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

February 3, 2015

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 (RR) N2-I4-LMT-002, LIMITED EXAMINATIONS FOR THE FOURTH TEN-YEAR INSPECTION INTERVAL PERIOD 1 (TAC NO. MF3982)

Dear Mr. Heacock:

By letter dated April 21, 2014, (Accession No. ML14115A066), as supplemented by letter dated August 26, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14245A403), Virginia Electric and Power Company - Dominion (the licensee) requested relief from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (B&PV Code) for coverage of the examination volume of welds. The licensee submitted relief request N2-I4-LMT-002 for the North Anna Power Station (North Anna) Unit 2.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(6)(i), the licensee requested relief from the required volumetric examination coverage of weld and to use alternative requirements (if necessary), for inservice inspection of welds identified in Relief Request N2-I4-LMT-002 on the basis that the ASME Code requirement is impractical.

Based on the review of the information, the U.S. Nuclear Regulatory Commission (NRC) 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. Therefore, the NRC staff grants RR N2-I4-LMT-002 at North Anna, Unit 2, for the fourth 10-year ISI interval which commenced on December 14, 2010, and will end on December 13, 2020, for the fourth 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,

Shawn Williams for

Robert J. Pascarelli, 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

RELIEF REQUEST N2-I4-LMT-002 REGARDING LIMITED EXAMINATION COVERAGE

VIRGINIA ELECTRIC AND POWER COMPANY – DOMINION

NORTH ANNA POWER STATION, UNIT 2

DOCKET NUMBER 50-339

INTRODUCTION

By letter dated April 21, 2014, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14115A066), as supplemented by letter dated August 26, 2014 (Accession No. ML14245A403), Virginia Electric and Power Company - Dominion (the licensee) requested relief from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (B&PV Code) for coverage of the examination volume of welds. The licensee submitted relief request N2-I4-LMT-002 for the North Anna Power Station (North Anna) Unit 2.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(6)(i), the licensee requested relief from the required volumetric examination coverage of weld and to use alternative requirements (if necessary), for inservice inspection of welds identified in Relief Request N2-I4-LMT-002 on the basis that the ASME Code requirement is impractical.

REGULATORY REQUIREMENTS

ASME Code Case N-460 "Alternative Examination Coverage for Class 1 and Class 2 Welds, Section XI, Division 1" allows a reduction in required 100 percent examination coverage on any Class 1 or Class 2 weld provided that the reduction in coverage for that weld is less than 10 percent (i.e., essentially 100 percent). The NRC accepted ASME Code Case N-460 in Regulatory Guide 1.147, Revision 16. The licensee requested relief from essentially 100 percent examination coverage as required in ASME Code Case N-460.

Pursuant to 10 CFR 50.55a(g)(4), the ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components.

Pursuant to 10 CFR 50.55a(g)(5)(iii), if the licensee has determined that conformance with certain ASME Code requirements is impractical for its facility, the licensee shall notify the Commission and submit, as specified in §50.4, information to support the determinations.

Pursuant to 10 CFR 50.55a(g)(6)(i), the Commission will evaluate determinations under paragraph (g)(5) of 10 CFR 50.55a that ASME 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 NRC to authorize the alternative requested by the licensee.

TECHNICAL EVALUATION

Relief Request N2-I4-LMT-002

Applicable Code Edition and Addenda

The code of record for the fourth 10-year ISI interval at North Anna, Unit 2, is the 2004 Edition with no Addenda of the ASME Code.

Duration of the Proposed Alternative

The licensee submitted Relief Request N2-I4-LMT-002 for the fourth 10-year ISI interval which commenced on December 14, 2010, and will end on December 13, 2020.

ASME Code Component Affected

The licensee identified the affected welds in Attachments A1, B1, B2, R1, and R2 to Relief Request N2-I4-LMT-002. They are discussed below.

Proposed Alternative and Basis for Use

A1. Pressurizer Nozzle-to-Vessel Welds
The components affected are ASME Code Class 1. In accordance with the ASME Code, Section XI, IWB-2500 and associated Table IWB-2500-1, these components are classified as Examination Category B-D, Item Number B3.110, pressurizer nozzle to vessel welds.

The licensee identified these welds as the pressurizer safety valve nozzle to vessel weld No. 10 (Line 2-RC-E-2) and the pressurizer spray nozzle to vessel weld No. 14 (Line 2-RC-E-2). The nozzles were constructed from carbon steel (SA-508, Class 2, P-Number 3, Group Number 3), with austenitic stainless steel inside diameter (ID) cladding and stainless steel inserts. The welds extended the full thickness of the pressurizer vessel. The pressurizer upper and lower heads were fabricated from carbon steel (SA-533, Grade A, Class 2). The nozzle-to-pressurizer upper and lower heads were welded with low alloy steel filler essentially the same as the nozzle material.

The ASME Code, Section XI, Table IWB-2500-1, Examination Category B-D, Item Number B3.110, requires volumetric examination of the pressurizer nozzle to vessel welds each inspection interval, and 100 percent coverage of the required examination volume. ASME

Code Case N-460 allows essentially 100 percent examination coverage on any Class 1 or Class 2 weld.

