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

February 25, 2019

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

SUBJECT: NINE MILE POINT NUCLEAR STATION, UNITS 1 AND 2 – ISSUANCE OF RELIEF REQUESTS I5R-06 AND I4R-06 RE: USE OF ENCODED PHASED ARRAY ULTRASONIC EXAMINATION TECHNIQUES IN LIEU OF RADIOGRAPHY (EPID L-2018-LLR-0088)

Dear Mr. Hanson:

By letter dated June 8, 2018 (Agencywide Documents Access and Management System Accession No. ML18159A059), Exelon Generation Company, LLC (Exelon or the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for the use of alternatives to certain American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel Code, Section XI requirements at Nine Mile Point Nuclear Station (Nine Mile Point), Units 1 and 2. The purpose of this letter is to provide the results of the NRC staff's review of Relief Requests I5R-06 and I4R-06. The NRC staff will provide separate correspondence regarding the other relief requests in the letter dated June 8, 2018.

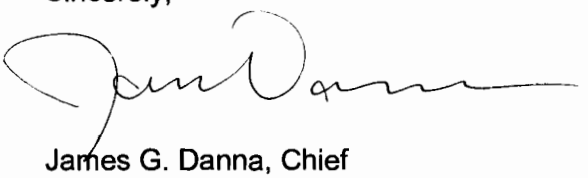
Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1), the licensee requested to use the proposed alternative on the basis that the alternative provides an acceptable level of quality and safety. In Relief Requests I5R-06 and I4R-06, the licensee proposed to use encoded phased array ultrasonic testing in lieu of radiographic testing for ferritic piping butt welds during repair and replacement activities at both facilities on the basis that it would provide an acceptable level of quality and safety.

The NRC staff has reviewed the subject requests and concludes, as set forth in the enclosed safety evaluation, that Exelon has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). The proposed alternative would use encoded phrased array ultrasonic testing in lieu of radiographic testing, which would provide an acceptable level of quality and safety. Therefore, the NRC staff authorizes the use of Relief Request I5R-06 for Nine Mile Point, Unit 1, and Relief Request I4R-06 for Nine Mile Point, Unit 2, for the duration of the applicable 10-year inservice inspection intervals listed in the table in Section 3.1.2 of the enclosed 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.

If you have any questions, please contact the Nine Mile Point Nuclear Station Project Manager, Michael Marshall, at (301) 415-2871 or Michael.Marshall@nrc.gov.

Sincerely,



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

Docket Nos. 50-220 and 50-410

Enclosure:
Safety Evaluation

cc: Listserv

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO RELIEF REQUESTS I5R-06 AND I4R-06

NINE MILE POINT NUCLEAR STATION, LLC

EXELON GENERATION COMPANY, LLC

NINE MILE POINT NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-220 AND 50-410

1.0 INTRODUCTION

By application dated June 8, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18159A059), Exelon Generation Company, LLC (the licensee) submitted Relief Request I5R-06 for Nine Mile Point Nuclear Station (Nine Mile Point), Unit 1, and Relief Request I4R-06 for Nine Mile Point, Unit 2, in accordance with Title 10 of the *Code of Federal Regulations* 50.55a(z)(1). Specifically, Relief Requests I5R-06 and I4R-06 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 & Pressure Vessel Code (B&PV Code) for ferritic piping butt welds during repair and replacement activities at both facilities. 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 B&PV 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 B&PV 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 Nine Mile Point, Units 1 and 2, the proposed alternative is for all ferritic piping butt welds that require radiography during repair and replacement activities in accordance with the ASME B&PV Code, Section XI.

3.1.2 Applicable Code Edition and Addenda

The licensee identified the applicable ASME B&PV Code editions and addenda for Nine Mile Point, Units 1 and 2, 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
Nine Mile Point, Unit 1	5th	2013 Edition	8/23/2019	8/22/2029
Nine Mile Point, Unit 2	4th	2013 Edition	8/23/2018	8/22/2028

3.1.3 Applicable Code Requirement

The licensee has proposed an alternative to the requirements in paragraphs IWA-4221 and IWA-4540(a)(2) of the ASME B&PV Code, Section XI. Subarticle IWA-4200 of the ASME B&PV 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 B&PV 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 B&PV Code, Section XI, requires that the nondestructive examination method and acceptance criteria of the 1992 or later editions of the ASME B&PV 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 B&PV Code, Section III. The acceptance standards for radiographic examination are specified in subarticles NB-5300, NC-5300, and ND-5300 of the ASME B&PV 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 B&PV Code-required RT for ferritic piping repair and replacement welds at Nine Mile Point, Units 1 and 2. The proposed alternative includes a qualification program that is based on 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 they are evaluated against the preservice acceptance standards of subarticles IWB-3400, IWC-3400, and IWD-3400 of the ASME B&PV 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 fifth 10-year ISI at Nine Mile Point, Unit 1, and the duration of the fourth 10-year ISI at Nine Mile Point, Unit 2.

3.2 NRC Staff's Evaluation

The licensee is proposing the use of encoded PAUT in lieu of the ASME B&PV 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 techniques 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 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 an NRC report, 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 PA-UT, 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 PA-UT 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 B&PV 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 B&PV Code, Section XI, for ASME Code Class 1, 2, and 3 welds, respectively.

In the previous Nine Mile Point, Units 1 and 2, 10-year ISI intervals, the NRC staff had authorized an alternative for each unit, which included the provisions 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 repair/replacement welds.

Without this alternative, the licensee would be required to use the radiographic acceptance standards in Section III of the ASME B&PV Code. Section III also provides ultrasonic

[1] The NRC authorized a similar alternative for the Exelon Generation Company, LLC fleet, which included Nine Mile Point Nuclear Station, Units 1 and 2, by letter dated June 5, 2017 (ADAMS Accession No. ML17150A091).

acceptance standards; however, the licensee has requested to use the preservice acceptance standards in Section XI of the ASME B&PV 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 B&PV Code, Section XI, preservice 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 NUREG/CR-7204, the NRC staff has reasonable assurance that the use of encoded PAUT, qualified as proposed by the licensee, for the repair and replacement of ferritic piping 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 NRC 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 Relief Request I5R-06 for Nine Mile Point, Unit 1, and Relief Request I4R-06 for Nine Mile Point, Unit 2, for the duration of the applicable 10-year ISI intervals 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: Keith Hoffman

Date: February 25, 2019

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ADAMS Accession No.: ML19046A114 *by safety evaluation dated

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