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

August 18, 2017

Mr. Joseph W. Shea
Vice President, Nuclear Regulatory
Affairs and Support Services
Tennessee Valley Authority
1101 Market Street, LP 3R-C
Chattanooga, TN 37402-2801

SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNIT 3 – RELIEF REQUEST NO. 3-ISI-29 REGARDING THIRD 10-YEAR INSERVICE INSPECTION INTERVAL REGARDING EXAMINATION COVERAGE FOR CERTAIN PRESSURE RETAINING PIPING WELDS (CAC NO. MF9258)

Dear Mr. Shea:

By letter dated January 31, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17031A351), Tennessee Valley Authority (the licensee) requested U.S. Nuclear Regulatory Commission (NRC) approval of Relief Requests (RRs) 3-ISI-28 and 3-ISI-29 for the third 10-year interval inservice inspection (ISI) program at the Browns Ferry Nuclear Plant, Unit 3. The subject of this safety evaluation is licensee's RR 3-ISI-29, which addresses the examination coverage for certain pressure retaining piping welds, as required by the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(g)(5)(iii), "ISI program update: Notification of impractical ISI Code requirements," the licensee requested relief from the requirements of the ASME Code, Section XI for ISI examination of certain pressure retaining piping welds, on the basis that compliance with the ASME Code requirement is impractical due to plant design.

Based on the NRC staff review of the information submitted by the licensee, the staff determines that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i). Accordingly, the NRC staff has determined that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life, or property, or the common defense and security and is otherwise in the public interest. Therefore, the NRC grants relief for the subject examinations of the components contained in RR 3-ISI-29 for Browns Ferry Unit 3 for the third 10-year ISI interval, which ended on January 31, 2016.

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.

If you have any questions, please contact the Project Manager, Ms. Farideh E. Saba at 301-415-1447 or Farideh.Saba@nrc.gov.

Sincerely,

Undine Shoop, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-296

Enclosure:
Safety Evaluation

cc: Listserv

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NO 3-ISI-29 REGARDING THIRD 10-YEAR

INSERVICE INSPECTION INTERVAL

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT, UNIT 3

DOCKET NO. 50-296

1.0 INTRODUCTION

By letter dated January 31, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17031A351), Tennessee Valley Authority (TVA, or the licensee) requested U.S. Nuclear Regulatory Commission (NRC) approval of Relief Request (RR) 3-ISI-29 for the third 10-year interval inservice inspection (ISI) program at the Browns Ferry Nuclear Plant (BFN), Unit 3. RR 3-ISI-29 addresses the examination coverage for certain pressure retaining piping welds, as required by the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(g)(5)(iii), "ISI program update: Notification of impractical ISI Code requirements," the licensee requested relief from the requirements of the ASME Code, Section XI for ISI examination of certain pressure retaining piping welds, on the basis that compliance with the ASME Code requirement is impractical due to plant design.

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g), "Inservice inspection requirements," ISI of the ASME Code, Class 1, 2, and 3, components is to be performed in accordance with the latest edition and addenda of Section XI of the ASME Code, except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i), "Impractical ISI requirements: Granting of relief." Additionally, pursuant to 10 CFR 50.55a(g)(4), "Inservice inspection standards requirements for operating plants," ASME Code Class 1, 2, and 3, components (including supports) shall 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. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals, comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(a)(1)(ii), 12 months prior to the start of the 120-month interval, subject to the conditions listed in 10 CFR 50.55a(b).

Section 50.55a(g)(5)(iii) of 10 CFR states, in part that:

> If the licensee has determined that conformance with a Code requirement is impractical for its facility the licensee must notify the NRC and submit, as specified in § 50.4, information to support the determinations. Determinations of impracticality in accordance with this section must be based on the demonstrated limitations experienced when attempting to comply with the Code requirements during the inservice inspection interval for which the request is being submitted. Requests for relief made in accordance with this section must be submitted ... no later than 12 months after ... the initial or subsequent 120-month inspection interval for which relief is sought.

The third 10-year ISI interval for BFN Unit 3 began on November 19, 2005, and ended on February 1, 2016.

Section 50.55a(g)(6)(i) of 10 CFR states:

> The Commission will evaluate determinations under paragraph (g)(5) of this section that code requirements are impractical. The Commission may grant such relief and may impose such alternative requirements as it determines are authorized by law, and will not endanger life or property or the common defense and security, and are otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

Pursuant to 10 CFR 50.55a(g)(5)(iii), TVA has requested relief from the requirements of 10 CFR 50.55a, "Codes and standards," for the third 10-year ISI interval for BFN Unit 3, on the basis that compliance with the ASME Code requirements is impractical due to physical obstructions and limitations due to design and geometry of the subject weld joints.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that there is a regulatory basis for the licensee to request, and the NRC to authorize, the proposed relief request.