The licensee stated that the ultrasonic testing (UT) of weld No. 10 was limited to 56.6 percent coverage of the ASME Code required examination volume due to nozzle geometry and the cladding that prevented extended ultrasonic V-path. The UT of weld No. 14 was limited to 56.7 percent of the ASME Code required examination volume due to the weld location in relation to the nozzle. The licensee proposed the above alternative coverage in lieu of the required essentially 100 percent coverage of the examination volume.

The licensee stated that it conducted the UT from the outside diameter (OD) of the nozzle with the procedure developed in accordance with the ultrasonic examination requirements of Article 4, Section V of the ASME Code. The licensee used manual scanning. The licensee performed the volumetric examination to the extent possible. The licensee did not identify any recordable indications in these welds during volumetric examinations.

The licensee stated that although the UT scans were primarily limited to the vessel side only, studies have found that inspections conducted through carbon steel are equally effective whether the ultrasonic waves have to only propagate through the base metal or have to also propagate through the carbon steel weldment. Therefore, it is expected that due to the fine-grained carbon steel microstructures, the UT techniques employed would have detected structurally significant flaws that may have occurred on either side of the subject welds.

In the August 26, 2014 letter, the licensee stated that these welds have received visual examinations at the beginning of each refueling outage as part of the Boric Acid Corrosion Control Program, and the VT-2 visual examinations during system leakage testing each refueling outage.

B1. Head Circumferential Weld

The component affected is ASME Code Class 2. In accordance with the ASME Code, Section XI, IWC-2500 with associated Table IWC-2500-1, this component is classified as Examination Category C-A, Item Number C1.20, pressure vessel head circumferential weld.

The licensee identified this weld as the vessel lower head circumferential weld (weld number 1) of the boron injection tank. The boron injection tank head was constructed from carbon steel (ASTM A-516, Grade 70) with stainless steel cladding (ASTM A-240, Type 304L).

The ASME Code, Section XI, Table IWC-2500-1, Examination Category C-A, Item Number C1.20, requires volumetric examination of the pressure vessel head circumferential welds each inspection interval, and 100 percent coverage of the required examination volume. ASME Code Case N-460 allows essentially 100 percent examination coverage on any Class 1 or Class 2 weld.

The licensee stated that it is impractical to obtain the required examination coverage due to weld configuration, including pipe supports, thermocouples, and weld profile. Destruction of the component, including removal of welded pipe supports and thermocouples, would be necessary. The licensee noted that these changes would be considered a burden and the ASME Code volumetric examination coverage requirements are impractical.

The licensee stated that the UT of this weld (the full 165 inches of the weld length) was limited to 87.6 percent coverage of the ASME Code required 100 percent examination volume. The limited coverage was due to four supports obstructed eight inches of the weld length each, two installed thermocouples obstructed 1.8 inches of the weld length each, and 0.9 inch of the weld length obstructed by the weld profile. The licensee proposed the above alternative coverage in lieu of the required essentially 100 percent coverage of the examination volume.

The licensee stated that it performed the UT examinations manually from the OD surface of the tank with the procedure developed in accordance with Article 4, Section V of the ASME Code. The licensee performed the volumetric examination to the extent possible and did not identify any recordable indications.

In the August 26, 2014 letter, the licensee stated that this weld has received visual examinations at the beginning of each refueling outage as part of the Boric Acid Corrosion Control Program, and the VT-2 visual examinations during system leakage testing each inspection period.

B2. Nozzle to Shell Weld

The component affected is ASME Code Class 2. In accordance with the ASME Code, Section XI, IWC-2500 with associated Table IWC-2500-1, this component is classified as Examination Category C-B, Item Number C2.21, nozzle to shell weld.

The licensee identified this weld as the nozzle to vessel weld (weld number 3) of the boron injection tank. The boron injection tank head was constructed from carbon steel (ASTM A-516, Grade 70) with weld deposited stainless steel (ASTM A-240, Type 304L) clad. The nozzles were constructed from low alloy steel (ASTM A-508, Class 1) and cladded with stainless steel (ASTM A-240, Type 304L).

The ASME Code, Section XI, Table IWC-2500-1, Examination Category C-B, Item Number C2.21, requires volumetric and surface examinations of nozzle to shell welds each inspection interval, and 100 percent coverage of the required examination volume and surface. ASME Code Case N-460 allows essentially 100 percent examination coverage on any Class 1 or Class 2 weld.

The licensee stated that the UT of this weld was limited to 27.4 percent coverage of the ASME Code required examination volume due to nozzle to shell weld configuration and single side access to the weld. The licensee proposed the above alternative coverage in lieu of the required essentially 100 percent coverage of the examination volume.

The licensee stated that it conducted the UT manually from the OD surface of the nozzle with the procedure developed in accordance with Article 4, Section V of the ASME Code. The licensee performed the volumetric examination to the extent possible. The licensee did not identify any recordable indications during volumetric examinations.

The licensee stated that 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 volume coverage for this configuration. The licensee stated that the destruction of the component and requiring a completely different

design would be necessary to achieve essentially 100 percent coverage of the required examination volume.

