



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

September 2, 2016

Mr. Joseph W. Shea  
Vice President, Nuclear Licensing  
Tennessee Valley Authority  
1101 Market Street, LP 3D-C  
Chattanooga, TN 37402-2801

SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3; SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2; WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2 – RELIEF REQUEST 16-PDI-5 FOR USE OF ALTERNATE CALIBRATION BLOCK REFLECTOR REQUIREMENTS (CAC NOS. MF7754, MF7755, MF7756, MF7757, MF7758, MF7759, AND MF7760)

Dear Mr. Shea:

By letter dated May 27, 2016, as supplemented on July 28, 2016, the Tennessee Valley Authority (the licensee) requested approval for use of an alternative to the requirements of Table III-3430-1 and paragraph (b)(3) of Supplement 1 of Appendix III to the American Society of Mechanical Engineers, Boiler and Pressure Vessel Code (ASME Code), Section XI. Relief request 16-PDI-5 pertains to the basic calibration blocks for the calibration of the ultrasonic testing at the Browns Ferry Nuclear Plant (Browns Ferry), Units 1, 2, and 3; Sequoyah Nuclear Plant (Sequoyah), Units 1 and 2; and Watts Bar Nuclear Plant (Watts Bar), Units 1 and 2.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(1), the licensee proposed to use the basic calibration blocks with alternative reflectors (notches) on the basis that the alternatives provide an acceptable level of quality and safety.

The Nuclear Regulatory Commission (NRC) staff has reviewed the subject request 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 of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC authorizes the use of the proposed alternative for the remainder of plant life for Browns Ferry, Units 1, 2, and 3; Sequoyah, Units 1 and 2; and Watts Bar, Units 1 and 2.

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

J. Shea

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If you have any questions, please contact Farideh Saba at (301) 415-1447 or [farideh.saba@nrc.gov](mailto:farideh.saba@nrc.gov).

Sincerely,

A handwritten signature in black ink, appearing to read "Tracy J. Orf". The signature is fluid and cursive, with a prominent initial "T" and a long, sweeping underline.

Tracy J. Orf, Acting Branch Chief  
Plant Licensing Branch II-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. 50-259, 50-260, 50-296,  
50-327, 50-328, 50-390,  
and 50-391

Enclosure: Safety Evaluation

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELIEF REQUEST NO. 16-PDI-5 REGARDING  
BASIC CALIBRATION BLOCKS FOR CALIBRATION OF ULTRASONIC TESTING  
TENNESSEE VALLEY AUTHORITY  
BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3  
DOCKET NOS. 50-259, 50-260, AND 50-296  
SEQUOYAH NUCLEAR PLANT UNITS 1 AND 2  
DOCKET NOS. 50-327 AND 50-328  
WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2  
DOCKET NOS. 50-390 AND 50-391

1.0 INTRODUCTION

By letter dated May 27, 2016 (Agencywide Documents Access and Management System Accession Number ML16151A010), as supplemented by letter dated July 28, 2016 (Accession Number ML16211A337), Tennessee Valley Authority (the licensee) requested approval for use of an alternative to the requirements of Table III-3430-1 and paragraph (b)(3) of Supplement 1 of Appendix III to the American Society of Mechanical Engineers, Boiler and Pressure Vessel Code (ASME Code), Section XI. Relief Request 16-PDI-5 pertains to the basic calibration blocks for the calibration of ultrasonic testing (UT) at the Watts Bar Nuclear Plant (Watts Bar), Units 1 and 2; Browns Ferry Nuclear Plant (Browns Ferry), Units 1, 2, and 3; and Sequoyah Nuclear Plant (Sequoyah), Units 1 and 2.

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Section 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.

1.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g)(4), the 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 the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components.

Enclosure

Pursuant to 10 CFR 50.55a(g)(4)(ii), inservice examination of components during successive 120-month inspection intervals must comply with the requirements of the latest edition and addenda of the ASME Code incorporated by reference in paragraph (a) of 50.55a 12 months before the start of the 120-month inspection interval (or the optional ASME Code Cases listed in NRC Regulatory Guide 1.147, Revision 17, when using Section XI, which is incorporated by reference in paragraph (a)(3)(ii) of 10 CFR 50.55a, subject to the conditions listed in paragraph (b) of 50.55a.

Pursuant to 10 CFR 50.55a(z), alternatives to the requirements of paragraph (g) of 10 CFR 50.55a may be used when authorized by the Director, Office of Nuclear Reactor Regulation. A proposed alternative must be submitted and authorized prior to implementation. The licensee must demonstrate (1) the proposed alternative would provide an acceptable level of quality and safety; or (2) compliance with the specified requirements of this section 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 U.S. Nuclear Regulatory Commission (NRC) staff finds that regulatory authority exists for the licensee to request and the NRC to authorize the alternative requested by the licensee.

