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

January 10, 2018

Mr. Daniel G. Stoddard
Senior Vice President and Chief Nuclear Officer
Innsbrook Technical Center
5000 Dominion Blvd.
Glen Allen, VA 23060

SUBJECT: NORTH ANNA POWER STATION, UNIT NO. 1, RELIEF REQUEST (RR) N1-I4-LMT-002, LIMITED COVERAGE EXAMINATIONS FOR THE FOURTH TEN-YEAR INSPECTION INTERVAL (CAC NO. MF9689, EPID L-2017-LLR-0024)

Dear Mr. Stoddard:

By letter dated April 24, 2017, (Agencywide Documents Access & Management System (ADAMS) Accession No. ML17121A036), Virginia Electric and Power Company (Dominion or the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for relief from certain American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (B&PV Code), Section XI requirements at North Anna Power Station Unit No. 1.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(5)(iii), the licensee requested relief from the required volumetric examination coverage and to use alternative requirements (if necessary), for inservice inspection (ISI) of those welds identified in Relief Request N1-I4-LMT-002 on the basis that the ASME Code requirement is impractical.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, 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 giving 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 N1-I4-LMT-002 at North Anna, Unit No. 1, for the fourth 10-year ISI interval, which commenced on May 1, 2009 and will end on April 30, 2019.

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, please contact the NRC Project Manager, Randy Hall, at 301-415-4032 or via e-mail at Randy.Hall@nrc.gov.

Sincerely,

Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-338

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST N1-I4-LMT-002 REGARDING LIMITED EXAMINATION COVERAGE

FOURTH TEN-YEAR INSERVICE INSPECTION INTERVAL

VIRGINIA ELECTRIC AND POWER COMPANY

NORTH ANNA POWER STATION, UNIT NO. 1

DOCKET NO. 50-338

1.0 INTRODUCTION

By letter dated April 24, 2017, (Agencywide Documents Access & Management System (ADAMS) Accession No. ML17121A036), Virginia Electric and Power Company (Dominion or the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for relief from certain American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (B&PV Code), Section XI requirements at North Anna Power Station (NAPS) Unit No. 1.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(5)(iii), the licensee requested relief from the required volumetric examination coverage and to use alternative requirements (if necessary), for inservice inspection (ISI) of those welds identified in Relief Request (RR) N1-I4-LMT-002 on the basis that the ASME Code requirement is impractical.

2.0 REGULATORY EVALUATION

The NRC staff finds the following requirements applicable for the review of the licensee's relief request. 10 CFR 50.55a(g), "Inservice inspection requirements," states, in part:

> Systems and components of boiling and pressurized water-cooled nuclear power reactors must meet the requirements of the ASME BPV Code as specified in this paragraph. Each operating license for a boiling or pressurized water-cooled nuclear facility is subject to the following conditions.

Paragraph 10 CFR 50.55a(g)(4), "Inservice inspection standards requirement for operating plants," states, in part:

> [C]omponents (including supports) that are classified as ASME Code Class 1, Class 2, and Class 3 must meet the requirements, except design and access provisions and preservice examination requirements, set forth in Section XI of editions and addenda of

> the ASME BPV Code...to the extent practical within the limitations of design, geometry, and materials of construction of the components.

Paragraph 10 CFR 50.55a(g)(5)(iii), "ISI program update: Notification of impractical ISI Code requirements," states:

> If the licensee has determined that conformance with a Code requirement is impractical for its facility the licensee must notify the NRC and submit, as specified in § 50.4, information to support the determinations. Determinations of impracticality in accordance with this section must be based on the demonstrated limitations experienced when attempting to comply with the Code requirements during the inservice inspection interval for which the request is being submitted. Requests for relief made in accordance with this section must be submitted to the NRC no later than 12 months after the expiration of the initial or subsequent 120-month inspection interval for which relief is sought.