The licensee stated that the ASME Code required surface examinations by the magnetic particle testing (MT) obtained essentially 100 percent coverage of the required examination surface. The inspection did not identify any recordable indications.

In the August 26, 2014 letter, the licensee stated that this weld has received visual examinations at the beginning of each refueling outage as part of the Boric Acid Corrosion Control Program, and the VT-2 visual examinations during system leakage testing each inspection period.

R1. Risk-Informed Piping Welds Subject to Thermal Fatigue

The components affected are ASME Code Class 1. In accordance with the NRC-approved North Anna risk informed (RI)-ISI program in the January 21, 2011, letter (ADAMS Accession No. ML110050003), these welds are classified in Table 1 of ASME Code Case N-716 "Alternative Piping Classification and Examination Requirements, Section XI, Division 1," as Examination Category R-A, Item Number R1.11. The North Anna RI-ISI program is based on the NRC-approved Electric Power Research Institute (EPRI) Technical Report (TR)-112657 Revision B-A, "Revised Risk-Informed Inservice Inspection (RI-ISI) Evaluation Procedure," (Accession No. ML013470102).

The licensee identified these welds as weld No. 2B (Line 6"-RC-420) of the reactor coolant system (RCS) at the nozzle from low head safety injection into the reactor coolant cold leg (27½"-RC-409), and weld No. 7 (Line 3-RC-615) of the RCS on the reactor coolant drain line off the crossover leg at valve 2-RC-HCV-2557A.

Weld No. 2B is in seamless stainless steel (Type 316) piping, with welding stainless steel (SFA 5.4 E316L-16, SFA 5.9 ER316L and/or SFA 5.30 1N316L) filler metal. Weld No. 7 is in seamless stainless steel (Type 316) piping, with welding stainless steel (SFA 5.4 E316L-16, SFA 5.9 ER316L, and/or SFA 5.30 1N316L) filler metal.

In accordance with the North Anna RI-ISI program, both welds were considered as high safety significant (HSS) and subject to possible degradation due to thermal fatigue.

The North Anna RI-ISI program, Examination Category R-A, Item Number R1.11, requires volumetric examination of elements subject to thermal fatigue, and 100 percent coverage of the required examination volume. ASME Code Case N-460 allows essentially 100 percent examination coverage on any Class 1 or Class 2 weld.

The licensee stated that the UT of the nozzle to pipe weld No. 2B was limited to 75.0 percent coverage of the ASME Code required examination volume due to the nozzle to pipe configuration. The licensee obtained additional "Best Effort" 4.0 percent coverage of the required examination volume with a 60-degree longitudinal search unit scanned from the upstream side. The licensee proposed the above alternative coverage in lieu of the required essentially 100 percent coverage. The licensee stated that it is impractical to meet essentially 100 percent coverage of the required examination volume due to the component (the nozzle to pipe weld) configuration limiting access to both sides of the weld. The examination was single sided and the licensee performed the scanning from upstream side of the weld. The licensee stated that it performed the volumetric examinations to the extent possible. The licensee did not

identify any recordable indications during volumetric examinations. In addition, this weld received augmented surface examination using the liquid penetrant testing (PT) and no indication was detected.

The licensee stated that the UT of the pipe to valve weld No. 7 was limited to 50.0 percent coverage of the ASME Code required examination volume due to the pipe to valve configuration. The licensee obtained additional "Best Effort" 9.0 percent coverage of the downstream side of the required examination volume with a 70-degree shear search unit scanned from the upstream (pipe) side. The licensee proposed the above alternative coverage in lieu of the required essentially 100 percent coverage. The licensee stated that it is impractical to meet essentially 100 percent coverage of the required examination volume due to component (pipe to valve weld) configuration limiting access. The examination was single sided and the licensee performed the scanning from upstream (pipe) side of the weld. The licensee stated that it performed the volumetric examinations to the extent possible. The licensee did not identify any recordable indications during volumetric examinations.

The licensee stated that it performed the UT manually from the OD surface with the procedures, equipment, and personnel qualified in accordance with Supplement 2 to Appendix VIII, Section XI of the ASME Code.

The licensee explained that the physical configuration of the nozzle to pipe weld and the pipe to valve weld confines inspection capabilities. No further actions can enable better examination coverage without destroying the component. Based on access and physical limitations of these welds, alternative or other advanced technologies would not have provided additional coverage of the examination volume at the time of the examinations performed.

The licensee stated that both welds have received visual examinations at the beginning of each refueling outage as part of the Boric Acid Corrosion Control Program, and the VT-2 visual examinations at the end of the refueling outage once operating pressure and temperature is achieved before unit startup.

R2. Risk-Informed Piping Welds not Subject to a Degradation Mechanism

The components affected are ASME Code Class 1 and non-Class welds. In accordance with the NRC-approved North Anna RI-ISI program, these welds are classified in Table 1 of ASME Code Case N-716, as Examination Category R-A, Item Number R1.20. These welds are as follows:

Weld No. SW-5 (32-SHP-459) classified as non-class, is a main steam pipe to header weld of the main steam system. The configuration is a mitered shop weld from the 32-inch piping (carbon steel, A155EFW, CLI, CMS 75) to the horizontal 40-inch main steam header (carbon steel, A155EFW, CLI, KC 70). In accordance with the North Anna RI-ISI program, this weld is considered as HSS (break exclusion region) and volumetric examination is required.

