August 8, 2003

Mr. J. A. Scalice
Chief Nuclear Officer and
Executive Vice President
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

SUBJECT: SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2 - RELIEF REQUESTS 1/2-ISI-17, 1/2-ISI-18, 1/2-ISI-19, 1/2-ISI-20, 2-ISI-21, AND 2-ISI-22 ASSOCIATED WITH INSERVICE TESTING REQUIREMENTS DURING CYCLE 10 REFUELING OUTAGES (TAC NOS. MB5474 AND MB5475)

Dear Mr. Scalice:

By letter dated August 10, 2001, as supplemented with letters dated July 31, 2002 and June 24, 2003, the Tennessee Valley Authority (TVA) requested relief from certain requirements prescribed in Section XI of the 1989 Edition of the American Society of Mechanical Engineers (ASME) Code (the Code) in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a. The relief requests (RRs) are based on limitations due to design configuration or material properties that preclude full code examination of ASME Class 1 and 2 welds. The RRs applied to inservice inspection (ISI) examinations that were conducted during the second 10-year ISI interval for Sequoyah Nuclear Plant (SQN), Units 1 and 2.

The U.S. Nuclear Regulatory Commission staff, with technical assistance from its contractor, the Pacific Northwest National Laboratory, has evaluated the information you provided in support of the subject requests for relief. This letter and the enclosed safety evaluation address RRs 1/2-ISI-17, 1/2-ISI-18, 1/2-ISI-19, 1/2-ISI-20, 2-ISI-21 and 2-ISI-22.

For RRs 1/2-ISI-18, 1/2-ISI-20, and 2-ISI-21, the staff finds that compliance with the Code requirements would result in a hardship or unusual difficulty with no compensating increase in quality or safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the staff is authorizing the limited coverage alternative proposed in your RR for the second inspection interval.

For RRs 1/2-ISI-17, 1/2-ISI-19, and 2-ISI-22, the staff finds that compliance with the Code requirements are impractical. Therefore, the staff is granting relief from the specified requirements in accordance with 10 CFR 50.55a(g)(6)(i) for the second inspection interval. The staff has concluded that the granting of relief is authorized by law and will not endanger life or property or the common defense and security, and is otherwise

in the public interest giving due consideration to the burden that could result if the requirements were imposed.

The staff's conclusions are presented in the attached safety evaluation.

If there are any questions regarding this issue, please contact me at (301) 415-2024.

Sincerely,

/RA/

Allen G. Howe, Chief, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-327 and 50-328

Enclosure: Safety Evaluation

cc w/enclosure: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SECOND 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM

RELIEF REQUESTS (RRs) 1/2-ISI-17, 1/2-ISI-18, ½-ISI-19,

1/2-ISI-20, 2-ISI-21, AND 2-ISI-22

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT, UNIT 2

DOCKET NO. 50-328

1.0 INTRODUCTION

In a letter dated August 10, 2001, as supplemented with letters dated July 31, 2002, and June 24, 2003, the Tennessee Valley Authority (TVA) requested relief under the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(g)(5)(iii) for the Sequoyah Nuclear Plant (SQN), Units 1 and 2. The relief requests are associated with inservice inspection (ISI) activities performed during Cycle 10 refueling outages for each unit.

The U.S. Nuclear Regulatory Commission (NRC) staff, with technical assistance from its contractor, the Pacific Northwest National Laboratory (PNNL), has evaluated the information you provided in support of the subject requests for relief. The results of that evaluation are presented below.

2.0 REGULATORY REQUIREMENTS

ISI of American Society of Mechanical Engineers (ASME) Code Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel (B&PV) Code (the Code), and applicable addenda, as required by 10 CFR 50.55a(g), except where specific relief has been granted by the U.S. Nuclear Regulatory Commission (NRC). In accordance with 10 CFR 50.55a(a)(3), the Commission may authorize licensee-proposed alternatives if it is determined that the alternative provides an acceptable level of quality and safety or if it is determined that compliance with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. It is stated in 10 CFR 50.55a(g)(6)(i), that the NRC will evaluate a licensee determination that conformance with certain Code requirements is impractical for its facility and may grant such relief and may impose such alternative requirements as it determines is authorized by law and will not endanger life or property, or the common defense and security, and is 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)(4), 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 B&PV Code, Section XI, "Rules for Inservice Inspection (ISI) 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 B&PV Code, which was incorporated by reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The Code of Record for SQN, Units 1 and 2 second 10-year interval inservice inspection programs, which began on December 16, 1995, is the 1989 Edition of Section XI of the ASME B&PV Code, with no addenda.

