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

February 11, 2020

Ms. Cheryl A. Gayheart
Regulatory Affairs Director
Southern Nuclear Operating Co., Inc.
3535 Colonnade Parkway
Birmingham, AL 35243

SUBJECT: EDWIN I. HATCH NUCLEAR PLANT, UNITS 1 AND 2; JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2; AND VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2 – RELIEF REQUEST GEN-ISI-ALT-2019-01 FOR PROPOSED ALTERNATIVE TO USE ASME CODE CASE N-831-1, ULTRASONIC EXAMINATION IN LIEU OF RADIOGRAPHY FOR WELDS IN FERRITIC OR AUSTENITIC PIPE SECTION XI, DIVISION 1 (EPID L-2019-LLR-0097)

Dear Ms. Gayheart:

By application dated September 30, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19273A926), Southern Nuclear Operating Company (SNC, the licensee) submitted Relief Request No. GEN-ISI-ALT-2019-01 in accordance with paragraph 50.55a(z)(1) of Title 10 of the *Code of Federal Regulations* (10 CFR) for use of a proposed alternative to the requirements of Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) at Edwin I. Hatch Nuclear Plant, Units 1 and 2; Joseph M. Farley Nuclear Plant, Units 1 and 2; and Vogtle Electric Generating Plant, Units 1 and 2. The proposed alternative would allow the licensee to use ASME Code Case N-831-1, "Ultrasonic Examination in Lieu of Radiography for Welds in Ferritic Pipe, Section XI, Division 1," in lieu of specified ASME Code requirements. Specifically, pursuant to 10 CFR 50.55a(z)(1), SNC requested to use an alternative on the basis that the alternative would provide an acceptable level of quality and safety.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the proposed alternative and concludes, as set forth in the enclosed safety evaluation, that the proposed alternative provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the use of the proposed alternative described in the licensee's application for the remainder of the applicable 10-year inservice inspection interval listed in Section 3.1.2 of the enclosed safety evaluation, or until such time as the NRC approves ASME Code Case N-831-1 for general use through the revision of NRC Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1" (ADAMS Accession No. ML16321A336), or other document.

All other requirements of the ASME Code, Section XI, for which relief has not been specifically requested and authorized by NRC staff remain applicable, including a third-party review by the Authorized Nuclear Inservice Inspector. The NRC staff notes that approval of this plant-specific authorization does not infer approval of ASME Code Case N-831-1 for generic use.

If you have any questions, please contact the SNC fleet Senior Project Manager, John G. Lamb, at 301-415-3100 or via e-mail at John.Lamb@nrc.gov.

Sincerely,

/RA/

Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-321, 50-348, 50-364,
50-366, 50-424, and 50-425

Enclosure:
Safety Evaluation

cc: Listserv

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

RELIEF REQUEST NO. GEN-ISI-ALT-2019-01

PROPOSED ALTERNATIVE TO USE ASME CODE CASE N-831-1

SOUTHERN NUCLEAR OPERATING COMPANY

EDWIN I. HATCH NUCLEAR PLANT, UNITS 1 AND 2

JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2

VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2

DOCKET NOS. 50-321, 50-348, 50-364, 50-366,

50-424, AND 50-425

1.0 INTRODUCTION

By application dated September 30, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19273A926), Southern Nuclear Operating Company (SNC, the licensee) submitted Relief Request No. GEN-ISI-ALT-2019-01 in accordance with paragraph 50.55a(z)(1) of Title 10 of the *Code of Federal Regulations* (10 CFR) for use of a proposed alternative to the requirements of Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) at Edwin I. Hatch Nuclear Plant (HNP), Units 1 and 2; Joseph M. Farley Nuclear Plant (FNP), Units 1 and 2; and Vogtle Electric Generating Plant (VEGP), Units 1 and 2. The proposed alternative would allow the licensee to use ASME Code Case N-831-1, "Ultrasonic Examination in Lieu of Radiography for Welds in Ferritic Pipe, Section XI, Division 1," in lieu of specified ASME Code requirements. Specifically, pursuant to 10 CFR 50.55a(z)(1), SNC requested to use an alternative on the basis that the alternative would provide an acceptable level of quality and safety.

