023
	6th	2017 Edition	4/2/2023	4/1/2033

Table 2: Applicable Construction Code

PLANT	CONSTRUCTION CODE: ASME BPV CODE
Clinton, Unit No. 1	Section III, 1971 Edition through Summer 1973 Addenda
Dresden, Units 2 and 3	Section III, 1963 Edition through Summer 1964 Addenda
FitzPatrick	Section III, 1965 Edition through Winter 1966 Addenda
LaSalle, Units 1 and 2	Section III, 1968 Edition through Summer 1970 Addenda, except paragraph N-355
Limerick, Units 1 and 2	Section III, 1968 Edition through Summer 1969 Addenda, except that Article 4 of the Winter 1969 Addenda applies
Nine Mile Point, Unit 1	Section I, 1962 Edition
Nine Mile Point, Unit 2	Section III, 1971 Edition through Winter 1972 Addenda
Peach Bottom, Units 2 and 3	Section III, 1965 Edition through Winter 1965 Addenda
Quad Cities, Units 1 and 2	Section III, 1965 Edition through Summer 1965 Addenda

3.1.3 ASME BPV Code Requirements

Flaw Removal

- Paragraph IWA-4412 of the ASME BPV Code, Section XI, states: "Defect removal shall be accomplished in accordance with the requirements of IWA-4420." (2007 Edition through 2008 Addenda, 2013 Edition, and 2017 Edition.)

- Subparagraph IWA-4611.1(a) of the ASME BPV Code, Section XI, 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." (2007 Edition through 2008 Addenda, 2013 Edition, and 2017 Edition.)

- Subarticle IWA-5250(a)(3) of the ASME BPV Code, Section XI, states: "Components requiring corrective action shall have repair/replacement activities performed in accordance with IWA-4000 or corrective measures performed where the relevant condition can be corrected without a repair/replacement activity." (2007 Edition through 2008 Addenda, 2013 Edition, and 2017 Edition, with minor editorial changes in the 2017 Edition.)

- Subarticle P-89 of the ASME BPV Code, Section I (1962 Edition); Subarticle PW-40 of the ASME BPV Code, Section I (1965 Edition though the 2019 Edition); Subarticle N-528 of the ASME BPV Code, Section III (1963 Edition through the Winter 1970 Addenda); and Subarticle NB-4453 of the ASME BPV Code, Section III (1971 Edition through the 2019 Edition), require repair of weld defects, including complete and satisfactory removal of defects detected visually, by examinations, or by leakage tests.

- Subarticle P-88 of the ASME BPV Code, Section I (1962 Edition); Subarticle PW-39 of the ASME BPV Code, Section I (1965 Edition through the 2019 Edition); Subarticle N-532 of the ASME BPV Code, Section III (1963 Edition through the Winter 1970 Addenda); and Subarticle NB-4620 of the ASME BPV Code, Section III (1971 Edition through the 2019 Edition), contain requirements for post-weld heat treatment.

Flaw Evaluation

- Subparagraph IWB-3142.1(b) of the ASME BPV Code, Section XI, 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 such components meet the requirements of IWB-3142.2, IWB-3142.3, or IWB-3142.4." (2007 Edition through 2008 Addenda, 2013 Edition, and 2017 Edition.)

- Subarticle IWA-3300(a) of the ASME BPV Code, Section XI, states, in part, that: "Flaws detected by the preservice and inservice examinations shall be sized." (2007 Edition through 2008 Addenda, 2013 Edition, and 2017 Edition.)

- Subarticle IWA-3300(b) of the ASME BPV Code, Section XI, states, in part, that: "Flaws shall be characterized in accordance with IWA-3310 through IWA-3390, as applicable." (2007 Edition through 2008 Addenda, 2013 Edition, and 2017 Edition.)

- Subarticle IWB-3420 of the ASME BPV Code, Section XI, 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." (2007 Edition through 2008 Addenda, 2013 Edition, and 2017 Edition.)

- Subparagraph IWB-3522.1 of the ASME BPV Code, Section XI, states, in part, that: "A component whose visual examination (IWA-5240) detects any of the following relevant conditions shall meet IWB-3142 and IWA-5250 prior to continued service." (2007 Edition through 2008 Addenda, 2013 Edition, and 2017 Edition.)

- Subarticle IWB-3610(b) of the ASME BPV Code, Section XI, states, in part, that: "For purposes of evaluation by analysis, the depth of flaws in clad components shall be defined in accordance with Fig. IWB-3610-1." (2007 Edition through 2008 Addenda, 2013 Edition, and 2017 Edition, with minor editorial changes in the 2013 and 2017 Editions.)

