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

August 17, 2012

Mr. David A. Heacock
President and Chief Nuclear Officer
Virginia Electric and Power Company
Innsbrook Technical Center
5000 Dominion Boulevard
Glen Allen, VA 23060-6711

SUBJECT: NORTH ANNA POWER STATION, UNIT NO. 2, RELIEF REQUEST N2-I3-PRT-002, LIMITED COVERAGE EXAMINATIONS FOR THE THIRD 10-YEAR INSERVICE INSPECTION INTERVAL (TAC NO. ME7180)

Dear Mr. Heacock:

By letter to the U.S. Nuclear Regulatory Commission (NRC), dated September 21, 2011, (Agencywide Documents Access & Management System (ADAMS Accession No. ML11270A122), and as supplemented by letter dated February 24, 2012 (ADAMS Accession No. ML12066A116), Virginia Electric and Power Company (the licensee) submitted a request for authorization for the inservice inspection (ISI) examinations of welds on the reactor vessel and pressurizer performed at North Anna Power Station, Unit No. 2 during the third10-year ISI interval that did not meet the ASME Code examination coverage requirements.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 55, Paragraph a(g)(5)(iii), the licensee requested relief and to use alternative requirements (if necessary), for in-service inspection (ISI) on the basis that the code requirement is impractical. The licensee requested relief from certain requirements of the ASME Code Section IWB-2500 for 100 percent inspection coverage for several welds and welded attachments.

Based on the review of the information the licensee provided, the NRC staff concludes that the licensee's proposed alternative 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 for the third 10-year Inservice Inspection (ISI) interval.

All other ASME Code, Section XI, requirements for which relief was not specifically requested and authorized herein by the NRC staff remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions concerning this matter, please contact Dr. V. Sreenivas at (301) 415-2597.

Sincerely,

John P. Boska for

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

Docket No. 50-339

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

REQUEST FOR RELIEF N2-I3-PRT-002

FOR THE THIRD 10-YEAR INSERVICE INSPECTION INTERVAL

NORTH ANNA POWER STATION, UNIT NO. 2

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)

DOCKET NO. 50-339

1.0 INTRODUCTION

By letter dated September 21, 2011 (Agencywide Document Access and Management System (ADAMS) Accession Number ML11270A122), as supplemented by letter dated February 24, 2012 (ADAMS Accession No. ML12066A116), the Virginia Electric And Power Company, Dominion, (the licensee) submitted a request for relief (RR) from certain requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(g)(5)(iii), the licensee requested relief and to use alternative requirements (if necessary), for inservice inspection (ISI) on the basis that the code requirement is impractical. The licensee requested relief from certain requirements of the ASME Code Section IWB-2500 for 100 percent inspection coverage for several welds and welded attachments in RR N2-I3-PRT-002 for North Anna Power Station, Unit No. 2 (North Anna Unit 2).

2.0 REGULATORY EVALUATION

The licensee has requested relief from ASME Code Section IWB-2500 requirements for essentially 100 percent coverage of several welds and welded attachments pursuant to 10 CFR 50.55a(g)(5)(iii).

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.

Section 50.55a(g)(5)(iii), states in, part that, that licensees may determine that conformance with certain Code requirements is impractical and that the licensee shall notify the U.S. Nuclear Regulatory Commission (NRC or the Commission) and submit information in support of the determination.

Section 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.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request and the Commission to grant the relief requested by the licensee.

3.0 TECHNICAL EVALUATION

Code of Record

The *Code of Record* for the third inspection interval at the North Anna Unit 2, is the 1995 Edition of Section XI up to the 1996 Addenda. The third inspection interval for North Anna Power Station, Unit 2, ended on December 13, 2010.

Duration of Relief

This RR covers the third inspection interval at the North Anna Power Station Unit 2. The third inspection interval ended on December 13, 2010.

ASME Code Requirements

Components identified in this request require examination of essentially 100 percent of the weld inspection volume or inspection surface. The required inspection volumes and inspection surfaces are defined by the Examination Category and Item Number for the weld and are specified for each section of the RR. "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.

The welds in Section R1 of this RR are governed by the Risk-Informed Inservice Inspection (RI-ISI) Program that was approved for use by the NRC for North Anna Power Station, Unit 2 in a letter dated September 18, 2001 (ADAMS Accession No. ML012470437). The North Anna Unit 2, RI-ISI Program was developed in accordance with the Westinghouse Owners Group Topical Report WCAP-14572, Revision 1-NPA, rather than per ASME Code Case N-577, as granted in the request to use RI-ISI. All welds in Section R1 are assigned category R-A, Item R1.11, and require volumetric examination. The Item R1.11 elements are either subject to Thermal Fatigue/Stratification or defaulted to "Thermal Fatigue" as the most likely degradation mechanism.

Relief Request Section A1

Relief Requested

The licensee is requesting relief from the essentially 100 percent volumetric examination requirements for an ASME Code Exam Category B-A, Item Number B1.11 weld in the reactor vessel (RV). The required inspection volume is defined in Figure IWB-2500-1.

Component Description

Weld W04 is the subject weld in Section A1 of the RR. The weld is an Exam Category B-A, Item Number B1.11, carbon steel vessel shell to carbon steel bottom head spherical ring. Both the ring and the shell are clad with stainless steel.

Impracticality of Compliance

The requirement for essentially 100 percent inspection coverage is considered impractical because of the configuration of the RV core support pads. Ultrasonic examination coverage was limited to 76 percent coverage due to obstruction caused by the core support pads at four locations along the path of the weld. No additional coverage was possible with existing technology.

Proposed Alternative

No alternative was proposed. The limited volumetric examination and vessel internal visual examination should detect any general patterns of degradation that may occur in the areas covered, therefore providing reasonable assurance of the continued structural integrity of the W04 subject weld.

Basis for Relief (As Stated):

> As part of the examination of the reactor vessel internal surfaces, complete electronic visual examination (EVT) was performed at each of these weld locations as well. Two other examinations were performed on Category B-A, Item B1.11 components in the third ISI inspection interval, Welds W02 and W03, obtaining "essentially 100 percent" volumetric examination coverage.
>
> The examination was performed using the Trans-World Services Reactor Vessel Inspection System (TWS) examination tool. TWS is a computer controlled, remotely operated manipulator. TWS, when lowered into the reactor vessel, can be positioned to provide inspection coverage of all accessible areas of the vessel. Six degrees of freedom allow the inspection head to examine vessel circumferential and longitudinal welds, bottom head welds, nozzle to vessel welds from the vessel and the nozzle bore, nozzle to pipe, elbow, and safe-end welds.

The examinations were performed in accordance with detailed scan plans developed to maximize coverage of the examination volume based on vessel configuration and manipulator search unit head layout. The examination procedures are based on advanced ASME Section XI, Appendix VIII demonstrated techniques. Based on access and physical limitations of the vessel, alternative or other advanced technologies would not provide complete coverage of the examination volume.

Detailed scan plans for the vessel examinations with limited coverage are included in Enclosure A1-1. Included in Enclosure A1-1 is the detailed vessel layout and configuration, scanning tool head configurations, dimensions and configuration details that resulted in the accessibility limitations for the subject vessel welds. Obstructions include the Core Support Pads as identified.

All Examination Category B-A examinations for the welds included in this request were conducted in accordance with the performance demonstration requirements described in ASME Code, Section XI, Appendix VIII.

Enclosure A1-1 includes the weld report for the Lower Shell to Bottom Head Spherical Ring Weld W04. Included in Enclosure A1-1 are details of the equipment setup and search unit head configurations which include the wave modality and insonification angles used for the ultrasonic testing (UT) examinations. Enclosure A1-1 also includes the detailed scan plans with cross sectional views of the examination volume with the extent of area scanned to maximize examination coverage. There were no recordable indications identified for the examination of Weld #4 (W04).

The examination of the Lower Shell to Bottom Head Spherical Ring Weld W04 was performed from the inside surface of the vessel. Access to the required scan areas on the outside surface of the vessel is not possible for increasing examination coverage. Any decrease in examination coverage from the second interval is based on differences in examination techniques between the two examinations. The third inspection interval examination technique is based on Appendix VIII demonstrations versus the standard Section V, Article 4 examination techniques used for the second interval inspections, including differences in search unit size and different methods required for determining coverage.

Staff Evaluation

As presented in Enclosure A1-1 of the September 21, 2011 letter, the core support pads that are attached to the shell directly above the subject weld restricted the coverage during the inspection to 76 percent; no indications were found in the limited examination. Two similar item B1.11 welds, W02 and W03, are more accessible and "essentially 100 percent" coverage was obtained in those cases.

The staff requested additional information (RAI) from the licensee regarding past inspections of the W04 subject weld. In the February 24, 2012 response to the RAI, the licensee stated that at the time of the second ISI, the same physical limitations were noted, but a higher coverage was obtained (91 percent); six indications were identified during the second ISI (all were acceptable according to the Code). The main issue contributing to the difference in flaw detection and inspection coverage between the two ISI inspections was the methodology. In the third ISI, an Appendix VIII demonstration methodology was used instead of the standard Section V, Article 4 examination used during the second ISI.

The staff noted that the RV design features make the ASME Code-required 100 percent coverage for the examination of the W04 subject weld impractical to meet. The RV would require design modifications and imposition of this requirement would cause a significant burden on the licensee. For the W04 subject weld, the licensee did obtain 76 percent volumetric coverage. With the core in position on the pad, the staff considers that these core support pads would induce a compressive stress at the surface of the W04 subject weld and reduce the likelihood of crack initiation adjacent to the pads; therefore, the limited inspection of the weld surface would have detected any significant patterns of degradation, if any had occurred. The staff also determined that the other Category B-A volumetric and VT-2 visual examinations performed during the third ISI provide reasonable assurance of structural integrity of the W04 subject weld.

