TECHNICAL LETTER REPORT
ON SECOND 10-YEAR INSERVICE INSPECTION INTERVAL
REQUESTS FOR RELIEF
FOR
TENNESSEE VALLEY AUTHORITY
SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2
DOCKET NUMBERS 50-327 AND 50-328

1. INTRODUCTION

By letter dated August 10, 2001, the licensee, Tennessee Valley Authority, submitted requests for relief from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, for Sequoyah Nuclear Plant (SQN), Units 1 and 2. The licensee revised Request for Relief 1/2-ISI-20 and submitted further information by letter dated July 31, 2002. In response to an NRC Request for Additional Information, the licensee provided further information on the remaining requests for relief 1/2-ISI-17, 1/2-ISI-18, 1/2-ISI-19, 2-ISI-21 and 2-ISI-22, in a letter dated June 24, 2003. Pacific Northwest National Laboratory (PNNL) has evaluated the revised requests for relief and supporting information submitted by the licensee in the following section.

2.0 REGULATORY REQUIREMENTS

Inservice inspection of the ASME Code Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME *Boiler and Pressure Vessel Code* (B&PV Code), and applicable addenda, as required by 10 CFR 50.55a(g), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). The regulation at 10 CFR 50.55a(a)(3) states that alternatives to the requirements of paragraph (g) may be used, when authorized by the U.S. Nuclear Regulatory Commission (NRC), if the licensee demonstrates that (i) the proposed alternatives would provide an acceptable level of quality and safety or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

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 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 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 1-2 second 10-year interval inservice inspection programs, which began on December 16, 1995, is the 1989 Edition of Section XI of the ASME Boiler and Pressure Vessel Code, with no addenda.

3.0 TECHNICAL EVALUATION

The information provided by Tennessee Valley Authority in support of the requests for relief from Code requirements has been evaluated and the bases for disposition are documented below.

3.1 Request for Relief 1/2-ISI-17, Examination Category C-B, Item C2.21, Pressure Retaining Nozzle Welds in Vessels, Safety Injection Centrifugal Charging Pump Tanks

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.

Licensee's Code Relief Request: In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the Code-required essentially 100% volumetric examination of nozzle-to-head welds BIT-5 (6-inch inlet) and BIT-2 (6-inch outlet) for safety injection centrifugal charging pump (CCP) tanks in SQN 1-2 (welds are designated BIT-5 and BIT-6 in both units).

Licensee Basis for Relief (as stated):

The design configuration of the subject nozzle-to-head welds precludes ultrasonic examination of essentially 100% of the required examination volume. In order to examine the welds in accordance with the Code requirements, the CCP tank would require extensive design modifications. The physical arrangement of subject nozzle welds in conjunction with the close curvature of the outside wall surfaces of the nozzle precludes ultrasonic examination from the nozzle side.

Scans normal to the weld from the head side were not obstructed allowing complete coverage of the weld from one side. Examination coverage from the one side provides reasonable assurance that no flaws parallel to the weld are present. In addition, approximately 100% of the required ultrasonic examination volume for flaws transverse to the weld was performed from the vessel head side. Total combined examination coverage of weld BIT-5 is approximately 67% of the code required volume. BIT-2 weld would achieve approximately the same coverage.

Radiographic examination as an alternate volumetric examination method, was determined to be impractical due the thickness of the component (nozzle 2.53 inches and head 2 inches minimum). Gaining access to the inside surface of the CCP Tank to place radiographic film would require extensive personnel protection due to high radiation and contamination levels. The CCP Tank manway would have to be removed, decontamination performed, and specialized scaffolding erected to gain access. The additional code coverage gained by radiography and/or ultrasonics from the inner surface are impractical when weighed against the radiological concerns.

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 centrifugal charging pump (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[1] 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 1-2. The outlet nozzles BIT-6 for SQN 1-2 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, 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.

In the licensee's response dated June 24, 2003, the surface examination method was clarified to be magnetic particle examination instead of liquid penetrant, as originally stated. The Code allows either of these surface examinations, 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 1-2.

For these reasons, the examinations that were performed provide reasonable assurance of the continued structural integrity of these welds. Based on the impracticality of

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1 Reports and drawings included in the licensee's submittal are not included in this report.

achieving the Code-required volumetric coverage requirements and the extent of examinations performed on these welds, it is recommended that relief be granted pursuant to 10 CFR 50.55a(g)(6)(i). However, if during the examinations of BIT-6 for SQN 1-2, the licensee does not achieve the same or greater volumetric coverage, a new request for relief will be required.

