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

April 26, 2011

Mr. George H. Gellrich, Vice President
Calvert Cliffs Nuclear Power Plant, LLC
Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
Lusby, MD 20657-4702

SUBJECT: THIRD 10-YEAR INTERVAL INSERVICE INSPECTION (ISI) PROGRAM PLAN REQUESTS FOR RELIEF ISI-24, ISI-25, ISI-26, AND ISI-27, FOR CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NOS. 1 AND 2 (TAC NOS. ME4220, ME4221, ME4222, AND ME4223)

Dear Mr. Gellrich:

By letter dated June 30, 2010, as supplemented by letter dated December 16, 2010, Calvert Cliffs Nuclear Power Plant, LLC, the licensee, proposed its Third 10-Year Inservice Inspection Interval Program Plan Requests for Relief (RRs) ISI-24, ISI-25, ISI-26, and ISI-27, for the Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2. The licensee submitted these RRs pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(5)(iii) based upon its determination that complete performance of the weld inspections is impractical.

The Nuclear Regulatory Commission (NRC) staff, with technical assistance from its contractor, the Pacific Northwest National Laboratory, has reviewed the licensee's submittals and concludes that the American Society of Mechanical Engineers Pressure and Vessel Code (ASME Code) examination coverage requirements are impractical for the subject welds. Furthermore, the staff concludes that the examinations performed to the extent practical provide reasonable assurance of structural integrity of the subject components.

Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i), and is in compliance with the requirements of 10 CFR 50.55a with the granting of these reliefs. Therefore, the staff grants relief for the subject examinations of the components contained in RRs ISI-24, ISI-25, ISI-26, and ISI-27. The staff has further determined that granting these RRs in accordance with 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 given due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

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

The NRC staff's evaluation and conclusions are contained in the enclosed safety evaluation. Please contact Douglas Pickett at 301-415-1364 if you have any questions.

Sincerely,

Nancy L. Salgado

Nancy L. Salgado, Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-317 and 50-318

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

THIRD 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM

REQUESTS FOR RELIEF

CALVERT CLIFFS NUCLEAR POWER PLANT, LLC.

CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT NOS. 1 AND 2

DOCKET NOS. 50-317 AND 50-318

1.0 INTRODUCTION

The Nuclear Regulatory Commission (NRC) staff, with technical assistance from its contractor, the Pacific Northwest National Laboratory (PNNL), has reviewed and evaluated the information provided by Calvert Cliffs Nuclear Power Plant, LLC, the licensee, in its letter dated June 30, 2010, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML101930245), which proposed its third 10-Year Inservice Inspection (ISI) Interval Program Plan Requests for Relief (RRs) ISI-24, ISI-25, ISI-26, and ISI-27, for the Calvert Cliffs Nuclear Power Plant, (CCNPP), Unit Nos. 1 and 2. Additionally, in response to an NRC request for additional information, the licensee submitted additional information in its letter dated December 16, 2010 (ML103550157).

The NRC staff adopts the evaluations and recommendations for granting relief contained in PNNL's Technical Letter Report (TLR) which has been incorporated into this safety evaluation (SE). Attachment 1 to this SE lists each relief request and the status of approval.

2.0 REGULATORY REQUIREMENTS

ISI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Code, and applicable addenda, as required by Title 10 of the *Code of Federal Regulations* (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 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 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 ASME Code of record for CCNPP, Unit Nos. 1 and 2 third 10-year interval ISI program, which ended on June 30, 2009, is the 1998 Edition, with no Addenda, of Section XI of the ASME Code.

3.0 EVALUATION

The information provided by the licensee in support of the requests for relief from, or alternatives to, ASME Code requirements has been evaluated and the bases for disposition are documented below. For clarity, the licensee's requests have been evaluated in several parts according to ASME Code Examination Category.

3.1 Requests for Relief ISI-24 (Unit 1) and ISI-26 (Unit 2), Part A, ASME Code, Section XI, Examination Category B-D, Items B3.110 and B3.130, Full Penetration Welded Nozzles in Vessels

ASME Code Requirement

ASME Code, Section XI, Examination Category B-D, Items B3.110 and B3.130 require 100 percent volumetric examination, as defined by ASME Code, Section XI, Figures IWB-2500-7 (a) through (d), as applicable, of full penetration ASME Code, Class 1 nozzle-to-vessel welds on the pressurizer (PZR) and steam generator (SG), respectively. ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds, Section XI, Division 1," as an alternative approved for use by the NRC in Regulatory Guide (RG) 1.147, Revision 16, Inservice Inspection Code Case Acceptability (RG 1.147, Revision 16), 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 of Class 1 nozzle-to-vessel welds listed below in Table 3.1.1 (CCNPP, Unit 1) and Table 3.1.2 (CCNPP, Unit 2) below.