Based on the above discussion, the NRC staff concludes that the licensee has shown that it is impractical to meet the ASME Code-required 100 percent volumetric examination coverage for the W04 subject weld due to their design configuration. However, based on the examination coverage that was obtained, along with the examinations of other Item B1.11 RV 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. Furthermore, the staff concludes that the examinations performed provide reasonable assurance of structural integrity of the W04 subject weld.

Relief Request Section A2

Relief Requested

The licensee is requesting relief from ASME Code required essentially 100 percent volumetric examination coverage of an Exam Category B-A, Item Number B1.21 Class 1 weld in the RV. The required inspection volume is defined in Figure IWB-2500-3.

Component Description

Weld W08 is the subject weld in Section A2 of the RR. The weld is an Exam Category B-A, Item Number B1.21, carbon steel bottom head spherical cap to carbon steel bottom head spherical ring. Both the ring and the cap are clad with stainless steel.

Impracticality of Compliance

The requirement for essentially 100 percent inspection coverage is considered impractical because of the configuration of the RV incore instrumentation nozzles. Ultrasonic examination

coverage was limited to 75 percent coverage due to the RV incore instrumentation nozzles. No additional coverage was possible with existing technology.

Proposed Alternative

No alternative was proposed. The limited volumetric examination and vessel external visual examination should detect any general patterns of degradation that may occur in the areas covered, therefore providing reasonable assurance of the continued structural integrity of the W08 subject weld.

Basis for Relief (As Stated):

> As part of the examination of the reactor vessel internal surfaces, complete electronic visual examination (EVT) was performed at this weld location as well.
>
> The examination was performed using the Trans-World Services Reactor Vessel Inspection System (TWS) examination tool. TWS is a computer controlled, remotely operated manipulator. TWS, when lowered into the reactor vessel, can be positioned to provide inspection coverage of all accessible areas of the vessel. Six degrees of freedom allow the inspection head to examine vessel circumferential and longitudinal welds, bottom head welds, nozzle to vessel welds from the vessel and the nozzle bore, nozzle to pipe, elbow, and safe-end welds.
>
> The examinations were performed in accordance with detailed scan plans developed to maximize coverage of the examination volume based on vessel configuration and manipulator search unit head layout. The examination procedures are based on advanced ASME Section XI, Appendix VIII demonstrated techniques. Based on access and physical limitations of the vessel, alternative or other advanced technologies would not provide complete coverage of the examination volume.
>
> Detailed scan plans for the vessel examinations with limited coverage are included in Enclosure A2-1. Included in Enclosure A2-1 is the detailed vessel layout and configuration, scanning tool head configurations, dimensions and configuration details that resulted in the accessibility limitations for the subject vessel welds. Obstructions include the Instrumentation Nozzles as identified.
>
> All Examination Category B-A examinations for the welds included in this request were conducted in accordance with the performance demonstration requirements described in ASME Code, Section XI, Appendix VIII.
>
> Enclosure A2-1 includes the weld report for the Bottom Head Spherical Ring to Bottom Head Cap weld W08. Included in Enclosure A2-1 are details of the equipment setup and search unit head configurations which include the wave modality and insonification angles used for the UT

examinations. Enclosure A2-1 also includes the detailed scan plans with cross sectional views of the examination volume with the extent of area scanned to maximize examination coverage. There were nine recordable indications identified for the examination of Weld #8 (W08), all evaluated as acceptable subsurface indications located within the weld and indicative of fabrication anomalies. The Flaw Evaluation Summary Sheets are enclosed.

The examination of the Bottom Head Spherical Ring to Bottom Head Cap weld W08 was performed from the inside surface of the vessel. Access to the required scan areas on the outside surface of the vessel is not possible for increasing examination coverage. Any decrease in examination coverage from the second interval is based on differences in examination techniques between the two examinations. The third inspection interval examination technique is based on Appendix VIII demonstrations versus the standard Section V, Article 4 examination techniques used for the second interval inspections, including differences in search unit size and different methods required for determining coverage.

Staff Evaluation

As presented in Enclosure A2-1 of the September 21, 2011 letter, the presence of the RV incore instrumentation nozzles through the bottom cap below the W08 subject weld makes access for the inspection tool impossible. The inspection of the W08 weld was able to obtain 75 percent and nine indications were found (none of the nine were found in previous examinations and all were acceptable according to the Code).

The staff requested information from the licensee regarding past inspections of the W08 subject weld. In the February 24, 2012 response to the RAI, the licensee has stated that at the time of the last inspection (second ISI), the same physical limitations were noted, but a higher coverage was obtained (91.25 percent) and two indications were identified (all were acceptable according to the Code). The main issue contributing to the difference in flaw detection and inspection coverage between the two ISI inspections was the methodology. In the third ISI, an Appendix VIII demonstration methodology was used instead of the standard Section V, Article 4 examination used during the second ISI.

The staff noted that the RV design features make the ASME Code-required 100 percent coverage for the examination of the W08 subject weld impractical to meet. The RV would require design modifications and imposition of this requirement would cause a significant burden on the licensee. For the subject weld, the licensee did obtain 75 percent volumetric coverage. The staff considers that these obstructions, which limited the ISI coverage, would not significantly change the stress state around the weld and not affect the likelihood of crack initiation at the surface; therefore, the limited examinations would have detected any significant patterns of degradation, if any had occurred. The staff also determined that the other Category B-A volumetric and VT-2 visual examinations performed during the third ISI provide reasonable assurance of structural integrity of the W08 subject weld.

Based on the above discussion, the NRC staff concludes that the licensee has shown that it is impractical to meet the ASME Code-required 100 percent volumetric examination coverage for the W08 subject weld due to the design configuration. However, based on the examination coverage that was obtained, along with the examinations of other RV 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. Furthermore, the staff concludes that the examinations performed provide reasonable assurance of structural integrity of the W08 subject weld.

Relief Request Section A3

Relief Requested

The licensee is requesting relief from ASME Code required essentially 100 percent volumetric examination coverage of Exam Category B-A, Item Number B1.22 Class 1 welds in the RV. The required inspection volume is defined in Figure IWB-2500-3.

Component Description

Weld W05 is the subject weld in Section A3 of the RR. The weld is an Exam Category B-A, Item Number B1.22, meridional joint at 0° between carbon steel weld components. Both components are clad with stainless steel.

Impracticality of Compliance

The requirement for essentially 100 percent inspection coverage is considered impractical because of the configuration of the RV incore instrumentation nozzles and core lug obstructions. Ultrasonic examination coverage was limited to 79 percent coverage due to the aforementioned obstructions. No additional coverage was possible with existing technology.

Proposed Alternative

No alternative was proposed. The limited volumetric examination and vessel external visual examination should detect any general patterns of degradation that may occur in the areas covered, therefore providing reasonable assurance of the continued structural integrity of the W05 subject weld.

Basis for Relief (As Stated)

> As part of the examination of the reactor vessel internal surfaces, complete electronic visual examination (EVT) was performed at each of these weld locations as well. Two other examinations were performed on a Category B-A, Item B1.22 component in the third ISI inspection interval, Welds W06 and W07, obtaining "essentially 100 percent" volumetric examination coverage.
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> The examination was performed using the Trans-World Services Reactor Vessel Inspection System (TWS) examination tool. TWS is a computer controlled, remotely operated manipulator. TWS, when lowered into the

reactor vessel, can be positioned to provide inspection coverage of all accessible areas of the vessel. Six degrees of freedom allow the inspection head to examine vessel circumferential and longitudinal welds, bottom head welds, nozzle to vessel welds from the vessel and the nozzle bore, nozzle to pipe, elbow, and safe-end welds.

The examinations were performed in accordance with detailed scan plans developed to maximize coverage of the examination volume based on vessel configuration and manipulator search unit head layout. The examination procedures are based on advanced ASME Section XI, Appendix VIII demonstrated techniques. Based on access and physical limitations of the vessel, alternative or other advanced technologies would not provide complete coverage of the examination volume.

Detailed scan plans for the vessel examinations with limited coverage are included in Enclosure A3-1. Included in Enclosure A3-1 is the detailed vessel layout and configuration, scanning tool head configurations, dimensions and configuration details that resulted in the accessibility limitations for the subject vessel welds. Obstructions include the instrumentation nozzles and core lug obstructions as identified.

All Examination Category B-A examinations for the welds included in this request were conducted in accordance with the performance demonstration requirements described in ASME Code, Section XI, Appendix VIII.

Enclosure A3-1 are details of the equipment setup and search unit head configurations which include the wave modality and insonification angles used for the UT examinations. Enclosure A3-1 also includes the detailed scan plans with cross sectional views of the examination volume with the extent of area scanned to maximize examination coverage. There were no recordable indications identified for the examination of weld #5 (W05). The examination of the Meridional at 0° weld W05 was performed from the inside surface of the vessel. Access to the required scan areas on the outside surface of the vessel is not possible for increasing examination coverage.

Any decrease in examination coverage from the second interval is based on differences in examination techniques between the two examinations. The third inspection interval examination technique is based on Appendix VIII demonstrations versus the standard Section V, Article 4 examination techniques used for the second interval inspections, including differences in search unit size and different methods required for determining coverage.

Staff Evaluation

As presented in Enclosure A3-1 of the September 21, 2011 letter, the presence of the RV incore instrumentation nozzles and core lug obstructions around the meridional weld at 0° restricts access. The inspection of the W05 weld was able to obtain 79 percent and no indications were found.

The staff requested information from the licensee regarding past inspections of the W05 subject weld. In the February 24, 2012 response to the RAI, the licensee has stated that at the time of the second ISI inspection, the same physical limitations were noted, but a higher coverage was obtained (100 percent) and eight indications were identified (all were acceptable according to the Code). The main issue contributing to the difference in flaw detection and inspection coverage between the two ISI inspections was the methodology. In the third ISI, an Appendix VIII demonstration methodology was used instead of the standard Section V, Article 4 examination used during the second ISI.