3.0 TECHNICAL EVALUATION

The information provided by TVA in support of the requests for relief from Code requirements, including detailed inspection reports with weld configuration diagrams, has been evaluated and the bases for disposition are documented below.

3.1 RR No. 1/2-ISI-17, Examination Category C-B, Item C2.21, Nozzle-to-Shell (or Head) Welds

Code Requirement: Examination Category C-B, Item C2.21 requires essentially 100% surface and volumetric examination, as defined by Figures IWC-2500-4(a) or (b), as applicable, of full penetration nozzle-to-shell or -head welds in Class 2 vessels greater than one-half inch nominal wall thickness. “Essentially 100%,” as clarified by ASME Code Case N-460, is greater than 90% coverage of the examination volume, or surface area, as applicable.

System - Component:

Safety Injection - System - 63
6 inch Inlet and Outlet, Centrifugal Charging Pump (CCP) Nozzles:
BIT-2 and BIT-5 Nozzle-to-Head Welds (Unit 1)
BIT-2 and BIT-5 Nozzle-to-Head Welds (Unit 2)

Licensee’s Code RR:

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the Code-required volumetric examination of the Safety Injection CCP tank nozzle-to-head full penetration welds. The design configuration of the CCP tank nozzle-to-head welds preclude 100% ultrasonic examination of the required volume for the BIT-5 (6 inch inlet) and BIT-2 (6 inch outlet) welds.

Licensee’s Basis for Requesting Relief (as stated):

> The design configuration of the CCP Tank precludes an ultrasonic examination of the required volume for the following nozzle-to-head welds: BIT-2 and BIT-5. The design configuration limits ultrasonic examination of weld BIT-5 to approximately 67% of required examination

volume, as calculated in accordance with TVA Procedure N-GP-28. Weld BIT-2 is currently scheduled for examination in the third period of the second inspection interval.

Licensee's Proposed Alternative Examination (as stated):

> In lieu of the code required 100% ultrasonic examination, a best effort ultrasonic examination will be performed on the accessible areas to the maximum extent practical, given the physical limitations of the nozzle-to-head weld. The code required surface examination (liquid penetrant) of 100% of the nozzle-to-head weld will be performed on the nozzle-to-head weld.

Evaluation: The Code requires essentially 100% volumetric and surface examination coverage of safety injection CCP tank nozzle-to-head welds BIT-5 (6-inch inlet) and BIT-2 (6-inch outlet). However, the component outside surface geometry restricts access for volumetric examination to only the vessel side of these welds. The subject welds and components would have to be redesigned and modified for the licensee to achieve 100% volumetric coverage. This would place a significant burden on the licensee, therefore, the Code required 100% volumetric examination is impractical.

As shown in the drawings and examination reports provided by the licensee, the set-in design of the nozzles precludes examining the welds from the nozzle side due to the orientation of the weld and the outside surface configuration of the nozzles and weld crowns. However, the licensee was able to obtain a substantial (aggregate 67%) amount of the required volumetric coverage and 100% of the required surface coverage on inlet nozzles BIT-5 for both SQN, Units 1 and 2. The outlet nozzles BIT-2 for SQN, Units 1 and 2 are scheduled for examination later in the current interval, but are expected to exhibit similar access restrictions due to the same design configuration. Volumetric examinations using shear waves were performed from the vessel side of the weld with greater than 80% (45-degree) and 100% (60-degree) of the Code required volumes being examined in a single sound path direction. Further, the base metal and weldment are ferritic materials (carbon steel) which are known to exhibit favorable ultrasonic transmission qualities due to their small, isotropic grain structures. During previous round robin tests, as reported in NUREG/CR-5068, "Piping Inspection Round Robin," it has been demonstrated that ultrasonic examinations of ferritic material from a single side provide high probabilities of detection (usually 90% or greater) for both near- and far-side cracks in blind inspection trials. It is expected that the licensee may perform a thorough examination of the Code required volume from one side of the weld.

