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

June 5, 2017

Mr. Bryan C. Hanson
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; DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3; 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; R. E. GINNA NUCLEAR POWER PLANT; AND THREE MILE ISLAND NUCLEAR STATION, UNIT 1 — PROPOSED ALTERNATIVE TO USE ENCODED PHASED ARRAY ULTRASONIC EXAMINATION TECHNIQUES (CAC NOS. MF8763–MF8782 AND MF9395)

Dear Mr. Hanson:

By application dated November 2, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16307A253), Exelon Generation Company, LLC (the licensee) submitted a request in accordance with Paragraph 50.55a(z)(1) of Title 10 of the *Code of Federal Regulations* (10 CFR) for a proposed alternative to the requirements of 10 CFR 50.55a, "Codes and standards," for Braidwood Station, Units 1 and 2; Byron Station, Unit Nos. 1 and 2; Calvert Cliffs Nuclear Power Plant, Units 1 and 2; Dresden Nuclear Power Station, Units 2 and 3; 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; R. E. Ginna Nuclear Power Plant; and Three Mile Island Nuclear Station, Unit 1. By letter dated March 13, 2017 (ADAMS Accession No. ML17072A385), the licensee revised its application and expanded its request to include Clinton Power Station, Unit No. 1.

The proposed alternative would allow the licensee to use encoded phased array ultrasonic testing in lieu of radiographic testing, required by the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, for ferritic piping butt welds during repair and replacement activities at each of the requested facilities. Specifically, pursuant to 10 CFR 50.55a(z)(1), the licensee requested to use the alternative on the basis that it will provide an acceptable level of quality and safety.

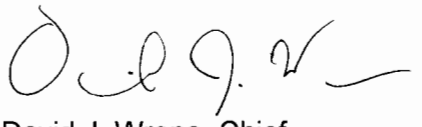
The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the use of the proposed alternative at the facilities requested in the

licensee's application, as supplemented, for the duration of the applicable 10-year inservice inspection interval, as specified in the licensee's March 13, 2017, letter.

All other ASME Code requirements for which relief 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,



David J. Wrona, 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, 50-237, 50-249,
50-373, 50-374, 50-352, 50-353,
50-220, 50-410, 50-277, 50-278,
50-254, 50-265, 50-244, and 50-289

Enclosure:
Safety Evaluation

cc w/encl: Distribution via ListServ

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PROPOSED ALTERNATIVE TO USE

ENCODED PHASED ARRAY ULTRASONIC EXAMINATION TECHNIQUES

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;

DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3;

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;

R.E. GINNA NUCLEAR POWER PLANT; AND

THREE MILE ISLAND NUCLEAR STATION, UNIT 1.

EXELON GENERATION COMPANY, LLC

DOCKET NOS. STN 50-456, STN 50-457, STN 50-454, STN 50-455, 50-317, 50-318, 50-461, 50-237, 50-249, 50-373, 50-374, 50-352, 50-353, 50-220, 50-410, 50-277, 50-278, 50-254, 50-265, 50-244, AND 50-289

1.0 INTRODUCTION

By application dated November 2, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16307A253), Exelon Generation Company, LLC (the licensee) submitted a request in accordance with Paragraph 50.55a(z)(1) of Title 10 of the *Code of Federal Regulations* (10 CFR) for a proposed alternative to the requirements of 10 CFR 50.55a, "Codes and standards," for Braidwood Station, Units 1 and 2; Byron Station, Unit Nos. 1

and 2; Calvert Cliffs Nuclear Power Plant, Units 1 and 2; Dresden Nuclear Power Station, Units 2 and 3; 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; R. E. Ginna Nuclear Power Plant; and Three Mile Island Nuclear Station, Unit 1. The U.S. Nuclear Regulatory Commission (NRC) staff requested additional information regarding the licensee's application by e-mail dated February 21, 2017 (ADAMS Accession No. ML17052A574). By letter dated March 13, 2017 (ADAMS Accession No. ML17072A385), the licensee responded to the staff's request, revised its application, and expanded its request to include Clinton Power Station, Unit No. 1.