- ASME Code Case N-749, "Alternative Acceptance Criteria for Flaws in Ferritic Steel Components Operating in the Upper Shelf Temperature Range, Section XI, Division 1," allows for the use of elastic-plastic fracture mechanics (EPFM) methods in lieu of IWB-3610 and IWB-3620 acceptance criteria to evaluate flaws in ferritic steel

components operating in the upper shelf temperature range. ASME Code Case N-749 is conditionally approved in RG 1.147, Revision 20.

3.1.4 Reason for Request

The licensee stated that the proposed alternative provides a repair technique for flawed or leaking WLI partial penetration nozzles on the RPV. The proposed repair is for the partial replacement of existing flawed WLI nozzle assemblies, which are susceptible to intergranular stress corrosion cracking (IGSCC), with partial penetration nozzle assemblies that are resistant to IGSCC. The licensee stated that a repair in accordance with the ASME BPV Code would require the removal or repair of the flaw from the inner portion of the RPV. This procedure would require a full core offload to access the repair location, result in significant risk associated with the introduction of loose parts and foreign material, and result in significant increase in radiological exposure. The licensee further stated that these areas of concern result in a significant hardship.

3.1.5 Proposed Alternative

The proposed alternative is for the repair of WLI partial penetration nozzles on the RPV that are susceptible to IGSCC. The specific nozzles for which the proposed alternative may be used are listed in the application. The full details of the proposed alternative are provided in the licensee's application, as supplemented. In lieu of the ASME BPV Code-compliant repair, the licensee proposed to repair the WLI nozzles for one operating cycle using the following:

- As an alternative to flaw removal or reduction in size to meet the applicable acceptance standards per paragraphs IWA-4412 and IWA-4611 of the ASME BPV Code, Section XI, the licensee proposed to implement an outside diameter repair of the RPV and the WLI partial penetration nozzles using an outside diameter weld pad and half nozzle.

- As an alternative to performing the nondestructive examinations (NDE) required by paragraph IWB-3420 and subparagraph IWB-3610(b) of the ASME BPV Code, Section XI, to characterize the flaw in the WLI partial penetration weld or nozzle, the licensee proposed to analyze a maximum postulated flaw that bounds the range of flaw sizes that could exist in the original J-groove weld and nozzle.

In accordance with 10 CFR 50.55a(z), the proposed alternative to these provisions in the ASME BPV Code, Section XI, requires prior NRC approval. The NRC staff's evaluation of the proposed alternative to these provisions is provided in Section 3.2 of this safety evaluation (SE).

As an alternative to the applicable construction code requirements for post-weld heat treatment when performing a repair using the proposed alternative, the licensee plans to install a welded pad in accordance with:

(1) the ASME Code Case N-638, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW [Gas Tungsten Arc Welding] Temper Bead Technique, Section XI, Division 1";

(2) the ASME Code Case N-839, “Similar and Dissimilar Metal Welding Using Ambient Temperature SMAW [Shielded Metal Arc Welding] Temper Bead Technique, Section XI, Division 1“; or

(3) a similar ASME code case.

The licensee stated it would use the latest revisions of these Code Cases, as approved or conditionally approved by the NRC in the latest revision of RG 1.147 incorporated by reference in 10 CFR 50.55a, when performing a repair using the proposed alternative.[1] The NRC staff understands that the licensee plans to only use code cases that the NRC has approved or conditionally approved for general use in RG 1.147 when applying this proposed alternative. The NRC staff determined that the use of such code cases does not require prior NRC approval under 10 CFR 50.55a(z) for the proposed alternative.

The proposed alternative would only allow the repair to remain in place for one operating cycle. However, the licensee stated that when it makes a repair using this proposed alternative it intends to request, prior to the end of the operating cycle, a separate proposed alternative to allow for the permanent acceptance of the repair.

3.1.6 Duration of the Proposed Alternative

The licensee requested to use the proposed alternative for the current 10-year ISI interval at each facility, as listed in Section 3.2 of this SE. In addition, the licensee requested to use the proposed alternative for the sixth 10-year ISI intervals at Dresden, Units 2 and 3, and Quad Cities, Units 1 and 2, which start in 2023. The licensee would only apply the proposed alternative for the duration of the operating cycle in which the degraded WLI nozzle is identified and repaired in accordance with the proposed alternative.

