



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

April 22, 2013

Mr. Thomas Joyce
President and Chief Nuclear Officer
PSEG Nuclear LLC
P.O. Box 236, N09
Hancocks Bridge, NJ 08038

SUBJECT: SALEM NUCLEAR GENERATING STATION, UNIT NO. 1 - SAFETY
EVALUATION OF RELIEF REQUEST NO. S1-I3R-114 FOR THIRD 10-YEAR
INTERVAL INSERVICE INSPECTION (TAC NO. ME8565)

Dear Mr. Joyce:

By letter dated April 24, 2012, as supplemented by letter dated November 1, 2012,¹ Public Service Enterprise Group Nuclear LLC (PSEG) submitted relief request S1-I3R-114, requesting relief from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (ASME Code), Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," for Salem Nuclear Generating Station, Unit 1 (Salem 1) for incomplete coverage of several Class 1 and Class 2 welds.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(5)(iii), the licensee requested relief and the use of alternative requirements (if necessary), for their inservice inspection (ISI) on the basis that the code requirements are impractical. The licensee requested relief from certain requirements of the ASME Code Sections IWB-2500 and IWC-2500 for essentially 100 percent inspection coverage for several welds for Salem 1. This request applies to the third 10-year ISI interval.

The NRC staff has completed its review of this relief request and determined that the requested alternative will provide an acceptable level of quality and safety. Therefore, the licensee's request for relief is granted pursuant to 10 CFR 50.55a(g)(6)(i) for the Salem 1, third 10-year ISI interval. The details of the NRC staff's review are included in the enclosed safety evaluation.

All other requirements of the ASME Code, Section XI for which relief has not been specifically requested remain applicable, including a third party review by the Authorized Nuclear Inservice Inspector.

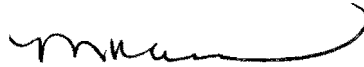
¹ Agencywide Documents and Access Management System Accession Nos. ML12125A152 and ML12307A074, respectively.

T. Joyce

- 2 -

If you have any questions concerning this matter, please contact the Salem Project Manager, Mr. John Hughey, at (301) 415-3204.

Sincerely,

A handwritten signature in black ink, appearing to read 'Meena Khanna', with a long, sweeping flourish extending to the right.

Meena Khanna, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-272

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO RELIEF REQUEST NO. S1-I3R-114

THIRD 10-YEAR INTERVAL INSERVICE INSPECTION

PSEG NUCLEAR LLC

SALEM NUCLEAR GENERATING STATION, UNIT NO. 1

DOCKET NO. 50-272

1.0 INTRODUCTION

By letter dated April 24, 2012, as supplemented in a letter dated November 1, 2012,¹ the licensee, Public Service Enterprise Group Nuclear LLC (PSEG), submitted Request for Relief (RR) S1-I3R-114 requesting relief from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (ASME Code), Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," for Salem Nuclear Generating Station, Unit 1 (Salem 1) for incomplete coverage of several Class 1 and Class 2 welds.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(5)(iii), the licensee requested relief and to use alternative requirements (if necessary), for in-service inspections (ISI) on the basis that the code requirements are impractical. The licensee requested relief from certain requirements of the ASME Code Sections IWB-2500 and IWC-2500 for essentially 100 percent inspection coverage for several welds in Relief Request S1-I3R-114 for Salem 1. This request applies to the third 10-year ISI interval.

2.0 REGULATORY REQUIREMENTS

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, 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.

¹ Agencywide Document Access and Management System (ADAMS) Accession Nos. ML12125A152 and ML12307A074, respectively.

10 CFR 50.55a(g)(5)(iii) states, in part, that that licensees may determine that conformance with certain ASME Code requirements is impractical and that the licensee shall notify the Commission and submit information in support of the determination. 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 to the Nuclear Regulatory Commission (NRC) no later than 12 months after the expiration of the initial 120-month inspection interval or subsequent 120-month inspection interval for which relief is sought.

10 CFR 50.55a(g)(6)(i) states that 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 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.

