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

February 6, 2020

Mr. Don Moul
Vice President, Nuclear Division and
Chief Nuclear Officer
Florida Power & Light Company
NextEra Energy Point Beach, LLC
NextEra Energy Seabrook, LLC
Mail Stop: NT3/JW
15430 Endeavor Drive
Jupiter, FL 33478

SUBJECT: POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2; SEABROOK STATION, UNIT NO. 1; ST. LUCIE PLANT, UNIT NOS. 1 AND 2; AND TURKEY POINT NUCLEAR GENERATING UNIT NOS. 3 AND 4 – PROPOSED ALTERNATIVE FRR-04 TO USE ENCODED PHASED ARRAY ULTRASONIC EXAMINATION TECHNQUES (EPID L-2019-LLR-0027)

Dear Mr. Moul:

By letter dated March 19, 2019 (Agencywide Documents Access and Management System Accession No. ML ML19080A057), NextEra Energy Point Beach, LLC/NextEra Energy Seabrook, LLC/Florida Power & Light Company (NextEra/FPL) 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 Point Beach Nuclear Plant, Units 1 and 2; Seabrook Station, Unit No. 1; St. Lucie Plant, Unit Nos. 1 and 2; and Turkey Point Nuclear Generating Unit Nos. 3 and 4.

The proposed alternative would allow NextEra/FPL to use encoded phased array ultrasonic testing in lieu of radiographic testing, required by the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), for ferritic and austenitic piping welds during repair and replacement activities at each of the requested facilities. Specifically, pursuant to 10 CFR 50.55a(z)(1), NextEra/FPL 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 NextEra/FPL 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 requested facilities for the duration of the applicable 10-year inservice inspection interval as specified in NextEra/FPL's application dated March 19, 2019.

All other requirements of the ASME Code 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 regarding this issue, please contact the NextEra project manager, Justin Poole, at (301) 415-2048 or by e-mail to Justin.Poole@nrc.gov.

Sincerely,

/RA/

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

Docket Nos. 50-250, 50-251, 50-266,
50-301, 50-335, 50-389, and
50-443

Enclosure:
Safety Evaluation

cc: Listserv

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PROPOSED ALTERNATIVE FRR-04 TO USE ENCODED PHASED ARRAY ULTRASONIC TESTING IN LIEU OF RADIOGRAPHY FOR FERRITIC OR AUSTENITIC PIPING WELDS

POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

SEABROOK STATION, UNIT NO. 1

ST. LUCIE PLANT, UNIT NOS. 1 AND 2

TURKEY POINT NUCLEAR GENERATING UNIT NOS. 3 AND 4

NEXTERA ENERGY RESOURCES AND FLORIDA POWER & LIGHT COMPANY, ET AL.

DOCKET NOS. 50-250, 50-251, 50-266, 50-301, 50-335, 50-389, AND 50-443

1.0 INTRODUCTION

By letter dated March 19, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML ML19080A057), NextEra Energy Point Beach, LLC; NextEra Energy Seabrook, LLC; and Florida Power & Light Company (NextEra/FPL) 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 Point Beach Nuclear Plant, Units 1 and 2 (Point Beach); Seabrook Station, Unit No. 1 (Seabrook); St. Lucie Plant, Unit Nos. 1 and 2 (St. Lucie); and Turkey Point Nuclear Generating Unit Nos. 3 and 4 (Turkey Point).

The proposed alternative FRR-04 would allow NextEra/FPL to use encoded phased array ultrasonic testing in lieu of radiographic testing required by the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), for ferritic and austenitic piping welds during repair and replacement activities at each of the requested facilities. Specifically, pursuant to 10 CFR 50.55a(z)(1), NextEra/FPL 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), "Inservice inspection standards requirement for operating plants," 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 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(z), "Alternatives to codes and standards requirements," 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.

In its submittal, NextEra/FPL cited 10 CFR 50.55a(z)(1), which covers requests for alternatives on the basis that the proposed alternative would provide an acceptable level of quality and safety. NextEra/FPL has requested an alternative from the requirements of ASME Code, Section XI, paragraph IWA-4221. ASME Code, Section XI, paragraph IWA-4200, covers repair/replacement activities, and paragraph IWA-4221 requires the use of ASME Code, Section III, Subarticles NB-5200, NC-5200, and ND-5200, which require the use of radiographic examinations on Class 1, 2, and 3 piping circumferential butt welds.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for NextEra/FPL to request, and the Commission to authorize, the alternative requested by NextEra/FPL.

