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

February 14, 2019

Mr. Daniel G. Stoddard
Senior Vice President and
Chief Nuclear Officer
Innsbrook Technical Center
5000 Dominion Blvd.
Glen Allen, VA 23060-6711

SUBJECT: NORTH ANNA POWER STATION, UNIT NO. 2 – INSERVICE INSPECTION ALTERNATIVE N2-I4-NDE-007 (EPID L-2018-LLR-0043)

Dear Mr. Stoddard:

By letter dated March 28, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18093B076), Virginia Electric and Power Company (the licensee) submitted a request for a proposed alternative to the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, to the U.S. Nuclear Regulatory Commission (NRC) for the North Anna Power Station, Unit No. 2. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Paragraph 55a(z)(1), the licensee requested the NRC to authorize the use of an alternative to the examination frequency requirements of 10 CFR 50.55a(g)(6)(ii)(F), with conditions, for steam generator outlet dissimilar metal butt welds, on the basis that the proposed alternative would provide an acceptable level of quality and safety.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that the licensee has demonstrated the proposed alternative in N2-I4-NDE-007 provides reasonable assurance of structural integrity of the subject components and would provide an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the use of proposed alternative N2-I4-NDE-007 at North Anna Power Station, Unit No. 2, as a one-time extension, until refueling outage N2R28, currently scheduled for the spring of 2022.

All other ASME Code, Section XI and 10 CFR 50.55a(g)(6)(ii)(F) requirements for which alternatives or relief were not specifically requested and approved in the subject request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact the 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. 50-339

Enclosure:
Safety Evaluation

cc: Listserv

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ALTERNATIVE NO. N2-I4-NDE-007

PROPOSED ALTERNATIVE TO STEAM GENERATOR COLD LEG NOZZLE WELD EXAMINATION FREQUENCY REQUIREMENTS

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION ENERGY VIRGINIA)

NORTH ANNA POWER STATION, UNIT NO. 2

DOCKET NO. 50-339

1.0 INTRODUCTION

By letter dated March 28, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18093B076), Virginia Electric and Power Company (Dominion Energy Virginia or the licensee) submitted a request for proposed alternative N2-I4-NDE-007 to the U.S. Nuclear Regulatory Commission (NRC or the Commission) for the North Anna Power Station, Unit No. 2. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Paragraph 55a(z)(1), the licensee requested the NRC to authorize the use of an alternative to the examination frequency requirements of 10 CFR 50.55a(g)(6)(ii)(F), with conditions, for steam generator outlet dissimilar metal butt welds (DMBWs) at the North Anna Power Station, Unit No. 2.

Specifically, pursuant to 10 CFR 50.55a(z)(1), the licensee requested to use a proposed alternative on the basis that the proposed alternative would provide an acceptable level of quality and safety.

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g)(4), "*Inservice inspection standards requirement for operating plants,*" American Society of Mechanical Engineers (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)(6)(ii), "*Augmented ISI program*," the NRC may require licensees to follow an augmented inservice inspection (ISI) program for systems and components for which the Commission deems that added assurance of structural reliability is necessary.

Pursuant to 10 CFR 50.55a(g)(6)(ii)(F)(1), "*Augmented ISI requirements: Examination requirements for Class 1 piping and nozzle dissimilar-metal butt welds—(1) Implementation,*" licensees shall implement the requirements of ASME BPV Code Case N-770-2 instead of ASME BPV Code Case N–770–1, subject to the conditions specified in paragraphs (g)(6)(ii)(F)(2) through (13) of this section, by the first refueling outage starting after August 17, 2017.

The regulation in 10 CFR 50.55a(z) states, in part, that alternatives to the requirements of paragraph (g) of 10 CFR 50.55a may be used, when authorized by the NRC, if the licensee demonstrates that (1) the proposed alternative provides an acceptable level of quality and safety, or (2) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the NRC to authorize the licensee's proposed alternative for the North Anna Power Station, Unit No. 2. Accordingly, the NRC staff reviewed and evaluated the licensee's request pursuant to 10 CFR 50.55a(z)(1).

