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

September 17, 2018

Mr. Daniel G. Stoddard
Senior Vice President and Chief Nuclear Officer
Innsbrook Technical Center
5000 Dominion Blvd.
Glen Allen, VA 23060-6711

SUBJECT: MILLSTONE POWER STATION, UNIT NOS. 2 AND 3 – ALTERNATIVE REQUESTS RR-04-27 AND IR-3-38 FOR THE USE OF ENCODED PHASED ARRAY ULTRASONIC EXAMINATION TECHNIQUES IN LIEU OF RADIOGRAPHY (EPID L-2018-LLR-0011)

Dear Mr. Stoddard:

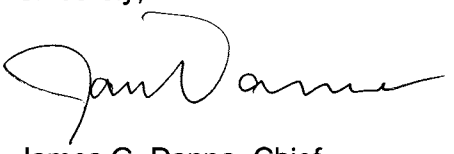
By letter dated February 28, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18066A522), Dominion Energy Nuclear Connecticut, Inc. (the licensee), submitted Alternative Requests RR-04-27 and IR-3-38 to request the use of alternatives to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) Section XI, Paragraphs IWA-4221 and IWA-4520(a)(2) for the Millstone Power Station, Unit Nos. 2 and 3 (Millstone 2 and 3). The ASME Code, Section XI, Paragraphs IWA-4221 and IWA-4520(a)(2), requires the use of several ASME Code, Section III, subarticles applicable to repaired and replaced components, which in turn specify the use of radiographic examinations. The licensee proposed to use encoded phased array ultrasonic testing as an alternative to the required radiographic testing at Millstone 2 and 3, for the remainder of the fourth and third 10-year inservice inspection (ISI) intervals, respectively.

Specifically, 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 encoded phased array ultrasonic examination alternative provides an acceptable level of quality and safety.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the subject requests and concludes, as set forth in the enclosed safety evaluation, that the licensee's proposed alternative to use encoded phased array ultrasonic examination techniques in lieu of radiographic examination techniques provides reasonable assurance of structural integrity and leak tightness of Class 1 and 2 ferritic and austenitic piping welds. Thus, ultrasonic testing using the procedure described in the submittals of the subject welds would provide an adequate 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 alternative request RR-04-27 for Millstone 2 for the remainder of the fourth 10-year ISI that is scheduled to end on March 31, 2020, and IR-3-38 for Millstone 3 for the remainder of the third 10-year ISI interval that is scheduled to end on April 22, 2019.

If you have any questions, please contact the Project Manager, Richard Guzman, at 301-415-1030 or by e-mail to Richard.Guzman@nrc.gov.

Sincerely,



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

Docket Nos. 50-336 and 50-423

Enclosure:
Safety Evaluation

cc: Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

ALTERNATIVE REQUESTS RR-04-27 AND IR-3-38

FOR THE FOURTH AND THIRD INSERVICE INSPECTION INTERVALS

MILLSTONE POWER STATION, UNIT NOS. 2 AND 3

DOMINION NUCLEAR CONNECTICUT, INC.

DOCKET NOS. 50-336 AND 50-423

1.0 INTRODUCTION

By letter dated February 28, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18066A522), Dominion Energy Nuclear Connecticut, Inc. (DENC, the licensee), submitted proposed alternatives RR-04-27 and IR-3-38, to request the use of alternatives to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) Section XI, Paragraphs IWA-4221 and IWA-4520(a)(2), for Millstone Power Station, Unit Nos. 2 and 3 (Millstone 2 and 3). ASME Code Section XI, Paragraphs IWA-4221 and IWA-4520(a)(2), require the use of several ASME Code, Section III, subarticles applicable to repaired and replaced components, which in turn, specify the use of radiographic examinations. The licensee is proposing to use encoded phased array ultrasonic testing (PAUT) as an alternative to the required radiographic testing (RT) at Millstone 2 and 3.

Specifically, 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 would provide an acceptable level of quality and safety.

2.0 REGULATORY EVALUATION

The licensee has requested relief from the requirements of ASME Code Section XI, Paragraphs IWA-4221 and IWA-4520(a)(2). The ASME Code, Section XI, Section IWA-4200, covers repair/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. Paragraph IWA-4520 requires that welded joints made for installation of items to be examined in accordance with the Construction Code identified in the repair/replacement plan.

Alternative Requests RR-04-27 and IR-3-38, cite 10 CFR 50.55a(a)(z)(1), which covers requests for alternatives on the basis that the proposed alternative would provide an acceptable level of quality and safety. Section 50.55a(z) of 10 CFR states, in part, that alternatives to the requirements of 10 CFR 50.55a(b)-(h) may be used when authorized by the U.S. Nuclear

Regulatory Commission (NRC or the Commission) if (1) the proposed alternatives would provide 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, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request, and the Commission to authorize, the alternatives requested by the licensee.

3.0 TECHNICAL EVALUATION

3.1 The Licensee's Relief Request

ASME Code Components Affected

Alternative Requests RR-04-27 and IR-3-38, cover ASME Code, Section XI, ferritic and austenitic piping butt welds requiring radiography during repair/replacement activities at the nuclear power reactors listed in Table 1.