3.2 Request for Relief 1/2-ISI-18, Examination Category C-B, Item C2.21, Pressure Retaining Nozzle Welds in Vessels, Residual Heat Removal Heat Exchanger

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.

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 nozzle-to-shell welds RHRW-15-A for residual heat removal (RHR) heat exchangers in SQN, 1-2 (weld is designated RHRW-15-A in both units).

Licensee Basis for Relief (as stated):

The design configuration of the subject nozzle-to-head weld precludes ultrasonic examination of essentially 100% of the required examination volume. In order to examine the weld in accordance with the Code requirement, the RHR heat exchanger would require extensive design modifications. The physical arrangement of weld RHRW-15-A in conjunction with the small radius of curvature of the outside wall surfaces of the nozzle precludes ultrasonic examination from the nozzle side. For scans normal to the weld on the vessel shell side, examinations are limited circumferentially due to large support pads attached by fillet welds at two locations (90 and 270 degree nozzle azimuths) and the close proximately of heat exchanger weld RHRW-16-A (tube sheet-to-head weld at 0 degree nozzle azimuth) and heat exchanger weld RHRW-17-A (bottom head-to-shell weld at 180 degree nozzle azimuth). The axial scan area is limited due to the close proximity of the support pad fillet weld. A total of four areas (24% of total circumference) are unrestricted for one side examination coverage. Total ultrasonic examination coverage for weld RHRW-15-A on each RHR heat exchanger was approximately 39% of the required code coverage for the weld.

Radiographic examination from the outside surface as an alternate volumetric examination method was determined to be impractical due to the component thickness (nozzle 2.5 inches and shell 1 inch) and a divider plate inside the component head affecting radiographic quality. Performing radiographic examination from the inside surface of the heat exchanger would require placing a radiographic source near the center of the head. This would require extensive modifications in order to gain access to the inside for source placement. The RHR heat exchanger would require disassembly at the tube-sheet and the component moved in an upward direction for approximately two feet. This additional Code coverage gained by radiography and/or

ultrasonic examinations from the inner surface to gain additional coverage are also impractical.

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 1-2. However, access to examine this weld from the outside surface is severely limited by the sharp blend 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 residual heat removal (RHR) heat exchanger would require disassembly and lifting of the vessel. This would place an undue burden on the licensee.

Drawings and examination reports[2] 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.

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. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), it is recommended that the licensee's limited coverage alternative be authorized for Weld RHRW-15-A.

3.3 Request for Relief 1/2-ISI-19, Examination Category B-D, Item 3.110, Full Penetration Welded Nozzles in Vessels, Pressurizer Relief Nozzles

2 Drawings and reports submitted by the licensee are not included in this report.

Code Requirement: Examination Category B-D, Item B3.110, requires essentially 100% volumetric examination of nozzle-to-vessel welds, as defined by Figure IWB-2500-7, of Class 1 full penetration nozzle welds in the pressurizer. "Essentially 100%", as clarified by ASME Code Case N-460, is greater than 90% coverage of the examination volume, or surface area, as applicable.

Licensee's Code Relief Request: In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from volumetric examination of four (4) nozzle-to-head welds at the 6-inch diameter pressurizer relief nozzles, licensee designations RCW-16, -17, -18 and -19, in each unit at SQN.

Licensee Basis for Relief (as stated):

The design configuration of the subject nozzle-to-head welds precludes ultrasonic examination of essentially 100% of the required examination volume. In order to examine the welds in accordance with the code requirements, the pressurizer would require extensive design modifications. The physical arrangement of subject nozzle welds in conjunction with the close curvature of the outside wall surfaces of the nozzle precludes ultrasonic examination from the nozzle side.

Scans normal to the weld from the head side were not obstructed allowing complete coverage of the weld from one side. Examination coverage from the one side provides reasonable assurance that no flaws parallel to the weld are present. In addition, approximately 100% of the required ultrasonic examination volume for flaws transverse to the weld was performed from the vessel head side. Total combined examination coverage for each weld (RCW-16 and RCW-17) is approximately 66.7% for unit 1 and 68.8% for unit 2 of the code required volume. Weld examinations of RCW-18 and RCW-19 are projected to receive essentially the same examination coverage.