3.0 TECHNICAL EVALUATION

3.1 NextEra/FPL Evaluation

ASME Code Components Affected

For each requested facility, the proposed alternative is for all ASME Code, Section XI, Class 1, 2, and 3 ferritic and austenitic piping welds requiring radiography (RT) during repair/replacement activities.

ASME Code of Record

The applicable 10-year inservice inspection (ISI) interval and ASME Code, Section XI, Edition and Addenda for each plant are listed below.

Table 1

Plant	Interval	Edition	Start	End
Point Beach, Units 1 and 2	Fifth	2007 Edition through 2008 Addenda	August 1, 2012	July 31, 2022
St. Lucie, Unit 1	Fifth	2007 Edition through 2008 Addenda	February 11, 2018	February 10, 2028
St. Lucie, Unit 2	Fourth	2007 Edition through 2008 Addenda	January 20, 2013	January 19, 2023
Seabrook	Third	2004 Edition no Addenda	August 19, 2010	August 18, 2020
Turkey Point, Unit 3	Fifth	2007 Edition through 2008 Addenda	February 22, 2014	February 21, 2024
Turkey Point, Unit 4	Fifth	2007 Edition through 2008 Addenda	April 1, 2014	April 14, 2024

ASME Code Requirement

Both the 2004 Edition with No Addenda and the 2007 Edition through the 2008 Addenda of ASME Code, Section XI, IWA-4221, require that components used for repair or replacement activities meet the applicable Owner's requirements and Construction Code requirements. ASME Code, Section XI, IWA-4520, requires that welded joints made during the performance of repair/replacement activities be examined in accordance with the Construction Code identified in the Repair/Replacement Plan.

The examination requirements for the ASME Code, 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 radiographic examination are specified in the ASME Code, Section III, Subarticles NB-5300, NC-5300, and ND-5300.

Reason for Request

The requirements in the relief request are based upon ASME Code, Section XI, Code Case N-831-1 and will apply to both ISI of ferritic and austenitic piping butt welds requiring RT during repair/replacement activities. This code case, however, has not been incorporated into NRC Regulatory Guide 1.147, "Inservice Inspection Code Case Applicability, ASME Section XI, Division 1."

Replacement of piping is periodically performed in support of the Flow Accelerated Corrosion (FAC) program, as well as other repair/replacement activities. The use of encoded phased array ultrasonic examination techniques (PAUT or PA-UT) in lieu of RT to perform the required examinations of the replaced welds would eliminate the safety risk associated with performing RT, such as the potential for personnel radiation exposure in limited access work locations. In addition, encoded PAUT is widely considered to be equivalent, or superior, to the ASME Code-required RT examination for ASME ferritic and austenitic piping repair and replacement welds for detecting and sizing critical (planar) flaws, such as cracks and lack of fusion. Encoded PAUT provides sizing capabilities for both depth and length dimensions of the flaw, which are required to apply the acceptance criteria of ASME Code Case N-831-1. RT does not provide depth-sizing capabilities.

The proposed alternative is requested to support both planned and unplanned piping repair/replacement activities. The duration of the proposed alternative request is for the remainder of the ISI intervals for the plants listed in Table 1 of this safety evaluation (SE).

Proposed Alternative

NextEra/FPL is proposing the use of encoded PAUT in lieu of the ASME Code-required RT examinations for ASME Code Class 1, 2, and 3 ferritic and austenitic piping repair or replacement welds. Similar techniques are being used throughout the nuclear industry for examination of dissimilar metal welds and overlaid welds, as well as other applications including ASME B31.1 piping replacements. This proposed alternative request includes requirements that provide an acceptable level of quality and safety that satisfy the requirements of 10 CFR 50.55a(z)(1). The capability of the alternative technique is comparable to the examination methods documented in the ASME Code, Sections III, VIII, and IX, and associated ASME Code cases using ultrasonic examination techniques for weld acceptance. The examinations will be performed using personnel and procedures qualified with the requirements listed below.