The proposed alternative would allow the licensee to use encoded phased array ultrasonic testing (PAUT) in lieu of radiographic testing (RT), required by the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code, for ferritic piping butt welds during repair and replacement activities at each of the requested facilities. Specifically, pursuant to 10 CFR 50.55a(z)(1), the licensee requested to use the alternative on the basis that it will provide an acceptable level of quality and safety.

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 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.

Additionally, 10 CFR 50.55a(b)(2)(xx)(B) requires, in part, that the nondestructive examination provision in paragraph IWA-4540(a)(2) of the 2002 Addenda of the ASME BPV Code, Section XI, must be applied when performing system leakage tests after repair and replacement activities performed by welding or brazing on a pressure retaining boundary.

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 Relief Request

3.1.1 ASME Code Components Affected

For each requested facility, the proposed alternative is for all ferritic piping butt welds that require radiography during repair and replacement activities per the ASME BPV Code, Section XI.

3.1.2 Applicable Code Edition and Addenda

The licensee identified the applicable ASME BPV Code editions and addenda for each plant as shown in the table below. In addition, the table shows the applicable 10-year inservice inspection (ISI) interval, including the start and end dates.

PLANT	ISI INTERVAL	ASME CODE EDITION	START	END
Braidwood Station, Unit 1	3rd	2001 Edition, through 2003 Addenda	7/29/2008	7/28/2018
Braidwood Station, Unit 2	3rd	2001 Edition, through 2003 Addenda	10/17/2008	10/16/2018
Byron Station, Unit Nos. 1 and 2	4th	2007 Edition, through 2008 Addenda	7/16/2016	7/15/2025
Calvert Cliffs Nuclear Power Plant, Units 1 and 2	4th	2004 Edition	10/10/2009	6/30/2019
Clinton Power Station, Unit No. 1	3rd	2004 Edition	7/1/2010	6/30/2020
Dresden Nuclear Power Station, Units 2 and 3	5th	2007 Edition, through 2008 Addenda	1/20/2013	1/19/2023
LaSalle County Station, Units 1 and 2	4th	2007 Edition, through 2008 Addenda	10/1/2017	9/30/2027
Limerick Generating Station, Units 1 and 2	4th	2007 Edition, through 2008 Addenda	2/1/2017	1/31/2027
Nine Mile Point Nuclear Station Unit No. 1	4th	2004 Edition	8/23/2009	8/22/2019
Nine Mile Point Nuclear Station, Unit 2	3rd	2004 Edition	4/5/2008	6/15/2018
Peach Bottom Atomic Power Station, Units 2 and 3	4th	2001 Edition, through 2003 Addenda	11/5/2008	12/31/2018
Quad Cities Nuclear Power Station, Units 1 and 2	5th	2007 Edition, through 2008 Addenda	4/2/2013	4/1/2023
R. E. Ginna Nuclear Power Plant	5th	2004 Edition	1/1/2010	12/31/2019
Three Mile Island Nuclear Station, Unit 1	4th	2004 Edition	4/20/2011	4/19/2022

3.1.3 Applicable Code Requirement

The licensee has requested an alternative to the requirements in paragraphs IWA-4221 and IWA-4540(a)(2) of the ASME BPV Code, Section XI. Subarticle IWA-4200 of the ASME BPV Code, Section XI, covers repair and replacement activities, and paragraph IWA-4221 requires that when the licensee replaces an existing item, the replacement shall meet the requirements of the construction code to which the original item was constructed.

As stated previously, 10 CFR 50.55a(b)(2)(xx)(B) requires that the nondestructive examination provision in paragraph IWA-4540(a)(2) of the 2002 Addenda of the ASME BPV Code, Section XI, must be applied when performing system leakage tests after repair and replacement activities performed by welding or brazing on a pressure retaining boundary. Paragraph IWA-4540(a)(2) of the 2002 Addenda of the ASME BPV Code, Section XI, requires that the nondestructive examination method and acceptance criteria of the 1992 or later editions of the ASME BPV Code, Section III, be met prior to returning the component to service in order to perform a system leakage test in lieu of a system hydrostatic test.