The licensee has requested relief from ASME Code requirements pursuant to 10 CFR 50.55a(g)(5)(iii). The ASME Code of record for Salem 1, third 10-year interval ISI program, which ended on May 20, 2011, is the 1998 Edition, including the 2000 Addenda, of Section XI of the ASME Code.

3.0 TECHNICAL EVALUATION

3.1 Request for Relief S1-I3R-114, Part A, Examination Category B-B, Item B2.40, Pressure Retaining Welds in Vessels Other than Reactor Vessels

ASME Code Requirement

Examination Category B-B, Item B2.40, requires essentially 100 percent volumetric examination, as defined by Figure IWB-2500-6, of the length of steam generator (SG) primary side tubesheet-to-head 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 has been approved for use by the NRC in Regulatory Guide 1.147, Revision 16, "Inservice Inspection Code Case Acceptability" (RG 1.147, R16).

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examination for SG #13 Lower Head-to-Tubesheet Weld 13-STG-11.

Licensee's Basis for Relief Request

Obtaining volumetric Code required coverage for weld 13-STG-11 is impractical due to portions of the weld being obscured at four locations by the lower steam

generator supports. To increase volumetric examination coverage, the support connections at four locations would require a design modification.

Staff Evaluation

The ASME Code requires essentially 100 percent volumetric examination of SG tubesheet-to-head welds. However, for the subject welds at Salem 1, complete ultrasonic testing (UT) examinations are restricted by weld geometric configuration and scan limitations caused by adjacent appurtenances. In order to effectively increase the examination coverage, the SG tubesheet and adjacent appurtenances would require design modifications or replacement, which would place a burden on the licensee.

As shown in the sketches and technical descriptions included in Attachment A of the licensee's submittal, examination of lower head-to-tubesheet Weld 13-STG-11 has been performed to the extent practical, with the licensee obtaining coverage of approximately 67.0 percent of the ASME Code-required inspection volume. Weld 13-STG-11 is fabricated of carbon steel with stainless steel inner diameter (ID) surface cladding. Ultrasonic examination limitations were caused by four SG lower vertical support members, the obstruction of the tubesheet radius on downstream examinations, and a vessel identification plate on upstream examinations. The SG tubesheet-to-head weld was examined with ultrasonic techniques using 0-degree longitudinal and 45- and 60-degree shear waves in accordance with applicable requirements of the ASME Code Section V, Article 4. No recordable indications were observed in this weld.

The licensee has shown that it is impractical to meet the ASME Code-required volumetric examination coverage for the subject weld due to the design configuration of the SG, and adjacent support components. Based on the volumetric coverage obtained, along with examinations completed on other Examination Category B-B pressure retaining welds, it is reasonable to conclude that if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. The NRC staff, therefore, concludes that the examinations performed provide reasonable assurance of structural integrity of the subject welds.

3.2 Request for Relief S1-I3R-114, Part B, Examination Category B-D, Item B3.120, Full Penetration Welded Nozzles in Vessels

ASME Code Requirement

Examination Category B-D, Item B3.120, requires 100 percent volumetric examination, as defined by Figures IWB-2500-7 (a) through (d), as applicable, of Class 1 pressurizer (PZR) nozzle inside radius sections. ASME Code Case N-460, as an alternative approved for use by the NRC in RG 1.147, R16, states that a reduction in examination coverage due to part geometry or interference for any Class 1 and 2 weld is acceptable, provided that the reduction is less than 10 percent (i.e., greater than 90 percent examination coverage is obtained).

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examinations for inside radius sections on PZR nozzle welds listed below in Table 3.2.1.