The Code allows either magnetic particle examination or liquid penetrant examination, and based on the vessel shell and nozzles being fabricated of carbon steel (SA-240 Grade 70 and SA-350 FL2, respectively), magnetic particle examination is the appropriate method. The licensee completed 100% of the required surface examinations on BIT-5 for SQN, Units 1 and 2.

Conclusion: PNNL has reviewed the licensee's submittal and concludes that there is reasonable assurance of the structural integrity of the subject components based upon the examinations that are being performed. The staff adopts this conclusion.

Therefore, for this request, the staff is granting relief pursuant to 10 CFR 50.55a(g)(6)(i).

If during the examinations of BIT-2 for SQN, Units 1 and 2, the licensee does not achieve the same or greater volumetric coverage, a new relief request will be required.

3.2 RR No. 1/2-ISI-18, Examination Category C-B, Item C2.21, Nozzle-to-Shell (or Head) Welds

Code Requirement: Examination Category C-B, Item C2.21 requires 100% surface and volumetric examination of nozzle-to-shell (or head) welds in Class 2 vessels as defined by Figure IWC-2500-4(a) or (b). In the case of multiple vessels of similar design, size, and service, the required examinations may be limited to one vessel or distributed among the vessels.

System - Component:

Residual Heat Removal System - System 74
RHR Heat Exchanger (1A and 2A)
Nozzle-to-Shell (or Head) Weld No. RHRW-15-A (Units 1 and 2)

Licensee's Code Relief Request (as stated):

> This request for relief addresses the Residual Heat Removal (RHR) heat exchanger (1A and 2A) nozzle-to-shell weld RHRW-15-A. The design configuration of the RHR heat exchanger nozzle-to-shell weld precludes a 100% ultrasonic examination of the required volume for the nozzle-to-shell weld. These physical examination limitations occur when the 1989 Code examination requirements are applied in areas of components constructed and fabricated to early plant physical designs.
>
> A liquid penetrant surface examination was performed on 91% of the subject weld. An ultrasonic examination was performed on accessible areas to the maximum extent practical, given the physical limitations of the subject weld. The design configuration limits the best effort ultrasonic examination to approximately 39% of weld volume of RHRW-15-A. Performance of an ultrasonic examination of essentially 100% of full penetration nozzle-to-shell weld RHRW-15-A is impractical. A surface examination and the maximum extent practical ultrasonic examination of the subject weld provides reasonable assurance of an acceptable level of quality and safety because the information and data obtained from the weld surface and the weld volume examined provides sufficient information to judge the overall integrity of the weld.

Licensee's Basis for Requesting Relief (as stated):

> The design configuration of the RHR heat exchanger nozzle, shell and component support precludes an ultrasonic examination of the required volume for the nozzle-to-shell weld RHR-15-A. The design configuration limits ultrasonic examination to approximately 39% of the required

examination volume as calculated in accordance with TVA procedure N-GP-28.

Licensee's Proposed Alternative Examination (as stated):

> In lieu of the code required 100% ultrasonic examination, an ultrasonic examination was performed on accessible areas to the maximum extent practical, given the physical limitations of the nozzle-to-shell weld. The code required surface examination (liquid penetrant) of 91% of the nozzle-to-shell weld was also performed.

Evaluation: The Code requires essentially 100% volumetric and surface examination of nozzle-to-shell welds RHRW-15-A at SQN, Units 1 and 2. However, access to examine these welds from the outside surface is severely limited by the sharp bend radius on the nozzle, and the proximity of welded support pads and adjacent tube sheet-to-shell and head-to-shell welds that obstruct ultrasonic scans. To gain access for examining this weld from the inside surface of the RHR heat exchanger would require disassembly and lifting of the vessel. This would place an undue burden on the licensee.

Drawings and examination reports submitted by the licensee provide a basis to support the limited access claimed for ultrasonic examinations from the outside surface. From the shell side of the weld, the licensee could obtain only 39% of the Code required volume due to interference from welded support pads and adjacent head-to-shell and tube sheet-to-shell welds. No examinations from the nozzle side were possible because of the nozzle taper and small radius design. Access to increase volumetric coverage from the inside surface of the RHR heat exchanger would require that the licensee disassemble the component and lift the shell. The radiation field for the inside of this vessel is estimated to be 10-12 Rem/hour and examiners would only be allowed approximately 5 minutes of stay time to complete further scans. This would be insufficient to complete a valid examination from the inner surface of the vessel.

