



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

October 27, 2021

Mr. David P. Rhoades
Senior Vice President
Exelon Generation Company, LLC
President and Chief Nuclear Officer (CNO)
Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: BRAIDWOOD STATION, UNITS 1 AND 2; BYRON STATION, UNIT NOS. 1 AND 2; CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2; CLINTON POWER STATION, UNIT NO. 1; LASALLE COUNTY STATION, UNITS 1 AND 2; LIMERICK GENERATING STATION, UNITS 1 AND 2; AND NINE MILE POINT NUCLEAR STATION, UNIT 2 — PROPOSED ALTERNATIVE TO USE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE CASE N-893 (EPIDS L-2020-LLR-0147 AND L-2020-LLR-0148)

Dear Mr. Rhoades:

By application dated November 16, 2020 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML20321A234), as supplemented by letter dated June 30, 2021, (ADAMS Package Accession No. ML21182A099), Exelon Generation Company, LLC (Exelon, the licensee) submitted a request for a proposed alternative to the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a, "Codes and standards," and the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code for Braidwood Station, Units 1 and 2; Byron Station, Unit Nos. 1 and 2; Calvert Cliffs Nuclear Power Plant, Units 1 and 2; Clinton Power Station, Unit No. 1; LaSalle County Station, Units 1 and 2; Limerick Generating Station, Units 1 and 2; and Nine Mile Point Nuclear Station, Unit 2 (collectively, the facilities). The proposed alternative would allow the licensee to use ASME Code Case N-893, "Use of Alloy Steel Bar and Mechanical Tubing in Class 2 and 3 Patented Mechanical Joints and Fittings Section III, Division 1."

Specifically, pursuant to 10 CFR 50.55a(z)(1), the licensee requested to use the proposed alternative on the basis that the alternative provides an acceptable level of quality and safety. The regulations in 10 CFR 50.55a(z) allow the U.S. Nuclear Regulatory Commission (NRC) staff to authorize alternatives to the requirements in paragraphs (b) through (h) of 10 CFR 50.55a. The requirements for the 10-year inservice inspection (ISI) intervals after the first ISI interval are established by 10 CFR 50.55a(g)(4)(ii), which requires licensees to comply with the ASME BPV Code requirements incorporated by reference in 10 CFR 50.55a(a) 18 months prior to the start of the ISI interval.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that Exelon has adequately addressed the regulatory requirements set forth in 10 CFR 50.55a(z)(1) for the current ISI interval at each facility. Since the ISI requirements for

future intervals at the facilities have not yet been established in accordance with 10 CFR 50.55a(g)(4)(ii), no authorization can be made at this time for subsequent ISI intervals beyond the current ISI intervals. Therefore, the NRC staff authorizes Exelon to use the proposed alternative described in its application, as supplemented, at Braidwood, Units 1 and 2; Byron, Unit Nos. 1 and 2; Calvert Cliffs, Units 1 and 2; Clinton; LaSalle, Units 1 and 2; Limerick, Units 1 and 2; and NMP-2 only for the remainder of their current 10-year ISI intervals.

The NRC approval of this alternative does not imply or infer the NRC approval of Code Case N-893 for generic use. All other ASME BPV Code requirements for which an alternative was not been 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,

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

Docket Nos. STN 50-456, STN 50-457,
STN 50-454, STN 50-455, 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 TO USE ASME CODE CASE N-893

BRAIDWOOD STATION, UNITS 1 AND 2

BYRON STATION, UNIT NOS. 1 AND 2

CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2

CLINTON POWER STATION, UNIT NO. 1

LASALLE COUNTY STATION, UNITS 1 AND 2

LIMERICK GENERATING STATION, UNITS 1 AND 2

AND NINE MILE POINT NUCLEAR STATION, UNIT 2

EXELON GENERATION COMPANY, LLC

DOCKET NOS. STN 50-456, STN 50-457, STN 50-454, STN 50-455, 50-317, 50-318,

50-461, 50-373, 50-374, 50-352, 50-353, AND 50-410

1.0 INTRODUCTION

By application dated November 16, 2020 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML20321A234), as supplemented by letter dated June 30, 2021, (ADAMS Package Accession No. ML21182A099), Exelon Generation Company, LLC (Exelon, the licensee) submitted a request for a proposed alternative to the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a, "Codes and standards," and the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code for Braidwood Station (Braidwood), Units 1 and 2; Byron Station (Byron), Unit Nos. 1 and 2; Calvert Cliffs Nuclear Power Plant (Calvert Cliffs), Units 1 and 2; Clinton Power Station, Unit No. 1 (Clinton); LaSalle County Station (LaSalle), Units 1 and 2; Limerick Generating Station (Limerick), Units 1 and 2; and Nine Mile Point Nuclear Station, Unit 2 (NMP-2) (collectively, the facilities). The proposed alternative would allow the licensee to use ASME Code Case N-893, "Use of Alloy Steel Bar and Mechanical Tubing in Class 2 and 3 Patented Mechanical Joints and Fittings Section III, Division 1."