Table 3.1.1 – ASME Code, Section XI, Examination Category B-D (Unit 1)			
ASME Code Item	**Weld ID**	**Weld Type**	**Coverage Obtained Percent**
B3.110	4-404	PZR Surge Nozzle-to-Lower Head	66.9
B3.110	4-405	PZR Spray Nozzle-to-Upper Head	65.2
B3.110	16-405A	Safety & Relief "A" Nozzle-to-PZR Upper Head	54.1
B3.110	16-405B	Safety & Relief "B" Nozzle-to-PZR Upper Head	54.1
B3.130	SG-11-W5	SG Inlet Nozzle-to-Primary Head Nozzle	83.4
B3.130	SG-12-W5	SG Inlet Nozzle-to-Primary Head Nozzle	83.4
B3.130	SG-11-W6	SG Outlet Nozzle-to-Primary Head Nozzle	74.2
B3.130	SG-11-W7	SG Outlet Nozzle-to-Primary Head Nozzle	74.2

Table 3.1.2 - ASME Code, Section XI, Examination Category B-D (Unit 2)			
ASME Code Item	**Weld ID**	**Weld Type**	**Coverage Obtained Percent**
B3.110	4-404	PZR Surge Nozzle-to-Lower Head	63.5
B3.110	4-405	PZR Spray Nozzle-to-Upper Head	71.5
B3.110	16-405A	Safety & Relief "A" Nozzle-to-Upper Head	53.5
B3.110	16-405B	Safety & Relief "B" Nozzle-to-Upper Head	53.5

Licensee's Basis for Relief Request (as stated)

The [PZR] nozzle-to-vessel head welds are accessible only from the head side based on the nozzle curvature. The scanning surface of the nozzle is essentially perpendicular to the head surface which prohibits the ultrasonic [UT] wave entering the [ASME] Code required examination volume at an angle that will interrogate the weld volume for in-service flaws.

The [SG] nozzle-to-vessel head welds are accessible only from the head side based on the designed nozzle configuration. The proximity of the nozzle radius prevented full examination coverage from the nozzle side. Scanning was performed from the nozzle; however, the [UT] waves did not cover the [ASME] Code required examination volume at an angle that will interrogate the weld volume for in-service flaws.

[CCNPP] has determined that the following welds (shown in Table [3.1.1 and Table 3.1.2 above]) were limited from achieving greater than 90 percent of the required examination volume for in-service examinations due to component

configuration or physical barriers which would require a major modification to the existing hardware.

In order to scan all of the required volume for these welds, the components would have to be redesigned to allow scanning from both sides of the weld, which is impractical.

Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject welds. However, the licensee's examinations were performed to the maximum extent practical.

Staff Evaluation

The ASME Code requires 100 percent volumetric examination of Class 1 nozzle-to-vessel welds. In addition, the ASME Code requires that the volumetric examinations be conducted from both sides of these pressure retaining welds. However, the design configurations of the subject nozzle-to-vessel welds limit access for UT scanning primarily to the vessel side of the welds. In order to effectively increase the examination coverage, the nozzle-to-head welds would require design modifications or replacement. This would place a burden on the licensee; thus, the ASME Code volumetric examination requirements are considered to be impractical.

The PZR and SG nozzle-to-vessel welds shown in Tables 3.1.1 and 3.1.2 above are constructed of carbon steel material, with stainless steel cladding on the inside surface. The welds extend the full thickness of the PZR and SG vessels. These nozzles are of the "set-in" design which essentially makes the welds concentric rings aligned parallel with the nozzle axes in the through-wall direction of the subject vessels. This design geometry limits ASME Code-required UT angle beam examinations to be performed primarily from the vessel side of the welds.