Weld No. 4 (6-RC-416) classified as Class 1, is a 45 degree elbow to branch connection weldolet of the RCS. The configuration is a 45 degree seamless stainless steel elbow to branch connection stainless steel weldolet, A-403-WP316, Schedule 160 seamless stainless steel fitting with welding filler metal SFA 5.4 E316L-16, SFA 5.9 ER316L, and/or SFA 5.30 1N316L, and the weldolet A-403-WP316 stainless steel.

Weld No. 6A (3-CH-814), classified as a Class 1 component, is a 3-inch check valve to elbow weld in the pressurizer auxiliary spray piping of the chemical and volume control system. Weld No. 6A configuration is a 3-inch check valve to elbow weld in the pressurizer auxiliary spray piping. This weld connects A403-WP316 Schedule 160 components, with welding filler metal (stainless steel SFA 5.4 E316L-16, SFA 5.9 ER316L, and/or SFA 5.30 1N316L).

In accordance with the North Anna RI-ISI program, these three welds were considered as HSS; however, no possible degradation mechanisms have been identified.

The North Anna RI-ISI program, Examination Category R-A, Item Number R1.20, requires 100 percent coverage of the examination volume. ASME Code Case N-460 allows essentially 100 percent examination coverage on any Class 1 or Class 2 weld.

The licensee stated that the UT of weld No. SW-5 was limited to 75.0 percent coverage of the ASME Code required examination volume due to the right angle between the pipe and the header. The licensee proposed the above alternative coverage in lieu of the required essentially 100 percent coverage. The licensee stated that it is impractical to meet essentially 100 percent coverage of the required examination volume due to limitations existed at the sides where the angle between the pipe and the header is at right angles. The licensee obtained full coverage at the top and bottom of the welds, but at the sides where the angle between the pipe and the header is at right angles, the licensee achieved no coverage. The licensee conducted the UT manually from the OD surface with the procedures, equipment, and personnel qualified in accordance with the performance demonstration requirements of Supplement 3 to Appendix VIII, Section XI of the ASME Code. The licensee performed the volumetric examination to the extent possible.

The UT identified two recordable indications in weld No. SW-5. The licensee evaluated the first indication in accordance with the ASME Code, Section XI, Table IWB-3514-1, and found acceptable. The licensee evaluated the second indication in accordance with the ASME Code, Section XI, Appendix VIII qualified procedure utilized for the examination, and determined it as inner diameter geometry. In the August 26, 2014 letter, the licensee stated that weld No. SW-5 (32-SHP-459) has been examined as part of the augmented inspection program in 1989 and 2002 as a non-classed Main Steam Postulated Break Location, using both surface and volumetric examinations. During previous inspections, the licensee identified the above indications, the first indication was below the reporting thresholds and the second was the geometry indication. There is no construction radiographs available because weld No. SW-5 is in a non-class section of piping. Based on review by licensee's qualified NDE personnel, no change in indication size has been identified from previous examinations. Weld No. SW-5 has received, and will continue to receive, augmented surface examination using magnetic particle testing (MT). The licensee did not identify any reportable indications in weld No. SW-5 by MT.

In addition, weld No. SW-5 receives regular walk down monitoring during normal operator rounds.

The licensee stated that the UT of weld No. 4 was limited to 75.0 percent coverage of the ASME Code required examination volume due pipe to weldolet configuration. The licensee obtained additional "Best Effort" 5.0 percent coverage of the required examination volume in the downstream side of the weld with a 60-degree longitudinal search unit. The cast nozzle configuration permits a weldolet side circumferential scans and the licensee obtained full

coverage. The licensee proposed the above alternative coverage in lieu of the required essentially 100 percent coverage. The licensee stated that it is impractical to meet essentially 100 percent coverage of the required examination volume due to component (pipe to weldolet to elbow) configuration limiting access. The examination was single sided and the licensee performed the scanning from upstream side of the weld. The licensee performed the volumetric examinations to the extent possible. The licensee conducted the UT manually from the OD surface with the procedures, equipment, and personnel qualified in accordance with the performance demonstration requirements of Supplement 2 to Appendix VIII, Section XI of the ASME Code. The licensee did not identify any recordable indications. This weld received augmented surface examination using the liquid PT and the licensee did not identify any indications.