Conclusion: For RR 1/2-ISI-18, the staff finds that compliance with the Code requirements would result in a hardship or unusual difficulty with no compensating increase in quality or safety. The licensee reported that 91% of the outside surface examinations were completed for Welds RHRW-15-A. Additionally, no degradation has been identified for these stainless steel RHR vessel welds, nor has any source of degradation been historically experienced by industry for RHR heat exchanger welds. Based on the limited volumetric examinations and the Code surface examinations completed, significant patterns of degradation, if present, should have been detected. Considering these factors, to require the licensee to disassemble the vessel for expanded volumetric coverage would constitute an undue hardship with no compensating increase in safety or quality. The alternatives proposed by the licensee provide reasonable assurance of the continued structural integrity of the subject welds. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the staff authorizes the licensee's limited coverage alternative for Weld RHRW-15-A for the second inspection interval.

3.3 Request for Relief No.1/2-ISI-19, Examination Category B-D, Item B3.110, Full Penetration Welds of Nozzles In Vessels

Code Requirement: Examination Category B-D, Item B3.110 requires essentially 100% volumetric examination of nozzle-to-vessel welds.

System - Component:

Reactor Coolant - System 68
Four Pressurizer Nozzles, Full Penetration Welds
RCW-16, RCW-17, RCW-18, and RCW-19

Licensee's Code Relief Request:

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the Code required volumetric examination of the following 6-inch pressurizer nozzle-to-head welds: RCW-16, RCW-17, RCW-18, and RCW-19.

Licensee's Basis for Requesting Relief (as stated):

> The design configuration of the pressurizer precludes an ultrasonic examination of the required volume for the following nozzle-to-head welds: RCW-16, RCW-17, RCW-18 and RCW-19. The design configuration limits ultrasonic examination to approximately 66.7% for Unit 1 and 68.8% for Unit 2 of the required examination volume, as calculated in accordance with TVA procedure N-GP-28, for welds RCW-16 and RCW-17. The Unit 2 Welds RCW-18 and RCW-19 are scheduled for examination in the third period of the second inspection interval.

Licensee's Proposed Alternative Examination (as stated):

> In lieu of the code required 100% ultrasonic examination, a best effort ultrasonic examination will be performed on the accessible areas to the maximum extent practical, given the physical limitations of the nozzle-to-head welds. The code required surface examination (liquid penetrant) of 100% of the nozzle-to-head weld will be performed on the nozzle-to-head weld.

Evaluation: The Code requires essentially 100% volumetric examination coverage of SQN, Units 1 and 2 pressurizer relief nozzles RCW-16, -17, -18 and -19. However, the nozzle outside surface geometry restricts access for volumetric examination to only the head side of these welds. The subject welds would have to be redesigned and modified for the licensee to achieve 100% volumetric coverage.

As shown in the drawings and examination reports provided by the licensee, the design of the nozzles precludes examining the welds from the nozzle side due to the orientation of the weld and the small radius of curvature of the outside surface. However, the licensee was able to obtain a substantial (aggregate 67% and 69% for SQN Units 1

and 2, respectively) amount of the required volumetric coverage for RCW-16, -17, -18, and -19 in SQN, Unit 1, and RCW-16 and -17 for SQN, Unit 2. Relief nozzles RCW-18 and -19 for SQN, Unit 2 are scheduled for examination later in the current interval, but are expected to exhibit similar access restrictions due to the same design configuration. Volumetric examinations using 45-degree and 60-degree shear waves were performed from the head side of the weld with 100% of the Code required volumes being examined in a single sound path direction. In addition, 100% of the Code required scans for flaws oriented transverse to the weld were completed. The base metal and weldment for these pressurizer relief nozzle welds are ferritic materials (carbon steel) which are known to exhibit favorable ultrasonic transmission qualities due to their small, isotropic grain structures. During previous round-robin tests, as reported in NUREG/CR-5068, it has been demonstrated that ultrasonic examinations of ferritic material from a single side provide high probabilities of detection (usually 90% or greater) for both near- and far-side cracks in blind inspection trials.