As shown on the sketches and technical descriptions included in the licensee's submittals, examinations of the subject nozzle-to-vessel welds have been completed to the extent practical with aggregate coverage of the ASME Code-required volumes as shown in Tables 3.1.1 and 3.1.2 above. Manual UT examinations were conducted using ASME Code, Section V, Article 4 techniques and included 0-degree longitudinal, and 45-and 60-degree shear waves primarily from the vessel side. A supplemental 35 degree angled beam scan was used to increase examination volumes. Limitations were caused by the curvature of the nozzles, adjacent appurtenances, orientation of the nozzle-to-vessel design, and proximity to nozzle outside diameter (OD) radius sections, or blend areas. The examination volumes included the weld and base materials near the inside surface of the weld joints, which are typically the highest regions of stress, and where one would expect degradation sources to be manifested should they occur. No unacceptable indications were recorded during these examinations. Although UT scans were primarily limited to the vessel side, recent studies have found that inspections conducted through carbon steel are equally effective whether the UT waves have only to propagate through the base metal, or have to also propagate through the carbon steel

weldment[1]. Therefore, due to the fine-grained carbon steel microstructures, it is expected that the UT 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 percent volumetric examination coverage for the subject PZR and SG nozzle-to-vessel welds due to the nozzles' designs. Based on the volumetric coverage obtained for the subject welds, and considering the licensee's performance of UT 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. Furthermore, the NRC staff determined that the examinations performed to the extent practical on the subject welds provide reasonable assurance of structural integrity of the subject welds.

3.2 Requests for Relief ISI-24 (Unit 1) and ISI-26 (Unit 2), Part B, ASME Code, Section XI, 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 CCNPP, Units 1 and 2 are governed by a Risk-Informed Inservice Inspection (RI-ISI) program that was approved by the NRC in an SE dated April 16, 2003 (ADAMS Accession Number ML030860547). 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[2], "*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 TR 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 subject to a known damage mechanism, respectively. This table requires 100 percent of the examination volume, as described in Figures IWB-2500-8(c), 9, 10, or 11, as applicable, including an additional ½-inch of base metal adjacent to the ASME Code volume, be completed for selected ASME Code, Class 1 piping welds. ASME Code Case N-460, as an alternative approved for use by the NRC in RG 1.147, Revision 16, states that a reduction in examination coverage due to part geometry or interference for any Class 1 and 2 weld is

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1 P. G. Heasler, and S. R. Doctor, 1996. *Piping Inspection Round Robin*, NUREG/CR-5068, PNNL-10475.

2 ASME Code Case N-578 has not been approved for use in RG-1.147, Revision 16. Licensees base their RI-ISI inspection sample size and examination methodology on Table 1 of ASME Code Case N-578.

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 100 percent volumetric examination of the Class 1 piping welds shown in Tables 3.2.1 (CCNPP, Unit 1) and 3.2.2 (CCNPP, Unit 2) below.

Table 3.2.1 – ASME Code, Section XI, Examination Category R-A (Unit 1)

ASME Code Item	Weld ID	Weld Type	Pipe Size-Thickness	Coverage Obtained Percent
R1.16	12-SI-1010-7	Pipe-to-Valve	12" – 1.20"	50.0
R1.20	10/12-SI-1009	Angled Branch Connection 12" Pipe-to-30" Pipe	12" – 3"	68.7
R1.20	12-SI-1011-12	Pipe-to-Safe End	12" – 1.125"	50.0
R1.20	4-SR-1006-4	Pipe-to-Tee	4" – 0.44"	68.0

Table 3.2.2 – ASME Code, Section XI, Examination Category R-A (Unit 2)

ASME Code Item	Weld ID	Weld Type	Pipe Size-Thickness	Coverage Obtained Percent
R1.11	30-RC-21A-10/2-CV-2005	Pipe-to-Branch Connection	8" –3"	75.0
R1.11	4-PS-2003-2	Tee-to-Pipe	4" – 0.44"	50.0
R1.11	4-PS-2003-4	Tee-to-Pipe	4" – 0.44"	50.0
R1.11	3-PS-2002-27	Valve-to-Pipe	3" – 0.41"	50.0
R1.11	2.5-SR-2003-4	Elbow-to-Pipe	2.5" –0.38"	43.0
R1.20	12-SI-2010-12	Elbow-to-Safe End	12" –1.13"	50.0
R1.20	12-SI-2011-12	Elbow-to-Safe End	12" – 1.13"	50.0
R1.20	12-SI-2012-12	Pipe-to-Safe End	12" – 1.13"	50.0
R1.20	4-SR-2001-1	Tee-to-Pipe	4" – 0.50"	29.9
R1.20	4-SR-2005-2	Safe End-to-Elbow	4" – 0.41"	36.7

Licensee's Basis for Relief Request (as stated)

> The [volumetric] examination of the above pipe welds was limited in coverage due to component configuration (weld location relative to scanning surface,

curvature/ taper) and/or immovable penetrations and/or attachments. For these welds obtaining full coverage from both sides of the weld was not attainable since one side of the weld was not optimally oriented for scanning of the weld and adjacent base metal based on the surface angle of the component; therefore, the welds received a single-sided examination or partial two-sided examination resulting in less than 90 percent coverage of the required examination volume.