Code Item	Weld ID	Weld Type	Coverage Obtained
B3.120	6-PRN-1103-IRS	Pressurizer Relief Nozzle Inside Radius	66.7%
B3.120	6-PRN-1104-IRS	Pressurizer Relief Nozzle Inside Radius	66.7%
B3.120	6-PRN-1105-IRS	Pressurizer Relief Nozzle Inside Radius	66.7%
B3.120	4-PSN-1131-IRS	Pressurizer Spray Nozzle Inside Radius	84.6%

Licensee's Basis for Relief Request

Obtaining Code required coverage is impractical for the subject examinations due to surface irregularities on the pressurizer head. The pressurizer head is a cast product and is mostly in the as-cast condition with localized grinding. The surfaces from which scanning is performed contain excessive waviness and are non-uniform including raised lettering adjacent to one nozzle. The portions of the inner radius that are scanned from surfaces where these conditions prevent adequate transducer contact are considered not examined.

Altering the Pressurizer head configuration would require extensive grinding to achieve a level surface to improve transducer contact. Because the head is a curved surface, manual grinding may actually result in worse conditions further decreasing obtainable coverage. Machine grinding would require special tooling with extensive development for deployment and application.

Staff Evaluation

The ASME Code requires 100 percent volumetric examination of full penetration welded nozzle and inside radius sections in Class 1 vessels. However, surface irregularities such as pitting and waviness in the as-cast head, and the presence of an integral identification stamp caused ultrasonic coupling problems resulting in volumetric coverage limitations. In order to effectively increase the examination coverage, the nozzle-to-vessel welds would require significant surface conditioning which would place a burden on the licensee.

The inside radius sections of PZR nozzle-to-vessel welds listed in Table 3.2.1 are constructed of carbon steel material with stainless steel ID surface cladding. The inner radius section is a portion of the transition area between the nozzle and the shell of the pressurizer, and is potentially susceptible to cyclic thermal fatigue degradation. For this reason, the ASME Code requires that a volume of material nearest the inner surface of this region be examined to detect any cracking that could be generated from the ID surface of the component. The surface of the

component has very irregular UT transducer placement areas due to as-cast conditions, such as pitting and waviness; this prevents continuous coupling in limited regions for ultrasonic scans from the outside surface of the nozzle. The licensee stated that further attempts using manual or machine grinding methods could actually worsen the surface condition. In addition, for the PZR spray nozzle inside radius, a further limitation was caused by an integral, raised lettering identification stamp located between the spray nozzle and man-way access point.

As shown on the sketches and technical descriptions included in the licensee's submittals, examinations of the subject inside radius sections of the subject PZR nozzle welds have been completed to the extent practical with volumetric coverage ranging from approximately 66.7 to 84.6 percent (see Table 3.2.1) of the ASME Code-required volumes. The inside radius section of the PZR nozzle weld examinations were performed with ultrasonic techniques developed in accordance with the applicable requirements of the ASME Code Section V, Article 4 and ASME Code Section XI, Appendix I. The welds were examined using 45-, 50-, 60- and/or 70-degree shear waves, as applicable. No recordable indications were observed in these welds.

The licensee has shown that it is impractical to meet the ASME Code-required 100 percent volumetric examination coverage for the subject inside radius section of the PZR nozzle welds due to as-cast surface conditions and proximity of the identification stamp. Based on the volumetric coverage obtained, and considering the licensee's performance of ultrasonic techniques employed to maximize this coverage, it is reasonable to conclude that if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. The NRC staff, therefore, concludes that the examinations performed provide reasonable assurance of structural integrity of the subject welds.

3.3 Request for Relief S1-I3R-114, Part C, Examination Category C-A, Items C1.10 and C1.20, Pressure Retaining Welds in Pressure Vessels

ASME Code Requirement

Examination Category C-A, Items C1.10 and C1.20, require essentially 100 percent volumetric examination, as defined by Figure IWC-2500-1, of the length of Class 2 circumferential shell and head welds. "Essentially 100 percent," as clarified by ASME Code Case N-460, is greater than 90 percent coverage of the examination volume, or surface area, as applicable. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, R16.

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examination of Class 2 circumferential shell and head welds shown in Table 3.3.1.