Conclusion: PNNL has reviewed the licensee's submittal, and concludes that the Code examination coverage requirements are impractical for the subject components listed in RR 1/2-ISI-19. Further, reasonable assurance of the structural integrity of the subject components has been provided by the examinations that are being performed. The staff adopts these conclusions. Therefore, for this request, the staff is granting relief in accordance with 10 CFR 50.55a(g)(6)(i) for the second inspection interval.

If during the examinations of RCW-18 and -19 for SQN, Unit 2, the licensee does not achieve the same or greater volumetric coverage, a new request for relief will be required.

3.4 Revised RR 1/2-ISI-20, Examination Category C-A, Item C1.20, Pressure Retaining Welds in Pressure Vessels, Seal Water Filters

Code Requirement: Examination Category C-A, Item C1.20 requires essentially 100% volumetric examination, as defined by Figure IWC-2500-1, of full penetration head-to-shell circumferential welds in Class 2 vessels. "Essentially 100%," as clarified by ASME Code Case N-460, is greater than 90% coverage of the examination volume, or surface area, as applicable.

System - Component:

Chemical and Volume Control - System 62
Seal Water Filter, Head-to-Shell Weld, Full Penetration Weld
SWFW-2

Licensee's Code Relief Request: In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the Code-required 100% volumetric examination of head-to-shell welds SWFW-2 for chemical and volume control seal water filters (SWF) in SQN, Units 1 and 2 (weld is designated SWFW-2 in both units).

Licensee's Basis for Relief (as stated):

> The wall thickness of the shell is less than 0.20 inch and is the basis for performance of a surface examination in lieu of a volumetric examination. The design configuration of the subject head-to-shell weld precludes surface examination of essentially 100% of the required examination area. In order to examine the weld in accordance with the code requirement, the SWF would require extensive design modifications. The physical arrangement of welds (SWFW-2) precludes a complete surface examination due to welded support attachments which carry the weight of the component to the floor. A total of four channel beam attachments are welded along the axial direction of the component at four equally spaced locations. Each attachment is approximately 4.4 inches in width and covers the adjoining circumferential head-to-shell weld. The complete circumference of the component is 50.25 inches. The Unit 1 unexamined area is 17.6 inches of a possible 50.25 inches. The Unit 2 weld coverage was approximately the same.
>
> The support attachments which cover the subject weld induce negligible stresses in the head-to-shell weld. The function of the support attachment is to carry the weight of the component.
>
> Radiographic examination from the outside surface as an alternate volumetric examination method was determined to be impractical due to the support attachment affecting radiographic quality. Performing radiographic examination from the inside surface of SWF would require placing a radiographic source near the center of the head. The SWF would require disassembly and access to the inner surface would result in extreme radiological conditions (high contamination and dose to personnel). Again radiographic quality is compromised due to the support attachments. Thus, radiography from the inner surface, to gain any additional coverage, is also impractical.
>
> Performance of an ultrasonic volumetric examination to supplement the required coverage was also deemed to be impractical. The support attachments are 4-inch channel steel. An ultrasonic search unit cannot be placed on top of the outside head-to-shell weld due to the support attachment interference.

Licensee's Proposed Alternative Examination (as stated):

> In lieu of the code required volumetric examination, a best effort liquid penetrant surface examination was performed on accessible areas to the maximum extent practical given the physical limitations of the head-to-shell weld.

Evaluation: The Code requires essentially 100% volumetric examination of Examination Category C-A head-to-shell welds on Class 2 vessels. The subject SWFs are fabricated

of Type 304 stainless steel less than 0.20 inch in wall thickness. The licensee states that volumetric examination is not practical because the wall thickness is insufficient for performance of the Code-required examination. In lieu of the volumetric examination, the licensee has performed a liquid penetrant examination on the accessible portions of the outside surface of Welds SWFW-2 at SQN, Units 1 and 2. The surface examination is limited due to welded support attachments that cover a large portion of these welds. The licensee obtained approximately 65% and 68% surface examination on Weld SWFW-2 for SQN, Units 1 and 2, respectively.

In the evaluation of this request, the staff took exception to the recommendation in its contractor's report. In the evaluation of this relief request, the staff finds that:

1. The licensee has obtained 65% and 68% surface examination coverage of Weld SWFW-2 for SQN, Unit 1 and 2, respectively, because of limited accessibility to the weld due to obstruction caused by welded support attachments. No defects or flaws were found by the licensee. This provides reasonable indication that the rest of the weld is also free of defects or flaws.