3.0 TECHNICAL EVALUATION

3.1 Applicable ASME Code Requirements

The ASME Code of record for BFN Unit 3 during the third 10-year ISI interval was the 2001 Edition through the 2003 Addenda of the ASME Code, Section XI. The third 10-year ISI interval for BFN Unit 3 ended on January 31, 2016. The examination requirements for certain pressure retaining piping welds are delineated in ASME Code, Subarticle IWB-2500, "Examination and Pressure Test Requirements," Table IWB-2500-1, Examination Category B-J, require essentially 100 percent volumetric examination. "Essentially 100 percent," as clarified by ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds," is greater than 90 percent coverage of the examination volume, or surface area, as applicable. ASME Code Case N-460 has been approved for use by the NRC in Regulatory Guide 1.147, Revision 17, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," dated August 2014. For Examination Category B-J, the examination volume is defined in Fig. IWB-2500-8.

Additionally, pursuant to 10 CFR 50.55a(b)(2)(xv)(A)(1) and 10 CFR 50.55a(b)(2)(xv)(A)(2), piping must be examined in two axial directions, and when examination in the circumferential

direction is required, the circumferential examination must be performed in two directions, provided access is available. Where examination from both sides is not possible for austenitic or dissimilar metal welds, full coverage credit from a single side weld may be claimed only after completing a successful single-sided Appendix VIII demonstration using flaws on the opposite side of the weld.

The examination requirements for Examination Categories R-A and C-F-2, for pressure retaining piping welds have similar requirements, therefore also require essentially 100 percent volumetric examination (i.e., greater than 90 percent).

For reference purposes the examination requirements for Examination Category R-A, Item Nos. R1.11 and R1.16 are derived from the licensee's risk-informed ISI program and ASME Code Case N-716-1, "Alternative Piping Classification and Examination Requirements, Section XI, Division 1." ASME Code Case N-716-1, has been approved for use by the NRC in Regulatory Guide 1.147, Revision 17, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," dated August 2014. For Items Nos. R1.11 and R1.16 the required examination consist of essentially 100 percent volumetric examination of examination volumes as shown in Figures IWB-2500-8(c) and IWB-2500-9, 10, and 11.

Additionally, the examination requirements for Examination Category C-F-2, Item Number C5.51 are delineated in ASME Code, Subarticle IWC-2500, "Examination and Pressure Test Requirements," Table IWC-2500-1, and require essentially 100 percent volumetric examination of the required volumes shown in Figure IWC-2500-7. Licensee's submittal had a typographical error that identified this item as "Item Number C3.20." However, the correct Item Number is C5.51, which was also used in the licensee's inspection reports enclosed as attachments for this submittal.

Components for which relief is requested are provide in the table below for reference purposes, along with a description of the limitation, as well as the credited examination coverage obtained.

ASME	**Pressure Retaining Welds with Limited Volumetric Coverage**				
Examination Category/ Item No.	**Weld Number (System)**	**Limitation/ Coverage**	**Pipe Size (inch)**	**Material 1 (Component)**	**Material 2 (Component)**
B-J, B9.11	RWCU-3-001-070 (Reactor Water Cleanup System)	Single side Pipe Branch Connection-to-Valve, 49% coverage obtained	6	ASTM A-403, WP-304, Stainless Steel (Sweepolet)	ASTM A-351, CF8M (Valve)
B-J, B9.11	RWCU-3-007-003 (Reactor Water Cleanup System)	Single side Pipe-to-Tee, 58% coverage obtained	4	ASTM A-420, WPL1 (Tee)	ASTM A-333, Grade 1 (Pipe)
B-J, B9.11	RWCU-3-007-011 (Reactor Water Cleanup System)	Single side Pipe-to-Valve, 89% coverage obtained	4	ASTM A-105, (Valve)	ASTM A-333, Grade 1 (Pipe)

