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

December 31, 2018

Mr. Joseph W. Shea
Vice President, Nuclear Regulatory
Affairs and Support Services
Tennessee Valley Authority
1101 Market Street, LP 4A
Chattanooga, TN 37402 2801

SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNIT 1 – RELIEF REQUEST NO. 1-ISI-29 REGARDING SECOND 10-YEAR INSERVICE INSPECTION INTERVAL CONCERNING EXAMINATION COVERAGE FOR CERTAIN PRESSURE RETAINING WELDS (EPID L-2018-LLR-0080)

Dear Mr. Shea:

By letter dated May 31, 2018, Tennessee Valley Authority (the licensee) requested U.S. Nuclear Regulatory Commission (NRC) approval of Relief Requests (RRs) 1-ISI-28 and 1-ISI-29 for the third 10-year interval inservice inspection (ISI) program at the Browns Ferry Nuclear Plant, Unit 1. The subject of this letter is RR 1-ISI-29, which addresses the examination coverage for certain pressure-retaining 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), the licensee requested relief from the "essentially 100 percent" volumetric examination coverage requirements of ASME Code Section XI for the welds on the basis that the code requirement is impractical.

Based on the NRC staff review of the information submitted by the licensee, the staff determines that the licensee has adequately addressed all 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 1-ISI-29 for Browns Ferry Unit 1 for the third 10-year ISI interval, which ended on June 1, 2017.

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. 50-259

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 1-ISI-29 REGARDING SECOND 10-YEAR

INSERVICE INSPECTION INTERVAL

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT, UNIT 1

DOCKET NO. 50-259

1.0 INTRODUCTION

By letter dated May 31, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18177A379), Tennessee Valley Authority (TVA, or the licensee) requested U.S. Nuclear Regulatory Commission (NRC) approval of Relief Request (RR) 1-ISI-29 for the second 10-year interval inservice inspection (ISI) program at the Browns Ferry Nuclear Plant (BFN), Unit 1. RR 1-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), Section XI.

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 are required 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 second 10-year ISI interval for BFN Unit 1 began on June 2, 2008, and ended on June 1, 2017.

In a letter dated February 28, 2011 (ADAMS Accession No. ML110460496), the NRC staff approved the licensee's risk-informed ISI program for the second 10-year ISI interval that follows the methodology contained in the Westinghouse Owners Group report WCAP-14572, Revision 1-NP-A "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report." The risk-informed ISI program is an alternative to the ASME Code, Section XI. The subject welds are covered under Code Case N-577-1, "Risk-Informed Requirements for Class 1, 2, or 3 Piping, Method A," Paragraph 2500 Table 1 and IWB-2500-1.

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, 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 second 10-year ISI interval for BFN Unit 1, 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 1 during the second 10-year ISI interval was the 2001 Edition through the 2003 Addenda of the ASME Code, Section XI. The second 10-year ISI

interval for BFN Unit 1 ended on June 1, 2017. 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 and Code Case N-577-1, Paragraph 2500 Table 1, that 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 18, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," dated March 2017. For Examination Category B-J, Item Nos. B9.11 and B9.31, the examination volume is defined in Figures IWB-2500-8 and IWB-2500-9, 10, and 11.

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 ASME Code, Section XI, Appendix VIII demonstration using flaws on the opposite side of the weld.

The examination requirements for Examination Category R-A, for pressure retaining piping welds have similar requirements and, 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 No. R1.16 are derived from the licensee's risk-informed ISI program and ASME Code Case N-577. The BFN-1 use of a risk-informed ISI program was authorized by NRC letter dated February 28, 2011 (ADAMS Accession No. ML110460496). For Item No. R1.16, the required examination consists of essentially 100-percent volumetric examination of examination volumes as shown in Figures IWB-2500-8(c) and IWB-2500-9, 10, and 11.

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.

Table 1

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-1-001-019 (Reactor Water Cleanup System)	Single side Pipe-to-Valve, 50% coverage obtained	6	ASME SA312 TP316 (Pipe)	ASTM A-351, CF8M (Valve)

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	RWR-1-001-003 (Reactor Water Recirculation System)	Single side Elbow-to-Valve 50% coverage obtained	28	ASME SA403 WP 316NG (Elbow)	ASTM A351 CF8 (Valve)
B-J, B9.11	RWR-1-002-12 (Reactor Water Recirculation System)	Single side Pipe-to-Valve 50% coverage obtained	28	ASME SA376 TP316NG (Pipe)	ASTM A351 CF8 (Valve)
B-J, B9.31	RWR-1-001-S023A (Reactor Water Recirculation System)	Single side Branch-to-Pipe 50% coverage obtained	4	ASME SA403 WP 316NG (Branch)	ASME SA-376 TP316NG (Pipe)
R-A, R1.16D	DRHR-1-12 (Residual Heat Removal System)	Physical Obstruction Penetration-to- Valve, 12% coverage obtained	24	ASTM A-182 F304 (Flued Head)	ASME SA-351, CF8M (Valve)
R-A, R1.16D	DRHR-1-11 (Residual Heat Removal System)	Physical Obstruction Pipe-to-Tee, 62% coverage obtained	24	ASTM A-106, Grade B (Pipe)	ASME SA-351, CF8M (Valve)
R-A, R1.16D	DRHR-1-3 (Residual Heat Removal System)	Physical Obstruction, Penetration-to- Valve 12% coverage obtained	24	ASTM A-182 F304 (Flued Head)	ASME SA-351, CF8M (Valve)
R-A, R1.16D	DRHR-1-2 (Residual Heat Removal System)	Physical Obstruction, Pipe-to-Valve, 78% coverage obtained	24	ASTM A-106, Grade B (Pipe)	ASME SA-351, CF8M (Valve)

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,

and R-A pressure retaining welds. The licensee stated that for the welds listed above due to limitations imposed by the components design and configuration, the achieved examination coverage ranged from 12 to 78 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 above, as DRHR-1-3 and DRHR-1-12 consist of austenitic stainless steel flued head penetration piping materials with corresponding austenitic stainless steel weld metal to cast stainless valves. Due to the physical configuration of the penetrations and the material of the valves, examination of welds DRHR-1-3 and DRHR-1-12 was restricted to the penetration side of the weld and resulted in 12-percent examination coverage, with no recordable indications. Examinations were conducted in accordance with ASME Section XI, Appendix VIII qualified generic PDI procedure, PDI-UT-2, for austenitic metal welds.

