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

January 26, 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: SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2 – RELIEF REQUEST NO. 17-ISI-1 REGARDING THE REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS CODE (CAC NOS. MF9690 AND MF9691; EPID L-2017-LLR-0025)

Dear Mr. Shea:

By letter dated April 28, 2017, Tennessee Valley Authority (the licensee) submitted Relief Request 17-ISI-1 to the U.S. Nuclear Regulatory Commission (NRC) to request relief from performing the essentially 100 percent volumetric and surface examination requirements specified in Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) during the third 10-year inservice inspection (ISI) interval, for certain ASME Class 1 and Class 2 pressure vessel and piping welds at Sequoyah Nuclear Plant (SQN) Units 1 and 2.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 55a, paragraphs (g)(5)(iii), the licensee requested relief from the requirements of 10 CFR 50.55a, "Codes and standards," for the third 10-year ISI interval for SQN Units 1 and 2, on the basis that for the components listed in this relief request, compliance with some of the ASME Code requirements is impractical because of physical obstructions and limitations due to design and geometry of the subject weld joints.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i). Therefore, the NRC grants the proposed relief request.

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, Andrew Hon, at 301-415-8480 or by email to Andrew.Hon@nrc.gov.

Sincerely,

for

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

Docket Nos. 50-327 and 50-328

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 17-ISI-1

THIRD 10-YEAR INSERVICE INSPECTION INTERVAL

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-327 AND 50-328

1.0 INTRODUCTION

By letter dated April 28, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17121A477), Tennessee Valley Authority (TVA or the licensee) submitted Relief Request 17-ISI-1 to the U.S. Nuclear Regulatory Commission (NRC), which requested relief from performing the essentially 100 percent volumetric and surface examination requirements specified in Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) during the third 10-year inservice inspection (ISI) interval, for certain ASME Class 1 and Class 2 pressure vessel and piping welds at Sequoyah Nuclear Plant (SQN) Units 1 and 2.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR)), Part 50, Section 55a, paragraphs (g)(5)(iii), the licensee requested relief from the ASME Code required examination coverage for ISI of the subject welds on the basis that the ASME Code requirements are impractical.

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g), "Inservice inspection requirements," ISI of 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 expiration of the initial or subsequent 120-month inspection interval for which relief is sought.

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 SQN Units 1 and 2, on the basis that for the components listed in this relief request, compliance with some of the ASME Code requirements is impractical because of 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 Edition and Addenda of the ASME Code

The ASME Code of record for SQN Units 1 and 2, during the third 10-year ISI interval was the 2001 Edition of the ASME Code, Section XI, through the 2003 Addenda. The third 10-year ISI interval for SQN Units 1 and 2, began on June 1, 2006, and ended on April 30, 2016.

3.2 Piping Weld Evaluation

3.2.1 Applicable ASME Code Class 1 and 2 Piping Weld Requirements

The examination requirements for ASME Code Class 1 and 2 pressure retaining piping welds in this relief request are delineated in SQN Units 1 and 2, Risk Informed ISI Program, which was approved by the NRC on April 30, 2007 (ADAMS Accession No. ML071070248). For Examination Category R-A, licensee's Risk Informed ISI Program assigns Item Numbers R1.11, R1.16, and R1.20 to piping elements subject to thermal fatigue, intergranular stress corrosion cracking, and segments not subject to a known damage mechanism, respectively. The examination requirement is to volumetrically examine essentially 100 percent of the circumferential piping welds. "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 is an unconditionally approved code case as documented by NRC Regulatory Guide 1.147, Revision 17, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1" (ADAMS Accession No. ML13339A689). The examination volumes for examination Category R-A, Item Numbers R1.11, R1.16, and R1.20 are defined by ASME Code, Section XI, Figures IWB-2500-8(c)[Note 1(1)], IWB-2500-9, IWB-2500-10, and IWB-2500-11.

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 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.

ASME Code Class 1 piping welds for which relief is requested are identified in Table 1 below for SQN Unit 1, along with a description of the limitation and the actual examination coverage obtained.