The June 30, 2021, supplement was provided in response to a U.S. Nuclear Regulatory Commission (NRC) staff request for additional information issued on May 5, 2021 (ADAMS Accession No. ML21117A034).

Enclosure

2.0 REGULATORY EVALUATION

The regulations in 10 CFR 50.55a(g)(4) state, in part, that ASME 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.

Paragraph 10 CFR 50.55a(g)(4)(ii) requires, 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 Code (or the optional ASME Code Cases) incorporated by reference in 10 CFR 50.55a(a) 18 months before the start of the 10-year interval subject to the conditions listed in 10 CFR 50.55a(b).

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.

3.0 TECHNICAL EVALUATION

3.1 Licensee's Request

3.1.1 ASME Code Components Affected

All ASME Code Class 2 and 3 carbon-steel piping systems nominal pipe size (NPS) 4 and smaller.

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.

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

PLANT	ISI INTERVAL	SECTION XI EDITION	START	END
Braidwood, Unit 1	4th	2013 Edition	8/29/2018	7/28/2028
Braidwood, Unit 2	4th	2013 Edition	11/5/2018	10/16/2028
Byron, Unit Nos. 1 and 2	4th	2007 Edition, through 2008 Addenda	7/16/2016	7/15/2025
Calvert Cliffs, Units 1 and 2	5th	2013 Edition	7/1/2019	6/30/2029
Clinton	4th	2013 Edition	7/1/2020	6/30/2030
LaSalle, Units 1 and 2	4th	2007 Edition, through 2008 Addenda	10/1/2017	9/30/2027

PLANT	ISI INTERVAL	SECTION XI EDITION	START	END
Limerick, Units 1 and 2	4th	2007 Edition, through 2008 Addenda	2/1/2017	1/31/2027
NMP-2	4th	2013 Edition	8/23/2018	8/22/2028

3.1.3 ASME BPV Code Requirements

Subsubarticle IWA-4220 of the ASME Code, Section XI, requires, in part, that items used for repair and replacement activities meet the applicable construction code. Exelon is requesting the alternative for Class 2 and 3 piping systems where the applicable construction code is Section III of the ASME BPV Code. Subparagraphs NC/ND-2121(a) of Section III (1971 Edition through the 2017 Edition) provide requirements for materials to be used in Class 2 and 3 piping systems.

3.1.4 Proposed Alternative

Exelon proposes to use ASME BPV Code Case N-893 as an alternative to the requirements in ASME BPV Code, Section III, subparagraphs NC/ND-2121(a). Code Case N-893 permits the use of Grade 4130 low-alloy steel made to ASTM International Standards A322¹ or A519,² with additional requirements listed in the code case. The alternative would allow Exelon to use nonstandard, proprietary, nonwelded pipe fittings made from material meeting the requirements in Code Case N-893 in ASME Code Class 2 and 3 piping systems of NPS 4 and smaller.

3.1.5 Duration of the Proposed Alternative

In its November 16, 2020, letter, Exelon requested to use the proposed alternative for the remainder of the current 10-year ISI interval for each plant, as specified in Section 2 of the letter, and for the remainder of the plant's life.

3.2 NRC Staff's Evaluation

3.2.1 Technical Evaluation

Subsubarticle IWA-4220 of the ASME Code, Section XI, requires, in part, that repairs made to systems constructed to the ASME BPV Code, Section III, must either meet the Section III requirements used for the original construction or subsequent editions and addenda of Section III. Subparagraphs NC/ND-2121(a) of Section III require that pressure-retaining material for Class 2 and 3 piping systems, respectively, conform to one of the material specifications in Table 1A of Section II, Part D, Subpart 1, of the ASME BPV Code. As an alternative to NC/ND-2121(a), Code Case N-893 provides the material requirements for Grade 4130 steel when used for the fabrication of Class 2 and 3 mechanical joints or fittings meeting paragraphs NC/ND-3671.7 and NC/ND-3649 provided the requirements of the Code Case are met. The NRC staff notes that Exelon has only requested an alternative to the ASME BPV Code, Section III, material requirements and will meet all design requirements in paragraphs NC/ND-3671.7 and NC/ND-3649. Exelon stated that the mechanical fittings

¹ ASTM International Standard A322, "Standard Specification for Steel Bars, Alloy, Standard Grades."