Paragraph 10 CFR 50.55a(g)(6)(i), "Impractical ISI requirements: Granting of relief," states:

> 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 are authorized by law, and will not endanger life or property or the common defense and security, and are 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.

Pursuant to 10 CFR 50.55a(g)(5)(iii), Dominion has requested relief from the requirements of 10 CFR 50.55a, "Codes and standards," for the fourth 10-year ISI interval for NAPS Unit No. 1, on the basis that compliance with the ASME Code requirements is impractical due to physical obstructions and limitations due to design and geometry of the applicable weld joints

3.0 TECHNICAL EVALUATION

The ASME Code of record for NAPS Unit No. 1 during the fourth 10-year ISI interval is the 2004 Edition of Section XI of the ASME Code with no Addenda. The fourth 10-year ISI interval for NAPS Unit No. 1 commenced in May 1, 2009, and ends on April 30, 2019.

3.1 Applicable ASME Code Requirements

3.1.1 ASME Code Class 1 Piping Weld Requirements

The examination requirements for the pressure retaining piping welds for which the licensee is seeking relief are described in the NAPS Unit No. 1, Risk-Informed ISI (RI-ISI) Program, as approved by the NRC in a letter dated on January 21, 2011 (ADAMS Accession No. ML110050003).

Welds in Examination Category R-A, Item Number R1.11 of the RI-ISI program are required to be volumetrically examined in the circumferential direction to "essentially 100 percent" of the piping weld volume. The term "Essentially 100 percent," as clarified by ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds," is defined as "greater than 90 percent" coverage of the examination volume or surface area, as applicable. ASME Code Case N-460 has been unconditionally approved and included in NRC Regulatory

Guide 1.147, Revision 17, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," (ADAMS Accession No. ML13339A689). The examination volumes of these piping welds are defined in ASME Code, Section XI, Figures IWB-2500-8(c), IWB-2500-9, IWB-2500-10, and IWB-2500-11.

Additionally, pursuant to 10 CFR 50.55a(b)(2)(xv)(A)(1) and 10 CFR 50.55a(b)(2)(xv)(A)(2), all piping must be examined in two axial directions. When examination in the circumferential direction is required, the circumferential examination must be performed in two directions, provided access is available. Where examination from both sides is not possible for austenitic welds, full coverage credit from a single side of the weld may be claimed only after successfully completing a single-sided, Section XI Appendix VIII demonstration, using flaws on the opposite side of the weld.

Reactor coolant system components for which relief is requested are identified in the table below, along with a description of the limitation and the actual examination coverage obtained.

	Table 1 – Examination Category R-A Welds with Limited Volumetric Coverage				
Item No.	**Weld Identification RC System**	**Limitation Coverage**	**Pipe Size (inch)**	**Material 1 (Component)**	**Meterial 2 (Component)**
R1.11	2 (6"-RC-18) Low Head Safety Injection	Single sided Valve-to-Pipe, 50% coverage	6	Austenitic SS Check Valve	Type 316 SS 0.719" (pipe)
R1.11	13 (6"-RC-19) Low Head Safety Injection	Single sided Valve-to-Pipe, 50% coverage	6	Austenitic SS Check Valve	Type 316 SS 0.719" (pipe)
R1.11	14 (6"-RC-19) Low Head Safety Injection	Single sided Elbow-to-Branch, 50% coverage	6	Type 316 SS 0.719" (pipe)	Austenitic SS (Weldolet)
R1.11	SW-1 (3"-CH-1) Regenerative Heat Exchanger	Obstruction Elbow-to-Pipe, 88% coverage	3	Type 316 SS 0.438" (elbow)	Type 316 SS 0.438" (pipe)

3.1.2 ASME Code Class 1 Vessel Weld Requirements

Table IWB-2500-1, Category B-D, Item B3.110 of Section XI of the ASME Code, requires that pressurizer nozzle-to-vessel welds be volumetrically examined once during each ISI interval. Essentially 100 percent of the weld and adjacent base material is to be examined in accordance with the requirements of I-2100 of Appendix I, "Ultrasonic Examinations," Section XI. The licensee invoked the use of ASME Code Case N-460, and therefore, relief was only requested for components obtaining less than 90 percent coverage of the weld volume. The applicable examination volume is defined by Section XI, Figure IWB-2500-7(b). The examination is to be

performed per the rules of ASME Section V, Article 4, "Ultrasonic Examination Methods for Welds."