	Table 1 – SQN Unit 1, Examination Category R-A, ASME Code Class 1 Welds with Limited Volumetric Coverage				
Item No.	**Weld Identification System**	**Limitation Coverage**	**Pipe Size (inch)**	**Material 1 (Component)**	**Material 2 (Component)**
R1.20	RCS-069 Reactor Coolant System	Obstruction Elbow-to-Pipe, 89% coverage	6	ASTM A403, Type WP316 SS (Elbow)	ASTM A376, Type 316 SS (Pipe)
R1.20	RCS-089 Reactor Coolant System	Obstruction Elbow-to-Pipe, 89% coverage	6	ASTM A403, Type WP316 SS (Elbow)	ASTM A376, Type 316 SS (Pipe)
R1.11	RCS-101 Reactor Coolant Control System	Obstruction Elbow-to-Pipe, 89% coverage	6	ASTM A403, Type WP316 SS (Elbow)	ASTM A376, Type 316 SS (Pipe)
R1.11	RHRF-106 Residual Heat Removal System	Single sided Valve-to-Pipe, 50% coverage	8	ASTM A351, Type CF8 SS (Valve)	ASTM A376, Type 316 SS (Pipe)
R1.11	RHRF-107 Residual Heat Removal System	Obstruction Pipe-to-Elbow, 66% coverage	8	ASTM A376, Type 316 SS (Pipe)	ASTM A403, Type WP316 SS (Elbow)
R1.11/ R1.16	SIF-196 Safety Injection System	Single sided Pipe-to-Valve, 50% coverage	6	ASTM A376, Type 316 SS (Pipe)	ASTM A182, Type F316 SS (Valve)
R1.11	SIF-197 Safety Injection System	Obstruction Valve-to-Elbow, 57% coverage	6	ASTM A182, Type F316 SS (Valve)	ASTM A182, Type F316 SS (Elbow)
R1.11/ R1.16	SIF-198 Safety Injection System	Obstruction Elbow-to-Branch Connection, 57% coverage	6	ASTM A182, Type F316 SS (Elbow)	ASTM A182, Type F316 SS (Branch Connection)

ASME Code Class 2 piping welds for which relief is requested are identified in Table 2 below for SQN Unit 1, along with a description of the limitation and the actual examination coverage obtained.

	Table 2 – SQN Unit 1, Examination Category R-A, ASME Class 2 Welds with Limited Volumetric Coverage				
Item No.	**Weld Identification System**	**Limitation Coverage**	**Pipe Size (inch)**	**Material 1 (Component)**	**Material 2 (Component)**
R1.11	CSF-058 Containment Spray System	Single sided Pipe-to-Elbow, 34% coverage	12	ASTM A358, Type 304 SS (Pipe)	ASTM A403, Type WP304W SS (Elbow)
R1.11	CSF-099A Containment Spray System	Single sided Valve-to-Pipe, 50% coverage	3	ASTM A351, Type CF8 SS (Valve)	ASTM A312, Type 304 SS (Pipe)
R1.11	CVCF-020 Chemical Volume Control System	Single sided Tee-to-Valve, 41% coverage	4	ASTM A403, Type WP304 SS (Tee 8"x8"x4")	ASTM A182, Type F304 SS (Valve)
R1.11/ R1.16	SIF-029 High Pressure Safety Injection System	Single sided Valve-to-Tee, 50% coverage	8	ASTM A351, Type CF8 SS (Valve)	ASTM A403, Type WP304 SS (Tee 8"x8"x8")
R1.11/ R1.16	SIF-031 High Pressure Safety Injection System	Obstruction Elbow-to-Valve, 63% coverage	8	ASTM A403, Type WP304 SS (Elbow)	ASTM A351, Type CF8 SS (Valve)

ASME Code Class 1 piping weld for which relief is requested are identified in Table 3 below for SQN Unit 2, along with a description of the limitation and the actual examination coverage obtained.

	Table 3 – SQN Unit 2, Examination Category R-A, ASME Code Class 1 Weld with Limited Volumetric Coverage				
Item No.	**Weld Identification System**	**Limitation Coverage**	**Pipe Size (inch)**	**Material 1 (Component)**	**Material 2 (Component)**
R1.11	RC-33 RCS Pressurizer Surge Line	Single sided Pipe-to-Tee, 50% coverage	14	ASTM A376, Type 316 SS (Pipe)	ASTM A376, Type 316 SS (Tee)

ASME Code Class 2 piping welds for which relief is requested are identified in Table 4 below for SQN Unit 2, along with a description of the limitation and the actual examination coverage obtained.