In order to scan all of the required volume for these welds, the components would have to be redesigned to allow scanning from both sides of the weld, which is impractical.

Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject welds. However, the licensee's examinations were performed to the maximum extent practical.

Staff Evaluation

The examination requirements for the subject piping welds at CCNPP, Units 1 and 2 are governed by an RI-ISI program that was approved by the NRC in an SE dated April 16, 2003. This program assigns ASME Code, 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 examination location volume for ASME Code, Class 1 circumferential piping welds. However, the design configurations of these welds limit volumetric examinations. In order to increase coverage, the welds would have to be re-designed and modified. This would place a burden on the licensee, therefore, the ASME Code required volumetric examinations are considered impractical.

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 ranging from 29.9 to 75.0 percent of the required volumes from at least one side of the welds. The design of these piping welds prevents full volumetric scanning due to tapers, radii, and cast stainless steel materials of these difficult to inspect weld geometries (see Tables 3.2.1 and 3.2.2 above). The licensee evaluated potential additional examinations of welds in similar risk-informed segments and concluded that no additional volumetric coverage or no increase in the level of quality and safety would be provided by choosing other welds for examination. The licensee also noted that, for Item R1.20 elements, this request represents only 13 percent of the total number of welds not subject to a known degradation source, with the remaining 87 percent examined to the full ASME Code extent.

All of the examinations were conducted with equipment, procedures and personnel that were qualified by performance demonstration in accordance with ASME Code, Section XI, Appendix VIII. These techniques have been qualified for flaws located on the near-side of the welds; far-side detection of flaws is considered to be a "best effort."

For this reason, the licensee has not taken credit for any of the far-side detection efforts in the volumetric coverage shown in Tables 3.2.1 and 3.2.2 above. The licensee performed manual UT techniques using 45-, 60-, and 70-degree (as applicable) shear waves for all the welds listed above, and 45-, 60-, and 70-degree refracted longitudinal wave (L-waves) on many of the subject welds in these reliefs. L-wave techniques have been shown to provide enhanced detection on the far-side of austenitic stainless steel welds[3,4], therefore, while the licensee has only taken credit for obtaining volumetric coverage for one side of the subject piping welds, the techniques employed would have provided coverage beyond the near-side of the welds. The UT examinations did not reveal any unacceptable flaws.

The licensee has shown 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 UT results and coverage obtained, in addition to the full examination of other piping welds in similar risk categories, it is reasonable to conclude that, if significant service-induced degradation had occurred in the subject piping segments, evidence of it would have been detected by the examinations performed.

3.3 Requests for Relief ISI-25 (Unit 1) and ISI-27 (Unit 2), Part A, ASME Code, Section XI, Examination Category C-A, Item C1.10, Pressure Retaining Welds in Pressure Vessels

ASME Code Requirement

ASME Code, Section XI, Examination Category C-A, Item C1.10 requires essentially 100 percent volumetric examination, as defined by ASME Code, Section XI, Figure IWC-2500-1, of the length of Class 2 circumferential shell 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, Revision 16.

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 of ASME Code, Class 2 circumferential shell welds listed in Tables 3.3.1 (CCNPP, Unit 1) and Table 3.3.2 (CCNPP, Unit 2) below.

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3 F. V. Ammirato, X. Edelmann, and S.M. Walker, *Examination of Dissimilar Metal Welds in BWR Nozzle-to-Safe End Joints*, 8th International Conference on NDE in the Nuclear Industry, ASM International, 1987.