The licensee stated that when it makes a repair using this proposed alternative it intends to request, prior to the end of the operating cycle, a separate proposed alternative to allow for the permanent acceptance of the repair.

3.2 NRC Staff’s Evaluation

The proposed alternative is for the repair of WLI partial penetration nozzles on the RPV that are susceptible to IGSCC. The NRC staff evaluated the design of the repair, examinations, flaw evaluation, corrosion evaluation, and loose parts evaluation associated with the proposed alternative. In addition, the NRC staff evaluated the hardship justification for the proposed alternative. As the proposed alternative would only allow the repair to remain in place for one operating cycle, the NRC staff’s evaluation did not consider the potential for such repairs to remain in place for longer than one operating cycle. The NRC staff would evaluate proposed alternatives for the permanent acceptance of such repairs if and when they are submitted by the licensee.

[1] Currently, ASME Code Cases N-638-10 and N-838 are the latest revisions of these code cases approved by the NRC in RG 1.147, Revision 20, which is the latest revision of RG 1.147 incorporated by reference in 10 CFR 50.55a.

3.2.1 Design of the Repair

If this proposed alternative is used, the licensee stated that it would replace the existing nozzle assembly with a nozzle penetration that is resistant to IGSCC, in accordance with the original construction code using ASME Code Case N-638, N-839, or similar code case. The licensee would use the latest revision of these Code Cases, as approved or conditionally approved by the NRC in the latest revision of RG 1.147 incorporated by reference in 10 CFR 50.55a, when using this proposed alternative. The licensee will apply a welded pad to the outside diameter surface of the RPV using IGSCC-resistant nickel alloy filler metal and will use the machine GTAW or manual SMAW ambient temperature temper bead welding processes. The licensee will attach the IGSCC-resistant nozzle to the new weld pad with a partial penetration weld using a non-temper bead, manual welding process and IGSCC-resistant filler metal. The original partial penetration J-groove weld and a remnant of the original nozzle would remain in place.

The licensee would analyze the design in accordance with the requirements of the construction code. The licensee would reconcile the new design to the original construction code and address all applicable loads to ensure all the ASME BPV Code requirements are met. The licensee stated: "The current accumulated Effective Full Power Years (EFPYs) and fluence values will be calculated to ensure the material in the area of this repair is not expected to have decreased fracture toughness or ductility associated with damage of the [low alloy steel] in the beltline region; therefore, there will not be a weldability concern for the repair."

In its February 2, 2022, letter, the licensee described the details of the repair procedures, examinations, and welding processes and provided diagrams of a typical repair for a WLI nozzle. The licensee stated that, for this repair design, there is no weld installed at the junction of the new nozzle and bore of the RPV shell. The licensee stated that a temporary plug may be used during the repair, but it would be removed prior to completion of the repair. The diagram shows a reducing coupling; however, depending on the plant-specific piping configurations, different couplings may be used.

In its February 2, 2022, letter, the licensee explained that the proposed repair would join two similar base materials with a J-groove weld to eliminate the triple point seen in other half-nozzle repairs. For the proposed alternative, the J-groove weld is attaching the replacement nozzle to the installed weld pad. Therefore, the NRC staff determined that the proposed repair would not create a triple point and an associated fabrication anomaly would not occur.

The NRC staff finds that the proposed design for nozzle repairs to be acceptable because, when implementing the proposed alternative, the licensee would comply with the construction code and use the latest revision of applicable code cases, as approved or conditionally approved by the NRC in the latest revision of RG 1.147 incorporated by reference in 10 CFR 50.55a.

3.2.2 Examinations

The application, as supplemented, discussed the various examinations that would be performed as part of the proposed repair process to ensure the structural integrity of the new WLI nozzle and RPV outer surface. The licensee stated that, prior to a repair, it would perform ultrasonic testing of the existing J-groove weld associated with the WLI nozzle in accordance with the Electric Power Research Institute (EPRI), TR-105696-R19 (BWRVIP-03), Revision 19, "Reactor

Pressure Vessel and Internals Examination Guidelines," [2] or a later version of this report. The licensee explained that the current volumetric examination technique on the RPV outside diameter surface has been demonstrated to only interrogate the partial penetration J-groove welds and the surrounding RPV low alloy steel material. The licensee stated that this examination technique provides a method for crack detection, length sizing, and depth sizing of flaws that initiate within the partial penetration J-groove weld material. The examination technique can also detect planar flaw indications in the low alloy steel material.