Table 3.3.1 - Examination Category C-A			
Code Item	Weld ID	Weld Type	Coverage Obtained
C1.10	1-BIT-A	Boric Acid Injection Tank -Lower Head To Transition Piece	86.6%
C1.10	1-BIT-B	Boric Acid Injection Tank -Transition Piece To Shell	79.8%
C1.10	1CVE18-SWIJ-1	Seal Water Injection Filter Flange to Shell Weld	59.7%
C1.10	1CVE18-SWIJ-2	Seal Water Injection Filter Shell to Lower Head Weld	64.0%
C1.20	1-CVCT-2	No.1 Volume Control Tank (VCT) Shell To Lower Head	81.6%

Licensee's Basis for Relief Request

Obtaining Code required coverage for welds 1-CVCT-2, 1CVE-18-SWIJ-2, 1-BIT-A and 1-BIT-B is impractical due to portions of each weld being obscured by support legs that are welded to the vessel shell.

Obtaining Code required coverage for weld 1 CVE-1 8-SWIJ-1 is impractical due to the flange configuration that prevents scanning from both sides of the weld and the location of an identification nameplate that is welded to the vessel shell. Appendix III, Supplement 1 of the Code only requires scanning from both sides of the weld when practical, but because the vessel shell and flange are fabricated from austenitic material, PSEG does not consider this a complete examination unless the examination volume is scanned from both sides.

To increase examination coverage, the support connections for the three vessels would require a design modification and the flange on the seal water injection filter would have to be replaced with a uniquely designed and fabricated flange that would allow scanning from the flange side of the weld.

Staff Evaluation

The ASME Code requires essentially 100 percent volumetric examination of pressure retaining welds on selected Class 2 pressure vessels. However, for the subject circumferential head and shell welds on the Boric Acid Injection Tank, Volume Control Tank, and Seal Water Injection Filter, complete volumetric examinations are limited due to their design configurations and adjacent appurtenances, such as welded supports and identification plates. In order to achieve greater volumetric coverage, the subject pressure vessels and adjacent appurtenances would have to be redesigned and modified, which would place a burden on the licensee.

As shown on the sketches and technical descriptions included in the licensee's submittal, examinations of the welds listed in Table 3.3.1 have been performed to the extent practical, with the licensee obtaining coverage ranging from approximately 59.7 to 86.6 percent of the ASME

Code-required inspection volumes. Ultrasonic scans on the Boric Acid Injection Tank lower head-to-transition piece Weld 1-BIT-A, and transition piece-to-shell Weld 1-BIT-B, were restricted by close proximity of welded support legs, branch connections, and a man-way. Scans were limited on Seal Water Injection Filter shell-to-lower head Weld 1CVE 18-SWIJ-2, due to support legs welded directly across this weld. Examination of Seal Water Injection Filter flange-to-shell Weld 1CVE18-SWIJ-1 was limited by a welded attachment, nameplate and the flange taper, which prevented angle beam scanning from the flange side of the weld. Ultrasonic scans on the No.1 Volume Control Tank shell-to-lower head Weld 1-CVCT-2 were restricted due to four welded supports that cover significant portions of the weld length.

The Boric Acid Injection Tank is constructed of carbon steel with stainless steel ID surface cladding, and the Seal Water Injection Filter and No. 1 Volume Control Tank are fabricated of stainless steel material. The licensee examined these welds using 0-degree longitudinal wave and 45-, 60-, and/or 70-degree shear waves, as applicable, to achieve partial coverage along the weld lengths. There were two recordable sub-surface indications identified that were evaluated in previous examinations of Weld 1-CVCT-2. The indications remained essentially unchanged and were determined to be acceptable for continued service.

The licensee has shown that it is impractical to meet the ASME Code-required volumetric examination coverage for the subject welds due to the physical limitations of their design geometries and adjacent appurtenances. However, based on the volumetric coverage obtained, and the ultrasonic techniques employed, it is reasonable to conclude that, if significant service-induced degradation had occurred in the subject welds, evidence of it would have been detected by the examinations performed. The NRC staff, therefore, concludes that the examinations performed provide reasonable assurance of structural integrity of the subject welds.