## 2.0 TECHNICAL EVALUATION

### 3.1 Component Affected

In this relief request, the affected components are ASME Code Class 1 and 2. The licensee identified the welds as:

Examination Category B-B	Item No. B2.50, B2.60, B2.70, B2.80 (Table IWB-2500-1)
Examination Category B-D	Item No. B3.150 (Table IWB-2500-1)
Examination Category B-F	Item No. B5.10, B5.40, B5.70, B5.100 (Table IWB-2500-1)
Examination Category B-J	Item No. B9.11, B9.22, B9.31 (Table IWB-2500-1)
Examination Category B-O	Item No. B14.10, B14.20, B14.21 (Table IWB-2500-1)
Examination Category C-A	Item No. C1.10, C1.20, C1.30 (Table IWC-2500-1)
Examination Category C-B	Item No. C2.21, C2.22, C2.32 (Table IWC-2500-1)
Examination Category C-F-1	Item No. C5.11, C5.21 (Table IWC-2500-1)
Examination Category C-F-2	Item No. C5.51, C5.61 (Table IWC-2500-1)

The licensee stated that this request for an alternate is for the basic calibration blocks. The basic calibration blocks, for calibrating an ultrasonic system, are standards that provide a means to correlate an ultrasonic system with reference reflectors (notches) of known dimensions. Reference reflectors are dimensioned surfaces used to establish accurately reproducible reference levels of the ultrasonic sensitivity, resolution, and sound path distance. The licensee proposed to utilize the basic calibration blocks with alternative reflectors.

### 3.2 Applicable Code Edition and Addenda

The code of record for the third 10-year inservice inspection (ISI) interval at Browns Ferry, Units 1, 2, and 3, is the 2007 Edition through 2008 Addenda of the ASME Code.

The code of record for the third 10-year ISI interval at Sequoyah, Units 1 and 2, is the 2001 Edition through 2003 Addenda of the ASME Code. The licensee stated that Sequoyah, Units 1 and 2, are in the process of transitioning to the 2007 Edition through 2008 Addenda in the upcoming fourth 10-year ISI interval.

The code of record for the second 10-year ISI interval at Watts Bar, Unit 1, is the 2001 Edition through 2003 Addenda of the ASME Code. The licensee stated that Watts Bar, Unit 1, is in the process of transitioning to the 2007 Edition through 2008 Addenda in the upcoming third 10-year ISI interval.

The code of record for the preservice inspection at Watts Bar, Unit 2, is the 2001 Edition through 2003 Addenda of the ASME Code. This unit has not begun commercial operation yet. The licensee stated that Watts Bar, Unit 2, is in the process of transitioning to the 2007 Edition through 2008 Addenda.

### 3.3 Duration of Relief Request

The licensee submitted this relief request for the remainder of plant life for Browns Ferry, Units 1, 2, and 3; Sequoyah, Units 1 and 2, and Watts Bar, Units 1 and 2.

### 3.4 ASME Code Requirement

The ASME Code requirements applicable to this request originate in Appendix III of Section XI as follows.

The requirement in III-1100(c) states that alternative examination techniques and calibration block designs and materials may be used as provided by IWA-2240 except when the requirements of III-3430 apply.

The requirement in III-3430 states, in part, that basic calibration blocks shall have a notch depth as specified in Table III-3430-1. Table III-3430-1 specifies that:

- For a nominal pipe wall thickness (t) of less than 0.312 inch, the calibration block shall have a notch depth of 0.10 inch with a tolerance of +0.005 to -0.010 inch;
- For a nominal pipe wall thickness (t) of 0.312 to 6.0 inches, the calibration block shall have a notch depth of  $(0.104 t - 0.009 t^2)$  with a tolerance of +10 percent to -20 percent. This equates to a nominal notch depth from 5 percent to 10 percent of "t" for ferritic materials.

Paragraph (b)(3) of Supplement 1 to Appendix III requires calibration blocks for austenitic, cast, and dissimilar metals welds to have a notch depth of 10 percent of "t."

The requirements of III-1100(c), III-3430, Table III-3430-1, and Supplement 1 of Appendix III in the 2007 Edition through 2008 Addenda and the 2001 Edition through 2003 Addenda of the ASME Code, Section XI, are similar.

### 3.5 Reason for Relief

The licensee stated that the provisions in the 1998 Edition or the earlier editions and addenda of the ASME Code, Section XI, Appendix III, III-1100 stated, in part, that "alternative calibration block designs may be used as provided by IWA-2240." This provision allows use of alternative calibration block reflectors to calibrate the UT instruments.

However, the licensee stated that the provisions in the 1999 Addenda or the later editions and addenda of the ASME Code, Section XI, Appendix III, III-1100 stated, in part, that "alternative calibration block designs may be used as provided by IWA-2240, except when the requirements of III-3430 apply." The inclusion of the phrase "*except when the requirements of III-3430 apply*" removes the provision for using alternative calibration block reflectors, and thus, requires use of the provisions in III-3430.