² ASTM International Standard A519, "Standard Specification for Seamless Carbon and Alloy Steel Mechanical Tubing."

fabricated from low-alloy steel will be used for any application in which plain carbon-steel materials, such as SA-106 Grade B, are used, subject to the proposed NPS 4 limit. Design temperatures may be up to 650 degrees Fahrenheit (°F), and design pressures could be high as 2000 pounds per square inch (psi) but will generally be less than 200 psi. The mechanical patented fittings that the applicant intends to use are manufactured by Lokring™.

The proposed alternative is similar to an alternative the NRC authorized on February 4, 2020 (ADAMS Accession No. ML20028E399), which allows Exelon to use ASME Code Case N-879, "Use of Micro-Alloyed Carbon Steel Bar in Patented Mechanical Joints and Fittings, Classes 1, 2, and 3, Section III, Division 1," for certain Class 2 and 3 piping systems at the facilities. Code Case N-879 allows the use of nonstandard (proprietary) welded and nonwelded pipe fittings fabricated from Alloy 15V24 material for certain carbon-steel piping systems. The current proposed alternative to use Code Case N-893 permits nonstandard (proprietary), nonwelded pipe fittings fabricated from Grade 4130 material for certain carbon-steel piping systems.

The subject mechanical fitting design requires that deformation occurs in the pipe and not the fitting material, thus requiring a higher strength material than plain carbon steels. As described in the *Lokring™ Fitting Applications Guide*,² Lokring™ fittings are installed by first inserting the pipe end into the fitting. A hydraulic tooling is used to advance the drive ring axially over the fitting body, radially compressing (swaging) the fitting body on to the outside diameter of the pipe. As the pipe is compressed, first elastically and then plastically, by the swaging action during installation, circumferential sealing lands, machined in the bore of the fitting body, grip and seal on the pipe outside diameter, forming a gas-tight, metal-to-metal seal without O-rings or other elastomeric seals. This process is the same for Lokring™ fittings made from either Grade 4130 steel meeting Code Case N-893 or Alloy 15V24 meeting Code Case N-879. Lokring™ fittings have a very low failure rate and nearly all failures are associated with improper installation. The NRC staff notes that Exelon's quality assurance program that meets 10 CFR Part 50, Appendix B, will provide assurance that the manufacturer's installation instructions will be correctly followed.

Grade 4130 steel is a low-alloy carbon-steel with 0.80–1.10 percent chromium and 0.15–0.25 percent molybdenum as alloying elements. Code Case N-893 requires a minimum tensile strength of 95 thousand pounds per square inch (ksi), yield strength of 80 ksi, and a maximum hardness of 229 Brinell. Grade 4130 is a quenched and tempered steel, so it can be heat treated to various hardness levels (tensile strengths). The maximum hardness specified in the code case ensures that the maximum tensile strength would not be greater than approximately 110 ksi. Grade 4130 steel heat treated to an ultimate tensile strength of 110 ksi is not considered to be susceptible to stress corrosion cracking. In addition, the chromium and molybdenum alloying elements provide a considerable increase in general corrosion resistance when compared to the carbon-steel materials that will be joined and fittings made from Alloy 15V24, as specified in Code Case N-879.

The *Lokring™ Fitting Application Guide* indicates that Lokring™ has conducted crevice corrosion testing that provides evidence that its fittings made from Grade 4130 steel are also more resistant to crevice corrosion than its Alloy 15V24 fittings. Lokring™ design guidance specifies that fittings made from Alloy 15V24 are limited to service temperatures from -20 °F (-29 degrees Celsius (°C)) to 650 °F (343 °C). Grade 4130 steel fittings are limited to service temperatures from -50 °F (-46 °C) to 800 °F (426 °C). Although not required by the ASME BPV Code or Code Case N-893, Lokring™ imposes Charpy V-Notch impact testing requirements of

² Available at www.lokring.com.