3.4 Request for Relief S1-I3R-114, Part D, Examination Category C-B, Item C2.21, Pressure Retaining Nozzle Welds in Vessels

ASME Code Requirement

Examination Category C-B, Item C2.21, requires 100 percent surface and volumetric examination, as defined by Figure IWC-2500-4(a) or (b), as applicable, of nozzle-to-shell (or head) welds in Class 2 vessels. ASME Code Case N-460, as an alternative approved for use by the NRC in RG 1.147, R16, states that a reduction in examination coverage due to part geometry or interference for any Class 1 and 2 weld is acceptable provided that the reduction is less than 10 percent (i.e., greater than 90 percent examination coverage is obtained).

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required 100 percent volumetric and surface (for Weld 16-BFN-2111-1) examinations of the Class 2 nozzle-to-shell (or head) welds shown in Table 3.4.1.

Code Item	Weld ID	Weld Type	Volumetric Coverage Obtained (Surface)
C2.21	16-BFN-2111-1	Steam Generator #11 Nozzle to Shell	70.6% (85.3%)
C2.21	1-BIT-1	Boric Acid Injection Tank-Inlet Nozzle to Head	43.4% (100%)
C2.21	1-BIT-2	Boric Acid Injection Tank-Outlet Nozzle To Head	73.9% (100%)

Licensee's Basis for Relief Request

The three nozzle-to-vessel welds described in Table 1 were volumetrically examined to the extent practical in accordance with ASME Section V, Article 4 using the required Supplements of ASME Section XI, Appendix I as defined in Table 1-2000-1 of the Code. The one nozzle-to-vessel weld requiring magnetic particle examination was examined to the extent practical in accordance with ASME Section V, Article 7.

Obtaining Code required volumetric coverage is impractical for weld 1-BIT-1 due to the nozzle configuration and surface condition, weld 1-BIT-2 due to weld crown and nozzle surface configuration and weld 16-BFN-2111-1 due to steam generator insulation package support ring.

To increase volumetric examination coverage, the head-to-nozzle configuration would require replacement with an altered configuration and the weld crowns removed. To increase volumetric and magnetic particle examination coverage, the head-to-nozzle configuration of 16-BFN-2111-1 would require removal or movement of the insulation ring.

Staff Evaluation

The ASME Code requires 100% volumetric and surface examinations of Class 2 nozzle-to-shell (or head) welds. However, for the subject SG nozzle-to-shell weld and boric acid injection tank nozzle-to-head welds, complete volumetric and surface examinations are limited due to the nozzle configuration, weld crown, and presence of the insulation support ring. In order to achieve greater volumetric or surface coverage, as applicable, the head-to-nozzle configuration would have to be redesigned and modified and the insulation support ring would need to be removed, which would place a burden on the licensee.

As shown on the sketches and technical descriptions included in the licensee's submittal, examination of nozzle-to-head Welds 1-BIT-1 and 1-BIT-2 on the boric acid injection tank were performed to the extent practical, with the licensee obtaining 43.4 and 73.9 percent, respectively, of the required examination volumes. The licensee applied 0-degree longitudinal,

and 45- and 60-degree shear, wave scans from the vessel side of these welds. The boric acid injection tank is fabricated of carbon steel with stainless steel ID surface cladding. The nozzles' "set-in" design essentially makes these welds concentric rings aligned parallel with their respective nozzles' axes. For this reason, no scans could be performed from the nozzle sides of the welds. In addition, ultrasonic scans could not be performed over the welded OD surface region due to the rough weld crown, which caused transducer lift-off issues, further limiting the volumetric examinations. Ultrasonic examinations were performed in accordance with the requirements of the ASME Code Section V, Article 4. The licensee also completed the full ASME Code-required surface examinations (using magnetic particle testing) on both of these welds. No unacceptable indications were noted during either the volumetric or surface examinations.