In its February 2, 2022, letter, the licensee stated that if a degraded WLI nozzle is detected it would perform an extent of condition inspection of accessible nozzles with the same design. Specifically, the licensee will perform a bare metal visual VT-2 examination of the other nozzles at normal operating pressure. This examination would look for through-wall leakage, degradation due to corrosion of a pressure retaining boundary, and evidence of pressure/flow loss or flow impairment.

The application states that, as part of the installation procedure, the licensee will examine the new weld pad in accordance with the ASME Code Case N-638, N-839, or similar code case. The licensee would use the latest revision of these Code Cases, as approved or conditionally approved by the NRC in the latest revision of RG 1.147 incorporated by reference in 10 CFR 50.55a, when performing a repair using the proposed alternative. These examinations will verify that there are no unacceptable indications in the newly installed weld pad or original base metal material. Specifically, the licensee stated in its February 2, 2022, letter that it will use ultrasonic, surface, and/or visual techniques to examine the RPV outer surface, weld pad, weld pad bore, new nozzle, new J-groove weld, and coupling-to-nozzle weld. The February 2, 2022, letter also states that the following acceptance criteria would apply to the results of these examination:

> The acceptance criteria for the weld pad is in accordance with the applicable ASME Code Case utilized, ASME Section XI, the construction code or ASME Section III. The acceptance criteria for the J-groove weld is in accordance with the applicable editions of ASME Section XI and the construction code or ASME Section III. The NDE exams and coverage are in accordance with the ASME Code Case utilized, ASME Section III, the construction code, and ASME Section V.

As discussed above, the licensee will perform various examinations when using this proposed alternative for the repair of a WLI nozzle on the RPV. Based on the NRC staff's review of the application, as supplemented, the NRC staff finds that the NDEs for the proposed repair will provide an acceptable level of safety because the licensee will perform the NDEs in accordance with the NRC-approved ASME Code Cases, Sections III and V of the ASME BPV Code, and the construction code. The NRC staff noted that the licensee will also perform an extent of condition and inspect accessible WLI nozzles in the event a degraded WLI nozzle is repaired. The NRC staff finds that these inspections on similar WLI nozzles will provide assurance of the structural integrity for the other WLI nozzles during the operating cycle following the nozzle repair.

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[2] BWRVIP-03 was prepared by EPRI and its Boiling Water Reactor Vessels and Internals Project (BWRVIP). BWRVIP-03, Revision 19, dated 2016, is also referred to as EPRI Technical Report 3002008095, and a non-proprietary version of this report is available under ADAMS Accession No. ML17054C674.

3.2.3 Flaw Evaluation

As an alternative to performing the NDE required to characterize the flaw in the WLI partial penetration 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. The NRC staff noted that the licensee will not inspect the existing J-groove weld and the remnant WLI nozzle to determine the growth of the existing flaw in the future. As an alternative, the licensee will evaluate the maximum flaw size in the original J-groove weld and remnant nozzle in lieu of performing examinations to demonstrate the structural integrity of the RPV. As such, the licensee stated that it will evaluate the growth of the flaw for one cycle of operation in accordance with paragraph IWB-3610 of the ASME BPV Code, Section XI, and the ASME Code Case N-749 or a similar code case. The licensee would use the latest revision of these Code Cases, as approved or conditionally approved by the NRC in the latest revision of RG 1.147 incorporated by reference in 10 CFR 50.55a, when using this proposed alternative.

The NRC staff noted that the flaw evaluation per the ASME BPV Code, Section XI, requires a projection of crack growth. The licensee stated that it will calculate the flaw growth in the remnant J-groove weld or nozzle propagating into the RPV low alloy steel material. The potential crack propagation is into the low alloy steel by fatigue and stress corrosion cracking.

The licensee's February 2, 2022, letter, cited similar alternatives for the repair of a partial penetration nozzle on the RPV at Limerick, Unit 2, and Peach Bottom, Unit 2, which the NRC staff approved by letters dated March 5, 2019 (ADAMS Accession No. ML19009A002), and April 23, 2021 (ADAMS Accession No. ML21110A680), respectively. The licensee stated that when using this proposed alternative it would perform a flaw evaluation similar to the proprietary flaw evaluations that were performed for Limerick, Unit 2, and Peach Bottom, Unit 2. These flaw evaluations were provided by letters dated May 4, 2018 (ADAMS Accession No. ML18129A331), and November 24, 2020 (ADAMS Accession No. ML20329A345), for Limerick, Unit 2, and Peach Bottom, Unit 2, respectively. As discussed in the SEs included with the March 5, 2019, and April 23, 2021, letters, the NRC staff reviewed these flaw evaluations and found[3] that they were adequate to support the proposed alternatives for Limerick, Unit 2, and Peach Bottom, Unit 2.