2.0 REGULATORY EVALUATION

The U.S. Nuclear Regulatory Commission (NRC) staff considered the following regulatory requirements and guidance in its evaluation.

The regulations in 10 CFR 50.55a(g)(4) state, in part, that ASME Code Class 1, 2, and 3 components must meet the requirements, except design and access provisions and the pre-service examination requirements, set forth in the Section XI of ASME Code.

Enclosure

The regulations in 10 CFR 50.55a(z) state, in part, that alternatives to the requirements of 10 CFR 50.55a(b) through (h) or portions thereof may be used when authorized by the NRC if: (1) the proposed alternative 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.

Regulatory Guide (RG) 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1" (ADAMS Accession No. ML16321A336), lists the ASME Section XI Code Cases that the NRC has approved for use as voluntary alternatives to the mandatory ASME Code provisions that are incorporated by reference into 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." The ASME Code Case N-831-1 is currently not incorporated into 10 CFR Part 50.

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 for the Commission to authorize, the alternative requested by the licensee.

3.0 TECHNICAL EVALUATION

3.1 The Licensee's Request for Alternative

3.1.1 ASME Code Components Affected

ASME Code, Section XI, piping welds made of the ferritic steel or austenitic stainless steel that require radiography as part of a repair/replacement activity are affected.

3.1.2 Applicable Code Edition and Addenda – Duration of Relief Request

The licensee provided the Code of record, and the duration of this relief request for each plant in the table below.

Plant	10-Year ISI Interval	ASME Code of Record	Duration of Relief Request	
			Interval Started	Interval is Scheduled to End
HNP, Units 1 and 2	5th	2007 Edition through 2008 Addenda	January 1, 2016	December 31, 2025
FNP, Units 1 and 2	5th	2007 Edition through 2008 Addenda	December 1, 2017	November 30, 2027
VEGP, Units 1 and 2	4th	2007 Edition and 2008 Addenda	May 31, 2017	May 30, 2027

3.1.3 ASME Code Requirement

Paragraph IWA-4221 of the 2007 Edition of the ASME Code, Section XI, requires the owner to meet the applicable Construction Code requirements when performing repair and replacement activities.

Sub-article IWA-4520 of the 2007 Edition and 2008 Addenda requires that welding or brazing areas and welded joints made for fabrication or installation of items be examined in accordance with the Construction Code identified in the Repair/Replacement Plan with certain specified exceptions.

3.1.4 Reason for Relief

In its letter dated September 30, 2019, the licensee stated:

> 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) in lieu of radiography (RT) to perform the required examinations of fabrication, installation, or repair welds would eliminate the safety risk associated with performing RT, which includes both planned and unplanned radiation exposure to plant workers. PAUT also minimizes the impact on other outage activities normally involved with performing RT such as limited access to work locations. In addition, encoded PAUT is equivalent or superior to the code-required RT examination for ASME ferritic and austenitic piping repair/replacement welds for detecting and sizing critical (planar) flaws such as cracks and lack of fusion. PAUT provides sizing capabilities for both depth and length dimensions of the flaw, which are required to apply the acceptance criteria of the applicable code case. RT does not provide depth sizing capabilities. This proposed alternative is requested to support both planned and unplanned piping repair and replacement activities.

3.1.5 Licensee's Proposed Alternative

The licensee proposed to use ASME Code Case N-831-1 requirements to perform the volumetric examination of the ferritic steel or austenitic stainless-steel piping welds during repair/replacement activities. This Code Case requires use of the PAUT technique as an alternative to the Code required RT. The capability of the alternative technique is comparable to the examination methods documented in the ASME Code Sections III, VIII, and IX, and associated Code Cases using UT techniques for weld acceptance. The examinations will be performed using procedures, equipment, and qualified personnel as defined in ASME Code Case N-831-1.