ASME	Pressure Retaining Welds with Limited Volumetric Coverage				
Examination Category/ Item No.	**Weld Number (System)**	**Limitation/ Coverage**	**Pipe Size (inch)**	**Material 1 (Component)**	**Material 2 (Component)**
R-A, R1.16D	DRHR-3-12 (Residual Heat Removal System)	Physical Obstruction Penetration-to-Valve, 30% coverage obtained	24	ASTM A-182, Grade 304, Stainless Steel (Fitting)	ASME SA-351, CF8M (Valve)
R-A, R1.11	DRHR-3-19 (Residual Heat Removal System)	Physical Obstruction Pipe-to-Tee, 59% coverage obtained	20	ASTM A-403, Grade WP-304, Stainless Steel (Elbow)	ASTM A-358, Grade 304 Stainless Steel (Pipe)
R-A, R1.16C	DSRHR-3-5A (Residual Heat Removal System)	Physical Obstruction, Pipe-to-Elbow 76% coverage obtained	24	ASTM A-358, Grade 304 Stainless Steel (Pipe)	ASTM A-403, Grade WP-304, Stainless Steel (Elbow)
R-A, R1.16C	TRHR-3-191 (Residual Heat Removal System)	Physical Obstruction, Valve-to-Elbow, 54% coverage obtained	20	ASME SA-351, CF8M (Valve)	ASME SA-234, Grade WPB (Pipe Fitting)
R-A, R1.16E	GR-3-63 (RECIRC System)	Single side Pipe-to-Valve, 50% coverage obtained	28	ASTM A-358, Grade 304 Stainless Steel (Pipe)	ASTM A-351, CF8M (Valve)
C-F-2, C5.51	HPCI-3-019-018 (High Pressure Core Injection System)	Physical Obstruction, Pipe-to-Flange, 85% coverage obtained	10	ASTM A-106, Grade B (Pipe)	ASTM A-105, Carbon Steel (Flange)
C-F-2, C5.51	HPCI-3-019-019 (High Pressure Core Injection System)	Physical Obstruction, Valve-to-Pipe, 78% coverage obtained	10	ASTM A-216, WCB (Valve)	ASTM A-106, Grade B (Pipe)

3.2 Licensee's Reason for Request

As stated by TVA and summarized by the above table, the licensee was not able to achieve examination coverage greater than 90 percent for the above ASME Examination Category B-J, R-A, and C-F-2 pressure retaining welds. The licensee stated that for the welds listed above due to limitations imposed by the components design and configuration, the archived examination coverage ranged from 30 to 89 percent. The licensee also stated that the subject

welds were examined to the maximum extent practical using the latest techniques, procedures, and equipment. Specifically, for the austenitic and dissimilar metal welds, the ultrasonic examinations were performed using personnel, equipment and procedures qualified in accordance with ASME Section XI, Appendix VIII as implemented by the Performance Demonstration Initiative (PDI). The licensee further stated that it examined the accessible areas to the maximum extent practical.

The welds identified in Table 1, as RWCU-3-001-070, GR-3-63, DRHR-3-12, DSRHR-3-5A, and DRHR-3-19 consist of austenitic stainless steel piping materials with corresponding austenitic stainless steel weld metal. With the exception of weld GR-3-63, the volumetric examinations for these welds resulted in credited ultrasonic examination coverage ranging from 30 to 79 percent, with no recordable indications. Volumetric examination of Weld GR-3-63 resulted in 50 percent coverage, and confirmed that the existing indications that were found during previous examinations are still acceptable and have not grown. These indications were found to be acceptable by evaluation and subsequent examinations of weld GR-3-63 have verified that the indications are still acceptable and have not grown. Weld TRHR-3-191 is a dissimilar metal weld for a cast stainless steel valve and low alloy carbon steel elbow. Due to the physical configuration of the valve, examination of weld TRHR-3-191 was restricted to the elbow side and resulted in 54 percent examination coverage, with no recordable indications.

The welds identified as RWCU-3-007-003, RWCU-3-007-011, HPCI-3-019-018, and HPCI-3-019-019 are for low alloy and carbon steel piping components that had physical obstructions resulting in limited examination coverage. The volumetric examination coverage achieved for these welds ranged from 58 to 89 percent, with no recordable indications. TVA stated that despite the noted limitations, these examination provide an acceptable level of quality and safety, because sufficient data were obtained to make a determination on the integrity of the piping. The licensee further stated that these welds are part of a larger population of welds, for which it was able to get the required examination coverage. When considered in aggregate with the entire weld population, and with the coverage obtained it was able to confirm the absence of significant degradation that could affect the structural integrity of the components.

3.3 NRC Staff Evaluation

The ASME Code, Section XI, Table IWA-2500-1 Examination Category B-J, requires essentially 100 percent volumetric and surface examinations. However, as stated by the licensee, complete volumetric examinations are restricted by component design, materials and weld configurations. These conditions precluded the licensee from obtaining full volumetric examinations from both sides of these welds. To gain access for the required examination coverage the subject welds would require design modifications. This would place a burden on the licensee, therefore, obtaining 100 percent of ASME Code-required volumetric examinations for the subject welds is considered impractical.