The staff noted that the RV design features make the ASME Code-required 100 percent coverage for the examination of the subject weld impractical to meet. The RV would require design modifications and imposition of this requirement would cause a significant burden on the licensee. For the W05 subject weld, the licensee did obtain 79 percent volumetric coverage. The staff considers that these obstructions, which limited the ISI coverage, would not significantly change the stress state around the weld and not affect the likelihood of crack initiation at the surface or crack propagation from subsurface flaws; therefore, the limited examinations would have detected any significant patterns of degradation, if any had occurred. The staff also determined that the other Category B-A volumetric and VT-2 visual examinations performed during the third ISI provide reasonable assurance of structural integrity of the W05 subject weld.

Based on the above discussion, the NRC staff concludes that the licensee has shown that it is impractical to meet the ASME Code-required 100 percent volumetric examination coverage for the W05 subject weld due to their design configuration. However, based on the examination coverage that was obtained, along with the examinations of other RV 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. Furthermore, the staff concludes that the examinations performed provide reasonable assurance of structural integrity of the W05 subject weld.

Relief Request Section A4

Relief Requested

The licensee is requesting relief from ASME Code required essentially 100 percent volumetric examination coverage of Exam Category B-D, Item Number B3.90 Class 1 welds in the RV. The required inspection volume is defined in IWB-2500-7.

Component Description

Welds 10 (W9), 12 (W11), and 14 (W13) are the subject welds in Section A4 of the RR. The welds are Exam Category B-D, Item Number B3.90, carbon steel shell to carbon steel nozzle. Both the shell and the nozzle are clad with stainless steel.

Impracticality of Compliance

The requirement for essentially 100 percent inspection coverage is considered impractical because of the configuration of the nozzles to the vessel. Ultrasonic examination coverage was limited to 81 percent coverage; no additional coverage was possible with existing technology. Three similar item B3.90 welds are more accessible and the "essentially 100 percent" coverage was obtained in those cases.

Proposed Alternative

No alternative was proposed. The limited volumetric examination and vessel external visual examination should detect any general patterns of degradation that may occur in the areas covered, therefore providing reasonable assurance of the continued structural integrity of Welds 10 (W9), 12 (W11), and 14 (W13).

Basis for Relief (As Stated)

> The examinations were performed using the Trans-World Services Reactor Vessel Inspection System (TWS) examination tool. TWS is a computer controlled, remotely operated manipulator. TWS, when lowered into the reactor vessel, can be positioned to provide inspection coverage of all accessible areas of the vessel. Six degrees of freedom allow the inspection head to examine vessel circumferential and longitudinal welds, bottom head welds, nozzle to vessel welds from the vessel and the nozzle bore, nozzle to pipe, elbow, and safe-end welds.
>
> The examinations were performed in accordance with detailed scan plans developed to maximize coverage of the examination volume based on vessel configuration and manipulator search unit head layout. The examination procedures are based on advanced ASME Section XI, Appendix VIII demonstrated techniques. Based on access and physical limitations of the vessel, alternative or other advanced technologies would not provide complete coverage of the examination volume.
>
> Detailed scan plans for the outlet nozzle welds with limited coverage are included in Enclosures A4-1 through A4-3. Included in the enclosures are the detailed nozzle layout and configuration, scanning tool head configurations, dimensions and configuration details that resulted in the accessibility limitations for the subject nozzle welds. Limitations are due to the configuration of the outlet nozzle boss as identified in the sketches.

All Examination Category B-D examinations for the welds included in this request were conducted in accordance with the performance demonstration requirements described in ASME Code, Section XI, Appendix VIII.

Enclosure A4-1 through A4-3 includes the weld reports for the outlet nozzle Weld 10 (W09), Weld 12 (W11), and Weld 14 (W13). Included in the enclosures are details of the equipment setup and search unit head configurations which include the wave modality and insonification angles used for the UT examinations. They also include the detailed scan plans with cross sectional views of the examination volume with the extent of area scanned to maximize examination coverage. Weld 10 had seven (7) recordable indications, all identified as fabrication anomalies located within the weld volume. There were no recordable indications identified for the examination of Weld 12. Weld 14 had eleven (11) recordable indications, also determined to be acceptable fabrication anomalies located within the weld volume.

The examination of the outlet nozzle welds was performed from the inside surface of the vessel. Access to the required scan areas on the outside surface of the vessel is not possible for increasing examination coverage.

Staff Evaluation

As presented in Enclosures A4-1, A4-2, and A4-3 of the September 21, 2011 letter, the configuration of the nozzles to the vessel restricts access for the examination tool. The inspection of the subject welds was able to obtain 81 percent coverage for each. The results of the examinations found seven indications in Weld 10 (W9), zero indications in Weld 12 (W11), and eleven indications in Weld 14 (W13) (all of the indications were acceptable according to the Code).

The staff requested information from the licensee regarding past inspections of the subject welds. In the February 24, 2012 response to the RAI, the licensee has stated that at the time of the second ISI inspection, the same physical limitations were noted, and essentially the same coverage was obtained (80.25 percent). No indications were identified in any of the subject welds during the second ISI. The main issue contributing to the difference in flaw detection between the two ISI inspections was the improved methodology used in the third ISI. The licensee requested and was granted relief from the "essentially" 100% coverage requirement for the second ISI, considering the same configuration issue that limits coverage in the third ISI.

The staff noted that the RV design features make the ASME Code-required 100 percent coverage for the examination of the subject weld impractical to meet. The RV would require design modifications and imposition of this requirement would cause a significant burden on the licensee. For the subject welds, the licensee did obtain 81 percent volumetric coverage. The staff considers that these obstructions, which limited the ISI coverage, would not significantly change the stress state around the weld and not affect the likelihood of crack initiation at the surface or crack propagation from subsurface flaws; therefore, the limited examinations would have detected any significant patterns of degradation, if any had occurred. The staff also

determined that the other Category B-D volumetric and VT-2 visual examinations performed during the third ISI provide reasonable assurance of structural integrity of the subject welds.

Based on the above discussion, the NRC staff concludes that the licensee has shown that it is impractical to meet the ASME Code-required 100 percent volumetric examination coverage for Welds 10 (W9), 12 (W11), and 14 (W13) due to their design configuration. However, based on the examination coverage that was obtained, along with the examinations of other RV 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. Furthermore, the staff concludes that the examinations performed provide reasonable assurance of structural integrity of Welds 10 (W9), 12 (W11), and 14 (W13).

Relief Request Section A5

Relief Requested

The licensee is requesting relief from ASME Code required essentially 100 percent volumetric examination coverage of five Exam Category B-D, Item Number B3.110 Class 1 pressurizer nozzle-to-vessel welds. The required inspection volume is defined in IWB-2500-7.

Component Description

Welds 10, 11, 12, 13, and 14 are the subject welds in Section A5 of the RR. The welds are Exam Category B-D, Item Number B3.110, carbon steel shell to carbon steel nozzle. Both the vessel and the nozzle are clad with stainless steel.

Impracticality of Compliance

The requirement for essentially 100 percent inspection coverage is considered impractical because of the configuration of the nozzles to the vessel. Ultrasonic examination coverage was limited for all five welds to between 56 and 81 percent. No additional coverage was possible with existing technology. A similar Item B3.110 weld, Weld 9, had similar limited examination and was included in RR NDE-007.

Proposed Alternative

No alternative was proposed. The limited volumetric examination and vessel external visual examination should detect any general patterns of degradation that may occur in the areas covered, therefore providing reasonable assurance of the continued structural integrity of Welds 10, 11, 12, 13, and 14.

Basis for Relief (As Stated)

The examinations were performed using standard ASME Section V, Article 4 UT techniques. Manual scanning was performed for these examinations. The configuration of the nozzle to shell weld limits the effective examination of the required examination volume. The nozzle's close proximity to the weld limits scanning due to the nozzle bend radius causing lift-off of the search unit during scanning. The physical limitation of each nozzle limits the effectiveness of alternative or advanced technologies from increasing the examination coverage for this configuration.

Enclosures A5-1, A5-2, A5-3, A5-4, and A5-5 include the complete Ultrasonic Examination Data Records for each Category B-D, Item B3.1 10, examination included in this request. Each report includes details of the UT scanning parameters, including transducer size, frequency and angle. Also included are coverage plots for each of the examinations showing the nozzle configuration and percent coverage for each individual scan.

The A5 Enclosures include search unit details, wave modality, and insonification angles used for all examinations, including the results of each scan. The examinations were performed with 45 degree shear wave, 60 degree shear wave, and 0 degree longitudinal wave search units (as identified in the reports).

Staff Evaluation

As presented in Enclosures A5-1 through A5-3 of the September 21, 2011 letter for Welds 10, 11, and 12, the nozzle geometry associated with the blend radius of the nozzles restricts access for the examination tool. The cladding also contributes to the reduced inspection coverage because the cladding prevents an extended V-path for the ultrasonic testing (UT) signal. The inspections of the Welds 10, 11, and 12 were unable to obtain at least 90 percent coverage; no recordable indications were found in the limited examinations.

As presented in Enclosure A5-4 of the September 21, 2011 letter for Weld 13, the nozzle geometry associated with the nozzle to pressurizer head transition restricts access for the examination tool. The inspection of the Weld 13 was unable to obtain at least 90 percent coverage; no recordable indications were found in the limited examinations.

As presented in Enclosure A5-5 of the September 21, 2011 letter for Weld 14, the weld location, relative to the nozzle, restricts access for the examination tool. The inspection of the Weld 14 was unable to obtain at least 90 percent coverage; no recordable indications were found in the limited examination.