3.0 TECHNICAL EVALUATION

3.1 ASME Code Components Affected by the Proposed Alternative

The licensee's request is applicable to the following nozzle-to-safe end DMBWs for the steam generators at the North Anna Power Station, Unit No. 2:

- A Cold Leg 31-RC-402/N-SE31 IN, Steam Generator Cold Leg Nozzle to Safe End Weld
- B Cold Leg 31-RC-405/N-SE31 IN, Steam Generator Cold Leg Nozzle to Safe End Weld
- C Cold Leg 31-RC-408/N-SE31 IN, Steam Generator Cold Leg Nozzle to Safe End Weld

3.2 Applicable Code Edition, Addenda, and Requirement

Paragraph 50.55a(g)(6)(ii)(F)(1) of 10 CFR requires the use of ASME Code Case N-770-2. The licensee's request pertains to the examination frequency requirements of ASME Code Case N-770-2, Table 1, Item B, which requires volumetric examination of unmitigated butt welds at cold leg operating temperature greater than or equal to 525 degrees Fahrenheit (°F) and less than 580 °F every second inspection period not to exceed 7 years.

The NRC staff notes that 10 CFR 50.55a(g)(6)(ii)(F) is a requirement that the licensee must meet independent of the inspection requirements of the 10-year ISI interval. This is because the requirement for which the licensee is requesting relief is an augmented ISI program in 10 CFR 50.55a.

3.3 Licensee's Proposed Alternative

The licensee's proposed alternative is to extend the weld examination frequency required by 10 CFR 50.55a(g)(6)(ii)(F) for the North Anna Power Station, Unit No. 2 steam generator cold

leg DMBWs from every second inspection period (not to exceed 7 years) to a one-time interval of six nominal 18-month fuel cycles, which is approximately 9 years.

3.4 Licensee's Bases for Use

The licensee explained that this alternative would allow the 10 CFR 50.55a(g)(6)(ii)(F) inspections of these welds to coincide with the steam generator hot leg DMBWs examinations, due in refueling outage N2R28, which is currently scheduled for the spring of 2022.

The licensee is seeking NRC authorization of the proposed alternative in accordance with 10 CFR 50.55a(z)(1) on the basis that the proposed alternative would provide an acceptable level of quality and safety. In its application, the licensee indicated that its proposed alternative does not adversely impact the level of safety or quality and provides reasonable assurance that the structural integrity and the leak tightness of the weld will be maintained for several reasons, including, but not limited to:

- Results of the most recent volumetric examinations, which were done in 2013/2014, and performed to Section XI, Appendix VIII, Supplement 10 requirements, achieved essentially 100 percent coverage for both circumferential and axial flaws with no reportable primary water stress corrosion cracking (PWSCC) indications.
- Each of the DMBWs has an inlay of Alloy 52 material on the inner surface of the weld, providing a more crack-resistant boundary layer between the PWSCC susceptible Alloy 182/82 weld metal and the environment necessary to cause cracking.
- The plant-specific crack growth evaluation concluded that more than 9 years is required for growth from the standard detectability limit size to the allowable size per the ASME Section XI, IWB-3640, flaw evaluation procedure.
- Conclusions from the Materials Reliability Program: PWR Reactor Coolant System Cold-Loop Dissimilar Metal Butt Weld Reexamination Interval Extension (MRP-349): A Basis for Revision to the Requirements of MRP-139 and American Society of Mechanical Engineers Code Case N-770 for Large-Diameter Welds at Cold-Leg Temperatures. EPRI, Palo Alto, CA: 2012.

3.6 Duration of Proposed Alternative

The licensee requested that the NRC authorize this alternative as a one-time extension until scheduled refueling outage N2R28, which is currently scheduled for the spring of 2022.