4 P. Lemaitre, 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.

Table 3.3.1 – ASME Code, Section XI, Examination Category C-A (Unit 1)				
ASME Code Item	Weld ID	Weld Type	Pipe Size-Thickness	Coverage Obtained Percent
C1.10	SCHE-11-1	Channel Barrel-to-Flange	45" - 1.25"	71.8
C1.10	SCHE-12-2	Tubesheet-to-Channel Cover	45" - 1.25"	79.6

Table 3.3.2 - ASME Code, Section XI, Examination Category C-A (Unit 2)				
ASME Code Item	Weld ID	Weld Type	Pipe Size-Thickness	Coverage Obtained Percent
C1.10	SCHE-22-1	Channel Barrel-to-Flange	45" - 1.25"	61.0
C1.10	SCHE-22-2	Channel Cover-to-Flange	45" - 1.25"	82.6

Licensee's Basis for Relief Request (as stated)

> [CCNPP] has determined that the following welds (shown in Tables [3.3.1 and 3.3.2 above]) were limited from achieving greater than 90 percent of the required examination volume for in-service examinations due to component configuration or physical barriers which would require a major modification to the existing hardware.
>
> The [UT] interrogation of the channel shell-to-flange weld could only be partially obtained from [the] flange side due to component configuration and close proximity of the [weld-to-flange] transition.
>
> In order to scan all of the required volume for these welds, the components would have to be redesigned to allow scanning from both sides of the weld, which is impractical.

Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject welds. However, the licensee's examinations were performed to the maximum extent practical.

Staff Evaluation

The ASME Code requires essentially 100 percent volumetric examination of circumferential shell welds on selected ASME Code, Class 2 pressure vessels. However, for the subject welds on the CCNPP, Units 1 and 2 shutdown cooling (SC) heat exchangers, complete examinations are limited due to the design configuration of these components. In order to achieve greater volumetric coverage, the SC heat

exchangers would have to be redesigned and modified. This would place a burden on the licensee, therefore, the ASME Code examinations are considered impractical.

As shown on the sketches and technical descriptions included in the licensee's submittals, examinations of the #11 and #12 (CCNPP, Unit 1) and #22 (CCNPP, Unit 2) SC heat exchangers' Shell-to-Flange Circumferential Welds SCHE-11-1, SCHE-12-2, SCHE-22-1, and SCHE-22-2 have been performed to the extent practical, with the licensee obtaining between 61.0 and 82.6 percent of the required ASME Code examination volumes. The SC heat exchangers are fabricated of carbon steel, with stainless steel cladding on the inner surface. Volumetric scan limitations were caused by the weld crowns and the close proximity to the flange transitions. The UT examinations conducted by the licensee included 45-, 60-, and 70-degree (as applicable) shear wave examinations primarily from the shell side of the welds. No recordable flaw indications were observed.

Although UT scans were primarily limited to the vessel side of the welds, studies have found that inspections conducted through carbon steel are equally effective whether the UT waves have only to propagate through the base metal, or have to also propagate through the carbon steel weldment[5]. Therefore, it is expected that the UT techniques employed by the licensee would detect structurally significant flaws that might occur on either side of the subject weld due to the fine-grained carbon steel microstructures in these materials.

The licensee has shown 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. However, based on the volumetric coverage obtained, and the UT techniques employed, it is reasonable to conclude that, if significant service-induced degradation had occurred on the subject welds, evidence of it would have been detected by the examinations performed. Furthermore, the NRC staff determined that the examinations performed to the extent practical on the subject welds provide reasonable assurance of structural integrity of the subject welds.

3.4 Requests for Relief ISI-25 (Unit 1) and ISI-27 (Unit 2), Part B, ASME Code, Section XI, Examination Category C-B, Item C2.21, Pressure Retaining Nozzle Welds in Vessels

ASME Code Requirement

ASME Code, Section XI, Examination Category C-B, Item C2.21 requires 100 percent surface and volumetric examination, as defined by ASME Code, Section XI, Figures IWC-2500-4 (a) or (b), as applicable, of full penetration ASME Code, Class 2 nozzle-to-shell (or head) welds. ASME Code Case N-460, as an alternative approved for use by the NRC in RG 1.147, Revision 16, states that a reduction in examination coverage due to part geometry or interference for any Class 1 and 2 weld is acceptable provided that

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5 P. G. Heasler, and S. R. Doctor, 1996. *Piping Inspection Round Robin*, NUREG/CR-5068, PNNL-10475, U. S. Nuclear Regulatory Commission, Washington, DC.

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 of ASME Code, Class 2 SC heat exchanger nozzle-to-shell welds listed in Table 3.4.1 (CCNPP, Unit 1) and Table 3.4.2 (CCNPP, Unit 2) below.