40 foot-pounds (ft-lbs) average and 30 ft-lbs minimum at -50 °F for Grade 4130 steel used to fabricate fittings. Exelon stated that the environmental conditions for the subject fittings are anything in the nuclear power plant environment, including air, water, or steam systems, and possibly lube oil or fuel systems, and they could be used inside or outside containment. The NRC staff finds that Grade 4130 steel, as specified in Code Case N-893, is acceptable for use in the subject piping systems because it is compatible with carbon steel and exhibits improved fracture toughness and improved corrosion resistance when compared to carbon-steels currently approved for use in these piping systems. In addition, the NRC staff notes that the subject material also has improved fracture toughness and improved corrosion resistance when compared to Alloy 15V24, as specified in Code Case N-879, which has been approved for use at the facilities.

Paragraphs NC/ND-3671.7 of the ASME BPV Code, Section III, state: "Coupling-type, mechanical gland type, and other patented joints may be used where experience or tests have demonstrated to the satisfaction of the designer that the joint is safe for the Design Loadings and when adequate provision is made to prevent separation of the joint." Lokring™ fittings made of Grade 4130 steel, as specified in Code Case N-893, have been subjected to burst testing, tensile testing to max load capacity, torsion testing, testing to determine stress intensity factors, and vibration testing. The NRC staff finds the testing of these fittings acceptable because these types of tests are more in line with prototype testing specified in Section III, paragraph NB-3671.7, for Class 1 components, which is more conservative than the requirements in Section III, paragraphs NC/ND-3671.7.

Based on the above, the NRC staff finds that the proposed alternative provides reasonable assurance of structural integrity and will provide an acceptable level of quality and safety for the subject piping.

3.2.2 Duration of Proposed Alternative

In its November 16, 2020, letter, Exelon requested to use the proposed alternative for the remainder of the current 10-year ISI interval for each plant, as specified in Section 2 of the letter, and "for the remainder of the plant's life."

The regulations in 10 CFR 50.55a(z) allow the NRC staff to authorize alternatives to the requirements in paragraphs (b) through (h) of 10 CFR 50.55a. The requirements for 10-year ISI intervals after the first inspection interval are established by 10 CFR 50.55a(g)(4)(ii), which requires licensees to comply with the ASME BPV Code requirements incorporated by reference in 10 CFR 50.55a(a) 18 months prior to the start of the ISI interval. The ISI requirements for the current 10-year ISI intervals at each plant, as described in Section 3.1.2 of this safety evaluation, were established in accordance with 10 CFR 50.55a(g)(4)(ii). The ISI requirements for future ISI intervals at each plant have not yet been established, as it is unknown what ASME BPV Code requirements will be in effect 18 months prior to the start of those ISI intervals. Therefore, the NRC staff cannot presently approve Exelon's request that this alternative be made permanent.

4.0 CONCLUSION

As set forth above, the NRC staff determined that use of the proposed alternative will provide an acceptable level of quality and safety. Accordingly, the NRC staff concludes that Exelon has adequately addressed the regulatory requirements set forth in 10 CFR 50.55a(z)(1) for the current 10-year ISI intervals at each plant. Since the ISI requirements for future intervals at the

facilities have not yet been established in accordance with 10 CFR 50.55a(g)(4)(ii), no authorization can be made at this time for subsequent ISI intervals beyond the current ISI intervals. Therefore, the NRC staff authorizes Exelon to use the proposed alternative described in its application, as supplemented, at Braidwood, Units 1 and 2; Byron, Unit Nos. 1 and 2; Calvert Cliffs, Units 1 and 2; Clinton; LaSalle, Units 1 and 2; Limerick, Units 1 and 2; and NMP-2 only for the remainder of their current 10-year ISI intervals.

The NRC approval of this alternative does not imply or infer the NRC approval of Code Case N-893 for generic use. All other ASME BPV Code requirements for which an alternative was not been specifically requested and approved remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: R. Davis, NRR

Date: October 27, 2021

SUBJECT: BRAIDWOOD STATION, UNITS 1 AND 2; BYRON STATION, UNIT NOS. 1 AND 2; CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2; CLINTON POWER STATION, UNIT NO. 1; LASALLE COUNTY STATION, UNITS 1 AND 2; LIMERICK GENERATING STATION, UNITS 1 AND 2; AND NINE MILE POINT NUCLEAR STATION, UNIT 2 — PROPOSED ALTERNATIVE TO USE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE CASE N-893 (EPIDS L-2020-LLR-0147 AND L-2020-LLR-0148) DATED OCTOBER 27, 2021

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