3.7 NRC Staff's Technical Evaluation

The NRC staff has reviewed and evaluated the licensee's request on the basis that the proposed alternative would provide an acceptable level of quality and safety. The applicable requirement is the qualified volumetric inspection of the subject welds within 7 years of the previous qualified volumetric inspection, as specified in 10 CFR 50.55a(g)(6)(ii)(F). This requirement is based on a general assessment of the necessary qualified volumetric inspection frequency for all cold leg operating temperature DMBWs, of any size, in the reactor coolant system to maintain structural integrity. Under this inspection requirement, the welds are expected to have no previous indications of PWSCC. The licensee stated in its submittal that no PWSCC has been found in these welds. The NRC staff verified this information and confirms that the licensee-identified DMBWs that are the subject of this proposed alternative are

applicable to this inspection category and the technical basis for qualified volumetric inspection frequency.

The licensee identified a hardship associated with the performance of the qualified volumetric inspection frequency within the required 7 years. However, because the licensee requested relief under 10 CFR 50.55a(z)(1), the NRC staff did not consider this hardship as part of the technical basis to support authorization of the licensee's proposed alternative.

The NRC staff reviewed the level of quality and safety of the licensee's proposed alternative to allow an approximately 2-year delay in the qualified volumetric examination, beyond the current regulatory requirement of 7 years. As part of this analysis, the NRC staff reviewed the licensee's technical basis regarding past operating history, fabrication history, and plant-specific flaw analysis. The NRC staff also considered additional supporting information provided by the licensee that included some conclusions from MRP-349 to provide additional supporting plant-specific technical bases for the proposed alternative. The NRC staff review does not provide generic acceptance of MRP-349. The NRC staff found that the additional information reinforced the conclusions drawn from the licensee's flaw analysis to support the proposed alternative. Furthermore, the NRC staff performed an independent flaw evaluation for the subject welds to verify the conclusions of the licensee's analysis.

The licensee provided the results of the most recent volumetric examinations of these welds, which resulted in no reportable PWSCC indications. The NRC staff notes that while this information is necessary to ensure the correct classification of the inspection category of the welds, the required volumetric inspection frequency is based on the past performance of qualified inspections, which found no indications of PWSCC. Therefore, the NRC staff finds that this factor alone does not provide sufficient basis to support the proposed alternative.

The NRC staff notes that each weld was fabricated with an inlay of Alloy 52 material on the inner surface of the weld. Alloy 52 weld material is considered to be more PWSCC resistant than the Alloy 182/82 weld metals upon which these welds rely for their structural integrity. The Alloy 52 material provides an isolation boundary between the more crack-susceptible Alloy 182/82 material and the primary coolant. The NRC staff recognizes that this inlay of material on each weld provides resistance to both crack initiation and growth of PWSCC flaws. However the inlay material is very thin and only consists of two or three weld layers. Since these welds still rely upon the Alloy 82/182 susceptible weld material for structural integrity, they are still required to be categorized as Inspection Item B welds under 10 CFR 50.55a(g)(6)(ii)(F) classification requirements. Therefore, until NRC categorizes these welds as a different mitigated inspection category, the presence of the inlay by itself is not sufficient to provide support on its own merits for the licensee's proposed alternative. However, the NRC staff recognizes the value of the inlay material in the flaw analysis of any hypothetical flaw in this material and considered its impact in the NRC's independent flaw evaluations.

The licensee performed analyses for postulated axial and circumferential flaws to demonstrate that a hypothetical PWSCC flaw will not grow to an unacceptable size within the period of extended inspection frequency (up to 9 years). The NRC staff reviewed the licensee's flaw analyses inputs and found them acceptable. The licensee's analysis documented the time for a flaw to meet an ASME Code limit of 75 percent through-wall depth of the weld. The licensee's most limiting analysis found that an axial flaw would take 9.1 years to reach 75 percent through-wall depth, and would grow to 100 percent through wall and cause leakage in 12.2 years. The NRC staff notes that the duration for the axial flaw is bounding because the licensee's analysis showed a circumferential flaw would take longer to reach these conditions, and longer still to