2. Requiring the licensee to perform the Code required volumetric examination will not increase the amount of coverage because the same obstruction applies to volumetric examination as well as to surface examination.

3. Two types of volumetric examinations are available to the licensee to meet the requirements of the ASME Code, Section XI, namely ultrasonic or radiographic examination. The licensee has provided compelling reasons why these options are impractical in this case.

4. The NRC's contractor concluded that using specialized equipment and technique, such as employing miniature transducers with shaped wedges utilizing 45 and 60 degree shear wave beam, would improve the quality of the ultrasonic examination. However, the staff has determined that requiring the use of such specialized techniques would, at this time, impose undue hardship upon the licensee without compensating increase in the level of quality and safety. This conclusion is based on fact that: ultrasonic examination is not a very effective method for examining the volume of very thin walled components, the use of specialized equipment and technique would only marginally improve the quality of examination, the licensee would be required to qualify the specialized ultrasonic procedure and personnel in order to perform the examination, and the licensee's personnel would receive additional radiation exposure in order to perform the ultrasonic examination.

5. The subject welds were fabricated of Type 304 austenitic stainless steel that is less than 0.20 inch thick. Type 304 stainless steel is very tough and corrosion resistant material. The material properties of Type 304 stainless steel provide reasonable assurance that in the unlikely event of a service-induced flaw, the component would leak before failing, allowing the licensee to take appropriate corrective actions.

Conclusion: For RR 1/2-ISI-20, the licensee has shown that compliance with the Code-required volumetric examinations would pose a hardship without a compensating increase in the level of quality or safety. Also, the limited (i.e., less than 100%) surface examinations performed provide reasonable assurance of continued structural integrity of the subject welds. The NRC staff finds that the alternative provided in RR 1/2-ISI-20 provides reasonable assurance of structural integrity. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the staff authorizes the alternative requested in RR 1/2-ISI-20 for the second interval at SQN, Units 1 and 2.

3.5 RR No. 2-ISI-21, Examination Category C-A, Item C1.10, Shell Circumferential Welds (steam generator (SG) secondary side weld)

Code Requirement: Examination Category C-A, Item C1.10 requires essentially 100% volumetric examination of shell circumferential welds.

System - Component:

Reactor Coolant System - System 68
SG Secondary Side Circumferential Shell Weld

Licensee's Code RR: In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the Code required volumetric examination of the SQN, Unit 2 SG secondary side circumferential shell weld SGW-D1.

Licensee's Basis for Requesting Relief (as stated):

> The design configuration of the permanent SG upper support precludes an ultrasonic examination of the required volume for shell circumferential weld SGW-D1. The design configuration limits ultrasonic examination to approximately 25.7% of the required examination volume as calculated in accordance with TVA procedure N-GP-28.

Licensee's Proposed Alternative Examination (as stated):

> In lieu of the code required 100% ultrasonic examination, an ultrasonic examination was performed on accessible areas to the maximum extent practical, given the physical restrictions (permanent SG support) preventing 100% ultrasonic examination coverage.

Evaluation: The Code requires essentially 100% volumetric examination of Examination Category C-A pressure retaining shell welds in Class 2 vessels. For the secondary side of the SGs, the examinations are limited to those welds with designs that exhibit structural discontinuities such as weld junctions with changes in wall thickness or head-to-shell configurations. Weld SGW-D1 is a full-penetration weld joining the lower cylindrical shell (wall thickness of approximately 2.9-inches) to the transition cone (wall thickness of approximately 3.7-inches) of the SG. However, the SG support structure severely limits access to examine this weld. This structure consists of a massive steel ring connected to the vessel at several points via welded attachments, with large snubbers providing thermal and seismic restraint between the vessel and the concrete wall of the SG cubicle. To gain access for increasing the volumetric coverage, the

support structure would have to be removed, requiring erection of scaffolding, insulation removal, installing temporary shimming of the SG, removal of snubbers, and lifting the support with a specially-designed hoist. All these modifications would have to be performed by many craft personnel working in a high-radiation field, and would present a significant personnel safety concern. This would place an undue burden on the licensee.