The examination requirements for circumferential butt welds are contained in subarticles NB-5200, NC-5200, and ND-5200 of the ASME BPV Code, Section III. The acceptance

standards for radiographic examination are specified in subarticles NB-5300, NC-5300, and ND-5300 of the ASME BPV Code, Section III.

3.1.4 Licensee's Proposed Alternative and Basis for Use

The licensee is proposing the use of encoded PAUT in lieu of the ASME BPV Code-required RT for ferritic piping repair and replacement welds at its facilities. The proposed alternative includes a qualification program that the NRC staff determined is substantially similar to ASME Code Case N-831, "Ultrasonic Examination in Lieu of Radiography for Welds in Ferritic Pipe," approved by the ASME Section XI Standards Committee on October 20, 2016. The differences between the proposed alternative and Code Case N-831 were limited to editorial changes that clarified the wording.

The encoded PAUT procedures, equipment, and personnel will be qualified using performance demonstration testing. The flaw acceptance standards for the PAUT examinations will consider all flaws to be planar and are evaluated against the preservice acceptance standards of subarticles IWB-3400, IWC-3400, and IWD-3400 of the ASME BPV Code, Section XI, for ASME Code Class 1, 2, and 3 welds, respectively.

The licensee states that the basis for the proposed alternative is that encoded PAUT is equivalent or superior to RT for detecting and sizing planar flaws. The examination procedure and personnel performing examinations are qualified via performance demonstration testing using representative piping conditions and flaws that demonstrate the ability to detect and size flaws that are both acceptable and unacceptable to the defined acceptance standards. The licensee also states that ultrasonic testing (UT) techniques are being used throughout the nuclear industry for examination of dissimilar metal welds and overlaid welds, as well as other applications including piping replacements covered under ASME B31.1, "Power Piping, ASME Code for Pressure Piping, B31."

3.1.5 Duration of Proposed Alternative

The licensee requested that the proposed alternative be applied for the duration of the 10-year ISI intervals for each facility, as shown in the table above. For LaSalle County Station, Units 1 and 2, the request is for the next 10-year ISI interval which begins on October 1, 2017, but does not include the current 10-year ISI interval. For the other facilities, the request is for the current 10-year ISI interval.

3.2 NRC Staff's Evaluation

The licensee is proposing the use of encoded PAUT in lieu of the ASME BPV Code-required RT for ferritic piping repair and replacement welds for the duration of each facility's 10-year ISI intervals, as shown in the table above. UT and RT are volumetric inspection technique that are commonly used to inspect welds in nuclear power plants and in other industries. Ultrasonic examinations differ from radiographic examinations, as they use different physical mechanisms to detect and characterize discontinuities. These differences in physical mechanisms result in several key differences in sensitivity and discrimination capability.

The NRC staff has been assessing the effectiveness of the use of ultrasound in lieu of radiography since 2009 through literature reviews, detailed evaluations of previous relief requests and proposed alternatives, and confirmatory experimental work to validate findings. An assessment of the use of UT in lieu of RT is described in NRC NUREG/CR-7204, "Applying

Ultrasonic Testing In Lieu of Radiography for Volumetric Examination of Carbon Steel Piping," published September 2015 (ADAMS Accession No. ML15253A674). This report included evaluation on the use of UT in lieu of RT for welded pipes and plates with thicknesses ranging from 0.844 inches to 2.2 inches.

NUREG/CR-7204 concludes, in part:

> Considering overall detections/non-detections for the piping specimens, as well as the Navy plates, it appears that [PAUT], based on the techniques applied in this study, provides an equally effective examination for identifying the presence of fabrication flaws in carbon steel welds. The [PAUT] parameters applied were shown to be more effective for planar flaws, but slightly less effective for small volumetric flaws, than RT.

Based on the assessment described in NUREG/CR-7204, the NRC staff finds that there is a sufficient technical basis for the use of UT in lieu of RT for ferritic steel welds. Given that UT can be effective, the staff considered whether the proposed alternative applies UT in a way that provides reasonable assurance of finding structurally-significant flaws.

Important aspects of the licensee's proposed alternative include:

- The examination volume shall include 100 percent of the weld volume and the weld-to-base-metal interface.