	Table 4 – SQN Unit 2, Examination Category R-A, ASME Class 2 Welds with Limited Volumetric Coverage				
Item No.	**Weld Identification System**	**Limitation Coverage**	**Pipe Size (inch)**	**Material 1 (Component)**	**Material 2 (Component)**
R1.11	AFWF-001 Auxiliary Feedwater System	Obstruction Tee-to-Pipe, 75% coverage	4	ASTM A106, Grade B, Carbon Steel (Tee)	ASTM A106, Grade B, Carbon Steel
R1.11	AFWF-007 Auxiliary Feedwater System	Obstruction Tee-to-Valve, 81% coverage	4	ASTM A234, WPB Carbon Steel (Tee)	ASTM A216, WCB Carbon Steel (Valve)
R1.11	AFWS-018 Auxiliary Feedwater System	Obstruction Elbow-to-Pipe, 82% coverage	4	ASTM A234, WPB Carbon Steel (Elbow)	ASTM A106, Grade B, Carbon Steel (Pipe)
R1.11	CSF-099A Containment Spray System	Single sided Valve-to-Pipe, 50% coverage	3	ASTM A351, Type CF8 SS (Valve)	ASTM A312, Type 304 SS (Pipe)
R1.11	CVCF-020 High Pressure Safety Injection System	Single Sided Tee-to-Valve, 50% coverage	4	ASTM A403, Type WP304 SS (Tee 8"x8"x4")	ASTM A182, Type F304 SS (Valve)
R1.11	RHRF-105 Residual Heat Removal System	Single Sided Valve-to-Elbow, 50% coverage	8	ASTM A351, Type CF8 SS (Valve)	ASTM A403, Type WP316 SS (Elbow)

3.2.2 Licensee's Reason for Request

As stated by the licensee and summarized by Tables 1 through 4, TVA was not able to achieve the required examination coverage (i.e., greater than 90 percent) for the above ASME Examination Category R-A pressure retaining piping welds due to limitations imposed by the components design and configuration. The licensee also stated that the limited examinations in this relief request were performed by using the requirements of ASME Section XI, Appendix VIII and with the requirements of the Performance Demonstration Initiative (PDI), as conditioned by 10 CFR 50.55a(b)(2)(xv) and 10 CFR 50.55a(b)(2)(xxiv).

The SQN Unit 1 piping welds identified in Tables 1 and 2, are all austenitic stainless steel piping welds using stainless steel filler metal and, due to access and physical obstructions, resulted in limited examination coverage that ranged from 34 percent to 89 percent of the required volume. In instances where the licensee had 100 percent coverage for these austenitic welds from a single side only, the volumetric examination coverage achieved for these welds was limited to 50 percent. TVA stated that recordable indications were not identified from these examinations.

The SQN Unit 2 piping welds identified in Tables 3 and 4, consist of ferritic and austenitic stainless steel piping welds. Specifically, welds RC-33, CSF-099A, CVCF-020, and RHRF-105 are stainless steel welds, and AFWT-001, AFWF-007, and AFWS-018 are ferritic steel. Due to access, the austenitic stainless steel welds were volumetrically examined from a single side only, and resulted in obtaining 50 percent coverage of the required examination volume. For the ferritic steel piping welds identified in Table 4, the obtained volumetric coverage ranged from 75 percent to 82 percent due to design limitations and physical obstructions.

The licensee stated that the subject ASME Class 1 pressure retaining welds are subject to periodic VT-2 visual examinations in accordance with ASME Code, Section XI, Examination Category B-P during each refueling outage. Additionally, the subject ASME Class 2 pressure retaining welds are subject to periodic VT-2 visual examinations in accordance with ASME Code, Section XI, Examination Category C-H each inspection period.

The licensee requested that the proposed relief request be authorized pursuant to 10 CFR 50.55a(g)(6)(i) for the third 10-year ISI interval at SQN Units 1 and 2.

3.2.3 NRC Staff Evaluation

As part of the TVA's Risk Informed ISI Program at SQN Units 1 and 2, Examination Category R-A, Item Number R1.11, R1.16, and R1.20 include essentially 100 percent volumetric examinations for the selected welds. However, complete volumetric examinations were restricted by component design, materials, obstructions, and weld configurations. These conditions precluded the licensee from obtaining essentially 100 percent volumetric examinations for the welds listed in Tables 1, 2, 3, and 4. To gain access for examination 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 on the subject welds were conducted using procedures and techniques 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 program, 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 for austenitic welds is considered to be a "best effort." Because there are currently no PDI qualified single-side examination procedures that demonstrate equivalency to two-sided examinations on austenitic piping welds, the staff considers that the licensee conducted the required examinations for the austenitic piping welds in this relief request to the maximum extent possible. Additionally, the ferritic steel welds in this relief request had physical obstructions which resulted in limitations from both sides of the weld in certain locations, which resulted in reduced coverage. Therefore, the NRC staff finds that the licensee's claim that it conducted the required examinations to the maximum extent possible, is justified.