Examinations of the carbon steel nozzle-to-shell Weld 16-BFN-2111-1 were performed to the extent practical, with the licensee obtaining approximately 70.6 percent of the required examination volume and 85.3 percent of the required examination surface. The nozzle-to-shell weld examinations were limited due to the SG insulation package support ring, making several inches of the weld length inaccessible for examination. The licensee argued that removal of this support ring would result in increased radiation dose with only minimal increases in examination coverage. Ultrasonic examinations were performed in accordance with the requirements of the ASME Code Section V, Article 4 using 0-degree longitudinal, and 45- and 60-degree, shear wave scans. For the ASME Code surface examination, magnetic particle testing was performed to the extent practical. No recordable indications were noted during the volumetric and surface examinations.

Ultrasonic scans for the subject nozzle-to-vessel welds were primarily limited to the vessel side of these welds; however, recent studies have shown that inspections conducted in carbon steel materials are equally effective whether the ultrasonic waves have only to propagate through the base metal, or have to also propagate through the carbon steel weldment (see Reference 4). Therefore, due to the fine-grained carbon steel microstructures, it is expected that the ultrasonic techniques employed would have detected structurally significant flaws that may have occurred on either side of the subject welds.

The licensee has shown that it is impractical to meet the ASME Code-required 100% volumetric and surface (Weld 16-BFN-2111-1) examination coverage for the subject nozzle-to-shell and head welds due to the nozzles' design configuration, surface conditions, and an adjacent appurtenance. However, based on the coverage obtained, it is reasonable to conclude that, if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations performed. The NRC staff, therefore, concludes that the examinations performed provide reasonable assurance of structural integrity of the subject welds.

3.5 Request for Relief S1-I3R-114, Part E, Examination Category R-A, Items R1.11, R1.16, and R1.20, Risk Informed Piping Examinations

ASME Code Requirement

The examination requirements for the subject piping welds at Salem 1 are governed by a Risk-Informed Inservice Inspection (RI-ISI) program that was approved by the NRC in a Safety Evaluation (SE) dated October 1, 2003.² The RI-ISI program was developed in accordance with the Electric Power Research Institute (EPRI) Topical Report TR-112657, Rev. B-A, "Revised Risk-Informed Inservice Inspection Evaluation Procedure." As part of the NRC-approved program, the licensee has implemented inspection requirements listed in ASME Code Case N-578, "Risk-Informed Requirements for Class 1, 2 or 3 Piping, Method B, Section XI, Division 1," with more detailed provisions contained in TR-112657. The topical report includes a provision for requesting relief from volumetric examinations if 100 percent of the required volumes cannot be examined.

Table 1 of ASME Code Case N-578 assigns Examination Category R-A, Items R1.11, R1.16, and R1.20, to piping inspection elements subject to thermal fatigue, intergranular stress-corrosion cracking (IGSCC), and elements not currently subject to a known damage mechanism, respectively. Table 1 of Code Case N-578, requires 100 percent of the examination volume, as described in Figures IWB-2500-8(c), 9, 10, 11, or IWC-2500-7(a), as applicable, including an additional ½-inch of base metal adjacent to the ASME Code volume, be examined for selected Class 1 and 2 piping welds. ASME Code Case N-460, as an alternative approved for use by the NRC in RG 1.147, R16, states that a reduction in examination coverage due to part geometry or interference for any Class 1 and 2 weld is acceptable provided that the reduction is less than 10 percent, i.e., greater than 90 percent examination coverage is obtained.

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required 100 percent volumetric examination of the Class 1 and 2 circumferential piping welds shown in Table 3.5.1.

Code Item	Weld ID	Weld Type	Pipe Size-Thickness	Coverage Obtained
R1.11	14-PS-1131-2	Nozzle To Safe-End	10.0" – 1.125"	83.3%
R1.11	2-CV-1175-36	Pipe To Tee	10.0" – 1.0"	50.0%
R1.16	10-SJ-1141-15	Tee To Pipe	10.0" – 1.0"	50.0%
R1.16	10-SJ-1121-16	Tee To Pipe	10.0" – 1.0"	50.0%

² ADAMS Accession No. ML032390034.