In the February 2, 2022, letter, the licensee states, in part, that:

> The purpose of this [flaw] evaluation is to determine the suitability of leaving a degraded J-groove weld at the instrument nozzle on the reactor vessel following the repair of the leaking nozzle through the end of licensed plant operation. Since a potential flaw in the J-groove weld cannot be sized by currently available nondestructive examination techniques, it is conservatively assumed that the 'as-left' condition of the remaining J-groove weld includes degraded or cracked weld material extending through the entire J-groove weld and Alloy 600 remnant nozzle material.

The licensee explained that in general, design inputs would include the geometry of the original and repair 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 further explained that in general, the methodology will

[3] The licensee's February 2, 2022, letter incorrectly states that the NRC staff approved these flaw evaluations.

postulate a conservative initial flaw. The licensee will use a finite element crack model to obtain stress intensity factors. Steady state and transient loads will then be applied to calculate crack grow.

The licensee stated that the acceptance criteria for the flaw evaluation of the existing J-groove weld and remnant nozzle will be based on the applicable edition of the ASME BPV Code, Section XI and, if necessary, Code Case N-749 or similar code case. The licensee would use the latest revision of these Code Cases, as approved or conditionally approved by the NRC in the latest revision of RG 1.147 incorporated by reference in 10 CFR 50.55a, when using this proposed alternative. The licensee further stated that acceptance of the postulated flaw will be based on available fracture toughness or ductile tearing resistance using the safety factors consistent with those used in the analyses developed for the Limerick, Unit 2, and Peach Bottom, Unit 2, repairs in May 2018 and November 2020, respectively.

The NRC staff determined that the licensee would perform a flaw evaluation for one cycle of operation consistent with the methodology and acceptance criteria of the ASME BPV Code, Section XI, paragraph IWB-3610; ASME Code Case N-749; or similar code case. The NRC staff also noted that the proposed flaw evaluations will be performed in a similar manner to flaw evaluations performed for successful repairs at Limerick, Unit 2, and Peach Bottom, Unit 2. These precedents provide additional assurance of the validity of the flaw evaluation methods for the proposed repair. Therefore, the NRC staff finds that the methods and acceptance criteria which will be used for flaw evaluations performed as part of the proposed repair are acceptable.

3.2.4 Corrosion Evaluation

The NRC staff noted that a small gap exists between the new WLI nozzle and the remnant WLI nozzle inside the bore of the RPV shell. The gap will cause the RPV low alloy steel to be in contact with the primary coolant, which may cause general corrosion of the RPV material in the gap. To address this issue, the licensee stated that it will perform a corrosion evaluation to consider potential material degradation that could result from the repair. The licensee's corrosion evaluation will address general corrosion, crevice corrosion, and galvanic corrosion of the exposed low alloy steel in the gap between the existing nozzle and the replacement nozzle. The licensee will review operating experience to determine implementation of the on-line noble metal chemical addition with hydrogen water chemistry to mitigate corrosion for applicable nozzles.

In its letter dated February 2, 2022, the licensee explained that its corrosion evaluation will be similar to the corrosion evaluation performed for the repairs at Limerick, Unit 2, and Peach Bottom, Unit 2 (see Section 3.2.3 of this SE). According to the licensee, the repair of the RPV nozzle would change the penetration configuration in the following ways: (1) the repair will expose the RPV low alloy steel to water conditions, (2) the repair will include a new Alloy 690 nozzle as part of the pressure boundary, and (3) the repair will include a new Alloy 52M weld pad and partial penetration J-groove weld as part of the pressure boundary. Also, the pipe coupling and weld to the nozzle may be dissimilar metals. The corrosion evaluation will consider potential material degradation due to each of these changes.

Specifically, the licensee will consider various corrosion mechanisms and use conservative corrosion rates based on established industry experience and testing. The corrosion evaluation will include the geometry of the repair, the material properties of new and existing components, the water chemistry of wetted components, galvanic interactions, and operating conditions.

The NRC staff finds that the licensee will perform a corrosion evaluation based on the ASME BPV Code, Sections III and XI, analyses and industry operating experience, and the evaluation will consider all potential corrosion mechanisms related to the proposed repair. Therefore, the NRC staff finds that the licensee's proposed methods and acceptance criteria for the corrosion evaluation that will be performed will ensure that potential corrosion issues related to the proposed repair are adequately addressed.