The staff requested information from the licensee regarding past inspections of the five subject welds. In the February 24, 2012 response to the RAI, the licensee has stated that at the time of the second ISI inspection, the same physical limitations were noted, and the same Appendix V, Article 4 UT methodology was used for both the second and third ISI. The coverage results

from the second and third ISI are summarized in Table 1. The licensee requested and was granted relief from the "essentially" 100% coverage requirement for the second ISI, considering the same configuration issue that limits coverage in the third ISI.

Table A5.1. Summary of second and third ISI for Section A5.

Weld ID	Third ISI % coverage	Second ISI % coverage
10	56.6	72
11	81	66
12	81	66
13	81	89.9
14	56.7	56

The staff noted that the design of the nozzles makes the ASME Code-required 100 percent coverage for the examination of Welds 10 through 14 impractical to meet. For Welds 10 through 14, the licensee did obtain 56 through 81 percent volumetric coverage. The staff considers that the design of the nozzles, which limited the ISI coverage, would not significantly change the stress state around the weld and not affect the likelihood of crack initiation at the surface; therefore, the limited examinations would have detected any significant patterns of degradation, if any had occurred. The staff also determined that the other Category B-D volumetric and VT-2 visual examinations performed during the third ISI provide reasonable assurance of structural integrity of the five subject welds.

Based on the above discussion, the NRC staff concludes that the licensee has shown in Section A5 of their September 21, 2011 letter that it is impractical to meet the ASME Code-required 100 percent volumetric examination coverage for Welds 10 through 14 due to their nozzle design and in some cases, the presence of the cladding. However, based on the examination coverage that was obtained, along with the examinations of similar RV 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. Furthermore, the staff concludes that the examinations performed provide reasonable assurance of structural integrity of Welds 10 through 14.

Relief Request Section B1

Relief Requested

The licensee is requesting relief from ASME Code required essentially 100 percent volumetric examination coverage of a Class 2, Exam Category C-B, Item Number C2.21 nozzle to vessel weld in the boron injection tank. The required inspection volume is described in ASME Code Section XI Figure IWC-2500-4(d).

Component Description

The nozzle to vessel weld is an Exam Category C-B Item Number C2.21 carbon steel nozzle to carbon steel boron injection tank vessel. Both the vessel and nozzle are clad with stainless steel. The weld is 10 inches in diameter.

Impracticality of Compliance

This requirement is considered impractical due to single-sided access. Ultrasonic examination of the identified nozzle-to-vessel welds on the boron injection tank are limited to 30.5 percent volume coverage because of single-sided access due to nozzle to shell weld configuration. It was not possible to scan over the weld with any angle. Examination was performed to the extent possible. Destruction of the component would be necessary to perform 100 percent of the required examination

Proposed Alternative

No alternative examinations were proposed. It was proposed by the licensee that the examinations already completed at the reduced coverage be counted as meeting the Code requirements.

Basis for Relief (As Stated)

> Two other components were examined in Category C-B, Item No. C2.21, in the third ISI inspection interval, obtaining "essentially 100 percent" volumetric examination coverage. Second interval relief was granted in RR NDE-44.
>
> The examinations were performed using standard ASME Section V, Article 4 UT techniques. Manual scanning was performed for these examinations. The configuration of the nozzle to shell weld limits the effective examination of the required examination volume. The nozzle's close proximity to the weld limits scanning due to the nozzle blend radius causing lift-off of the search unit during scanning. The physical limitation of each nozzle limits the effectiveness of alternative or advanced technologies from increasing the examination coverage for this configuration.
>
> Enclosure B1-1 includes the complete Ultrasonic Examination Data Record for the Category C-B, Item C2.21, examination included in this request. The report includes details of the UT scanning apparatus, including transducer size, frequency and angle. Also included are scan plots for the examination showing the nozzle configuration and percent coverage for each individual scan. The wave modality and insonification angles are also included. No recordable indications were identified during the examination.

Magnetic Particle Examination (MT) was performed for the subject weld included in this request, and the exam was a full ASME Code examination (>90 percent coverage). There were no recordable indications detected. The complete MT Examination report is included in Enclosure B1-1.

The Boron Injection Tank head is ASTM A-516 Grade 70 carbon steel with 0.125" weld deposit clad ASTM A-240 Type 304L. Tank head design thickness is a minimum of 2.00". The nozzles are ASTM A-508 Class 1, and are just over 5" thick. The nozzles are also clad with ASTM A-240 Type 304L.

Staff Evaluation

The licensee is requesting relief from 100 percent volumetric examination coverage of a nozzle to vessel weld in the boron injection tank. ASME Code required 100 percent coverage for Exam Category C-B Item Number C2.21 welds. The design configurations of the subject nozzle-to-vessel welds limit access for ultrasonic scanning primarily to the vessel side of the welds. Obtaining 100 percent coverage would require redesigning or destroying the nozzle to vessel weld, which would put a significant burden on the licensee.

As shown on the sketches and technical descriptions included in the licensee's submittals, examinations of the subject nozzle-to-vessel weld have been completed to the extent practical. The licensee was able to obtain 30.5 percent of the code required volume. This scanning was confined to the vessel side of the weld. The weld obtained 100 percent coverage for circumferential flaws from the vessel side of the weld and 0 percent from the nozzle side. For axial flaws only 15 percent of the weld was scanned from the vessel side and 0 percent from the Nozzle side. A combination of 0, 45, and 60 degree shear waves were used for the inspection. Based on this coverage one would expect that the inspections would be able to detect a circumferential flaw and a low probability of detecting an axial flaw. It is worth noting that circumferential flaws are more safety significant than an axial flaw, as axial flaws will likely result in detectable leakage prior to rupture.

The most likely degradation mechanism in carbon steel nozzle to vessel welds is fatigue. Fatigue cracking in this region would be expected to progress relatively slowly in this region of the nozzle, and there have been no reported leaks in similar components in the past.

The staff has determined that based on the above the licensee has shown that it would place a significant burden on the licensee to meet the ASME Code-required 100 percent volumetric examination coverage for the subject nozzle-to-vessel weld due to the nozzle design. In addition, based on the volumetric coverage obtained for the subject weld, 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. The staff has determined that the examinations performed provide reasonable assurance of structural integrity of the subject weld. Thus, the criteria set forth in 10 CFR 50.55a(g)(6)(i) for impracticality has been met.

Relief Request Section B2

Relief Requested

The licensee is requesting relief from ASME Code required essentially 100 percent surface examination coverage of three Class 2, Exam Category C-C, Item Number C3.10 pressure vessel integrally welded attachments. The required inspection area is described in ASME Code Section XI Figure IWC-2500-5.

Component Description

The components are Exam Category C-C, Item Number C3.10 welded attachments. They are described in Table B2.1.

Table B2.1: Details of Exam Category C-C, Item Number C3.10 Welded Attachments

Weld	Line Number	Coverage	Material	Description
WS-1	2-RH-E-1B	81%	Carbon Steel	Residual Heat Removal Exchanger Lower Support
WS-2	2-RH-E-1B	76%	Carbon Steel	Residual Heat Removal Exchanger Lower Support
WS-3	2-SI-TK-2	80%	Carbon Steel	Boron Injection Tank Support

Impracticality of Compliance

Access to the full length of the welds is limited due to the proximity of the concrete support structures for Welds WS-1 and WS-2, and the adjacent support plate for electronics for Weld WS-3. Examination was performed to the extent possible.

Basis for Relief (As Stated)

> Among eight (8) active components in Category C-C, Item No. C3.10, 25 percent (2) were required to be examined (only one welded attachment of only one of the multiple vessels shall be selected for examination), and six (6) were examined, three limited and included in this request, and three with full coverage. Second interval relief was granted for Weld # WS-2 in request NDE-20.
>
> The material for the support and residual heat removal heat exchanger tube side shell is ASTM A-240 TP 304. The boron injection tank shell is ASME SA-264 material, and the support is ASTM A-36 STL.
>
> Reportable indications were identified for weld # WS-1 on 2-RH-E-1B, included in this report. The indications were found at the weld toe, ground out for identification, and found to be insignificant with regard to the structural integrity of the weld and support. As a result of the reportable indications, scope was expanded to examine the C3.10 welds on 2-RH-E-1A, and similar indications were identified there as well. The

evaluation indicates that the indications were construction defects rather than service induced flaws and had no impact on the structural integrity of the components.

Proposed Alternative

No alternative examinations were proposed. It was proposed by the licensee that the examinations already completed at the reduced coverage be counted as meeting the Code requirements.

Staff Evaluation

The licensee is requesting relief from obtaining the ASME code required 100 percent surface examination coverage for three Category C-C Item number 3.10 welded attachments. The design configurations of the welded attachments and due to the proximity of the concrete support structures for welds WS-1 and WS-2, and the adjacent support plate for electronics for weld WS-3. Obtaining 100 percent coverage for these attachments would require redesigning or disassembling the components and/or nearby structures, which would place a significant burden on the licensee.

As shown on the sketches and technical descriptions included in the licensee's submittals, examinations of the subject welds have been completed to the extent practical. The licensee was able to obtain surface coverage ranging from 76 to 81 percent.

After reportable indications were found in the initial examination set, four additional Category C-C, Item No. C3.10 welded attachments were examined with full coverage. The additional four inspections increase the probability of finding degradation in these components if there had been an issue with these components.

The degradation mechanisms that could affect the welded supports include general corrosion and fatigue cracking. The coverage obtained would have a high probability of detecting significant cracking or corrosion. While the limited coverage could result in small undetected flaws, significant degradation would likely be visible in the inspected areas. Based on the coverage obtained one would expect that the inspections would be able to detect significant cracking or corrosion.

The staff has determined that based on the above the licensee has shown that it would place a significant burden on the licensee to meet the ASME Code-required 100 percent surface examination coverage for the subject welded attachments. In addition, based on the surface coverage obtained for the subject 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. Four additional welded attachments were examined, increasing the total inspected area and increasing the confidence in these inspections. The staff has determined that the examinations performed provide reasonable assurance of structural integrity of the subject welded attachments. Thus, the criteria set forth in 10 CFR 50.55a(g)(6)(i) for impracticality has been met for these welded attachments.