Code Item	Weld ID	Weld Type	Pipe Size-Thickness	Coverage Obtained
R1.16	10-SJ-1111-16	Tee To Pipe	10.0" – 1.0"	50.0%
R1.20	6-PR-1105-6	Elbow To Elbow	10.0" – 1.0"	85.7%
R1.20	31-RC-1140-3	Elbow To Pipe	4.0" – 0.531"	50.0%
R1.20	31-RC-1140-4	Pipe To Elbow	4.0" – 0.531"	50.0%
R1.20	10-SW-2141-5	Flange To Pipe	4.0" – 0.531"	50.0%
R1.20	10-SW-2183-3	Elbow To Flange	2.5" – 0.375"	50.0%

Licensee's Basis for Relief Request

Obtaining Code required coverage is impractical for the ten examination Category R-A welds listed in Table [3.5.1] due to configurations and material properties as uniquely described for each Component ID. Substantial design modification and the design, fabrication and installation of special fittings would be required to increase volumetric examination coverage.

Staff Evaluation

Examination requirements for the subject piping welds at Salem 1 are governed by an RI-ISI program that was approved by the NRC in an SE dated October 1, 2003.³ This program assigns Examination Category R-A, Items R1.11, R1.16 and R1.20 to piping inspection elements subject to thermal fatigue, IGSCC, and piping elements not subject to a known damage mechanism, respectively. The program requires inspection of 100 percent of the defined examination volumes for Class 1 and 2 circumferential piping welds. However, the design configurations and materials of the subject welds limit volumetric examinations. In order to increase coverage, the welds would have to be re-designed and modified, which would place a burden on the licensee.

As shown in the technical descriptions and sketches provided in the licensee's submittals, examinations of the subject welds have been performed to the extent practical, with the licensee obtaining volumetric coverage of approximately 50 to 85.7 percent of the required inspection volumes (see Table 3.5.1). The limitations encountered during the performance of the ultrasonic examinations were caused by austenitic stainless steel materials and existing tapers in the nozzle-to-safe end, pipe-to-tee, elbow-to-pipe, elbow-to-elbow, flange-to-pipe, and elbow-to-flange connection weld configurations. These configurations limit ultrasonic scan access primarily to one side of the welds. The licensee stated that selection of one-sided examinations (e.g., pipe-to-valve welds) would normally be avoided for these risk-informed piping examinations, but in some cases, no substitutions were available. The licensee also noted that only the subject 10 of the total 146 welds in the risk-informed program had limited examinations

³ ADAMS Accession No. ML032390034.

due to their configurations, with 9 additional Class 1 welds being examined to ensure that Class 1 examinations were not reduced significantly less than 10 percent.

Volumetric examinations on the subject welds were conducted with equipment, procedures and personnel that were qualified to a performance demonstration process outlined in ASME Code Section XI, Appendix VIII. These techniques have been qualified for flaws located on the near-side of the welds in austenitic stainless steel materials and combined near- and far-side detection of flaws in carbon steel materials. No Appendix VIII requirements currently exist for ultrasonic examination through cast stainless steel. For these reasons, along with the stated physical configurations, the licensee has only taken partial credit for the ASME Code-required inspection volumes on the subject austenitic piping welds. The licensee's ultrasonic techniques included 45-, 60- and 70-degree shear waves, and 35-, 45-, and 60-degree refracted longitudinal waves (L-waves), as applicable. For austenitic stainless steel piping equal to or less than 0.50-inches in thickness, procedures that include a 70-degree shear wave are required by the industry's Performance Demonstration Initiative (PDI) approved techniques for flaw detection in these thin-walled piping welds. For piping greater than 0.50-inches thick, longitudinal wave search units that provide supplemental coverage of the far-side of the weld are included in PDI approved techniques for flaw detection in austenitic stainless steel welds. L-waves have been shown to provide enhanced detection on the far-side of austenitic stainless steel welds (see References 1-3). While the licensee has only taken credit for limited volumetric coverage obtained from primarily one side, it is expected that the techniques employed would have provided coverage beyond the near-side of the welds. The ultrasonic examinations performed did not reveal any rejectable indications.