Elements of the proposed alternative examination include:

(1) The welds to be examined under the alternative shall be limited to welds made as part of a repair or replacement activity and is subject to review by the authorized inspection agency.

(2) The welds to be examined shall be conditioned such that transducers properly couple with the scanning surface with no more than a 1/32 in. (0.8 mm) gap between the search unit and the scanning surface.

(3) The ultrasonic examination shall be performed with equipment, procedures, and personnel qualified by performance demonstration.

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

a. Angle beam examination of the complete examination volume for fabrication flaws oriented parallel to the weld joint shall be performed.

b. Angle beam examination for fabrication flaws-oriented transverse to the weld joint shall be performed to the extent practical. Scan restrictions that limit complete coverage shall be documented.

c. A supplemental straight beam examination shall be performed on the volume of base metal through which the angle beams will travel to locate any reflectors that can limit the ability of the angle beam to examine the weld. Detected reflectors that may limit the angle beam examination shall be recorded and evaluated for impact on examination coverage. The straight beam examination procedure, or the straight-beam portion of the procedure, is required to be qualified in accordance with ASME Section V, Article 4.

(5) All detected flaw indications from (4)(a) and (4)(b) in the submittal shall be considered planar flaws and compared to the preservice acceptance standards for volumetric examination in accordance with IWB-3000, IWC-3000, or IWD-3000. Preservice acceptance standards shall be applied. Analytical evaluation for acceptance of flaws in accordance with IWB-3600, IWC-3600, or IWD-3600 is permitted for flaws that exceed the applicable acceptance standards and are confirmed by surface or volumetric examination to be non-surface connected.

(6) When analytical evaluation has not been performed for flaws exceeding the applicable acceptance standards to justify acceptance, the flaws shall be reduced to an acceptable size or removed and repaired, and the location of the repair shall be reexamined using the same ultrasonic examination procedure that detected the flaw.

(7) The ultrasonic examination shall be performed using encoded PAUT technology that produces an electronic record of the ultrasonic responses indexed to the probe position, permitting off-line analysis of images built from the combined data.

(8) A written ultrasonic examination procedure qualified by performance demonstration shall be used. The qualification shall be applicable to the scope of the procedure,

e.g., flaw detection and/or sizing (length or through-wall height), encoded or non-encoded, single and/or dual side access, etc.

(9) Performance demonstration specimens shall conform to a list of requirements related to fabrication, geometry, flaw direction, size, and distribution.

(10) Ultrasonic examination procedures shall be qualified by performance demonstration in accordance with the specific requirements.

(11) Ultrasonic examination personnel shall be qualified in accordance with ASME Code, Section XI, IWA-2300. Additionally, examination personnel shall demonstrate their capability to detect and size flaws by performance demonstration using a qualified procedure.

(12) NextEra Energy is responsible for reviewing the procedure and demonstration results to validate that the ranges of the essential variables in the procedure were included in the demonstration.

(13) Documentation of the qualifications of procedures and personnel shall be maintained by NextEra Energy. Documentation shall include identification of personnel, nondestructive examination procedures, equipment, and specimens used during qualification, and results of the performance demonstration.

Basis for Use

NextEra/FPL is proposing that encoded PAUT is equivalent or superior to the required radiographic examination for detecting and sizing critical (planar) flaws. The examination procedure and the personnel performing the examinations will be qualified 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 demonstrated ability of the examination procedure and personnel to appropriately detect and size flaws provides an acceptable level of quality and safety alternative as allowed by 10 CFR 50.55a(z)(1).

Duration of Proposed Alternative

This alternative request will be applied for the remainder of the ISI intervals for the plants defined in Table 1 of this SE.

3.2 NRC Staff Evaluation

The NRC staff has evaluated NextEra/FPL's proposed alternative FRR-04 to use encoded PAUT in lieu of RT for repair and replacement activities in the plants listed in Table 1 of this SE for the remainder of their current 10-year inspection intervals. Ultrasonic testing (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 divided its review of the capabilities and limitations of the application of PAUT in lieu of RT for (1) ferritic steel welds and (2) austenitic steel welds.