Relief Request Section B3

Relief Requested

The licensee is requesting relief from ASME Code required essentially 100 percent surface examination coverage of five Class 2, Exam Category C-C, Item Number C3.20 pressure vessel integrally welded attachments. The required inspection area is described in ASME Code Section XI Figure IWC-2500-5.

Component Description

The components are Class 2 Exam Category C-C, Item Number C3.20 welded attachments. The welded attachments are described in Table B3.1 below.

Table B3.1 Details for Exam Category C-C, Item Number C3.20 Welded Attachments

Weld	Line Number	Coverage	Material	Description
SW-92	32"-SHP-401	66%	Carbon Steel	32" Main Steam Line Off Steam Generator
45H	16"-WFPO-424	50%	Carbon Steel	16" Feedwater Line To Steam Generator
46H	16"-WFPO-424	50%	Carbon Steel	16" Feedwater Line To Steam Generator
52H	8"-QS-403	85.15%	Carbon Steel	8" Discharge line from Quench Spray Pump
66H	3"-SI-456	81%	Carbon Steel	3" Safety Injection Line near 2-SI-MOV-2836

Impracticality of Compliance

For Weld # SW-92, the limitation is due to the obstruction of the large U-bolt clamps against the integral attachment weld. The U-bolts cover approximately one-third of the weld and are not practical to remove. There were no reportable indications.

Welds # 45H and 46H were examined to the extent possible, with limitations due to the configuration associated with the adjacent welded pad. Fifty percent of the total required examination area was examined per the Code, with an additional 15 percent best effort coverage (VT-1 examination). There were no reportable indications.

Weld # 52H was limited in areas not accessible due to the installed pipe clamp. It is not practical to remove the clamp for this examination. There were no reportable indications found.

Weld # 66H was limited in areas under the support at the lug to support interface, and would require destruction in order to examine. There were no reportable indications identified.

Disassembly or destruction of the components would be necessary to perform 100 percent of the Code required.

Basis for Relief (As Stated)

The limited surface examination should detect any general patterns of degradation that may occur in the areas covered, therefore providing reasonable assurance of the continued structural integrity of the subject weld.

A total of nineteen (19) examinations were completed among 165 active components in Category C-C, Item No. C3.20, during the third ISI inspection interval with no unacceptable indications found.

Proposed Alternative

No alternative examinations were proposed. It was proposed by the licensee that the examinations already completed at the reduced coverage be counted as meeting the Code requirements.

Staff Evaluation

The licensee is requesting relief from obtaining the ASME code required 100 percent surface examination coverage for five Category C-C Item number 3.20 welded attachments. The surface coverage for the welded attachments was limited by the design of the pipes, nearby weld pads and pipe clamps. Obtaining 100 percent coverage for these attachments would require disassembling the components and/or nearby structures, which would place a significant burden on the licensee.

As shown on the sketches and technical descriptions included in the licensee's submittals, examinations of the subject welds have been completed to the extent practical. The licensee was able to obtain surface coverage ranging from 50 to 81 percent.

The degradation mechanisms that could affect the welded supports include corrosion and fatigue cracking. Welds # 45H and 46H, where coverage was limited to 50 percent, were also examined with VT-1 for an additional 15 percent of best effort coverage. While VT-1 is not as sensitive as penetrant or magnetic particle testing, VT-1 is capable of detecting large cracks and general corrosion. The coverage obtained would have a high probability of detecting significant cracking or corrosion. Additionally, no degradation was found on the other Category C-C, Item Number 3.20, welded attachments.

The staff has determined that based on the above the licensee has shown that it would place a significant burden on the licensee to meet the ASME Code-required 100 percent surface examination coverage for the subject welded attachments. In addition, based on the surface coverage obtained for the subject 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 staff has determined that the examinations performed provide reasonable assurance of structural integrity of the subject welded attachments. Thus, the criteria set forth in 10 CFR 50.55a(g)(6)(i) for impracticality has been met for these welded attachments.

Relief Request Section B4

Relief Requested

The licensee is requesting relief from ASME Code required essentially 100 percent surface examination coverage of five Class 2, Exam Category C-C, Item Number C3.20 pressure vessel integrally welded attachments. The required inspection area is described in ASME Code Section XI Figure IWC-2500-5.

Component Description

The components are Class 2 Exam Category C-C, Item Number C3.30 welded attachments. The welded attachments are described in Table B4.1.

Table B4.1 Details for Exam Category C-C, Item Number C3.30 Welded Attachments

Weld	Line Number	Coverage	Material	Description
WS-01	2-CH-P-1B	76%	Carbon Steel	Centrifugal Charging Pump 2-CH-P-1B Lug
WS-02	2-CH-P-1B	78%	Carbon Steel	Centrifugal Charging Pump 2-CH-P-1 B Lug
WS-03	2-CH-P-1B	78%	Carbon Steel	Centrifugal Charging Pump 2-CH-P-l1B Lug
WS-04	2-CH-P-1B	78%	Carbon Steel	Centrifugal Charging Pump 2-CH-P-l1B Lug

Impracticality of Compliance

Inaccessibility to the examination area prevented full examination of each of these welds. No other NDE method would obtain a greater percentage of coverage. 76 percent of weld # WS-01 was examined, and 78 percent of Weld #'s WS-02, WS-03, and WS-04 were examined.

Disassembly or destruction of the components would be necessary to perform 100 percent of the Code required examination as written in the 1995 ASME Section XI Code with 1996 Addenda.

Basis for Relief (As Stated)

> Among 12 active components in Category C-C, Item No. C3.30, a total of two (2) were required to be examined. Four (4) integrally welded attachments on pumps were examined, all with limitations and included in this request. The Centrifugal Charging Pump casing material is ASME SA-182 grade 304 stainless steel.
>
> Second interval relief was granted per RR NDE-19, NRC Letter dated 8/8/1995 (TAC No. M89740), and NDE-30, NRC Letter dated 10/10/1996 (TAC No. M95202).

Proposed Alternative

No alternative examinations were proposed. It was proposed by the licensee that the examinations already completed at the reduced coverage be counted as meeting the Code requirements.

Staff Evaluation

The licensee is requesting relief from obtaining the ASME code required 100 percent surface examination coverage for four Category C-C Item number 3.30 welded attachments. The surface coverage for the welded attachments was limited by the design of the pumps. Obtaining 100 percent coverage for these attachments would require disassembling the pumps, which would place a significant burden on the licensee.

As shown on the sketches and technical descriptions included in the licensee's submittals, examinations of the subject welds have been completed to the extent practical. The licensee was able to obtain surface coverage ranging from 76 to 78 percent. To offset the limited coverage the licensee examined two additional welded attachments, increasing the inspected surface area for this item number significantly.

The degradation mechanisms that could affect the welded supports include corrosion and fatigue cracking. While small flaws could be hidden by the limited coverage, significant cracking or corrosion would most likely be visible in the areas inspected.

Two additional Category C-C, Item No. C3.30 welded attachments were examined, increasing the total inspected area for this inspection item number. The coverage obtained for these components would have an improved probability of detecting significant cracking or corrosion.

The staff has determined that based on the above the licensee has shown that it would place a significant burden on the licensee to meet the ASME Code-required 100 percent surface examination coverage for the subject welded attachments. In addition, based on the surface coverage obtained for the subject 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 staff has determined that the examinations performed provide reasonable assurance of structural integrity of the subject welded attachments. Thus, the criteria set forth in 10 CFR 50.55a(g)(6)(i) for impracticality has been met for these welded attachments.

Relief Request Section B5

Relief Requested

The Licensee is requesting relief from the ASME Code required essentially 100 percent volumetric examination coverage requirement for ten Category C-F-1 Item No. C5.11 welds. The volumetric inspection requirements are described in ASME Code Section XI Figure IWC-2500-7.

Component Description

The components are Class 2 Exam Category C-F-1, Item Number C5.11 Piping Welds. The welds are described in Table B5.1.

Table B5.1 Details for Exam Category C-F-1 Item No. C5.11 Circumferential Piping Welds

Weld	Line Number	Coverage	Material	Description
6A	12"-RS-407	42.50%	Stainless Steel to Stainless Steel	12" Piping to Recirculation Spray Pump
4A	12"-RS-408	88%	Stainless Steel to Stainless Steel	12" Upstream Piping to Recirculation Spray Pump
66	10"-RS-410	50%	Stainless Steel to Stainless Steel	Piping Weld on Outside Recirculation Spray Pump outside reactor containment
2	16"-SI-407	48%	Stainless Steel to Stainless Steel	Discharge side of manual valve at Refueling Water Storage Tank, 16" Charging Pump Suction Line
SW-55	6"-SI-570	54.50%	Stainless to Carbon with Alloy 182 Weld	Boron Injection Tank Discharge 6" Nozzle To Safe End Weld
SW-73	6"-SI-570	60.50%	Stainless to Carbon with Alloy 182 Weld	Boron Injection Tank Inlet 6" Nozzle To Safe End Weld
14	8"-CH-605	50%	Stainless Steel to Stainless Steel	8" Charging Pump Suction Pipe on downstream side of 2-CH-MOV-2115D
1	8"-SI-440	49.50%	Stainless Steel to Stainless Steel	8" Charging Pump Suction Pipe on downstream side of 2-CH-MOV-2863A
1	10"-RH-413	50%	Stainless Steel to Stainless Steel	10" RHR Return Piping on inlet side of 2-RH-MOV-2720B in Reactor Containment
SW-56	6"-RH-417	88%	Stainless Steel to Stainless Steel	Weld at 6" elbow off of RHR Return Piping in Reactor Containment

Impracticality of Compliance

Relief is requested from the "essentially 100 percent" volumetric examination coverage requirement for the identified piping welds. This requirement is considered impractical primarily due to single-sided access for these components.