The welds identified in Table 1, as RWCU-1-001-019, RWR-1-002-12, RWR-1-001-S023A, and RWR-1-001-003 consist of austenitic stainless steel piping materials with corresponding austenitic stainless steel weld metal. With the exception of weld RWR-1-001-S023A, the volumetric examinations for these welds was limited due to the physical configuration of the valve present on one side of the weld and resulted in credited ultrasonic examination coverage of 50 percent. The examination of weld RWR-1-001-S023A consists of a stainless steel tee to stainless steel pipe weld. Due to the configuration, the examination was limited to the tee side of the weld and resulted in credited ultrasonic examination coverage of 50 percent. Examinations were conducted in accordance with ASME Section XI, Appendix VIII qualified generic PDI procedure, PDI-UT-2, for austenitic metal welds. Welds RWCU-1-001-019 and RWR-1-001-S023A had no recordable indications. Welds RWR-1-002-12 and RWR-1-001-003 had geometric indications that were determined to be acceptable. The geometric indication in RWR-1-002-12 was identified previously and verified to not have significantly changed.

The physical configuration of welds DRHR-1-2 and DRHR-1-11, which join low alloy and carbon steel piping to cast austenitic stainless steel valves, resulted in limited examination coverage. The credited volumetric examination coverage achieved for these welds ranged from 62 to 78 percent, with no recordable indications. Examinations were conducted in accordance with ASME Section XI, Appendix VIII qualified generic PDI procedure, PDI-UT-2, for austenitic metal welds.

TVA stated that despite the noted limitations, these examinations 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 achieve 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, required

volumetric examination coverages are restricted by component design, materials and weld configurations. These conditions precluded the licensee from obtaining essentially 100-percent volumetric examination coverages 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 essentially 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 austenitic stainless steel weld metal, 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.

The NRC staff determined that the subject piping configurations and base materials severely limited volumetric examination coverages. As shown in the sketches and technical descriptions included in the licensee's submittal, examinations of the subject penetration-to-valve, branch-to-pipe, pipe-to-valve, and elbow-to-valve connection welds have been completed to the maximum extent practical. The volumetric coverage ranged from to 12.4 to 78-percent of the ASME Code-required volumes as shown in Table 1 above. The examination volume coverage 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."

The NRC staff determines that welds DRHR-1-3 and DRHR-1-12 were examined for circumferential flaws to the extent possible with 45 and 60-degree shear wave examinations. Scans for axial flaws and refracted longitudinal wave mode examinations were unable to be performed because of the joint configuration. The areas where qualified examinations were performed included the heat-affected zone of the penetration base metal and weld material, which are the areas the NRC considers most susceptible to degradation. The area where no coverage could be claimed was the base metal of the cast austenitic stainless steel valves where degradation usually does not occur.

Welds RWR-1-002-12, RWR-1-001-S023A, and RWR-1-001-003 were all examined to the extent possible with phased array ultrasonic techniques. Because of the limitation on coverage credit from a single side weld examination discussed earlier the licensee may only claim 50-percent coverage after completing a single-sided exam on these welds. The weld identified in Table 1, as RWCU-1-001-019 was examined to the extent possible with 45 and 60-degree shear waves, but is subject to the same limitation on coverage credit from a single side weld exam and, therefore, the licensee can only claim 50-percent coverage.

Welds DRHR-1-2 and DRHR-1-11 were scanned to the extent practical axially with 45 and 60-degree refracted longitudinal wave and 45-degree shear wave examinations and scanned circumferentially with 45-degree refracted longitudinal wave and 45-degree shear wave

examinations. The NRC staff recognizes that because of the configuration no examinations could be performed from the valve side.

The NRC staff notes that in addition to the ultrasonic examinations, Examination Category B-J, Item Nos. B9.11 and B9.31, 4 inch and larger piping require surface examinations. Therefore, the subject welds have received required surface examinations in accordance with the ASME Code, Section XI. In addition, 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. The NRC staff finds that the licensee's surface examination and 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 NRC staff finds that the licensee has demonstrated that due to the configuration and geometric scanning limitations it was impractical to meet the ASME Code-required "essentially 100 percent" volumetric examination coverage for the subject piping welds during the second ISI Interval at BFN, Unit 1. 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. The NRC staff further finds that 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 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-1-001-019, RWR-1-001-003, RWR-1-002-12, RWR-1-001-S023A, DRHR-1-12, DRHR-1-11, DRHR-1-3, and DRHR-1-2.

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 1-ISI-29 for BFN Unit 1 for the second 10-year ISI interval, which ended on June 1, 2017.

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: Keith Hoffman

Date: December 31, 2018

SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNIT 1 – RELIEF REQUEST NO. 1-ISI-29 REGARDING SECOND 10-YEAR INSERVICE INSPECTION INTERVAL REGARDING EXAMINATION COVERAGE FOR CERTAIN PRESSURE RETAINING WELDS (EPID L-2018-LLR-0080) DATED DECEMBER 31, 2018

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