The licensee stated that the UT of weld No. 6A was limited to 50.0 percent coverage of the ASME Code required examination volume due valve to elbow weld configuration. The licensee obtained additional "Best Effort" 1.5 percent coverage of the required examination volume in the upstream side of the weld with a 60-degree longitudinal search unit. The coverage was limited to the downstream side because of the pipe to weldolet configuration. The licensee proposed the above alternative coverage in lieu of the required essentially 100 percent coverage. The licensee stated that it is impractical to meet essentially 100 percent coverage of the required examination volume due to component (valve to elbow) configuration limiting access to upstream side of the weld. The examination was single sided. The licensee performed the volumetric examinations to the extent possible. The licensee conducted the UT manually from the OD surface with the procedures, equipment, and personnel qualified in accordance with the performance demonstration requirements of Supplement 2 to Appendix VIII, ASME Code, Section XI. The licensee did not identify any recordable indications. In addition, this weld received augmented surface examination using the liquid PT and the licensee did not identify any indications.

Furthermore, welds No. 4 and No. 6A are included in the Class 1 pressure boundary, receiving visual examinations at the beginning of each refueling outage as part of the Boric Acid Corrosion Control Program, and VT-2 visual examinations at the end of the refueling outage once operating pressure and temperature is achieved before unit startup.

NRC Staff Evaluation

The NRC staff has evaluated Relief Request N2-I4-LMT-002 pursuant to 10 CFR 50.55a(g)(6)(i). The NRC staff focuses on whether a technical justification exists to support the determination that the ASME Code requirement is impractical, imposing the requirements could result a burden upon the facility, and the structural integrity or leak tightness of component is reasonably assured.

A1. Pressurizer Nozzle to Vessel Welds

As described in Attachment A1 and demonstrated in Enclosure A1-1 and A1-2 to Relief Request N2-I4-LMT-002, the predominant limitations that prevented the licensee's UT to achieve essentially 100 percent coverage of the ASME Code required volume were the nozzle geometry and cladding for weld No. 10 (2-RC-E-2), and the weld location in relation to the nozzle for weld No. 14 (2-RC-E-2). The licensee performed the UT by scanning the welds primarily from the pressurizer side due to design configuration limiting access from nozzle side. The NRC staff confirms that the design configurations of these welds would limit the effectiveness of alternative

(or advanced UT) technologies from increasing the coverage of the examination volume. To effectively increase the examination coverage, the licensee would have to make major design modifications or replace the components. Therefore, the NRC staff finds that a technical justification exists to support the determination that achieving essentially 100 percent coverage is impractical and if the requirements were imposed on the facility, these welds would require major design changes and components replacement which would be a burden upon the licensee.

From review of Enclosure A1-1 through A1-2 to relief request, the NRC staff confirms that the licensee's proposed volumetric inspection achieved 56.6 percent coverage of the ASME Code required examination volume for weld No. 10 and 56.7 percent coverage for weld No. 14. The coverage obtained represents the aggregate coverage of the required UT performed (axial and circumferential directions combined). The NRC staff finds that the licensee performed the UT with the procedure developed in accordance with Article 4, Section V of the ASME Code, Section XI. From review of the scan plots in Enclosure A1-1 and A1-2 of the relief request and the August 26, 2014 letter, the NRC staff verified that the volumes scanned by the UT included the weld root and the heat affected zone (HAZ) of the base materials near the inside diameter (ID) surface of the joint that are typically susceptible to higher stresses and, therefore, potential degradation. The licensee did not identify any unacceptable indications in the volume examined. The NRC staff confirms that in carbon steel materials, the one sided scanning is effective in detecting flaws, should they exist, on either side of the welds and the HAZ of base materials. The NRC staff confirms that considering the above existing limitations (physical access and design configuration), use of alternative (or advanced UT) technologies would not be effective in increasing the examination coverage. Therefore, the NRC staff determines that based on the coverage obtained, considering the licensee's UT procedures and performance, and its efforts to maximize the 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 the licensee performed.

The NRC staff notes that the licensee volumetrically examined these welds in the second and third 10-year ISI intervals, obtained similar coverage, and found no unacceptable indications in the volume covered. This provides additional assurance that any pattern of degradation in these weld, if it were to occur, would be detected.

The NRC staff finds that, despite reduced coverage of the examination volume, the licensee's visual examinations performed at the beginning of each refueling outage as part of its Boric Acid Corrosion Control Program, and during the ASME Code system leakage testing in accordance with the ASME Code, Section XI, IWB-5000 every refueling outage will provide additional assurance that any pattern of degradation in these welds, if it were to occur, would be detected.

Therefore, the NRC staff finds that the volumetric examinations performed to the extent possible and accompanied by other examinations (visual, augmented, and regular walk down) provides a reasonable assurance of structural integrity and leak tightness of the subject welds. Compliance with the coverage requirement for these welds would be a burden upon the licensee.

B1. Head Circumferential Weld (Weld No. 1)

As described in Attachment B1 and demonstrated in Enclosure B1-1 to the relief request, the predominant limitations that prevented the licensee's UT to achieve essentially 100 percent

coverage of the ASME Code required volume were the weld and component configuration including supports, thermocouples, and weld profile. Each of the four supports obstructs eight inches of weld length, each of the two installed thermocouples obstructs 1.8 inches of weld length, and weld profile obstructs 0.9 inch of weld length. The NRC staff confirms that the design configurations of this weld would limit the effectiveness of alternative (or advanced UT) technologies from increasing the coverage of the examination volume. To effectively increase the examination coverage, the licensee would have to make major design modifications or replace the components. Thus, the NRC staff finds that a technical justification exists to support the determination that achieving the required essentially 100 percent coverage is impractical and if the requirements were imposed on the facility, this weld would require major design modifications and replacement which would be a burden upon the licensee.