Radiographic examination as an alternate volumetric examination method was determined to be impractical due the 2.5 inches minimum wall thickness of the component. Gaining access to the inside surface of the pressurizer to place radiographic film would require extensive personnel protection due to high radiation and contamination levels. The pressurizer manway would have to be removed, decontamination performed, and specialized scaffolding erected to gain access. The additional code coverage gained by radiography and/or ultrasonics from the inner surface are impractical when weighed against the radiological concerns.

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 accessible areas to the maximum extent practical, given the physical limitations of the pressurizer nozzle-to-head welds.

Evaluation: The Code requires essentially 100% volumetric examination coverage of SQN 1-2 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. 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[3] 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 1, and RCW-16 and -17 for SQN 2. Relief nozzles RCW-18 and -19 for SQN 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. It is expected that the licensee may perform a thorough examination of the Code-required volume from one side of the weld.

For these reasons, the examinations that were performed provide reasonable assurance of the continued structural integrity of these welds. Based on the impracticality of achieving the Code-required volumetric coverage requirements and the extent of examinations performed on these welds, it is recommended that relief be granted pursuant to 10 CFR 50.55a(g)(6)(i). However, if during the examinations of RCW-18 and -19 for SQN 2, the licensee does not achieve the same or greater volumetric coverage, a new request for relief will be required.

3.4 Revised Request for Relief 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.

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 1-2 (weld is designated SWFW-2 in both units).

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3 Reports and drawings included in the licensee's submittal are not included in this report.

Licensee 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 four-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 seal water filters are fabricated of Type 304 stainless steel less than 0.20 inches in wall thickness. The licensee argues 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 1-2. However, the surface examination is also 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 Units 1 and 2, respectively.

To gain access for examination of these welds from the inside of the vessel, the seal water filters would have to be disassembled. This could potentially place an undue burden on the licensee due to excessive radiation exposures that might be incurred (it is expected that general radiation fields inside these filters are on the order of 2 Rem/hour). The staff agrees that to require the seal water filters to be disassembled to enable access to the inside surface is not warranted.

However, the licensee has not provided convincing evidence that effective volumetric examinations cannot be performed from the outside surface of these vessels. In fact, successful volumetric examinations on thin components have been performed by other licensees, e.g., 8- and 10-inch diameter, Schedule 20 safety injection pump supply lines. The wall thickness of these lines was on the order of 0.180-inch in thickness. Miniature transducers with shaped wedges allowed 45 and 60-degree shear wave beams to be used for interrogation of circumferential welds in this example.

Further, it is expected that inservice degradation would be initiated from the inside surface of these vessels. An outside surface examination method, as the licensee performed, does not provide reasonable assurance that the expected degradation would be identified prior to through-wall leakage having occurred, therefore continued structural integrity may be compromised. For these reasons, it is recommended that the licensee's request for relief be denied. It is further recommended that the licensee pursue a volumetric examination for the limited portions that are accessible on SWFW-2 head-to-shell welds during the remainder of the current interval at SQN 1-2.

3.5 Request for Relief 2-ISI-21 (Unit 2 only), Examination Category C-A, Item C1.10, Pressure Retaining Welds in Pressure Vessels, Steam Generator

Code Requirement: Examination Category C-A, Item C1.10 requires essentially 100% volumetric examination, as defined by Figure IWC-2500-1, of full penetration circumferential shell 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.

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 circumferential shell weld SGW-D1 on the secondary side of the steam generator (SG) at SQN Unit 2.

Licensee Basis for Relief (as stated):

The design configuration of the upper SG support bracket precludes ultrasonic examination of essentially 100% of the required examination volume for SG shell circumferential weld [SGW-D1]. In order to examine the weld in accordance with code requirements, the SG support bracket would require extensive design modifications.

Scans normal to the weld from the transition shell were partially obstructed allowing partial coverage of the weld from one side. Examination from the one side provides reasonable assurance that no flaws parallel to the weld are present. In addition, approximately 22% of the required ultrasonic examination volume for flaws transverse to the weld was performed from the transition shell side. Total combined examination coverage is approximately 25.7% of the code required volume.

In order to remove the permanent support from the SG would require extensive modifications to provide access for weld SGW-D1. The SG would require extensive scaffolding, insulation removal, bolting removal, removing Paul Monroe snubbers, unshimming the support, and moving the massive support structure with a special designed hoist. Working in this region of the SG is of concern due to personnel fall potential. It would be impractical to perform these modifications to gain access to 100% of the weld volume.