The following table lists the two affected pressurizer nozzle-to-vessel welds and the combined examination coverages achieved by the licensee.

Table 2 – Examination Category B-D Welds with Limited Volumetric Coverage			
ASME Code Category	**ASME Code Item**	**Component ID Number**	**ASME Code Coverage Obtained**
B-D	B3.110	11715-WMKS-RC-E-2/1-RC-E-2/11	78.36%
B-D	B3.110	11715-WMKS-RC-E-2/1-RC-E-2/12	78.36%

3.2 Proposed Alternative

3.2.1 Relief for Class 1 Piping Welds

As stated by the licensee and summarized in Table 1, "Examination Category R-A Welds with Limited Volumetric Coverage," Dominion was not able to achieve the required examination coverage (i.e., greater than 90 percent) for the ASME Examination Category R-A specified welds due to limitations posed by the design and configuration of the affected components. The licensee also stated that the ultrasonic examinations were performed manually using procedures qualified in accordance with ASME Section XI, Appendix VIII, as implemented by performance demonstration initiative (PDI) qualified procedures.

The welds in Table 1 identified as 2 (6"-RC-19), 13 (6"-RC-19), and 14 (6"-RC-19) are austenitic stainless steel piping welds, and due to access and physical obstructions, were limited to only an examination from a single side. Consequently, the volumetric examination coverage achieved for these welds was 50 percent. Dominion stated that the only recordable indication identified from these examinations was in weld 14 (6"-RC-19). This indication was confirmed to be due to the geometry of the weld counter bore. Additionally, the examinations for weld SW-1 (3"-CH-1) were partially obstructed from the elbow side due to the presence of a permanent nameplate. As a result, the licensee was able to achieve only 88 percent coverage for this location.

The licensee stated that the subject welds are included in the ASME Code Class 1 pressure boundary and are subject to visual examination during leakage testing at the end of the refueling outage when the piping is at operating pressure and temperature. The licensee also stated that these welds are included within the boric acid corrosion control program inspection boundaries. The licensee's proposed alternative is for the examinations already completed at the reduced coverage to be accepted for meeting the Code requirements.

Pursuant to 10 CFR 50.55a(g)(5)(iii), the licensee requested that the proposed alternative be authorized for the fourth ten-year ISI interval at NAPS Unit No. 1.

3.2.2 Relief for Class 1 Vessel Welds

The licensee stated that ultrasonic examinations of the two subject pressurizer nozzle-to-vessel welds were limited due to the components' geometric configuration. The examinations were

performed in accordance with ASME Code, Section V, Article 4. The ASME Code requires that exams be performed from both sides of the pressure retaining welds, however, the configuration limits the ultrasonic exams primarily to one side of these welds. This configuration also precludes advanced or alternative technologies from being pertormed to obtain further examination coverage. Obtaining additional coverage would require redesign or replacement of the component.

The licensee proposed that the examinations already completed be considered acceptable for meeting the ASME Code requirements, on the basis that the examinations were performed to the maximum extent practical, no further coverage is possible with existing technology, and the examinations performed should detect any general degradation patterns.

Pursuant to 10 CFR 50.55a(g)(5)(iii), the licensee requested that the proposed alternative be authorized for the fourth ten-year ISI interval at NAPS Unit No. 1.