- The electronic data files for the PAUT examinations will be stored as archival-quality records. In addition, hard copy prints of the data will also be included as part of the PAUT examination records to allow viewing without the use of hardware or software.

- Ultrasonic examination procedures shall be qualified by using either a blind or a non-blind performance demonstration using a minimum of 30 flaws covering a range of sizes, positions, orientations, and types of fabrication flaws. The demonstration set shall include specimens to represent the minimum and maximum diameter and thickness covered by the procedure.

- The flaw through-wall heights for the performance demonstration testing shall be based on the applicable acceptance standards for volumetric examination in accordance with subarticles IWB-3400, IWC-3400 or IWD-3400 of the ASME BPV Code, Section XI. At least 30 percent of the flaws shall be classified as acceptable planar flaws, with the smallest flaws being at least 50 percent of the maximum allowable size based on the applicable aspect ratio for the flaw.

- Ultrasonic examination personnel shall demonstrate their capability to detect and size flaws by performance demonstration using the qualified procedure. The demonstration specimen set shall contain at least 10 flaws covering a range of sizes, positions, orientations, and types of fabrication flaws.

- All flaws detected using angle-beam ultrasonic inspections will be treated as planar flaws and will be evaluated against the preservice acceptance standards in subarticles IWB-3400, IWC-3400, and IWD-3400 of the ASME BPV Code, Section XI, for ASME Code Class 1, 2, and 3 welds, respectively.

The NRC staff has authorized similar alternatives for other licensees which included aspects similar to those listed above.[1] The staff finds that the use of performance demonstration for personnel and procedure qualification and the use of encoded data provide assurance that the PAUT methods will be sufficiently rigorous to detect and size flaws in the welds.

Currently, the licensee is required to use the radiographic acceptance standards in Section III of the ASME BPV Code. Section III also provides ultrasonic acceptance standards, however, the licensee has requested to use the flaw acceptance standards in Section XI of the ASME BPV Code as an alternative. The Section III radiographic and ultrasonic acceptance standards (subarticles NB-5300, NC-5300, and ND-5300) require the inspector to detect and determine the type of flaw (e.g., porosity, lack of fusion, slag, incomplete penetration). While RT is effective at discerning between different flaw types, it is less capable than UT at detecting planar flaws such as cracks and lack-of-fusion defects. While subarticles IWB-3400, IWC-3400, and IWD-3400 of Section XI allow larger flaws than paragraphs NB-5330, NC-5330, and ND-5330 of Section III, the use of Section XI acceptance standards has proven effective for ISI of piping welds. The NRC staff finds that the use of the ASME BPV Code, Section XI, acceptance standards is appropriate for the proposed alternative, as the alternative is for repair and replacement activities, not new plant construction, and industry experience with Section XI acceptance standards has demonstrated their effectiveness.

Based on the inspection and qualification requirements described in the proposed alternative, and the results of NUEG/CR-7204, the NRC staff has reasonable assurance that the use of encoded PAUT, qualified as proposed by the licensee, for ferritic piping repair and replacement welds will provide an adequate level of quality and safety.

4.0 CONCLUSION

As set forth above, the NRC staff determined that the licensee's proposed alternative to use encoded PAUT in lieu of RT provides an acceptable level of quality and safety. Accordingly, the staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the use of the proposed alternative at the facilities requested in the licensee's application, as supplemented, for the duration of the applicable 10-year ISI interval listed in the table in Section 3.1.2 of this safety evaluation.

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

Principal Contributor: Stephen Cumblidge, NRR/DE/EPNB

Date of issuance: June 5, 2017.

[1] For example, the NRC authorized a similar alternative for Millstone Power Station, Unit Nos. 2 and 3, by letter dated January 23, 2017 (ADAMS Accession No. ML16363A089).

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; DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3; 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; R. E. GINNA NUCLEAR POWER PLANT; AND THREE MILE ISLAND NUCLEAR STATION, UNIT 1 — PROPOSED ALTERNATIVE TO USE ENCODED PHASED ARRAY ULTRASONIC EXAMINATION TECHNIQUES (CAC NOS. MF8763–MF8782 AND MF9395) DATED JUNE 5, 2017.

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