As shown in the sketches and technical descriptions included in the licensee's submittal, and summarized in Tables 1 and 2, the volumetric examinations of the subject austenitic stainless steel welds for SQN Unit 1 achieved from 34 to 89 percent volumetric coverage of the ASME Code-required volumes. The austenitic stainless steel welds for SQN Unit 2 (Tables 3 and 4) due to access limitations were volumetrically examined from a single side and resulted in obtaining 50 percent of the required examination volume. The ferritic steel welds for SQN Unit 2 (Table 4), had physical obstruction which resulted in obtaining 75 to 82 percent examination coverage of the required volumes.

The ultrasonic techniques employed for these welds meet 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 (i.e., side not credited).

The NRC staff notes that in addition to the ultrasonic examinations, ASME Code Class 1, Examination Category 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. Additionally, the licensee stated that these piping components are also managed by its Boric Acid Corrosion Program. Therefore, these components are also visually examined at the beginning of each refueling outage. The NRC staff further notes that ASME Code Class 2, Examination Category R-A 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 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 for the fourth ISI Interval at SQN Units 1 and 2. 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, which provides some limited volumetric coverage for the weld materials on the opposite (far) side of these welds. The aggregate coverage obtained for the subject welds, the extent of the examinations, and considering that no recordable indications were observed on any of these welds, provides reasonable assurance that service-induced degradation, if present, would be have been detected. Because the subject ASME Class 1 pressure retaining welds are also subjected to VT-2 examinations during every refueling outage (ASME Code Class 2 welds have similar examinations every inspection period), there is additional assurance that significant service related degradation would be detected and corrected during scheduled outages. The NRC staff finds that the licensee's system leakage testing provides further assurance that significant degradation, if it is present, would be detected and corrected.

Based on its review, the NRC staff determined that obtaining the ASME Code-required examination volume is impractical because it would imposes 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 SQN Unit 1 welds RCS-069, RCS-089, RCS-101, RHRF-106, RHRF-107, SIF-196, SIF-197, SIF-198, CSF-058, CSF-099A, CVCF-020, SIF-029, and SIF-031, and SQN Unit 2 welds RC-33, AFWF-001, AFWF-007, AFWF-018, CSF-099A, CVCF-020, and RHRF-105.

3.3 Vessel Weld Evaluation

3.3.1 Applicable ASME Code Class 1 & 2 Pressure Vessel Weld Requirements

The examination requirements for ASME Code Class 1 and 2 pressure vessel welds in this relief request are specified in Table IWB-2500-1 for Examination Categories B-A and B-D, and in Table IWC-2500-1 for Examination Categories C-A and C-B. The examination requirement for Category B-A, Item Number B1.40, reactor vessel head-to-flange welds is volumetric and surface examination of essentially 100 percent of the weld length, with the required examination

length and volume as specified in Figure IWB-2500-5. The examination requirement for Category B-D, Item Number B3.110, pressurizer nozzle-to-vessel welds is volumetric examination of all nozzles, with the required examination volume as specified in Figure IWB-2500-7. The examination requirement for Category C-A, Item Numbers C1.10 and C1.20, circumferential pressure vessel welds is volumetric examination of essentially 100 percent of the weld length, with the required examination volume as specified in Figure IWC-2500-1. Table IWC-2500-1, Note 5 allows a surface examination to be substituted for a required volumetric examination for Category C-A welds with nominal wall thickness of 0.2 inch or less. The examination requirement for Category C-B, Item Number C2.21 nozzle welds in vessels is surface and volumetric examination of all nozzles at terminal ends of piping runs, with the required examination length and volume as specified in Figure IWC-2500-4.

"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 is an unconditionally approved code case as documented by NRC Regulatory Guide 1.147, Revision 17, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1." Thus, where the ASME Code requires 100 percent examination coverage, the licensee need not request relief due to impracticality unless the licensee is unable to achieve greater than 90 percent examination coverage.

ASME Code Class 1 pressure vessel welds for which relief is requested are identified in Table 5 below for SQN Unit 1, along with the actual examination coverage obtained and the examination results.