As shown in the drawings and examination reports provided by the licensee, the design of the lower shell-to-transition cone Weld SGW-D1 includes an outside surface taper on the upper side and the SG support structure is located within 2-inches of the outside surface on the lower side of the weld. For these reasons, limited scans may only be applied from the transition cone (upper) side of the weld. The licensee calculated approximately 25% of the Code-required volumetric coverage could be claimed. However, based on the coverage plots provided in the licensee's submittal, nearly 50% of the Code-required volume, including the entire inner surface portion of the weld and base metal, were examined with 45 and 60 degree shear waves from a single sound path direction. The base metal and weldment for Weld SGW-D1 are ferritic materials (carbon steel) which are known to exhibit favorable ultrasonic transmission qualities due to their small, isotropic grain structures. During previous round robin tests, as reported in NUREG/CR-5068, it has been demonstrated that ultrasonic examinations of ferritic material from a single side provide high probabilities of detection (usually 90% or greater) for both near- and far-side cracks in blind inspection trials. It is expected that inservice degradation would most probably be initiated from the inner surface of this component. Because the licensee was able to scan this region of the weld from one side, any significant degradation should have been detected. Further, other shell welds on this SG were examined to the full extent of Code requirements with acceptable results.

Conclusion: PNNL has reviewed the licensee's submittal and concludes that compliance with the Code requirements would result in a hardship or unusual difficulty with no compensating increase in quality or safety for RR 2-ISI-21. The examinations completed provide reasonable assurance of the continued structural integrity of the SG shell welds. To require the licensee to remove the SG support structure in order to gain access for expanding coverage on Weld SGW-D1 would cause an unusual difficulty with no compensating increase in quality and safety. The staff adopts these conclusions. Pursuant to 10 CFR 50.55a(a)(3)(ii), the staff authorizes the alternative requested in RR 2-ISI-21 for the second interval at SQN, Unit 2. The licensee should make every effort to use emerging technologies (e.g., phased array ultrasonic), to increase coverage during future examinations.

3.6 RR No. 2-ISI-22, Examination Category B-J, Item B9.11, Circumferential Welds Nominal Pipe Size 4 Inches or Larger

Code Requirement: 10 CFR 50.55a(b)(2)(xv)(A), requires the following examination coverage when applying Supplements 2 and 3 to ASME B&PV Code, Section XI, Appendix VIII:

(1) 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.

(2) Where examination from both sides is not possible, full coverage credit from a single side may be claimed only after completing a successful single sided Appendix VIII demonstration using flaws on the opposite side of the weld.

As stated in 10 CFR 50.55a(b)(2)(xvi)(B), examinations performed from one side of a ferritic or stainless steel pipe weld must be conducted with equipment, procedures, and personnel that have demonstrated proficiency with single side examinations. To demonstrate equivalency to two-sided examinations, the demonstration must be performed to the requirements of ASME B&PV Code, Section XI, Appendix VIII as modified by the paragraph and 10 CFR 50.55a(b)(2)(xv)(A).

System - Component:

Safety Injection System
Piping Pressure Retaining Welds:
SIF-198, Elbow-to-Branch Circumferential Weld
SIF-198B, Valve-to-Elbow Circumferential Weld
SIF-198C, Pipe-to-Valve Circumferential Weld

Licensee's Code Relief Request: In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the Code required volumetric examination of the following piping pressure retaining welds in the Safety Injection System:

SIF-198, Elbow-to-Branch Circumferential Weld
SIF-198B, Valve-to-Elbow Circumferential Weld
SIF-198C, Pipe-to-Valve Circumferential Weld

Licensee's Basis for Requesting Relief (as stated):

> Preservice examinations were being performed on piping circumferential welds due to the replacement of a Safety Injection System valve.
>
> The 10 CFR 50.55a requirement is that, if accessible, the weld shall be scanned in each of the four directions (parallel and perpendicular to the weld) where required. Coverage credit may be taken for single side examination on ferritic piping. However, for austenitic piping, a procedure must be qualified with flaws on the inaccessible side of the weld. There are currently no qualified single side examination procedures for austenitic piping welds. Current technology is not capable of reliably detecting or sizing flaws on the far side of an austenitic weld for single side examinations. The Performance Demonstration Initiative (PDI) Program conforms with 10 CFR 50.55a regarding single-side access for piping. PDI Performance Demonstration Qualification Summary certificates for austenitic piping list the limitation that single-side examinations are performed on a best effort basis. The best effort qualification is provided in place of a complete single-side qualification to demonstrate that the examiner's qualification and the subsequent weld examination is based on application of the best available technology.