From review of Enclosure B1-1 to the relief request, the NRC staff confirms that the licensee's proposed volumetric inspection achieved 87.6 percent coverage of the ASME Code required examination volume for the subject weld. The coverage obtained represents the aggregate coverage of the required UT performed (axial and circumferential directions combined). The licensee performed the UT with the procedure developed in accordance with Article 4, Section V of the ASME Code, Section XI. The NRC staff verified that the volumes scanned included the weld metal and the HAZ of the base materials to the extent possible. The licensee did not detect any unacceptable indications in the volume examined. The NRC staff confirms that the physical access and the design configuration would limit the effectiveness of alternative (or advanced UT) technologies from increasing the coverage of the examination volume. Therefore, the NRC staff determines that based on the coverage obtained, considering the licensee's UT procedures and performance, and its efforts to maximize the 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 the licensee performed.

The NRC staff finds that, despite reduced coverage of the examination volume, the licensee has performed the visual examination of this weld as part of its Boric Acid Corrosion Control Program, and the ASME Code required system leakage testing in accordance with the ASME Code, Section XI, IWC-5000 every inspection period. These supplemental and other examinations will provide additional assurance that any pattern of degradation in this weld, if it were to occur, would be detected.

Furthermore, the NRC staff notes that the licensee has scheduled one additional weld on the boron injection tank for inspection during the fourth 10-year ISI interval. The selection of additional similar weld to examine will provide additional assurance that any pattern of degradation in the subject weld, if it were to occur, would be detected.

Therefore, the NRC staff finds that the volumetric examinations performed to the extent possible and accompanied by other inspections (visual) provides a reasonable assurance of structural integrity and leak tightness of the subject weld. Compliance with the coverage requirement for this weld would be a burden upon the licensee.

B2. Nozzle to Shell Weld (Weld No. 3)

As described in Attachment B2 and demonstrated in Enclosure B2-1 to the relief request, the predominant limitations that prevented the licensee's UT to achieve essentially 100 percent coverage of the ASME Code required volume was the nozzle to shell weld configuration (the nozzle bend radius) on the boron injection tank. The licensee performed the UT by scanning

the weld primarily from the upstream side (shell side). The nozzle's close proximity to the weld and the nozzle blend radius causing lift-off of the search unit limited scanning from the nozzle side. The NRC staff confirms that the design configurations of this weld would limit the effectiveness of alternative (or advanced UT) technologies from increasing the coverage of the examination volume. To effectively increase the examination coverage, the licensee would have to make major design modifications or replace the components. Therefore, the NRC staff finds that a technical justification exists to support the determination that the ASME Code required coverage is impractical and if the requirements were imposed on the facility, this weld would require major design modifications and replacement which would be a burden upon the licensee.

From review of Enclosure B2-1 to the relief request, the NRC staff confirms that the licensee's proposed volumetric inspection achieved 27.4 percent coverage of the ASME Code required examination volume. The coverage obtained represents the aggregate coverage of the ASME Code required UT performed (axial and circumferential directions combined). The NRC staff finds that the licensee performed the UT with the procedure developed in accordance with Article 4, Section V of the ASME Code, Section XI. The NRC staff verified that the volumes scanned by the UT included, to the extent possible, the weld root and the HAZ of the base material near the ID surface of the joint that are typically susceptible to higher stresses and, therefore, potential degradation. The licensee did not identify any unacceptable indications during volumetric examinations. Therefore, the NRC staff determines that based on the coverage obtained, considering the licensee's UT procedures and performance, and its efforts to maximize the 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 the licensee performed.

The NRC staff finds that, in addition to the volumetric examinations, the licensee performed the required surface examination using MT, and achieved essentially 100 percent coverage of the ASME Code required surface area of the weld. The licensee did not identify any unacceptable surface indications.

The NRC staff notes that the licensee volumetrically examined weld No. 3 in the third 10-year ISI interval, obtained similar coverage, and found no unacceptable indications. The licensee has scheduled additional two components (similar welds) in this Category C-B, Item No. C2.21, to be examined in the fourth 10-year ISI interval. During previous examinations of welds at these locations, the licensee obtained full coverage and found no unacceptable indications. The examination history of weld No. 3 and the selection of additional similar welds for inspection will provide additional assurance that any pattern of degradation in this weld, if it were to occur, would be detected.

The NRC staff finds that, despite reduced coverage of the examination volume, the licensee has performed the visual examination of this weld as part of its Boric Acid Corrosion Control Program, and the ASME Code required system leakage testing in accordance with IWC-5000 every inspection period. These supplemental and other examinations will provide additional assurance that any pattern of degradation in this weld, if it were to occur, would be detected.

The NRC staff notes that the fatigue could be the potential degradation mechanism for carbon steel weld in this type of configuration, however, fatigue crack is known to have relatively slow growth. Significant degradation due to fatigue would likely be detected by the volume covered.