	Table 5 – SQN Unit 1, Examination Category B-A & B-D, ASME Code Class 1 Welds with Limited Coverage				
Item No.	**Weld Identification**	**Volumetric Coverage**	**Examination Results**	**Base Material 1 (Component)**	**Base Material 2 (Component)**
B1.40	W08-09, Reactor Vessel Head to Flange	70.9%	No recordable indications	Alloy steel forging with austenitic stainless steel cladding (Head Ring)	Alloy steel forging with austenitic stainless steel cladding (Flange)
B3.110	RCW-16, Pressurizer 6" Safety, Head to Nozzle	65.6%	No recordable indications	Alloy steel plate with austenitic stainless steel cladding (Head)	Alloy steel forging (Nozzle)
B3.110	RCW-17, Pressurizer 6" Relief, Head to Nozzle	67.1%	No recordable indications	Alloy steel plate with austenitic stainless steel cladding (Head)	Alloy steel forging (Nozzle)
B3.110	RCW-18, Pressurizer 6" Safety, Head to Nozzle	77.0%	No recordable indications	Alloy steel plate with austenitic stainless steel cladding (Head)	Alloy steel forging (Nozzle)

	Table 5 – SQN Unit 1, Examination Category B-A & B-D, ASME Code Class 1 Welds with Limited Coverage				
Item No.	**Weld Identification**	**Volumetric Coverage**	**Examination Results**	**Base Material 1 (Component)**	**Base Material 2 (Component)**
B3.110	RCW-19, Pressurizer 6" Safety, Head to Nozzle	75.5%	No recordable indications	Alloy steel plate with austenitic stainless steel cladding (Head)	Alloy steel forging (Nozzle)
B3.110	RCW-21, Pressurizer 14" Surge, Nozzle to Head	59.3%	No recordable indications	Alloy steel forging (Nozzle)	Alloy steel plate with austenitic stainless steel cladding (Head)

ASME Code Class 2 pressure vessel welds for which relief is requested are identified in Table 6 below for SQN Unit 1, along with the actual examination coverage obtained and the examination results.

	Table 6 – SQN Unit 1, Examination Category C-A & C-B, ASME Code Class 2 Welds with Limited Coverage				
Item No.	**Weld Identification**	**Coverage (Volu-metric unless otherwise stated)**	**Examination Results**	**Base Material 1 (Component)**	**Base Material 2 (Component)**
C1.20	SWFW-2, CVCS Seal Water Filter, Shell to Head	65% (PT Surface Exam)	No recordable indications	Austenitic stainless steel plate (Shell)	Austenitic stainless steel plate (Head)
C2.21	BIT-5, Safety Injection System Centrifugal Charging Pump Tank, Head to Nozzle	65.6%	Previously recorded geometric root indication	Carbon steel plate with austenitic stainless steel cladding (Head)	Carbon and alloy steel forging with austenitic stainless steel cladding (Nozzle)

ASME Code Class 1 pressure vessel welds for which relief is requested are identified in Table 7 below for SQN Unit 2, along with the actual examination coverage obtained and the examination results.

	Table 7 – SQN Unit 2, Examination Category B-D, ASME Code Class 1 Welds with Limited Coverage				
Item No.	**Weld Identification**	**Volumetric Coverage**	**Examination Results**	**Base Material 1 (Component)**	**Base Material 2 (Component)**
B3.110	RCW-15, Pressurizer 4" Spray, Nozzle to Head	75.6%	No recordable indications	Alloy steel forging (Nozzle)	Alloy steel plate with austenitic stainless steel cladding (Head)
B3.110	RCW-16, Pressurizer 6" Safety, Head to Nozzle	74.6%	One recordable indication, acceptable	Alloy steel plate with austenitic stainless steel cladding (Head)	Alloy steel forging (Nozzle)
B3.110	RCW-17, Pressurizer 6" Safety, Head to Nozzle	76.6%	No recordable indications	Alloy steel plate with austenitic stainless steel cladding (Head)	Alloy steel forging (Nozzle)
B3.110	RCW-18, Pressurizer 6" Relief, Head to Nozzle	71.0%	No recordable indications	Alloy steel plate with austenitic stainless steel cladding (Head)	Alloy steel forging (Nozzle)
B3.110	RCW-19, Pressurizer 6" Safety, Head to Nozzle	70.1%	No recordable indications	Alloy steel plate with austenitic stainless steel cladding (Head)	Alloy steel forging (Nozzle)
B3.110	RCW-21, Pressurizer 14" Surge, Nozzle to Head	59.5%	No recordable indications	Alloy steel forging (Nozzle)	Alloy steel plate with austenitic stainless steel cladding (Head)

ASME Code Class 2 pressure vessel welds for which relief is requested are identified in Table 8 below for SQN Unit 2, along with the actual examination coverage obtained and the examination results.