Ferritic Steel Welds

The NRC staff has been assessing the effectiveness of the use of ultrasound in lieu of radiography for ferritic steel welds 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 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 of the use of UT in lieu of RT for ferritic steel welded pipes and plates with thicknesses ranging from 0.844 inches to 2.2 inches.

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

> 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 this research, the NRC staff finds that there is a sufficient technical basis to support 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. UT has a higher sensitivity to planar flaws and similar sensitivity to volumetric flaws and can detect cracks and lack of fusion defects more effectively than simple RT. The higher spatial resolving power of RT allows RT to effectively discriminate between different types of planar and volumetric flaws. RT provides a clear image of many flaws, allowing the examiner to distinguish between slag, porosity, undercut, and cracks by looking at the image. UT generally presents all indications as similar-looking regions, and multiple inspection angles are required to distinguish planar flaws from volumetric flaws, and different types of volumetric flaws provide nearly identical indications to UT techniques. In ferritic materials, advanced PAUT methods can detect, size, and differentiate between planar flaws such as cracks and lack of fusion defects and volumetric flaws such as slag and porosity.

Austenitic Steel Welds

The Electric Power Research Institute (EPRI) Technical Report No. 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," dated June 2017, discusses EPRI's performance-based approach to demonstrate the effectiveness of encoded PAUT for detection and sizing fabrication flaws in austenitic stainless-steel piping welds based on the ASME Code, Section XI, Appendix VIII. The primary difference in the effectiveness of using encoded PAUT in examining ferritic steel welds versus austenitic steel welds is the inability to differentiate between planar and volumetric flaws in the more challenging austenitic materials. Austenitic welds have larger grain sizes than ferritic welds, and the austenitic weld grains are anisotropic, meaning that sound goes faster in some crystalline directions than others. These large anisotropic grains can redirect the ultrasonic beam and provide reflections, creating increased noise. While detection and sizing of flaws is possible in an austenitic weld, it is significantly more challenging to discriminate between a volumetric flaw and a planar flaw. For this reason, this proposed alternative does not attempt to discriminate between flaw types. All flaws detected using angle-beam ultrasonic testing 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. Since it is not necessary to differentiate between planar and volumetric flaws, the primary weakness of UT in lieu of RT in austenitic welds is mitigated.

Given the information stated above, 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/t 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.

Based on the inspection and qualification requirements described in NextEra/FPL's request for alternative and the evaluation results reported in NUREG/CR-7204 and EPRI Technical Report No. 3002010297, the NRC staff concludes that there is reasonable assurance that the encoded PAUT, applied and qualified as proposed by NextEra/FPL, will provide an adequate level of quality and safety because (1) in ferritic steel welds, encoded PAUT provides capability for detection and sizing fabrication flaws, and (2) in austenitic steel welds, all flaws similarly detected by encoded PAUT will be treated as planer flaws and will subsequently be evaluated against appropriate preservice acceptance standards. Therefore, the NRC staff finds NextEra/FPL's request for alternative acceptable.

4.0 CONCLUSION

As set forth above, the NRC staff concludes that NextEra/FPL's proposed alternative to use encoded PAUT in lieu of RT provides reasonable assurance of structural integrity and leak-tightness of ferritic and austenitic piping welds requiring radiography during repair or replacement activities. Thus, encoded PAUT using the procedure described in the submittal of

the subject welds will provide an adequate level of quality and safety. Accordingly, the NRC staff concludes that NextEra/FPL has adequately addressed all the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the use of the proposed alternative FRR-04 at the requested facilities for the remainder of the 10-year ISI intervals as described in Table 1 of this SE.

The NRC staff notes that the approval of proposed alternative FRR-04 does not imply or infer the NRC approval of ASME Code Case N-831-1 for generic use.

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: A. Young

Date: February 6, 2020

SUBJECT: POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2; SEABROOK STATION, UNIT NO. 1; ST. LUCIE PLANT, UNIT NOS. 1 AND 2; AND TURKEY POINT NUCLEAR GENERATING UNIT NOS. 3 AND 4 – PROPOSED ALTERNATIVE FRR-04 TO USE ENCODED PHASED ARRAY ULTRASONIC EXAMINATION TECHNQUES (EPID L-2019-LLR-0027) DATED FEBRUARY 6, 2020

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