Ultrasonic examinations of the identified piping welds are limited primarily due to single-sided access. Examinations were performed to the extent possible.

Basis for Relief (As Stated)

> It is proposed that the examinations already completed at the reduced coverage be counted as meeting the Code requirements. The limited volumetric examinations should detect any general patterns of degradation that may occur in the areas covered, therefore providing reasonable assurance of the continued structural integrity of the subject welds.

Several of these examinations obtained additional Best Effort Coverage as identified in the figures and tables that follow. Best Effort Coverage refers to the required examination volume past the weld centerline that is examined with an Appendix VIII demonstrated procedure for single sided coverage. Best Effort Coverage is clearly indicated in the attached tables.

Weld # 6A was a single sided examination due to the obstruction caused by the weldolet. An additional 7.5% best-effort (non-Code) coverage was obtained. Acceptable ID geometry indications were identified. Liquid penetrant (surface) examinations identified surface indications that were either ground out and removed or found within acceptable ASME Section XI, IWB-3514 acceptance standards. In accordance with ASME Code Case N-586-1, the determination of the root cause of the flaws is identified as porosity in the original weld that has existed in this location from the time of original construction. The indications were not indicative of inservice induced defects, and the weld was fully capable of performing its design function.

Weld # 4A examination was limited due to two two-inch sockolets adjacent to the weld toe. The weld was examined to the maximum extent possible. There were no reportable indications. Second interval relief was granted in NDE-19, NRC Letter dated 8/8/1995 (TAC No. M89740).

Weld # 66 was a single sided examination due to the pipe to valve configuration of the subject weld. An additional 8.4% best effort (non-Code) coverage was obtained. There were no reportable indications.

Weld # 2 was a single sided examination due to the pipe to valve configuration of the subject weld. An additional 3% best effort (non-Code) coverage was obtained. There were no reportable indications.

Weld # SW-73 examination was performed from the safe end side only due to the nozzle configuration. The weld was examined to the extent possible. Geometric indications were identified and determined to be acceptable. Liquid penetrant (surface) examinations were performed with no limitations and with no reportable indications.

Weld # SW-55 examination was performed from the safe end side only due to the nozzle configuration. The weld was examined to the extent possible. Geometric indications were identified and determined to be acceptable. Liquid penetrant (surface) examinations were performed with no limitations and with no reportable indications.

Weld # 14 was a single side examination due to the pipe to valve configuration. An additional 4.1% best effort (non-Code) coverage was obtained. There were no reportable indications identified.

Weld # 1 (8-SI-440) was a single sided examination due to the valve to pipe configuration and the cast valve material of the valve. No credit was taken for scanning of the weld on the valve side. The techniques used for this examination are considered best effort for single side detection of far side defects parallel to the weld. There were no recordable indications.

Weld # 1 (10-RH-413) was a single sided examination due to the pipe to valve configuration. An additional 11% best effort (non-Code) coverage was obtained. There were no reportable indications.

Weld # SW-56 was limited due to the elbow to tee configuration, as well as no scan for 2.5-inches due to a ¾" branch connection 0.5" from the weld toe in the scanning path. An additional 8% best effort (non-Code) coverage was obtained. There were no reportable indications.

A total of 77 examinations were completed among 877 components in Category C-F-1 Item No. C5.1 1, during the third ISI inspection interval. 66 examinations (7.5%) were required. Code case N-663 was implemented, limiting required surface examinations to those areas susceptible to outside surface attack.

Weld #'s 6A, 4A, 66, 14, and 1 (8-SI-440), are material type ASTM A-312-TP 304 stainless steel, except AISI type 316 stainless steel is acceptable for valve bodies (in pipe to valve configurations).

Weld 2 is in material type ASTM A-358-TP 304 stainless steel, with AISI type 316 as an acceptable valve body material.

Weld SW-56 is in material type ASTM A-376-TP 304 stainless steel, Weld # 1 (10-RH-413) is in material type ASTM A-376-TP 316 stainless steel.

Weld #'s SW-73 and SW-55 are dissimilar metal welds between ASTM A-312-TP 316 stainless steel safe end and the ASTM A-508 carbon steel nozzles.

Proposed Alternative

No alternative examinations were proposed. It was proposed by the licensee that the examinations already completed at the reduced coverage be counted as meeting the Code requirements.

Staff Evaluation

The licensee is requesting relief from obtaining the ASME code required 100 percent volumetric examination coverage for ten Category C-F-1 Item number C5.11 full penetration welds. The examination coverage for these welds was limited by the single-sided access to the welds in eight cases, a nearby tee in one case, and the presence of socket welds in one case. Eight of the welds are stainless steel welds joining stainless steel components, and two are alloy 182 weld metal joining carbon steel and stainless steel components. Obtaining 100 percent

coverage for these welds would require redesigning or disassembling the components, which would place a significant burden on the licensee.

As shown on the sketches and technical descriptions included in the licensee's submittals, volumetric examinations of the subject full-penetration welds have been completed to the extent practical. The licensee was able to obtain volumetric coverage ranging from 42.5 to 88 percent. All examinations were performed by inspectors and procedures that are in compliance with ASME Code Section XI Appendix VIII requirements. Additional non-Code "Best Effort" examinations were performed. While best effort examinations do not have the same effectiveness as Appendix VIII qualified examinations, they are significantly better than obtaining no additional inspection coverage. The additional best effort coverage is detailed in Table B5.2.

Table B5.2 Best Effort Coverage for Exam Category C-F-1, Item Number C5.11 Piping Welds

Weld	Line Number	Code Coverage	Best Effort Coverage	Total Insonified Area
6A RS	12"-RS-407	42.50%	7.50%	50.00%
66 RS	10"-RS-41 0	50%	8.40%	58.40%
2 SI	16"-SI-407	48%	3.00%	51.00%
14 CH	8"-CH-605	50%	4.10%	54.10%
1 RH	10"-RH-413	50%	11.00%	61.00%
SW-56 RH	6"-RH-417	88%	8.00%	96.00%

Welds SW-73 and SW-75 are the nickel alloy 182 dissimilar metal welds and are vulnerable to stress corrosion cracking. They were examined with a combination of 40, 45, and 60 degree longitudinal and shear waves. Additionally, the scans for circumferential flaws had 77 percent coverage. This is important as circumferential flaws are more safety significant than axial flaws. Additionally, axial flaws in alloy 182 tend to propagate across the entire weld width, so limited axial coverage has a reasonable probability of detecting a large axial flaw.

At normal reactor (i.e., relatively high) temperatures reduced coverage in alloy 182 can be cause for concern because alloy 182 is susceptible to stress corrosion cracking at high temperatures. However, Welds SW-73 and SW-75 are on the boron injection tank inlet and outlet piping which are held at lower temperatures between 145-155 degrees Fahrenheit to keep the boric acid in solution. At 145-155 degrees Fahrenheit SCC in alloy 182 material would be expected to have a long incubation period for crack initiation and slow crack growth rate.

The remaining welds are stainless steel. These welds were primarily examined using shear waves with inspection angles ranging from 45 to 70 degrees. The only known degradation mechanism for the stainless steel welds and associated components in PWR environments is thermal fatigue. Thermal fatigue cracks propagate relatively slowly and operational experience has not shown similar welds to be challenged by thermal fatigue. Significant thermal cracking would likely extend into the examined section of the weld. Thus, significant circumferential cracking in this weld has a high likelihood of being found by the examinations that have been performed.

The licensee has shown that it would be a significant burden to meet the ASME Code-required volumetric and surface examination coverage for the subject welds due to the design of the welds and proximity of other components. Considering the volumetric coverage obtained, the low temperatures of the two alloy 182 welds, and the crack resistant materials in the remaining eight welds, it is reasonable to conclude that if significant service-induced degradation had occurred in the subject welds, evidence of it would have been detected. The staff has determined that the examinations performed provide reasonable assurance of structural integrity of the subject welds. Thus, the criteria set forth in 10 CFR 50.55a(g)(6)(i) for impracticality has been met for welds described in Table B5.1.

Relief Request Section B6

Relief Requested

The licensee is requesting relief is from the ASME Code required essentially 100 percent volumetric examination coverage requirement for ten Category C-F-1 Item No. C5.21 welds. The volumetric inspection requirements are described in ASME Code Section XI Figure IWC-2500-7.

Component Description

The components are Class 2 Exam Category C-F-1, Item Number C5.21 Piping Welds. The welds are described in Table B6.1.

Table B6.1: Details for Exam Category C-F-1, Item Number C5.21 Piping Welds

Weld	Line Number	Coverage	Material	Description
SW-49W	3-CH-402	47%	Stainless Steel to Stainless Steel	3" HPSI Pipe To Valve
2A	3-CH-403	63%	Stainless Steel to Stainless Steel	3" HPSI Pipe To Valve
SW-64	3-SI-424	50%	Stainless Steel to Stainless Steel	3" HPSI Piping From Boron Injection Tank
23A	3-SI-423	47%	Stainless Steel to Stainless Steel	3" HPSI Piping From Boron Injection Tank
7A	3-SI-536	50%	Stainless Steel to Stainless Steel	3" HPSI Piping From Boron Injection Tank
24A	3-SI-571	50%	Stainless Steel to Stainless Steel	3" HPSI Piping From Boron Injection Tank
26	3-SI-571	50%	Stainless Steel to Stainless Steel	3" HPSI Piping From Boron Injection Tank

Weld	Line Number	Coverage	Material	Description
SW-39W	2-CH-422	88%	Stainless Steel to Stainless Steel	2" HPSI Pipe to MOV-2373 at a 3" to 2" reducer

Impracticality of Compliance

Relief is requested from the "essentially 100 percent" volumetric examination coverage requirement for the identified piping welds. This requirement is considered impractical primarily due to single-sided access for these components.