Therefore, the NRC staff finds that the volumetric examination performed to the extent possible in conjunction with the required surface examinations and accompanied by other inspections (visual), provide a reasonable assurance of structural integrity and leak tightness of the subject weld. Compliance with the ASME Code requirements for this weld would be a burden upon the licensee.

R1. Risk-Informed Piping Welds Subject to Thermal Fatigue

As described in Attachment R1 and demonstrated in Enclosure R1-1 and R1-2 to the relief request, the predominant limitations that prevented the licensee's UT to achieve essentially 100 percent coverage of the ASME Code required volume were the nozzle to pipe configuration for weld No. 2B (6-RC-420) and the pipe to valve configuration for weld No. 7 (3-RC-615). The licensee performed primarily the single sided UT due to the single sided access to these welds. For weld No. 2B, the limitations prevented downstream side axial coverage. For weld No. 7, the limitations prevented downstream side axial and circumferential coverage. The NRC staff confirms that the design configurations of these welds would limit the effectiveness of alternative (or advanced UT) technologies from increasing the coverage of the examination volume. To effectively increase the examination coverage, the licensee would have to make major design modifications or replace the components. Therefore, the NRC staff finds that a technical justification exists to support the determination that the required examination coverage is impractical and if the requirements were imposed on the facility, these welds would require major design modifications and replacement which would be a burden upon the licensee.

The NRC staff confirms that the licensee's proposed volumetric inspection achieved 75.0 percent coverage of the ASME Code required examination volume for weld No. 2B, and 50.0 percent coverage for weld No. 7. The coverage obtained represents the aggregate coverage of the ASME Code required UT performed (axial and circumferential directions combined) for each weld. The licensee performed the UT with the procedure developed and qualified in accordance with Supplement 2 (austenitic piping welds) to Appendix VIII to the ASME Code, Section XI. The NRC staff notes that the coverage obtained for axial scans was limited to the volume up to the weld centerline (near-side), because claiming coverage for the volume on the opposite side of the weld centerline (far-side) requires meeting the 10 CFR 50.55a(b)(2)(xv)(A)(2) far-side UT qualifications, which has not been demonstrated in any qualification attempts to date. As an extra effort to interrogate the examination volume on the far-side in a single-sided examination, the licensee conducted a supplemental UT. From the supplemental UT, the licensee obtained additional ("Best Effort") coverage of 4.0 percent for weld No. 2B (6-RC-420) and 9.0 percent for weld No. 7 (3-RC-615) that represent the far-side examination volume that does not meet the requirements of 10 CFR 50.55a(b)(2)(xv)(A)(2); therefore, it is not included in the aggregate coverage. The NRC staff confirms that the physical access, the design configuration, and the material type would limit the effectiveness of alternative (or advanced UT) technologies from increasing the coverage of the examination volume.

The NRC staff verified that the licensee's UT has covered, to the extent possible, the regions (i.e., the weld root and HAZ of the base material near the ID surface of the joint) that are typically susceptible to higher stresses and, therefore, potential degradation. The licensee did not identify any unacceptable indications in any of the welds during volumetric examinations. Therefore, the NRC staff determines that based on the coverage achieved by the qualified UT, the additional "Best Effort" coverage obtained, and the examination of the weld root and its HAZ to the extent possible, it is reasonable to conclude that if significant service induced degradation

had occurred, evidence of it would have been detected by the examinations that the licensee performed.

The NRC staff finds that, in addition to the volumetric examinations, these welds have received the visual examinations at the beginning of each refueling outage as part of the Boric Acid Corrosion Control Program, and the system leakage test accompanied by the VT-2 visual examinations in accordance with the ASME Code, Section XI, IWB-5000 at the end of each refueling outage. In addition, weld No. 2B received surface examination using PT and the licensee did not identify any unacceptable surface indications. Despite reduced coverage of the required examination volume, the NRC staff finds that the licensee's supplemental and other inspections will provide additional assurance that any pattern of degradation, if it were to occur, would be detected and the licensee will take appropriate correction actions.

These welds and piping are governed by the NRC-approved North Anna RI-ISI program, and identified as susceptible to potential thermal fatigue degradation. The NRC staff notes that experience has shown that thermal fatigue crack tends to grow relatively slow and significant degradation due to thermal fatigue would likely be detected by the volume covered in the licensee's UT examinations.

Therefore, the NRC staff finds that the volumetric examinations performed to the extent possible and accompanied with supplemental examinations provide a reasonable assurance of structural integrity and leak tightness of the subject welds. Compliance with the ASME Code requirements for these welds would be a burden upon the licensee.