3.2.5 Loose Parts Evaluations

The NRC staff determined that the fragments of degraded existing J-groove weld material and the remnant WLI nozzle may enter the RPV and become loose parts. Loose parts in the RPV have a potential to damage the fuel and RPV internals and could be detrimental to the safe operation of the plant. To address this concern, the licensee stated that it will assess the potential for the original J-groove weld material and remnant nozzle segments to enter the RPV during power operation, including the potential impact on the fuel and internal RPV components. In its letter dated February 2, 2022, the licensee stated that the loose parts evaluation will be consistent with existing loose part evaluation procedures and will assess the potential for nozzle segments to enter the RPV during power operations. The licensee stated that it will consider interfacing systems, flow blockage, and adverse chemical reactions.

The NRC finds that the licensee has considered the potential for the fragments of the degraded J-groove weld and remnant WLI nozzle falling into the RPV and will perform the evaluations accordingly. Therefore, the NRC staff finds that the proposed scope of the licensee's loose parts evaluation would adequately address the potential for loose parts related to the proposed repair.

3.2.6 Technical Evaluation Summary

As discussed above, the NRC staff evaluated the design of the repair, examinations, flaw evaluation, corrosion evaluation, and loose parts evaluation associated with the proposed alternative. Based on this evaluation, the NRC staff determined that the licensee's proposed alternative for the repair of WLI partial penetration nozzles on the RPV that are susceptible to IGSCC would restore the primary system pressure boundary and would provide reasonable assurance of the structural integrity of the RPV and repaired WLI nozzle for one operating cycle.

3.2.7 Hardship Justification

The regulations in 10 CFR 50.55a(z)(2) 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 a licensee demonstrates that 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 staff finds that the licensee's hardship justification is reasonable, because performing the repair and associated NDE of a WLI nozzle in accordance with the ASME BPV Code requirements would result in an increased radiological exposure and significant risk associated with the inclusion of loose parts and foreign material inside the RPV. Therefore, the NRC staff finds licensee's hardship justification acceptable.

3.2.8 Regulatory Commitment

In Attachment 1 to the August 12, 2021, letter, 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.

Providing these evaluations within the committed timeframe would support the NRC staff's oversight responsibilities. However, the NRC staff did not rely on this regulatory commitment to reach any findings or conclusions for this SE.

4.0 CONCLUSION

As set forth above, the NRC staff determined that the licensee's proposed alternative for the repair of WLI partial penetration nozzles on the RPV that are susceptible to IGSCC would restore the primary system pressure boundary and would provide reasonable assurance of the structural integrity of the RPV and repaired WLI nozzle for one operating cycle. The NRC staff also determined that complying with the requirements in paragraphs IWA-4412, IWA-4611, and IWB-3420 and subparagraph IWB-3610(b) of the ASME BPV Code, Section XI, would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2).

Therefore, the NRC authorizes the licensee to use the proposed alternative described in its application, as supplemented, at Clinton, Unit No. 1; Dresden, Units 2 and 3; FitzPatrick; LaSalle, Units 1 and 2; Limerick, Units 1 and 2; Nine Mile Point, Units 1 and 2; Peach Bottom, Units 2 and 3; and Quad Cities, Units 1 and 2. This authorization is for the remainder of the current 10-year ISI intervals for each facility and for the upcoming sixth 10-year ISI intervals at Dresden, Units 2 and 3, and Quad Cities, Units 1, and 2, as specified in the licensee's application. However, each use of the proposed alternative is limited to the duration of the operating cycle in which the degraded WLI nozzle is identified and repaired in accordance with the proposed alternative. Prior NRC approval would be required for such a repair to remain in place for longer than one operating cycle.

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

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Date: April 15, 2022

SUBJECT: CLINTON POWER STATION, UNIT NO. 1; DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3; JAMES A. FITZPATRICK NUCLEAR POWER PLANT; LASALLE COUNTY STATION, UNITS 1 AND 2; LIMERICK GENERATING STATION, UNITS 1 AND 2; NINE MILE POINT NUCLEAR STATION, UNITS 1 AND 2; PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3; AND QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2 — PROPOSED ALTERNATIVE FOR REPAIR OF WATER LEVEL INSTRUMENTATION PARTIAL PENETRATION NOZZLES (EPIDS L-2021-LLR-0057 AND L-2021-LLR-0058) DATE APRIL 15, 2022

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