	Table 8 – SQN Unit 2, Examination Category C-A & C-B, ASME Code Class 2 Welds with Limited Coverage				
Item No.	**Weld Identification**	**Coverage (Volu-metric unless otherwise stated)**	**Examination Results**	**Base Material 1 (Component)**	**Base Material 2 (Component)**
C1.10	SWIFW-1-A, CVCS Seal Water Injection Filter "A", Flange to Shell	87.7%	No recordable indications	Austenitic stainless steel forging (Flange)	Austenitic stainless steel plate (Shell)
C1.20	SWIFW-2-A, CVCS Seal Water Injection Filter "A", Shell to Head	64.7%	No recordable indications	Austenitic stainless steel plate (Shell)	Austenitic stainless steel plate (Head)
C1.20	SWFW-2, CVCS Seal Water Filter, Shell to Head	68% (PT Surface Exam)	No recordable indications	Austenitic stainless steel plate (Shell)	Austenitic stainless steel plate (Head)
C1.10	SGW-D1, Steam Generator Shell to Shell Cone	45.0%	Recordable indications, acceptable	Steel plate (Shell)	Steel plate (Shell Cone)
C2.21	BIT-2, Safety Injection System Centrifugal Charging Pump Tank, Head to Nozzle	74.6%	No recordable indications	Carbon steel plate with austenitic stainless steel cladding (Head)	Carbon and alloy steel forging with austenitic stainless steel cladding (Nozzle)
C2.21	BIT-5, Safety Injection System Centrifugal Charging Pump Tank, Head to Nozzle	66.7%	No recordable indications	Carbon steel plate with austenitic stainless steel cladding (Head)	Carbon and alloy steel forging with austenitic stainless steel cladding (Nozzle)

3.3.2 Licensee's Reason for Request

As stated by the licensee and summarized by Tables 5 through 8 above, TVA was not able to achieve the required examination coverage (i.e., greater than 90 percent) for the above pressure vessel welds due to limitations imposed by the components design and configuration.

For the reactor vessel head to flange weld (Table 5: Weld W08-09), the licensee stated that interference from the three lifting lugs restricted access to volumetric examination. The ultrasonic examination was performed in accordance with Section V, Article 4 of the ASME Code.

For the pressurizer nozzle to vessel welds (Table 5: Welds RCW-16, RCW-17, RCW-18, RCW-19, RCW-21, and Table 7: Welds RCW-15, RCW-16, RCW-17, RCW-18, RCW-19, RCW-21), the licensee stated that the geometry of the nozzle restricted access, especially for the nozzle side scans. The ultrasonic examinations were performed in accordance with Section V, Article 4. For the pressurizer nozzle to vessel welds, the licensee identified a planar flaw in Unit 2, Weld RCW-16. The licensee evaluated this planar flaw in accordance with Section XI, Article IWB-3512 of the ASME Code and found it to be acceptable.

For the safety injection system centrifugal charging pump tank welds (Table 6: Weld BIT-5, and Table 8: Welds BIT-2 and BIT-5), the licensee stated that the geometry of the nozzle restricted access, especially for the nozzle side scans. The ultrasonic examinations were performed in accordance with Section V, Article 4. For Unit 1 Weld BIT-5 (Table 6), a root geometry condition that was originally identified in a previous inspection was re-identified in the most recent third ISI examination.

For the Chemical and Volume Control System (CVCS) Seal Water Injection Filter "A" Shell Circumferential Welds (Table 8: Weld SWIFW-1-A), the licensee stated that the geometry of the flange tape and a close bracket restricted access. The ultrasonic examinations were performed in accordance with Appendix III.

For the CVCS Seal Water Injection Filter "A" Head Circumferential Welds (Table 8: Weld SWIFW-2-A), the licensee stated that the support legs restricted access. The ultrasonic examinations were performed in accordance with Appendix III.

For the Steam Generator Shell Circumferential Weld (Table 8: Weld SGW-D1), the licensee stated that the proximity of secondary supports restricted access. The ultrasonic examinations were performed in accordance with Appendix VIII. The licensee documents that recordable acceptable indications were found. The licensee noted that this steam generator was subsequently replaced.

For the CVCS Seal Water Filter Head Circumferential Welds (Table 6: Weld SWFW-2, and Table 8: Weld SWFW-2) volumetric examination was not performed. Surface examination (by liquid penetrant) was performed in lieu of ultrasonic examination as allowed by Note 5 of Examination Category C-A, Table IWC-2500-1, Section XI of the ASME Code for vessels with a nominal wall thickness of 0.2 inches or less. The licensee reported limited surface examination coverages of 65.0 percent and 68.0 percent respectively for Units 1 and 2, due to the obstruction of welded support legs.