R2. Risk-Informed Piping Welds not Subject to a Degradation Mechanism

As described in Attachment R2 and demonstrated in Enclosure R2-1 through R2-3 to the relief request, the predominant limitations that prevented the licensee's UT to achieve essentially 100 percent coverage of the ASME Code required volume were the right angle between the pipe and header for weld No. SW-5 (32-SHP-459), the pipe to weldolet to elbow configurations for weld No. 4 (6-RC-416), and the valve to elbow configuration for weld No. 6A (3-CH-814). The licensee performed primarily single sided UT due to the single sided access to these welds. For weld No. SW-5, the limitations prevented downstream side circumferential coverage. For weld No. 4, the limitations prevented downstream side axial coverage. For weld No. 6A, the limitation prevented upstream side axial and circumferential coverage. The NRC staff confirms that the design configurations of these welds would limit the effectiveness of alternative (or advanced UT) technologies from increasing the coverage of the examination volume. To effectively increase the examination coverage, the licensee would have to make major design modifications or replace the components. Therefore, the NRC staff finds that a technical justification exists to support the determination that the ASME Code required coverage is impractical and if the requirements were imposed on the facility, these welds would require major design modifications and replacement which would be a burden upon the licensee.

From review of Enclosure R2-1 through R2-3 to the relief request, the NRC staff confirms that the licensee's proposed volumetric inspection achieved 75.0 percent coverage of the ASME Code required examination volume for weld No. SW-5, 75.0 percent for weld No. 4, and 42.3 percent for weld No. 6A. The coverage obtained represents the aggregate coverage of the ASME Code required UT performed (axial and circumferential directions combined) for each weld. The licensee performed the UT with the procedure developed and qualified in accordance with Supplement 2 (austenitic piping welds) and Supplement 3 (ferritic piping welds) to

Appendix VIII of the ASME Code, Section XI. The NRC staff notes that the coverage obtained for axial scans was limited to the volume up to the weld centerline (near-side), because claiming coverage for the volume on the opposite side of the weld centerline (far-side) requires meeting the 10 CFR 50.55a(b)(2)(xv)(A)(2) far-side UT qualifications, which has not been demonstrated in any qualification attempts to date. As an extra effort to interrogate the examination volume on the far-side in a single-sided examination, the licensee conducted a supplemental UT using the 60 degree refracted longitudinal waves. The NRC staff notes that the 60 degree refracted longitudinal waves have better penetration capability in austenitic steel materials. From the supplemental UT, the licensee obtained additional ("Best Effort") coverage of 5.0 percent for weld No. 4 and 1.5 percent for weld No. 6A that represent the far-side examination volume that does not meet the requirements of 10 CFR 50.55a(b)(2)(xv)(A)(2), therefore, it is not included in the aggregate coverage. The NRC staff confirms that the physical access, the design configuration, and the material type would limit the effectiveness of alternative (or advanced UT) technologies from increasing the coverage of the examination volume.

The NRC staff verified that the licensee's UT has covered, to the extent possible, the weld root and HAZ of the base material near the ID surface of the joint that are typically susceptible to higher stresses and, therefore, potential degradation. The licensee did not identify any unacceptable indications in any of these welds during volumetric examinations. Therefore, the NRC staff determines that based on the coverage achieved by the qualified UT and accompanied with the "Best Effort" coverage of the far-side, and the examination of the weld root and its HAZ to the extent possible, it is reasonable to conclude that if significant service induced degradation had occurred, evidence of it would have been detected by the examinations that the licensee performed.

The NRC staff finds that, in addition to the volumetric examinations, weld No. 4 and weld No. 6A have received the visual examination at the beginning of each refueling outage as part of the Boric Acid Corrosion Control Program, and the system leakage testing accompanied by the VT-2 visual examinations in accordance with the ASME Code, Section XI, IWB-5000 at the end of each refueling outage. Weld No. SW-5 has received the surface examination (MT) with full coverage and no identifiable indications under the Augmented Inspection Program for Main Steam System Postulated Break Locations, and regular walk down during normal operator rounds. Despite reduced coverage of the required examination volume, the NRC staff finds that the licensee's augmented and other inspections will provide additional assurance that any pattern of degradation, if it were to occur, would be detected and the licensee will take appropriate correction actions.

These welds and piping are governed by the NRC approved North Anna RI-ISI program, and no known active degradation mechanisms have been identified. The NRC staff notes that the likelihood of occurrence of loads greatly in excess of the design basis loads and the effect of stress concentrations (the only known failure mode) in these welds and piping are inherently considered in their design with safety margins.

Therefore, the NRC staff finds that the volumetric examinations performed to the extent possible accompanied by augmented and supplemental examinations provide a reasonable assurance of structural integrity and leak tightness of the subject welds. Compliance with the ASME Code requirements for these welds would be a burden upon the licensee.

CONCLUSION

As set forth above, the NRC staff determines that it is impractical for the licensee to comply with the ASME Code, Section XI requirement. The NRC staff also determines that the extent of volumetric examinations accompanied with other examinations (visual, augmented, and walk down) provide reasonable assurance of structural integrity and leak tightness of the subject welds. Granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. 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 the use of Relief Request N2-I4-LMT-002 at North Anna, Unit 2, for the fourth 10-year ISI interval which commenced on December 14, 2010, and will end on December 13, 2020.

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

Principal Contributor: Ali Rezai, NRR

Date: February 3, 2015

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

Sincerely,

/RA/ Shawn Williams for

Robert J. Pascarelli, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-339

Enclosure:
Safety Evaluation

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