3.3 NRC Staff Evaluation

3.3.1 ASME Code Class 1 Piping Welds

The selected welds per the RI-ISI program that are identified as Examination Category R-A, Item Number R1.11, require essentially 100 percent volumetric examinations. However, in the case of NAPS Unit No. 1, complete volumetric examinations of these welds are constricted by component design, materials, and weld configurations. These conditions precluded the licensee from obtaining full volumetric examinations from both sides of the welds. This would require the licensee to modify the design configurations of the affected components in order to gain access to perform the required examination of the affected welds. This would place a burden on the licensee, therefore obtaining 100 percent coverage for the ASME Code-required volumetric examinations of the affected welds is considered impractical.

Dominion stated that volumetric examinations were conducted using procedures and techniques that were qualified to a performance demonstration process outlined in Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," of Section XI of the ASME Code. These techniques have been qualified through the industry's performance demonstration initiative (PDI) which meets the intent of the ASME Code Section XI, Appendix VIII requirements for flaws located on the near-side of the welds. The far side detection of flaws is considered to be a "best effort." Because the subject welds are austenitic stainless steel, and since there are currently no PDI qualified single-side examination procedures that demonstrate equivalency to two-sided examination on austenitic piping welds, the NRC staff finds that the licensee's claim that it achieved examination coverage to the maximum extent practical is justified.

As shown in the weld examination drawings and technical descriptions included in the licensee's submittal, examinations of the subject pipe-to-valve, pipe-to-elbow, and pipe-to-branch connection welds have been completed to the maximum extent practical. The volumetric coverage ranged from 50 to 88 percent of the ASME Code-required volumes as shown in Table 1 of this SE. The NRC staff acknowledges that weld coverage identified by the licensee using qualified examination procedures is limited. However, the use of ultrasonic L-waves have been shown to provide enhanced detection on the far-side of austenitic stainless steel welds. Therefore, while the licensee has only taken credit for obtaining limited volumetric coverage, the

staff finds that the techniques employed by the licensee provided additional coverage beyond the near-side and into the uncredited far-side of the welds.

NRC staff notes that in addition to the volumetric examinations performed, these welds are also subject to system leakage testing per the requirements of Examination Category B-P, "All Pressure Retaining Components," of ASME Code, Section XI. Additionally, the licensee stated that these piping components are included in the Boric Acid Corrosion Control Program (BACCP) inspection boundary as part of the overall plant management of boric acid leaks. The NRC staff finds that the ASME Code-required system leakage testing and BACCP provide further assurance that possible degradation of the subject welds could be detected prior to a significant leak or system failure.

The licensee has demonstrated that due to geometric limitations it was impractical to meet the ASME Code-required "essentially 100 percent" volumetric examination coverage for the subject piping welds for the fourth 10-year ISI Interval at NAPS Unit No. 1. Although the ASME Code-required coverage could not be obtained, the ultrasonic techniques employed provided nearly full volumetric coverage from the near-side of the welds and subsequently provided limited volumetric coverage for the weld materials on the opposite (far) side.

Based on its review, the NRC staff determined that obtaining the ASME Code-required examination volume is impractical and compliance with the Code requirements would impose a burden upon the licensee. Furthermore, the staff concludes that the aggregate coverage obtained and the extent of the examinations, along with other site programs that are capable of identifying degradation of the subject welds, provide reasonable assurance that significant service-induced degradation, if present, would be identified prior to challenging the structural integrity of the piping system. Therefore, the NRC staff concludes that the ultrasonic examinations performed provide reasonable assurance of the structural integrity for the subject welds listed in Table 1 of this SE.

3.3.2 ASME Code Class 1 Vessel Welds

Section XI of the ASME Code requires essentially 100 percent volumetric examination of all pressurizer nozzle-to-vessel welds and adjacent base metal. As shown in Table 2, "Examination Category B-D Welds with Limited Volumetric Coverage," the licensee was unable to obtain greater than 90 percent coverage of the subject welds. The licensee attributed the inability to achieve the required coverage of the welds to the geometric configuration of the nozzle, and to the alteration of the ultrasonic wave off the inner surface due to the cladding.