cause failure of the structural integrity of the weld. The NRC staff notes that the growth of only a circumferential flaw could result in a loss of structural integrity because a circumferential flaw can grow around the weld, and it could lead to a double-ended guillotine break in the pipe. Alternatively, given that PWSCC does not propagate through either the stainless steel or low alloy steel adjacent to the weld, the NRC staff recognizes that axial flaws cannot grow sufficiently in length to cause a rupture of the weld and adjacent piping system in a DMBW. The licensee did not take credit for the Alloy 52 inlay in their flaw analysis results. The NRC staff's review of the licensee's flaw analysis finds it is adequate for circumferential flaw growth and axial flaw growth. Given these mechanisms, the NRC staff finds the licensee's flaw analysis demonstrates structural integrity of the subject DMBWs will be maintained if the volumetric inspection frequency is extended from 7 to 9 years.

The NRC staff also performed a series of independent flaw evaluations to evaluate the licensee's analyses and performed sensitivity analyses to determine the margin to leakage and rupture of the subject DMBWs. The NRC staff recognizes that there are significant uncertainties in the performance of these flaw analyses. Conservative assumptions are used to address these uncertainties. The level of conservatism applied can significantly affect the results. As a result, variations in results should not be viewed as either correct or incorrect but rather as an input to the overall assessment of the licensee's proposed alternative. The NRC staff's calculations applied the guidelines in Electric Power Research Institute Report, "Materials Reliability Program: Primary Water Stress Corrosion Cracking (PWSCC) Flaw Evaluation Guidance (MRP-287)," dated December 2010. The NRC staff flaw analysis used the NRC accepted licensee inputs, industry inputs for sensitivity analyses, and included the potential effect of the Alloy 52 weld inlay. The NRC staff calculation results verify the conclusions of the licensee's flaw analysis for both hypothetical axial and circumferential flaw growth. The NRC staff calculations for circumferential flaws confirmed the licensee's conclusion that structural integrity would be maintained during the period of the licensee's requested volumetric inspection extension to 9 years. Furthermore, the NRC staff's sensitivity analysis confirmed significant margin for time to rupture beyond the 9-year time frame even under earthquake loading conditions. In summary, the NRC staff's calculations verified that structural integrity would be maintained by the subject DMBWs with significant margin for the licensee's proposed inspection interval.

The NRC staff finds the licensee's proposed alternative is acceptable on the basis that the licensee demonstrated reasonable assurance of structural integrity for the subject welds through the period of inspection extension of approximately 2 years. Therefore, the NRC staff finds that the proposed alternative would provide an acceptable level of quality and safety.

4.0 CONCLUSION

As set forth above, the NRC staff determines that the licensee has demonstrated the proposed alternative in N2-I4-NDE-007 provides reasonable assurance of structural integrity of the subject components and would provide an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the use of proposed alternative N2-I4-NDE-007 at the North Anna Power Station, Unit No. 2, as a one-time extension, until refueling outage N2R28, currently scheduled for the spring of 2022.

All other ASME Code, Section XI and 10 CFR 50.55a(g)(6)(ii)(F) 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: J. Collins, NRR

Date: February 14, 2019

SUBJECT: NORTH ANNA POWER STATION, UNIT NO. 2 – INSERVICE INSPECTION ALTERNATIVE N2 I4 NDE 007 (EPID L-2018-LLR-0043) DATED FEBRUARY 14, 2019

DISTRIBUTION:
PUBLIC
RidsACRS_MailCTR Resource
RidsNrrLAKGoldstein Resource
RidsNrrDorl Resource
RidsRgn2MailCenter Resource
RidsNrrPMNorthAnna Resource
RidsNrrDmlrmphb Resource
JCollins, NRR

ADAMS Accession No. ML19039A236 ***via email**

OFFICE	DORL/LPLII-1/PM	DORL/LPLII-1/LA	DMLR/MPHB/BC*	DORL/LPLII-1/BC
NAME	JRHall	KGoldstein	SRuffin	MMarkley
DATE	02/13/19	02/13/19	11/13/18	02/14/19
OFFICE	DORL/LPLII-1/PM			
NAME	JRHall			
DATE	02/14/19			

OFFICIAL RECORD COPY