The licensee stated that the subject ASME Class 1 pressure retaining welds are subject to periodic VT-2 visual examinations in accordance with ASME Code, Section XI, Examination Category B-P during each refueling outage. Additionally, the subject ASME Class 2 pressure

retaining welds are subject to periodic VT-2 visual examinations in accordance with ASME Code, Section XI, Examination Category C-H each inspection period.

The licensee requested that the proposed relief request be authorized pursuant to 10 CFR 50.55a(g)(6)(i) for the third 10-year ISI interval at SQN Units 1 and 2.

3.3.3 NRC Staff Evaluation

For the reactor vessel head to flange weld (Table 5: Weld W08-09), the NRC staff confirmed that the lifting lugs restricted access to volumetric examination as stated by the licensee, and that it would be impractical to achieve greater than essentially 100 percent volumetric coverage without extensive weld or component design modifications. The NRC staff also confirmed that volumetric examination in accordance with Article 4, Section V of the ASME Code was acceptable since Article I-2110(b) of the ASME Code requires ultrasonic examination of closure head-to-flange welds to be conducted in accordance with Article 4 of Section V. Access for surface examination was not restricted and the licensee was able to achieve 100 percent coverage for the surface examination required by Table IWB-2500-1 for Examination Category B-A, Item No. B1.40 welds. Although the licensee submittal does not specify the Code requirement for the surface examination, Paragraph 7.1 of Enclosure (3) to the licensee's "Risk-Informed Inservice Inpection (RI-ISI) Program and Updated Inservice Inspection (ISI) Program for Third 10-Year Interval" (ADAMS Accession No. ML061210105) states that nondestructive examination (NDE) methods shall be in accordance with Article IWA-2200 of the ASME Code. The NRC staff confirms that surface examination in accordance with Article IWA-2200 is acceptable.

For the pressurizer nozzle to vessel welds (Table 5: Welds RCW-16, RCW-17, RCW-18, RCW-19, RCW-21, and Table 7: Welds RCW-15, RCW-16, RCW-17, RCW-18, RCW-19, RCW-21), the NRC staff confirmed that the geometry of the nozzle restricted access to volumetric examination as stated by the licensee, and that it would be impractical to achieve greater than essentially 100 percent volumetric coverage without extensive weld or component design modifications. The NRC staff also confirmed that volumetric examination in accordance with Article 4, Section V of the ASME Code was acceptable since Article I-2120 of the ASME Code requires ultrasonic examination of all other vessels greater than 2 inches in thickness to be conducted in accordance with Article 4 of Section V. For the planar flaw identified by the licensee in Unit 2, Weld RCW-16, the NRC staff confirmed the licensee's evaluation in accordance with Section XI, Article IWB-3512 of the ASME Code that the flaw was acceptable.

For the safety injection system centrifugal charging pump tank welds (Table 6: Weld BIT-5, and Table 8: Welds BIT-2 and BIT-5), the NRC staff confirmed that the geometry of the nozzle restricted access to volumetric examination as stated by the licensee, and that it would be impractical to achieve greater than essentially 100 percent volumetric coverage without extensive weld or component design modifications. The NRC staff also confirmed that volumetric examination in accordance with Article 4, Section V of the ASME Code was acceptable since Article I-2120 of the ASME Code requires ultrasonic examination of all other vessels greater than 2 inches in thickness to be conducted in accordance with Article 4 of Section V. Access for surface examination was not restricted and the licensee was able to achieve 100 percent coverage for the surface examination required by Table IWC-2500-1 for Examination Category C-B, Item No. C2.21 welds. Although the licensee submittal does not specify the Code requirement for the surface examination, Paragraph 7.1 of Enclosure (3) to the licensee's "Risk-Informed Inservice Inpection (RI-ISI) Program and Updated Inservice Inspection (ISI) Program for Third 10-Year Interval" states that NDE methods shall be in accordance with Article IWA-2200 of the ASME Code. The NRC staff confirms that surface examination in accordance with Article IWA-2200 is acceptable.

For the CVCS Seal Water Injection Filter "A" Shell and Head Circumferential Welds (Table 8: Welds SWIFW-1-A and SWIFW-2-A), the NRC staff confirmed that the geometry of the flange taper and the close proximity of a bracket and support legs restricted access to volumetric examination as stated by the licensee, and that it would be impractical to achieve greater than essentially 100 percent volumetric coverage without extensive weld or component design modifications. The NRC staff also confirmed that volumetric examination in accordance with Section XI, Appendix III was acceptable since Article I-2210 of the ASME Code requires ultrasonic examination of vessels not greater than 2 inches in thickness to be conducted in accordance with Section XI, Appendix III.