The NRC staff has determined that it is impractical to meet the ASME Code-required volumetric examination coverage for the subject welds due to the design geometry of the welds and materials of construction. Based on the ultrasonic results and coverage obtained, and the use of optimized examination techniques, it is reasonable to conclude that, if significant degradation was present in the subject welds, evidence of it would have been detected by the examinations performed. The NRC staff, therefore, concludes that the examinations performed provide reasonable assurance of structural integrity of the subject welds.

4.0 CONCLUSIONS

Due to the configurational issues at Salem 1, the ASME Code requirements, with respect to the subject welds, are impractical. An imposition of the ASME Code requirements would result in a burden to the licensee. The weld coverage achieved provides reasonable assurance of the structural integrity of the subject welds. Therefore, the licensee's requests for relief is granted pursuant to 10 CFR 50.55a(g)(6)(i) for the Salem 1, third 10-year ISI interval. 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 giving due consideration to the burden upon the licensee that could result if the requirements were imposed.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in the subject request for relief remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

5.0 REFERENCES

- 1 Ammirato, F.V., X. Edelmann, and S.M. Walker, "Examination of Dissimilar Metal Welds in BWR [boiling-water reactor] Nozzle-to-Safe End Joints," 8th International Conference on NDE [nondestructive examination] in the Nuclear Industry, ASM [American Society for Metals] International, 1987.
- 2 Lemaitre, P., T.D. Koble, and S.R. Doctor, "PISC III Capability Study on Wrought-to-Wrought Austenitic Steel Welds: Evaluation at the Level of Procedures and Techniques," Effectiveness of Nondestructive Examination Systems and Performance Demonstration, PVP-Volume 317, NDE-Volume 14, ASME, 1995.
- 3 Anderson, M.T., A.A. Diaz, A.D. Cinson, S.L. Crawford, S.E. Cumblidge, S.R Doctor, K.M. Denslow, and S. Ahmed, 2011. "An Assessment of Ultrasonic Techniques for Far-Side Examinations of Austenitic Stainless Steel Piping Welds," NUREG/CR-7113, PNNL-19353, U. S. Nuclear Regulatory Commission, Washington, DC.
- 4 Heasler, P. G. and S. R. Doctor, 1996. "Piping Inspection Round Robin," NUREG/CR-5068, PNNL-10475, U. S. Nuclear Regulatory Commission, Washington, DC.

Principal Contributors: Daniel S. Widrevitz
Stephen E. Cumblidge

Date: April 22, 2013

T. Joyce

- 2 -

If you have any questions concerning this matter, please contact the Salem Project Manager, Mr. John Hughey, at (301) 415-3204.

Sincerely,

/ra/

Meena Khanna, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-272

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

DISTRIBUTION:

PUBLIC
LPL1-2 R/F
RidsNrrDorlLpl1-2 Resource
RidsNrrLAABaxter Resource
RidsNrrPMSalem Resource
S. Cumblidge, NRR
J. Whited, NRR

SKennedy, EDO Region I
RidsAcrsAcnw_MailCTR Resource
RidsRgn1MailCenter Resource
RidsNrrDeEpnb Resource
D. Widrevitz, NRR
RidsNrrDeCvib Resource

ADAMS Accession No.: ML13071A215

*via memo dated

**via email

OFFICE	LPL1-2/PM	LPL1-2/PM	LPL1-2/LA**	CVIB/BC*	LPL1-2/BC
NAME	JWhited	JHughey (with comments)	ABaxter	SRosenberg	MKhanna
DATE	04/08/2013	04/08/2013	04/08/2013	1/28/2013	04/22/2013

OFFICIAL RECORD COPY