The configuration of the pressurizer nozzle-to-vessel welds precludes effective examination of the required volume due to the proximity of the weld to the nozzle bend radius. Approaching the radius causes lift-off of the scanning unit from the metal surface, creating an ineffective examination. Obtaining further examination coverage to meet the essentially 100 percent requirement would entail either full replacement or modification to the design of the pressure retaining welds. Therefore, the NRC staff concluded that it is impractical for the licensee to comply with the applicable ASME Code requirement, as its imposition would cause an unnecessary burden without a compensating increase in safety.

The ultrasonic exams were conducted in accordance with techniques outlined in ASME Code, Section V, Article 4, and utilized 0-degree longitudinal, and 45- and 60-degree shear waves. Each wave mode was scanned manually in the upstream (from head to nozzle), downstream (from nozzle to head), clockwise and counter-clockwise directions. Enclosures A1-1 and A1-2

of the licensee's submittal provide coverage plots for each scan, tables listing the coverage obtained by each scan and complete Ultrasonic Examination Data Reports for each weld. The total coverage was calculated by averaging the coverages obtained for each scan in each direction, producing a total exam coverage of 78.36 percent for each of the welds. This coverage total was similar to that obtained in the second and third ISI intervals, 72 percent and 78.36 percent respectively. The difference in coverage during the second interval was attributed to different NDE guidelines for calculating coverage. After reviewing the licensee's coverage plots and calculations, the NRC staff determined that, due to the configuration of the nozzle, the licensee obtained the maximum practical volumetric coverage of the welds.

The pressurizer nozzle-to-vessel welds are fabricated from SA-508 Class 2 carbon steel with austenitic stainless steel cladding. The pressurizer upper and lower heads are fabricated from SA-533 Grade A, Class 2 carbon steel. Ultrasonic waves easily propagate through carbon steel due to its particularly fine-grained microstructure; therefore, although the scans primarily obtained coverage in the upstream direction, the staff has a high degree of confidence that the actual sound penetration was sufficient to allow observation of the full required exam area. Furthermore, the exams included coverage of the weld and base materials near the inside surface of the weld joints, which are typically the highest stress regions and where degradation would most likely be expected to occur. Lastly, no recordable indications were found during the examinations.

Based on the above, the NRC staff has determined that obtaining the required ASME Code volumetric coverage would impose an unnecessary burden on the licensee and is impractical in accordance with 50.55a(g)(5)(iii). The NRC staff concludes that the ultrasonic examinations performed, despite the limitations in coverage, should detect any general patterns of degradation, and, therefore, provide reasonable assurance of the continued structural integrity of the subject pressurizer nozzle-to-vessel welds.

4.0 Conclusion

As set forth above, the NRC staff has determined that it is impractical for the licensee to comply with the ASME Code, Section XI requirements for examination of the subject welds. The NRC staff has further determined that the extent of volumetric examinations performed, in addition to the other examinations and programs described, provide reasonable assurance of structural integrity and leak tightness of the subject welds. Also, 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 grants relief for the subject piping weld examinations of the components contained in relief request N1-I4-LMT-002 for the fourth 10-year ISI interval at North Anna Power Station, Unit No. 1, which commenced on May 1, 2009, and will end on April 30, 2019.

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

Principal Contributors: Austin Young, Roger Kalikian

Date: January 10, 2018

SUBJECT: NORTH ANNA POWER STATION, UNIT NO. 1, RELIEF REQUEST (RR) N1-I4-LMT-002, LIMITED COVERAGE EXAMINATIONS FOR THE FOURTH TEN-YEAR INSPECTION INTERVAL (CAC NO. MF9689; EPID L-2017-LLR-0024) DATED JANUARY 10, 2018

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