Table 3.4.1 – ASME Code, Section XI, Examination Category C-B (Unit 1)				
ASME Code Item	**Weld ID**	**Weld Type**	**Pipe Size-Thickness**	**Coverage Obtained Percent**
C2.21	SCHE-12-N2	Outlet Nozzle-to-Shell	10" – 1.125"	51.9
C2.21	SCHE-11-N1	Inlet Nozzle-to-Shell	10" – 1.125"	45.0

Table 3.4.2 – ASME Code, Section XI, Examination Category C-B (Unit 2)				
ASME Code Item	**Weld ID**	**Weld Type**	**Pipe Size-Thickness**	**Coverage Obtained Percent**
C2.21	SCHE-21-N2	Outlet Nozzle-to-Shell	10" – 1.125"	51.3
C2.21	SCHE-21-N1	Inlet Nozzle-to-Shell	10" – 1.125"	50.0

Licensee's Basis for Relief Request (as stated)

> [CCNPP] has determined that the following welds (shown in Table [3.4.1 and Table 3.4.2 above]) were limited from achieving greater than 90 percent of the required examination volume for in-service examinations due to component configuration or physical barriers which would require a major modification to the existing hardware.
>
> The nozzle-to-shell weld is primarily accessible from the shell side based on the component configuration. The nozzle scanning surface is essentially perpendicular to the shell which prohibits the [UT] wave entering the [ASME] Code required examination volume at an angle that will interrogate the weld volume for in-service flaws.
>
> In order to scan all of the required volume for these welds, the components would have to be redesigned to allow scanning from both sides of the weld, which is impractical.

Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject welds. However, the licensee's examinations were performed to the maximum extent practical.

Staff Evaluation

The ASME Code requires 100 percent volumetric and surface examinations of ASME Code, Class 2 nozzle-to-shell (or head) welds. However, complete examinations of SC heat exchanger nozzle-to-shell welds are limited due to the nozzle configuration. In order to achieve greater volumetric coverage, the nozzles and/or vessel would have to be redesigned and modified. This would place a burden on the licensee, therefore, the ASME Code volumetric examination is considered impractical.

As shown on the sketches and technical descriptions included in the licensee's submittals, examination of the carbon steel, with stainless steel cladding, SC Heat Exchanger Nozzle-to-Shell Welds SCHE-11-N1, SCHE-12-N2, SCHE-21-N1, and SCHE-21-N2 were performed to the extent practical, with the licensee obtaining between 45.0 and 51.9 percent of the required examination volumes. The examinations included 45-, 60-, and 70-degree (as applicable) shear wave scans from the shell side of the welds. The nozzles' "set-in" design essentially makes the welds concentric rings aligned parallel with the nozzle axes. For this reason, no scans could be performed from the nozzle side of the welds. Manual UT examinations were performed in accordance with the requirements of the ASME Code, Section XI, Appendix III. No unacceptable indications were noted during the volumetric examinations.

Although UT scans were primarily limited to the shell side only, recent studies have found that inspections conducted through carbon steel 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[6]. Therefore, due to the fine-grained carbon steel microstructures, it is expected that the UT 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 percent volumetric examination coverage for the subject nozzle-to-shell welds due to the nozzles' design configurations. However, based on the volumetric coverage obtained, and the carbon steel materials involved, it is reasonable to conclude that, if significant service-induced degradation had occurred, evidence of it would be have been detected by the examinations performed. Furthermore, the NRC staff determined that the examinations performed to the extent practical on the subject welds provide reasonable assurance of structural integrity of the subject welds.

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6 P. G. Heasler, and S. R. Doctor, 1996. *Piping Inspection Round Robin*, NUREG/CR-5068, PNNL-10475, U. S. Nuclear Regulatory Commission, Washington, DC.

3.5 Requests for Relief ISI-25 (Unit 1) and ISI-27 (Unit 2), Part C, ASME Code, Section XI, Examination Category R-A, Items R1.11 and R1.20, Risk Informed Piping Examinations

ASME Code Requirement

The examination requirements for the subject piping welds at CCNPP, Units 1 and 2 are governed by an RI-ISI program that was approved by the NRC in an SE dated April 16, 2003 (ADAMS Accession Number ML030860547). The RI-ISI program was developed in accordance with EPRI TR-112657, Rev. B-A. As part of the NRC-approved program, the licensee has implemented inspection requirements listed in ASME Code Case N-578, with more detailed provisions contained in TR-112657. The TR 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 and R1.20, to piping inspection elements subject to thermal fatigue and elements not subject to a known damage mechanism, respectively. This table requires 100 percent of the examination location volume, as described in ASME Code, Section XI, Figure IWC-2500-7(a), including an additional ½-inch of base metal adjacent to the ASME Code volume, be completed for selected ASME Code, Class 2 piping welds. ASME Code Case N-460, as an alternative approved for use by the NRC in RG 1.147, Revision 16, states that a reduction in examination coverage due to part geometry or interference for any ASME Code, 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 100 percent volumetric examination of the ASME Code, Class 2 piping welds shown in Table 3.5.1 (CCNPP, Unit 1) and Table 3.5.2 (CCNPP, Unit 2) below.