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 steam generators, the examinations are limited 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) in Steam Generator 1 at SQN-2. However, the steam generator 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 steam generator 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 steam generator, 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[4] 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 steam generator 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

4 Reports and drawings included in the licensee's submittal are not included in this report.

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, therefore, 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 steam generator were examined to the full extent of Code requirements. For these reasons, the examinations completed provide reasonable assurance of the continued structural integrity of the steam generator shell welds. To require the licensee to remove the steam generator 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. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), it is recommended that Request for Relief 1/2-ISI-20 be authorized for the second interval at SQN-2. The licensee should make every effort to use emerging technologies, e.g., phased array ultrasonic, to increase coverage during future examinations.

3.6 Request for Relief 2-ISI-22 (Unit 2 only), Examination Category B-J, Item B9.11, Pressure Retaining Welds in Piping - Preservice Examinations

Code Requirement: ASME Section XI, Paragraph IWB-2200(c) requires preservice examinations to be performed on all Class 1 components that are replaced, added, or altered during the service lifetime of a plant. Preservice examinations are performed to establish a baseline for comparison with future inservice examinations of these components. As such, preservice examinations must be conducted in accordance with the requirements of Table IWB-2500, which lists inservice examination requirements for all Class 1 components. Examination Category B-J, Item B9.11 requires essentially 100% surface and volumetric examinations, as defined by Figure IWB-2500-8, of full penetration circumferential piping welds. "Essentially 100%", as clarified by ASME Code Case N-460, is greater than 90% coverage of the examination volume, or surface area, as applicable. In addition, procedures, personnel and equipment used for conducting ultrasonic examinations on piping welds must be qualified in accordance with ASME Appendix VIII, Supplement 2, as modified by 10 CFR 50.55a(b)(2)(xv) and (xvi).

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 the following circumferential replacement piping welds at SQN Unit 2:

SIF-198	Elbow-to-branch configuration
SIF-198B	Valve-to-elbow configuration
SIF-198C	Pipe-to-valve configuration

Licensee Basis for Relief (as stated):

Preservice examinations were being performed on piping circumferential welds due to the replacement of a safety injection system valve. 10 CFR 50.55a requires that, if accessible, the weld 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 (PDQS) 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 are 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 the fabrication of the subject piping welds precludes preservice ultrasonic examination of essentially 100% of the required examination volume. In order to examine the welds in accordance with the code requirements, the safety injection system would require extensive modification. The design configuration and materials used limit the best effort ultrasonic examination to approximately 50% for welds SIF-198 (elbow-to-branch), SIF-198B (valve-to-elbow), and SIF-198C (pipe-to-valve).

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

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 form the accessible side of the weld. The Code required preservice surface examination (liquid penetrant) of 100% of the weld was also performed.

Evaluation: ASME 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[5] 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 Performance Demonstration Initiative (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). However, 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. Therefore, pursuant to 10 CFR 50.55a(g)(6(i), it is recommended that relief be granted.

4.0 CONCLUSIONS

Pacific Northwest National Laboratory has reviewed the licensee's submittal and concludes that the Code examination coverage requirements are impractical for the subject components listed in Requests for Relief 1/2-ISI-17, 1/2-ISI-19 and 2-ISI-22. Further, reasonable assurance of the structural integrity of the subject components has been provided by the examinations that are being performed. Therefore, for these requests, it is recommended that relief be granted pursuant to 10 CFR 50.55a(g)(6)(i).

For Requests for Relief 1/2-ISI-18 and 2-ISI-21, it has been shown that compliance with the Code requirements would result in a hardship or unusual difficulty with no compensating increase in quality or safety. The alternatives proposed by the licensee provide reasonable assurance of the continued structural integrity of the subject welds. Therefore, for these requests, it is recommended that relief be granted pursuant to 10 CFR 50.55a(a)(3)(ii).

For Request for Relief 1/2-ISI-20, the licensee has not shown that the Code-required volumetric examinations are impractical, nor provided information to support a basis for hardship or

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5 Drawings and reports included in the licensee's submittal are not included in this report.

unusual difficulty if the volumetric examinations are imposed. Further, the limited surface examinations performed do not provide reasonable assurance of continued structural integrity of the subject welds. Therefore, it is recommended that Request for Relief 1/2-ISI-20 be denied.