TVA stated that volumetric examinations of the subject welds were conducted with equipment, procedures, and personnel that were qualified to a performance demonstration process outlined in the ASME Code, Section XI, Appendix VIII. These techniques have been qualified through the industry's PDI, which meets the intent of the ASME Code Section XI, Appendix VIII requirements for flaws located on the near-side of the welds; far-side detection of flaws is considered to be a "best effort." Because the subject welds are wrought austenitic stainless steel, and there are currently no PDI qualified single-side examination procedures that demonstrate equivalency to two-sided examination on austenitic piping welds, the NRC staff

finds that the licensee's claim that it achieved examination coverage to the maximum extent possible and by the "best effort," is considered justified.

As shown in the sketches and technical descriptions included in the licensee's submittal, examinations of the subject pipe-to-tee, pipe-to-valve, and pipe-to-elbow connection welds have been completed to the maximum extent practical. The volumetric coverage ranged from to 30.0 to 89 percent of the ASME Code-required volumes as shown in Table 1 above. The examination volume was limited because these welds could not completely be examined from both sides of the weld due to the geometric configuration of these components (i.e., the tee side or near side. The ultrasonic techniques employed for these welds meets the ASME Code, Section XI, Appendix VIII requirements for austenitic stainless steel welds. These techniques have been qualified for flaws located on the near-side, not the far-side, of the welds; far-side detection of flaws is considered to be a "best effort." However, L-waves have been shown to provide enhanced detection on the far-side of austenitic stainless steel welds. Therefore, while the licensee has only taken credit for obtaining limited volumetric coverage, the NRC staff expects that the techniques employed by the licensee would have provided some coverage beyond the near-side, into the far-side of the welds.

NRC staff notes that in addition to the ultrasonic examinations, Examination Category B-J and R-A welds are also subject to system leakage testing requirements of ASME Code, Section XI, IWB-2500 (Table IWB-2500-1, Examination Category B-P, All Pressure Retaining Components) during each refueling outage. Similarly, in addition to the ultrasonic examinations, Examination Category C-F-2 welds are also subject to system leakage testing requirements of ASME Code, Section XI, IWC-2500 (Table IWC-2500-1, Examination Category C-H, All Pressure Retaining Components) during each inspection period. The NRC staff finds that the licensee's periodic system leakage tests performed on these pressure retaining welds provide additional assurance that significant degradation, if it is present, would be detected and corrected.

The licensee has demonstrated that due to geometric limitations it was impractical to meet the ASME Code-required "essentially 100 percent" volumetric examination coverage for the subject piping welds during the third ISI Interval at BFN, Unit 3. Although the ASME Code-required coverage could not be obtained, the ultrasonic techniques employed provided nearly full volumetric coverage from the near-side of the welds, and some limited volumetric coverage for the weld materials on the opposite (far) side of these welds. Based on the aggregate coverage obtained for the subject welds, the extent of the examinations, and considering the licensee's performance of essentially 100 percent examination coverage of similar accessible welds, it is reasonable to conclude that if significant service-induced degradation is present in these welds, some evidence of degradation would have been detected.

Based on its review, the NRC staff determined that obtaining the ASME Code-required examination volume is impractical because it would impose a burden upon the licensee. The NRC staff also determined that the ultrasonic examinations performed, despite the limited coverage obtained by the licensee, provide reasonable assurance of the structural integrity for the welds RWCU-3-001-070, GR-3-63, DRHR-3-12, DSRHR-3-5A, DRHR-3-19, TRHR-3-191, RWCU-3-007-003, RWCU-3-007-011, HPCI-3-019-018, and HPCI-3-019-019.

4.0 CONCLUSION

As set forth above, the NRC staff determines that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i). Accordingly, the NRC staff has determined that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life, or property, or the common defense and security and is otherwise in the public interest. Therefore, the NRC grants relief for the subject examinations of the components contained in RR 3-ISI-29 for BFN Unit 3 for the third 10-year ISI interval, which ended on January 31, 2016.

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.

Principal Contributor: Roger Kalikian

Date: August 18, 2017

SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNIT 3 – RELIEF REQUEST NO. 3-ISI-29 REGARDING THIRD 10-YEAR INSERVICE INSPECTION INTERVAL REGARDING EXAMINATION COVERAGE FOR CERTAIN PRESSURE RETAINING PIPING WELDS (CAC NO. MF9258) DATED AUGUST 18, 2017

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