Ultrasonic examinations of the identified piping welds are limited primarily due to single-sided access. Examinations were performed to the extent possible.

Basis for Relief (As Stated)

It is proposed that the examinations already completed at the reduced coverage be counted as meeting the Code requirements. The limited volumetric examination should detect any general patterns of degradation that may occur in the areas covered, therefore providing reasonable assurance of the continued structural integrity of the subject weld.

Weld # SW-49W was limited due to the tee to elbow configuration. An additional 12% best effort (non-Code) coverage was obtained. An acceptable ID geometry indication was identified and confirmed in previous radiographs.

Weld # 2A was limited due to the configuration associated with the upstream valve body taper. The techniques used for this examination are considered best effort for single sided detection of far side defects parallel to the weld. Additional scans or alternative techniques will not provide additional coverage within the limitations of the procedure. There were no reportable indications.

Weld # SW-64 was a single sided examination limited due to the pipe to tee configuration. An additional 16.66% best effort (non-Code) coverage was obtained. A liquid penetrant (surface) examination was performed with full coverage. There were no reportable indications.

Weld # 23A was a single sided examination due to the elbow to valve configuration, limited at the elbow intrados. An additional 13% best effort (non-Code) coverage was obtained. A liquid penetrant examination (surface) was performed at full coverage. There were no reportable indications.

Weld # 7A was limited due to the pipe to valve configuration during a preservice examination. ID geometry indication was identified due to the weld root, verified by reviews of cross sectional plots and RT film. An

additional 23% best effort coverage was obtained. Liquid penetrant (surface) examination was performed at full coverage. There were no reportable indications.

Weld # 24A was a preservice examination limited due to the tee to valve configuration. An additional 14% best effort (non-Code) coverage was obtained. A liquid penetrant (surface) examination and a VT-2 visual examination were also performed. There were no reportable indications.

Weld # 26 was a single sided preservice examination limited due to the elbow to valve configuration. An additional 20% best effort coverage was obtained. A liquid penetrant (surface) and a VT-2 visual examination were also performed. There were no reportable indications.

Weld # SW-39W was a single-sided examination limited due to the pipe to reducer configuration. The techniques used for this examination are considered best effort for single sided detection of far side defects parallel to the weld. Additional scans or alternative techniques will not provide additional coverage within the limitations of the procedure. There were no reportable indications.

There were twenty six exams performed among 323 active components in Category C-F- 1, Item No. C5.21, in the third ISI inspection interval. There were no reportable indications other than acceptable geometry indications identified among the required examinations.

All welds identified in Category C-F-1, Item No. C5.21, included in this report, are made in ASTM A376-TP 316 stainless steel material.

Proposed Alternative

No alternative examinations were proposed. It was proposed by the licensee that the examinations already completed at the reduced coverage be counted as meeting the Code requirements.

Staff Evaluation

The licensee is requesting relief from obtaining the ASME code required 100 percent volumetric examination coverage for eight Category C-F-1 Item number C5.21 full penetration welds. The examination coverage for these welds was limited by the single-sided access to the weld or weld geometry. These eight welds are stainless steel welds joining stainless steel components. Obtaining 100 percent coverage for these welds would require redesigning or disassembling the components, which would place a significant burden on the licensee.

As shown on the sketches and technical descriptions included in the licensee's submittals, volumetric examinations of the subject full-penetration welds have been completed to the extent practical. The licensee was able to obtain volumetric coverage ranging from 47 to 88 percent. Additional non-Code "Best Effort" examinations were performed. While best effort examinations do not have the same effectiveness as Appendix VIII qualified examinations, they are

significantly better than obtaining no additional inspection coverage. The additional best effort coverage is detailed in Table B6.2.

Table B6.2: Best Effort Coverage for Category C-F-1, Item Number C5.21 Piping Welds

Weld	Line Number	Coverage	Best Effort Coverage	Total Insonified Area
SW-49W	3-CH-402	47.00%	12.00%	59.00%
2A	3-CH-403	63.00%	Far Side	>63%
SW-64	3-SI-424	50.00%	16.66%	66.66%
23A	3-SI-423	47.00%	13.00%	60.00%
7A	3-SI-536	50.00%	23.00%	73.00%
24A	3-SI-571	50.00%	14.00%	64.00%
26	3-SI-571	50.00%	20.00%	70.00%

All examinations were performed by inspectors and procedures that are in compliance with ASME Code Section XI Appendix VIII requirements. These Category C-F-1 welds are composed of stainless steel and join stainless steel components. These welds were primarily examined using shear waves with inspection angles ranging from 40 to 70 degrees. The likely degradation mechanism for the stainless steel welds in the subject piping systems is thermal fatigue. Thermal fatigue cracks propagate relatively slowly and operational experience has not shown similar welds to be challenged by thermal fatigue. Significant thermal cracking would likely extend into the examined section of the weld. Thus, significant circumferential cracking in this weld has a high likelihood of being found by the examinations that have been performed.

The licensee has shown that it would be a burden to meet the ASME Code required volumetric and surface examination coverage for the subject welds due to the design of the welds and proximity of other components. Considering the volumetric coverage obtained and the crack resistant materials in the remaining eight welds, it is reasonable to conclude that if significant service-induced degradation had occurred in the subject welds, evidence of it would have been detected. The staff has determined that the examinations performed provide reasonable assurance of structural integrity of the subject welds. Thus, the criteria set forth in 10 CFR 50.55a(g)(6)(i) for impracticality has been met for welds described in Table B6.1.

Relief Request Section R1

Relief Requested

The licensee is requesting relief is from the ASME Code required essentially 100 percent volumetric examination coverage requirement for ten Category R-A Item No. R1.11 welds.

Component Description

The components are Class 2 Exam Category R-A, Item Number R1.11 Piping Welds. The welds are described in Table R1.1.

Table R1.1 Details for Category R-A, Item Number R1.11 Piping Welds

Weld	Line Number	Coverage	Material	Description
2	6-RC-421	89%	Stainless Steel to Stainless Steel	6" Weld at Nozzle Into 29" Hot Leg From Low Head Safety Injection
20	3-SI-417	53%	Stainless Steel to Stainless Steel	Check Valve to 3" HPSI line from Boron Injection Tank
1	6-RC-417	50%	Stainless Steel to Stainless Steel	Weld on check valve on piping to Loop 1 Cold Leg
2	6-RC-417	88%	Stainless Steel to Stainless Steel	Piping to inlet nozzle weld to Loop 1 Cold Leg
1	6-RC-420	50%	Stainless Steel to Stainless Steel	Weld on downstream side of check valve 2-SI-1 06 on piping to Loop 3 Cold Leg
2b	6-RC-420	50%	Stainless Steel to Stainless Steel	Piping to inlet nozzle weld to Loop 3" Cold Leg
80	6-RC-419	50%	Stainless Steel to Stainless Steel	Weld on check valve on piping to Loop 2 Cold Leg
SW-5	14-RC-410	75%	Stainless Steel to Carbon Steel with nickel alloy weld	Pressurizer Nozzle-To-Safe End weld on the Surge Line, examined prior to full structural weld overlay
9	27½-RC-403	49.9%	Stainless Steel to Cast Stainless Steel	Weld at Reactor Coolant Pump discharge, Loop 1 Cold Leg
SW-43	27½-RC-403	36%	Stainless Steel to Cast Stainless Steel	6" Nozzle to Loop 1 Cold Leg Weld line from Low Head Safety Injection
21	27½-RC-406	50%	Stainless Steel to Cast Stainless Steel	Weld at Reactor Coolant Pump discharge, Loop 2 Cold Leg
33	27½-RC-406	75%	Stainless Steel to Cast Stainless Steel	Weld at Reactor Coolant Pump discharge, Loop 3 Cold Leg
SW-49	27½-RC-409	35%	Stainless Steel to Cast Stainless Steel	6" Nozzle to Loop 3 Cold Leg Weld line from Low Head Safety Injection
SW-36	27-RC-407	52%	Stainless Steel to Cast Stainless Steel	Hot Leg to 14" Schedule 160 Nozzle Weld, with thermal sleeve, Pressurizer Surge Line
SW-9	6-RC-438	63%	Stainless Steel to Carbon Steel with nickel alloy weld	Nozzle-To-Safe End weld at Pressurizer to safety valve, examined prior to full structural weld overlay
SW-17	6-RC-439	53%	Stainless Steel to Carbon Steel with nickel alloy weld	Nozzle-To-Safe End weld at Pressurizer to safety valve, examined prior to full structural weld overlay

N-SE29 IN	29-RC-401	80%	Stainless Steel to Carbon Steel with nickel alloy weld	Steam Generator hot leg nozzle to safe end weld
N-SE31IN	31-RC-402	80%	Stainless Steel to Carbon Steel with nickel alloy weld	Steam Generator cold leg nozzle to safe end weld
22	27½ RC-406	50%	Stainless Steel to Cast Stainless Steel	Weld on inlet side of Loop Stop Valve, Reactor Coolant Pump discharge side

Impracticality of Compliance

Relief is requested from the "essentially 100 percent" volumetric examination coverage requirement for the identified piping welds. This requirement is considered impractical primarily due to single-sided access for these components.

The welds in Section R1 of the RR are governed by the Risk-Informed Inservice Inspection (RI-ISI) Program that was approved for use by the NRC for North Anna Power Station Unit 2 in a letter dated September 18, 2001 (ADAMS Accession No. ML012470437). The North Anna Unit 2 risk-informed inservice inspection (ISI) Program was developed in accordance with the Westinghouse Owners Group Topical Report WCAP-14572, Revision 1-NPA, rather than per ASME Code Case N-577, as granted in the request to use RI-ISI. All welds in Section R1 of the RR are assigned category R-A, Item R1.11, and require volumetric examination. The Item R1.11 elements are either subject to Thermal Fatigue/Stratification or defaulted to "Thermal Fatigue" as the most likely degradation mechanism.