ASME Code Requirement

The ASME Code Section XI, Paragraph IWA-4221, requires the owner to use the requirements of the Construction Code for repair/replacement activities. The examination requirements for ASME Section III, circumferential butt welds are contained in the ASME Code, Section III, Subarticles NB-5200, NC-5200, and ND-5200. The acceptance standards for RT are specified in Subarticles NB-5300, NC-5300, and ND-5300.

ASME Codes of Record

The Editions and Addenda for each nuclear power reactor covered by this request for alternative are listed in Table 1, along with the dates of the current inservice inspection (ISI) interval for each unit.

Table 1: ASME Code Section XI Applicable Codes of Record

Plant	Interval	Edition (no Addenda)	Start	End
Millstone Power Station, Unit 2	Fourth	2004	April 1, 2010	March 31, 2020
Millstone Power Station, Unit 3	Third	2004	April 23, 2009	April 22, 2019

Proposed Alternative

The licensee is proposing to perform encoded PAUT examination techniques using demonstrated procedures, equipment and personnel in accordance with the process defined in ASME approved Code Case N-831, Ultrasonic Examination in Lieu of Radiography for Welds in Ferritic Pipe, dated October 26, 2016.

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

Basis for Use

The basis for the licensee's request for alternative is that encoded PAUT is equivalent to or superior for detecting and sizing planar flaws as compared to the required radiographic examination. The basis for the proposed alternative was developed from numerous codes, code cases, associated industry experience, articles, and the results of RT and encoded PAUT examinations. The examination procedures 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.

Ultrasonic testing (UT) techniques are being used throughout the nuclear industry for examination of dissimilar metal welds and overlaid welds. In addition, UT techniques are used for other applications, including ASME B31.1 piping replacements.

Duration of Proposed Alternative

The licensee is requesting that this proposed alternative be applied for the duration of the current 10-year ISI interval for each of the facilities as described in Table 1.

3.2 NRC Staff Evaluation

The licensee is proposing to use encoded PAUT in lieu of RT for repair and replacement activities in alternative requests RR-04-27 and IR-3-38 for Millstone 2 and 3, respectively, for the remainder of their current 10-year inspection intervals. The UT, like RT, is a volumetric inspection technique that is commonly used to inspect welds in nuclear power plants and in other industries. Ultrasonic examinations are not equivalent to 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, including literature reviews, detailed evaluations of previous relief requests and proposed alternatives, and confirmatory experimental work to validate the findings. An assessment of the use of UT in lieu of RT by the NRC is described in the 2015 document NUREG/CR-7204, "Applying Ultrasonic Testing In Lieu of Radiography for Volumetric Examination of Carbon Steel Piping" (ADAMS Accession No. ML15253A674). This report included evaluation of the use of UT in lieu of RT for welded pipes and plates with thicknesses ranging from 0.844 inches to 2.2 inches.

In NUREG/CR-7204, the NRC staff stated that:

> 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 conclusions of 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. While the spatial resolving power of UT is lower than that of RT, the UT methods can provide more contrast (signal to noise ratio in UT) than RT. In ferritic materials advanced PAUT methods is able to detect, size and discriminate between planar flaws such as cracks and lack of fusion defects and volumetric flaws such as slag and porosity.

The EPRI Report 3002010297 "Technical Basis for Substituting Ultrasonic Testing for Radiographic Testing for New, Repaired, and Replacement Welds for ASME Section XI, Division 1, Stainless Steel Piping," presents data showing that fabrication flaws can be detected and sized accurately in austenitic steel welds using ultrasonic techniques. The primary difference is that the ability to discriminate between planar and volumetric flaws has not demonstrated for the more challenging austenitic materials.

Given that UT in lieu of RT can be effective, the NRC staff considered whether the proposed alternative applies UT in a way that provides reasonable assurance of finding structurally-significant flaws.

Important aspects of this 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 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 IWB-3400, IWC-3400, or IWD-3400. 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 a/l 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 of ASME Section XI, IWB-3400, IWC-3400, or IWD-3400 for ASME Code Class 1, 2, or 3 welds, respectively. As there is no

need to discriminate between planar and volumetric flaws, the primary weakness of UT in lieu of RT in austenitic welds is mitigated.

Based on the inspection and qualification requirements described in the licensee's request for alternative and the evaluation results reported in NUREG/CR-7204, the NRC staff concludes that there is reasonable assurance that the encoded PAUT, applied and qualified as proposed by the licensee, will provide an adequate level of quality and safety.

4.0 CONCLUSION

As set forth above, the NRC staff concludes that the licensee's proposed alternative to use UT in lieu of RT using encoded phased array examinations provides reasonable assurance of structural integrity and leak tightness of Class 1 and 2 ferritic and austenitic piping welds. Thus, UT using the procedure described in the submittals of the subject welds would provide an adequate 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 proposed alternatives RR-04-27 and IR-3-38 at Millstone 2 and 3 for the remainder of the 10-year ISI interval for each unit, as listed in Table 1.

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

Principal Contributor: S. Cumblidge

Date: September 17, 2018

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