When the examination area is limited to one side of an austenitic weld, examination coverage does not comply with 10 CFR 50.55a(b)(2)(xvi)(B), and full coverage credit may not be claimed.

The design configuration and materials used in fabrication of the subject Safety Injection System welds preclude a preservice ultrasonic examination of the required volume because there are no current qualified single side examination procedures that demonstrate equivalency to two-sided examination procedures on austenitic piping. The design configuration and material limits ultrasonic examination to the extent indicated as calculated in accordance with TVA procedure N-GP-28.

Weld	PDI Best Effort Coverage	ASME B&PV Section XI Coverage*
SIF-198	50%	95%
SIF-198B	50%	100%
SIF-198C	50%	100%

Note: *Coverage does not consider the inherent limitations associated with the PDI for one side access.

Licensee's Proposed Alternative Examination (as stated):

In lieu of the code required 100% preservice ultrasonic examination, a preservice ultrasonic examination was performed on accessible areas to the maximum extent practical given the physical limitations of the subject welds. The best available techniques, as qualified through the PDI for Supplement 2 for single side examination, were used from the accessible side of the weld. The code required preservice surface examination (liquid penetrant) of 100% of the weld was also performed.

Evaluation: ASME B&PV Section XI requires that a preservice examination on all Class 1 piping replacement welds be performed prior to placing the system in operation. The licensee replaced a Safety Injection System valve, requiring three (3) new piping welds to be fabricated. The preservice examination is to establish a baseline for future examinations and must conform to the same requirements as are listed in the Code for inservice examinations. The Code requires essentially 100% volumetric and surface examinations be performed for these Examination Category B-J welds. However, the configuration of the replaced components restricts access for volumetric examination to only one side of each weld. The subject welds, including the valve, elbow and branch connection tee would have to be redesigned and modified for the licensee to achieve 100% volumetric coverage. This would place a significant burden on the licensee; therefore, the Code required 100% volumetric examination is impractical.

As shown on the drawings and inspection reports provided by the licensee, the outside surface taper on the valve and tee branch restrict scanning the welds from these surfaces. Therefore, scans could only be performed from the pipe and elbow sides of the welds. As required by the Code, the licensee used ultrasonic methods qualified through the industry's PDI but claimed only 50% volumetric coverage because these techniques have yet to be qualified for detecting flaws located on the far-side of austenitic welds with single (near) side access. The PDI methods are qualified for far-side detection on a "best-effort" basis. The limited 50% coverage claimed complies with the rules listed in 10 CFR 50.55a(b)(2)(xvi)(B).

Conclusion: PNNL has reviewed the licensee's submittal and concludes that the Code examination coverage requirements are impractical for the subject components listed in RR 2-ISI-22. Further, reasonable assurance of the structural integrity of the subject components has been provided by the examinations that are being performed. The licensee was able to cover 100% of the entire Code required volume with 45 and 60 degree shear waves by scanning across the weld from a single scan direction. In addition, the licensee completed 100% of the Code required surface examinations. The examinations completed establish a reasonable basis for comparison with future inservice examinations and should have detected any significant conditions that might challenge the structural integrity of the subject welds. The staff adopts this conclusion. Therefore, pursuant to 10 CFR 50.55a(g)(6(i), the staff grants the relief requested in RR 2-ISI-22 for the second inservice inspection interval.

4.0 CONCLUSION

For RRs 1/2-ISI-18, 1/2-ISI-20, and 2-ISI-21, the staff finds that compliance with the Code requirements would result in a hardship or unusual difficulty with no compensating increase in quality or safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the staff is authorizing the limited coverage alternative proposed in your RR for the second inspection interval.

For RRs 1/2-ISI-17, 1/2-ISI-19, and 2-ISI-22, the staff finds that compliance with the Code requirements are impractical. Therefore, the staff is granting relief from the specified requirements in accordance with 10 CFR 50.55a(g)(6)(i) for the second inspection interval. The staff has concluded that the granting of relief is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden that could result if the requirements were imposed.

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Attachment: PNNL Technical Letter Report

Date: August 8, 2003

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