These examinations were performed manually using advanced ASME Section XI, Appendix VIII demonstrated procedures and techniques in accordance with the performance demonstration requirements. Based on access and physical limitations of these welds, alternative or other advanced technologies would not have provided complete coverage of the examination volume at the time of these examinations. The attached enclosures include the complete Ultrasonic Examination Data Records for each Category R-A, Item R1.11, examination included in this request. Each report includes details of the UT scanning apparatus, including transducer size, frequency, angle, wave modality, and insonification angles.

Basis for Relief (As Stated)

> It is proposed that the examinations already completed at the reduced coverage be counted as meeting the Code requirements. The limited volumetric examination should detect any general patterns of degradation that may occur in the areas covered, therefore providing reasonable assurance of the continued structural integrity of the subject weld. A portion of each of the subject welds was examined volumetrically. In addition, these welds receive a visual examination during the system leakage test. Therefore, any pattern of degradation should be detected by these examinations ensuring reasonable assurance of operational readiness.

Proposed Alternative

No alternative examinations were proposed. It was proposed by the licensee that the examinations already completed at the reduced coverage be counted as meeting the Code requirements.

Staff Evaluation

Section R1 of the RR seeks relief from the "essentially 100 percent" volumetric examination coverage requirement for the nineteen piping welds described in Table R1.1. These welds either consist of stainless steel or nickel alloy welds. The nickel alloy welds either have an alloy 52 inlay or have had a full structural overlay of alloy 52 weld metal applied after the inspection. Coverage is limited due to single sided access caused by geometry and materials issues. Obtaining 100 percent coverage for these welds would require redesigning or disassembling the components, which would place a significant burden on the licensee.

As stated in the Regulatory Requirements section, the Welds in Section R1 are governed by the Risk-Informed Inservice Inspection (RI-ISI) Program that was approved by the NRC for North Anna Power Station Unit 2 in a letter dated September 18, 2001. The North Anna Unit 2 risk-informed ISI Program was developed in accordance with the Westinghouse Owners Group Topical Report WCAP-14572, Revision 1-NPA as granted in the request to use RI-ISI. The Item R1.11 elements are either subject to Thermal Fatigue/Stratification or Defaulted to Thermal Fatigue as the most likely degradation mechanism. This classification is only valid for the nickel alloy weld when one takes the alloy 52 inlays and overlays in to account. Alloy 52 has been shown in laboratory testing to be susceptible to stress corrosion cracking (although much less susceptible than 82 or 182), with relatively long incubation times and a slow crack growth rates when compared to 82/182 weld metal. Thermal fatigue in these components is also expected to have a slow growth rate.

As shown on the sketches and technical descriptions included in the licensee's submittals, volumetric examinations of the subject full-penetration welds have been completed to the extent practical. The licensee was able to obtain volumetric coverage ranging from 35 to 89 percent. All examinations were performed by inspectors and procedures that are in compliance with ASME Code Section XI Appendix VIII requirements. Additional non-Code "Best Effort" examinations were performed. While best effort examinations do not have the same effectiveness as Appendix VIII qualified examinations, they are significantly better than obtaining no additional inspection coverage. The additional best effort coverage is detailed in Table R1.2.

Table R1.2 Best Effort Coverage for Category R-A, Item Number R1.11 Piping Welds

Weld	Line Number	Code Coverage	Best Effort Coverage	Total Insonified Area
2	6-RC-421	89.00%	2.00%	0.91%
1	6-RC-417	50.00%	13.00%	0.63%
2	6-RC-417	88.00%	3.00%	0.91%
1	6-RC-420	50.00%	20.00%	0.70%
2b	6-RC-420	50.00%	7.00%	0.57%
80	6-RC-419	50.00%	6.40%	0.56%

9	27-1/2RC-403	49.90%	3.80%	0.54%
21	27-1/2RC-406	50.00%	25.00%	0.75%
SW-49	27-1/2RC-409	35.00%	13.00%	0.48%
22	27-1/2RC-406	50.00%	25.00%	0.75%

The welds with line numbers 6-RC-421, 3-SI-417, 6-RC-417, 6-RC-417, 6-RC-420, 6-RC-420, and 6-RC-419 consist of stainless steel components welded with a stainless steel weld. Coverage in these welds ranges from 50 to 89 percent. In a PWR environment the likely degradation mechanism for these welds is thermal fatigue, and no similar pipes in PWRs have been severely affected by thermal fatigue.

Welds SW-5, SW-9, and SW-17 with line numbers 14-RC-410, 6-RC-438, and 6-RC-439, were examined prior to having a full structural weld overlay applied. The coverage obtained for these welds SW-5 ranged from 53 to 75 percent. Nickel alloy welds are known to be vulnerable to stress corrosion cracking, especially in and near the pressurizer where temperatures are relatively high. While no flaws were found in the examinations a crack can grow very quickly in nickel alloy welds at high temperatures. Allowing any missed inspection coverage on a high temperature nickel alloy weld requires a strong justification. A critical factor considered in this RR is that an overlay of resistant material was applied over the vulnerable weld after the inspections. With a full structural overlay a crack could penetrate the alloy 82/182 weld and would either stop or slow down greatly at the alloy 52 overlay. Also, the licensee achieved 100 percentage examination coverage after the alloy 52 overlays were installed.

Welds 9, SW-43, 21, 33, SW-49, and SW-36, line numbers 27½-RC-403, 27½-RC-403, 27½-RC-406, 27½-RC-406, 27½-RC-409, and 27-RC-407, are stainless steel to cast stainless steel welds. Coverage on these welds ranged from 35 to 75 percent. An additional 13 percent of "Best Effort" examination coverage was obtained on weld SW-49. These welds are as resistant to cracking as non-cast stainless steel, but are significantly more challenging to inspect. Cast stainless steel is notorious for absorbing and redirecting ultrasound. The licensee used 1MHz probes to perform the inspections, which is valuable as these low frequencies are less affected by the cast stainless steel microstructure. They used inspection angles of either 45 degrees or a combination of 45 and 60 degrees. With these frequencies and the coverage obtained one would expect the inspections to be able to find significant thermal fatigue cracks. Thermal fatigue cracks grow relatively slowly and no similar components in PWRs have shown such cracking in the past.

Welds N-SE29 IN and N-SE31 IN, line numbers 29-RC-401 and 31-RC-402, require careful evaluation in that they are very similar to the weld in North Anna Unit 1 that recently was found to have several deep cracks. Additionally, these deep cracks were missed by at least one inspection. The cracks were determined to be primary water stress corrosion cracking (PWSCC). The weld in the North Anna Unit 1 steam generator hot leg dissimilar metal weld was made of the PWSCC susceptible alloy 82 and 182 weld metals, making it vulnerable to this form of degradation. This combination of vulnerability to PWSCC and recent issues with lack of reliability of flaw detection put similar welds in Unit 2 under extra scrutiny.

In evaluating the 80 percent coverage for the examinations of welds N-SE29 IN and N-SE31 IN, the staff took several items into consideration. In the case of welds N-SE29 IN and N-SE31 IN, the staff noted that the inspection procedure used to inspect welds N-SE29 IN and N-SE31 IN is

not the same procedure that missed the deep flaws in North Anna 1. The NRC staff has determined that the inspections of the welds N-SE29 IN and N-SE31 IN followed the practices common to the time they were conducted. In 2002 the inspection procedure was considered to be sufficient by the Performance Demonstration initiative and the authorized nuclear inservice inspector.

A critical factor in this evaluation is that the welds N-SE29 IN and N-SE31 IN have a nickel alloy 52 inlay that is resistant to stress corrosion cracking. This inlay should protect the alloy 182 and 82 from exposure to primary coolant water. With the alloy 52 inlay one would expect PWSCC to have a long incubation period for crack initiation and that any PWSCC would progress slowly through the alloy 52 inlay.

Another factor taken into account by the staff is the future inspection frequency of these welds. The re-inspection interval for these welds is governed by Code Case N-770-1, the use of which has been mandated in 10 CFR 50.55a(b). Code Case N-770-1 requires that dissimilar metal welds such as N-SE29 IN and N-SE31 IN be removed from RI-ISI programs and be examined in an augmented schedule. N770-1 requires 25 percent of the inlaid welds to receive a volumetric and surface examinations of the inside surfaces of the welds each inspection interval.

Given the 80 percent coverage, the alloy 52 inlay, the enhanced inspection procedure, and the N770-1 re-inspection frequency the staff have determined that there is reasonable assurance of leak tightness and structural integrity for the welds N-SE29 IN and N-SE31 IN.

The licensee has shown that it would be a burden to meet the ASME Code-required volumetric and surface examination coverage for the subject welds due to the design of the welds, materials, and proximity of other components. Considering the volumetric coverage obtained and the crack resistant materials it is reasonable to conclude that if significant service-induced degradation had occurred in the subject welds, evidence of it would have been detected. The staff has determined that the examinations performed provide reasonable assurance of structural integrity of the subject welds. Thus, the criteria set forth in 10 CFR 50.55a(g)(6)(i) for impracticality has been met for welds described in Table R1.1 above.

4.0 CONCLUSION

As set forth above, the 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 given due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. The staff finds 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). Therefore, the NRC staff grants relief for the subject examinations of the components contained in RR N2-I3-PRT-002 at the North Anna Unit 2 for the third ten year inspection interval.

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 Contributor: Patrick Purtscher, NRR
Stephen Cumblidge, NRR

Date: August 17, 2012

If you have any questions concerning this matter, please contact Dr. V. Sreenivas at (301) 415-2597.

Sincerely,

/RA/ John P. Boska for

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

Docket No. 50-339

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