Furthermore in Attachment B, "Ultrasonic Calibration Standards (L18 960329 800)," of Enclosure to the relief request, the licensee documented that the ultrasonic calibration blocks for the Browns Ferry baseline examinations were fabricated to the 1971 Edition of the ASME Code, Section XI, requirements, and for the Sequoyah and Watts Bar baseline examinations were fabricated to the 1974 Edition with Summer 1975 Addenda requirements. These calibration blocks were fabricated with 5 percent of nominal pipe wall thickness (t) notches and were allowed to be used according to the 1998 Edition or the earlier editions and addenda, therefore, relief has not been required till now.

The licensee stated that since the code of record for Watts Bar, Browns Ferry, and Sequoyah has been updated, or in the process of being updated, to the 2007 Edition through 2008 Addenda, relief is required to use the same calibration blocks (i.e., calibration blocks that were previously fabricated with 5 percent of "t" notches).

In addition, the licensee stated that re-machining or replacing the calibration blocks to comply with the ASME Code requirements has no added values because the proposed alternative calibration blocks with notch depth of 5 percent of "t" have been demonstrated to provide more sensitive examinations.

### 3.6 Proposed Alternative

In lieu of the required notches (reflectors) in Appendix III to the 2007 Edition through 2008 Addenda of the ASME Code, Section XI, the licensee proposed utilizing ultrasonic calibration blocks containing 5 percent of "t" notches for all pipe thicknesses up to and including 6 inches. These calibration blocks will be used to calibrate the ultrasonic instrument for the examination of the ferritic, austenitic, cast stainless steels, and dissimilar metal weld materials (i.e., the components identified in this relief request).

### 3.7 Basis for Use of Alternative

Attachments B and C of the relief request document the licensee's technical justification for use of 5 percent of "t" notches for all pipe thicknesses up to and including 6 inches in lieu of the required notches in III-3430 and paragraph (b)(3) of Supplement 1 to Appendix III. The licensee stated that two demonstrations were conducted on sample calibration blocks that had both 5 percent and 10 percent of "t" nominal notches. Both demonstrations concluded that the nominal 5 percent of "t" notches increased the examination sensitivity by +2 to +6 decibels (dB) when compared to the nominal 10 percent of "t" notches, therefore, use of alternative calibration blocks with nominal 5 percent notches provide an acceptable level of quality and safety.

### 3.8 NRC Staff Evaluation

The NRC staff has evaluated this request pursuant to 10 CFR 50.55a(z)(1). The NRC staff focused on whether the proposed alternative provides an acceptable level of quality and safety.

In evaluating the technical sufficiency of the licensee's proposed alternative, the NRC staff considered the licensee's demonstrations of the ultrasonic equipment on sample calibration blocks that had both 5 percent and 10 percent of "t" nominal notches. In the demonstrations, the licensee documented the ultrasonic signal response from the proposed basic calibration block with 5 percent nominal notches as compared to response from the ASME Code required basic calibration block with 10 percent of "t" nominal notches. From the review of Attachments B and C of the relief request, the NRC staff confirms that:

- The licensee conducted demonstrations on sample calibration blocks that contained both 5 percent and 10 percent of "t" nominal notches. Both conventional UT technique and phased array UT technique were utilized in the demonstrations. The demonstrations were proctored by the licensee's Site Authorized Nuclear Inspection Inspector Supervisor.
- The ultrasonic equipment was selected in accordance with the ASME Code requirements and the industry nondestructive examination program guidelines.
- The calibration was performed using longitudinal and shear wave transducers.
- The signal response was observed from the 5 percent and 10 percent inside diameter notches.
- The sensitivity of the 10 percent of "t" notch was compared to that of the 5 percent of "t" notch.
- The result of the demonstrations revealed that the sensitivity level was (+2 to +6 dB) higher for 5 percent of "t" notch than for the 10 percent of "t" notch. Therefore, the reasonable conclusion is that the basic calibration blocks containing 5 percent of "t" notches provide equivalent or even better calibration for the UT equipment than the 10 percent notches.

Based on the results of the demonstrations performed, it is reasonable to conclude that the volumetric examinations performed with the UT instruments calibrated on the basic calibration blocks containing 5 percent of "t" notches are equivalent or better in sensitivity to those calibrated on the ASME Code required notches.

Therefore, the NRC finds that the use of alternative 5 percent of "t" reflectors (notches) in the basic calibration blocks is acceptable, and provides an acceptable level of quality and safety.

#### 4.0 CONCLUSION

As set forth above, the NRC staff determines that the proposed alternative 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 authorizes the use of the proposed alternative for the remainder of plant life for Browns Ferry, Units 1, 2, and 3; Sequoyah, Units 1 and 2, and Watts Bar, Units 1 and 2.

All other ASME Code, Section XI, requirements for which relief was not specifically requested and authorized herein by the NRC staff remain applicable, including the third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributors: Ali Rezai

Date: September 2, 2016



J. Shea

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If you have any questions, please contact Farideh Saba at (301) 415-1447 or [farideh.saba@nrc.gov](mailto:farideh.saba@nrc.gov).

Sincerely,

*/RA/*

Tracy J. Orf, Acting Branch Chief  
Plant Licensing Branch II-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. 50-259, 50-260, 50-296,  
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\* By a memorandum

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