Table 3.5.1 – ASME Code, Section XI, Examination Category R-A (Unit 1)				
ASME Code Item	Weld ID	Weld Type	Pipe Size-Thickness	Coverage Obtained Percent
R1.11	12-SC-1215-18	Pipe-to-Tee	12" – 0.33"	84.0
R1.20	14-SI-1201-1	Valve-to-Elbow	14" – 0.25"	50.0
R1.20	12-SI-1216-1	Tee-to-Pipe	12" – 0.25"	75.0
R1.20	12-SI-1214-3	Pipe-to-Tee	12" – 0.28"	50.0
R1.20	12-SI-1214-5	Pipe-to-Tee	12" – 0.28"	50.0
R1.20	12-SI-1214-12	Elbow-to-Valve	12" – 0.25"	50.0
R1.20	4-SI-1206-7	Valve-to-Pipe	4" – 0.38"	50.0
R1.20	4-SI-1209-1	Branch-to-Elbow	4" – 0.38"	50.0
R1.20	10-SC-1214-1	Tee-to-Pipe	10" – 0.25"	38.0
R1.20	12-SC-1213-1	Valve-to-Tee	10" – 0.33"	50.0

Table 3.5.2 – ASME Code, Section XI, Examination Category R-A (Unit 2)				
ASME Code Item	Weld ID	Weld Type	Pipe Size-Thickness	Coverage Obtained Percent
R1.20	10-SI-2002-3	Pipe-to-Valve	10" – 0.25"	44.0
R1.20	10-SI-2003-2	Flange-to-Expander	10" – 0.38"	50.0
R1.20	6-SI-2004A-19	Elbow-to-Reducer	6" – 0.43"	78.7
R1.20	6-SI-2017-11	Elbow-to-Pipe	6" – 0.30"	75.0

Licensee's Basis for Relief Request (as stated)

The ultrasonic examination of the above pipe welds was limited in coverage due to component configuration (weld location relative to scanning surface, curvature/ taper) and/or immovable penetrations and/or attachments. For these welds obtaining full coverage from both sides of the weld was not attainable since one side of the weld was not optimally oriented for scanning of the weld and adjacent base metal based on the surface angle of the component; therefore, the welds received a single-sided examination or partial two-sided examination resulting in less than 90 percent coverage of the required examination volume.

In order to scan all of the required volume for these welds, the components would have to be redesigned to allow scanning from both sides of the weld, which is impractical.

Staff Evaluation

The examination requirements for the subject piping welds are governed by an RI-ISI program that was approved by the NRC in an SE dated April 16, 2003. This program assigns ASME Code, Examination Category R-A, Items R1.11 and R1.20 to piping inspection elements subject to thermal fatigue and piping elements not subject to a known damage mechanism, respectively. The program requires inspection of 100 percent of the examination volume for the subject circumferential piping welds. However, the design configurations of these welds limit volumetric examinations. In order to increase coverage, the welds would have to be re-designed and modified. This would place a burden on the licensee, therefore, the ASME Code required volumetric examinations are considered impractical.

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 ranging from 38.0 to 84.0 percent of the required volumes from at least one side of the welds. The design of these piping welds prevents full volumetric scanning due to tapers, OD radii, integral attachments, intrados of tees, and cast stainless steel materials of these difficult to inspect weld geometries (see Table 3.5.1 and Table 3.5.2 above). The licensee evaluated potential additional examinations of welds in similar risk-informed segments and concluded that no additional volumetric coverage or no increase in the level of quality and safety would be provided by choosing other welds for examination. The licensee also noted that, for ASME Code, Item R1.20 elements, this request represents only 13 percent of the total number of welds not subject to a known degradation source, with the remaining 87 percent examined to the full ASME Code extent.