For the Steam Generator Shell Circumferential Weld (Table 8: Weld SGW-D1), the NRC staff confirmed that the proximity of secondary supports restricted access to volumetric examination as stated by the licensee, and that it would be impractical to achieve greater than essentially 100 percent volumetric coverage without extensive weld or component design modifications. The NRC staff notes that although volumetric examination in accordance with Section XI, Appendix VIII may be technically justifiable and may meet or exceed the requirements of the Code of Record, Appendix VIII does not meet the regulatory requirements of the Code of Record for ultrasonic examination of vessels other than reactor vessels. However, the 2005 Addendum of the ASME Code was modified to add Article I-2600, which allows components for which Appendix VIII is not applicable to have procedures qualified in accordance with Appendix VIII, provided that the components, materials, sizes and shapes are within the scope of the qualified examination procedure. Also as stated by the licensee, the steam generator that was examined to Appendix VIII was subsequently replaced. Based on the allowance of more recent versions of the ASME Code, and on the fact that the steam generator was replaced, the NRC staff finds the examination of Unit 2, Weld SGW-D1 to be acceptable.

For the CVCS Seal Water Filter Head Circumferential Welds (Table 6: Weld SWFW-2, and Table 8: Weld SWFW-2) the NRC staff confirmed that the obstruction of welded support legs restricted access to surface examination as stated by the licensee, and that it would be impractical to achieve greater than essentially 100 percent surface coverage without extensive weld or component design modifications. Although the licensee submittal does not specify the Code requirement for the surface examination, Paragraph 7.1 of Enclosure (3) to the licensee's "Risk-Informed Inservice Inspection (RI-ISI) Program and Updated Inservice Inspection (ISI) Program for Third 10-Year Interval" states that NDE methods shall be in accordance with Article IWA-2200 of the ASME Code. The NRC staff confirms that surface examination in accordance with Article IWA-2200 is acceptable.

In addition to the volumetric examinations required by the ASME Code, the system leakage tests required by the ASME Code for Category B-P (Class 1) and Category C-H (Class 2) pressure retaining components listed in Tables 5 through 8 are an additional line of defense in the detection of service induced degradation. Table IWB-2500-1 requires a system leakage test for all Category B-P pressure retaining components each refueling outage. Table IWC-2500-1 requires a system leakage test for all Category C-H pressure retaining components each inspection period. Both Tables IWB-2500-1 and IWC-2500-1 require that VT-2 visual examination be performed in accordance with Article IWA-5240. The VT-2 visual examination specified in the ASME Code for these leakage tests requires, in part, that:

- Accessible external exposed surfaces be examined for evidence of leakage
- The surrounding areas of inaccessible surfaces be examined for evidence of leakage

The acceptance criteria specified in the ASME Code for these leakage tests require, in part, that corrective action be taken for identified leakage, unless within defined permissible limits.

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 vessel welds for the fourth ISI Interval at SQN Units 1 and 2. Although the ASME Code-required coverage could not be obtained, the ultrasonic techniques employed provided nearly full volumetric coverage from the head-side of the nozzle-to-head and head-to-flange welds, which provides 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 the satisfactory disposition of the few recordable indications, the NRC staff has reasonable assurance that service-induced degradation, if present, would have been detected. Because the subject ASME Class 1 pressure retaining welds are also subjected to VT-2 examinations during every refueling outage (ASME Code Class 2 welds have similar examinations every inspection period), there is additional assurance that significant service related degradation would be detected and corrected during scheduled outages. The NRC staff finds that the licensee's system leakage testing provides further assurance that significant degradation, if it is present, would be detected and corrected.

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 examinations performed, despite the limited coverage obtained by the licensee, provide reasonable assurance of the structural integrity for SQN Unit 1 welds W08-09, RCW-16, RCW-17, RCW-18, RCW-19, RCW-21, BIT-5 and SWFW-2, and SQN Unit 2 welds RCW-15, RCW-16, RCW-17, RCW-18, RCW-19, RCW-21, BIT-2, BIT-5, SWIFW-1-A, SWIFW-2-A, SGW-D1 and SWFW-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 ASME Code Class 1 and Class 2 weld examinations for the components contained in Relief Request 17-ISI-1 for SQN Units 1 and 2, third 10-year ISI interval that ended on April 30, 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 Contributors: Joel Jenkins
Roger Kalikian

Date: January 26, 2018

SUBJECT: SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2 – RELIEF FROM THE REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS CODE (CAC NOS. MF9690 AND MF9691; EPID L-2017-LLR-0025) DATED JANUARY 26, 2018

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