ASME Code Case N-831-1 has not been incorporated by reference into 10 CFR 50.55a via inclusion in RG 1.147, Revision 18.

3.1.6 Basis for Use of Alternative

In its submittal, the licensee stated that the basis for this proposed alternative is that encoded PAUT is equivalent or superior to RT for detecting and sizing critical (planar) flaws. It also stated that the basis for the proposed alternative was developed from the ASME Code, code cases, relevant industry experience, articles, and the results of RT and encoded PAUT examinations. It further stated that the examination procedure and personnel performing examinations are 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.

3.1.7 Duration of Proposed Alternative

The licensee is requesting approval of this proposed alternative for the duration of the ISI 10-year interval as identified in Section 3.1.2 of this safety evaluation.

3.2 NRC Staff Evaluation

The NRC staff has evaluated Proposed Alternative GEN-ISI-ALT-2019-01 pursuant to 10 CFR 50.55a(z)(1) to determine if the proposed alternative provides an acceptable level of quality and safety. The Ultrasonic examinations (UT), like RT, is a volumetric inspection technique that is commonly used to inspect welds in nuclear power plants and in other industries. The UT are not the same as RT 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 UT in lieu of RT 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 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 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 that:

> Considering overall detections/non-detections for the piping specimens, as well as the Navy plates, it appears that [phased array ultrasonic inspection] 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 above, the NRC staff finds that there is 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. The 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. The RT provides a clear image of many flaws, allowing the examiner to distinguish between slag, porosity, undercut, and cracks by looking at the image. However, 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 (TP) 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," (June 2017) summarizes EPRI's performance-based approach based on the ASME Code, Section XI, Appendix VIII to demonstrate the effectiveness of the encoded PAUT for detection and sizing fabrication flaws in the austenitic stainless-steel piping welds.

When compared to the information for ferritic steel materials, the primary difference between UT and RT is that the ability to discriminate between planar and volumetric flaws has not demonstrated for 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 using UT. For this reason, this proposed alternative does not attempt to discriminate between flaw types when using UT. 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 when UT is used, the primary weakness of UT in lieu of RT in austenitic welds is mitigated.

Based on the 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 as specified in Code Case N-831-1 include:

> 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 [a = flaw depth and l = flaw length] aspect ratio for the flaw.
>
> 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 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.

NRC Staff Technical Evaluation

Based on the inspection and qualification requirements described in the licensee's request for alternative as specified in Code Case N-831-1 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 the licensee, 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 staff finds the licensee's request for alternative acceptable.

4.0 CONCLUSION

As set forth above, the NRC staff concludes that the licensee's proposed alternative to use PAUT in lieu of RT provides reasonable assurance of structural integrity and leak tightness of ferritic and austenitic piping welds requiring radiography during repair and replacement activities. Thus, UT using the procedure described in Proposed Alternative GEN-ISI-ALT-2019-01 will provide an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee 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 GEN-ISI-ALT-2019-01 for the remainder of the applicable 10-year ISI interval listed in the table above, or until such time as the NRC approves ASME Code Case N-831-1 for general use through revision of RG 1.147 or other document.

The NRC staff notes that authorization of Proposed Alternative GEN-ISI-ALT-2019-01 does not 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: B. Fu, NRR
J. Lamb, NRR

Date: February 11, 2020

SUBJECT: EDWIN I. HATCH NUCLEAR PLANT, UNITS 1 AND 2; JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2; AND VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2 – RELIEF REQUEST GEN-ISI-ALT-2019-01 FOR PROPOSED ALTERNATIVE TO USE ASME CODE CASE N-831-1, ULTRASONIC EXAMINATION IN LIEU OF RADIOGRAPHY FOR WELDS IN FERRITIC OR AUSTENITIC PIPE SECTION XI, DIVISION 1 (EPID L-2019-LLR-0097) DATED FEBRUARY 11, 2020

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