All of the examinations were conducted with equipment, procedures and personnel that were qualified by performance demonstration in accordance with ASME Code, Section XI, Appendix VIII. These techniques have been qualified for flaws located on the near-side of the welds; far-side detection of flaws is considered to be a "best effort." For this reason, the licensee has not taken credit for any of the far-side detection efforts in the volumetric coverage shown in Table 3.5.1 and Table 3.5.2 above. The licensee performed manual UT examination techniques with 45-, 60-, and/or 70-degree shear waves to these welds. The UT examinations did not reveal any unacceptable flaws.

The licensee has shown 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 UT results and coverage obtained, in addition to the full examination of other piping welds in the similar risk categories, it is reasonable to conclude that, if significant service-induced degradation had occurred in the subject piping segments, evidence of it would have been detected by the examinations performed.

4.0 CONCLUSIONS

The NRC staff has reviewed the licensee's submittals and concludes that ASME Code examination coverage requirements are impractical for the subject welds listed in RRs ISI-24, ISI-25, ISI-26, and ISI-27. The staff concludes that based on the volumetric, and surface examination 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 that were performed. Furthermore, the staff concludes that the examinations performed to the extent practical provide reasonable assurance of structural integrity of the subject components.

For certain stainless steel welds contained in RRs ISI-24 (Unit 1) and ISI-26 (Unit 2) Part B, and RRs ISI-25 (Unit 1) and ISI-27 (Unit 2) Part C the licensee employed only shear wave techniques from a single accessible side. In order to ensure that the volumetric examination coverage is maximized, it is recommended that the licensee apply both shear and longitudinal wave techniques on the subject welds during their next scheduled inspections for the components contained in RRs ISI-24 (Unit 1) and ISI-26 (Unit 2) Part B, and RRs ISI-25 (Unit 1) and ISI-27 (Unit 2) Part C. The staff is not including any conditions on the approval of RRs ISI-24 (Unit 1) and ISI-26 (Unit 2) Part B, and RRs ISI-25 (Unit 1) and ISI-27 (Unit 2) Part C.

Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i), and is in compliance with the requirements of 10 CFR 50.55a with the granting of these reliefs. Therefore, the staff grants relief for the subject examinations of the components contained in RRs ISI-24, ISI-25, ISI-26, and ISI-27. The staff has further determined that granting these RRs in accordance with 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 given due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

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

Principal Contributors: T. McLellan, NRR
D. Naujock, NRR

Date: April 26, 2011

CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2
Third 10-Year ISI Interval

TABLE 1
SUMMARY OF RELIEF REQUESTS

Relief Request Number	TLR RR Sec.	System or Component	Exam. Category	Item No.	Volume or Area to be Examined	Required Method	Licensee Proposed Alternative	Relief Request Disposition
ISI-24, ISI-26, Part A	3.1	Full Penetration Welded Nozzles in Vessels	B-D	B3.110 B3.130	100% of PZR and SG nozzle to vessel welds	Volumetric	Use volumetric coverage obtained	Granted 10 CFR 50.55a(g)(6)(i)
ISI-24, ISI-26, Part B	3.2	Risk Informed Piping Examinations	R-A	R1.11 R1.16 R1.20	100% of Class 1 piping subject to specified damage mechanisms	Volumetric	Use volumetric coverage obtained	Granted 10 CFR 50.55a(g)(6)(i)
ISI-25, ISI-27, Part A	3.3	Pressure Retaining Welds in Class 2 Pressure Vessels	C-A	C1.10	100% of circumferential shell welds in shutdown cooling heat exchangers	Volumetric	Use volumetric coverage obtained	Granted 10 CFR 50.55a(g)(6)(i)
ISI-25, ISI-27, Part B	3.4	Pressure Retaining Nozzle Welds in Class 2 Vessels	C-B	C2.21	100% of shutdown cooling heat exchangers nozzle to vessel welds	Volumetric and Surface	Use volumetric coverage obtained	Granted 10 CFR 50.55a(g)(6)(i)
ISI-25, ISI-27, Part C	3.5	Risk Informed Piping Examinations	R-A	R1.11 R1.20	100% of Class 2 piping subject to specified damage mechanisms	Volumetric	Use volumetric coverage obtained	Granted 10 CFR 50.55a(g)(6)(i)

ATTACHMENT 1

The NRC staff's evaluation and conclusions are contained in the enclosed safety evaluation. Please contact Douglas Pickett at 301-415-1364 if you have any questions.

Sincerely,

/ra/

Nancy L. Salgado, Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-317 and 50-318

Enclosure:
Safety Evaluation

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