September 18, 2007

Mr. David A. Christian
Senior Vice 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 - THIRD 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM PLAN, RELIEF REQUEST NO. PRT-001(TAC NO. MD4935)

Dear Mr. Christian:

By letter dated March 23, 2007, Virginia Electric and Power Company (Dominion), the licensee for North Anna Power Station, Unit No. 2 (North Anna 2), submitted a proposal for its Third 10-Year Inservice Inspection Program Plan Request for Relief No. PRT-001, from the requirements of the American Society of Mechanical Engineers (ASME), *Boiler and Pressure Vessel Code* (Code), Section XI for Inservice Inspection (ISI).

The staff has reviewed the licensee's submittal and concludes that the ASME Code requirements are impractical and that the licensee's proposed alternative to volumetrically examine RPV Head-to-Flange Weld 1 to the extent practical provides reasonable assurance of the structural integrity of the subject weld. Therefore, relief is granted pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(g)(6)(i) for the North Anna 2 third 10-year ISI interval.

The staff has determined that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) for the limited examination of the RPV head weld 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.

Furthermore, the staff concludes that for the licensee to perform the ASME Code-required examination in the second period of the third 10-year ISI interval it would be a hardship without a compensating increase in quality and safety. Therefore the licensee's proposed alternative to perform the ASME Code-required examination in the third inspection period of the third 10-year ISI interval is authorized pursuant to 10 CFR 50.55a(a)(3)(ii) for the North Anna 2 third 10-year ISI interval.

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

The NRC staff's safety evaluation is enclosed.

Sincerely,

/RA/

Evangelos C. Marinos, 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: See next page

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

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Safety Evaluation

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

THIRD 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM PLAN

RELIEF NO. PRT-001

VIRGINIA ELECTRIC AND POWER COMPANY

NORTH ANNA POWER STATION, UNIT NO. 2

DOCKET NO. 50-339

1.0 INTRODUCTION

The Nuclear Regulation Commission (NRC) staff has reviewed and evaluated the information provided by Virginia Electric and Power Company (the licensee) in its letter dated March 23, 2007, which proposed its Third 10-Year Interval Inservice Inspection Program Plan Request for Relief (RR) No. PRT-001, for North Anna Power Station, Unit No. 2 (North Anna 2).

2.0 REGULATORY REQUIREMENTS

Inservice inspection (ISI) of the American Society of Mechanical Engineers (ASME), *Boiler and Pressure Vessel Code* (Code), Class 1, 2, and 3 components is performed in accordance with Section XI of the ASME Code and applicable addenda as required by Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(g), except where specific relief has been granted by the (NRC) pursuant to 10 CFR 50.55a(g)(6)(i). Section 50.55a(a)(3) states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if: (i) the proposed alternatives would provide an acceptable level of quality and safety or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the pre-service 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. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) twelve months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The ASME Code of record for the North Anna 2 third 10-year interval ISI program, is the 1995 edition through 1996 addenda of Section XI of the ASME Code.

3.0 EVALUATION

RR No. PRT-001

ASME Code Components

Reactor Pressure Vessel (RPV) Head-to-Flange Weld 1

ASME Code Requirements

ASME Code, Section XI, Table IWB-2500-1, Examination Category B-A, Item Number B1.40 requires volumetric and surface examinations, as defined by Figure IWB-2500-5, of essentially 100 percent of the weld length of the reactor pressure vessel (RPV) closure head-to-flange weld.

Note 4 of ASME Code, Section XI, Table IWB-2500-1, Examination Category B-A, Item Number B1.40 states deferral is not permissible for the head-to-flange weld. However, during the first and second periods, the examination need only be performed from the flange face, provided these same portions are examined from the head during the third period.

ASME Code Case N-460, *Alternative Examination Coverage for Class 1 and Class 2 Welds*, as an alternative approved for use by the NRC in Regulatory Guide (RG) 1.147, Revision 14, *Inservice Inspection Code Case Acceptability*, *Section XI, Division 1* (RG 1.147), states that a reduction in examination coverage due to part geometry or interference for any ASME Code Class 1 or 2 weld is acceptable provided that the reduction is less than 10%, i.e., greater than 90% examination coverage is obtained.

Licensee's Basis for Relief Request (As Stated)

> The ultrasonic examination of the reactor pressure vessel head-to-flange weld is conducted in accordance with Section XI, Appendix I of the ASME Code, and 1995 Edition through 1996 Addenda. Section XI, Appendix I states that the ultrasonic examination shall be conducted in accordance with Article 4 of Section V as supplemented by Table I-2000-1 in the Appendix. [ASME Code,] Section V, Article 4 requires the weld and the adjacent base metal be examined using [ultrasonic transducers with] nominal angles of 45 and 60 degrees (deviation is permitted if geometry limits the coverage, however, separation of angles must be at least 10 degrees) and a straight beam. Four basic scan directions are required for the angle beams; two perpendicular to the weld axis (axial scan) from opposite directions and two parallel to the weld axis (circumferential scan) from opposite directions. These requirements apply for each of the 45 and 60 degree angle beams used. Each of the 45 and 60 degree angle beams is required to pass through all of the weld volume in the four basic scan directions.
>
> The cross-sectional geometry of the component at the reactor pressure vessel head-to-flange weld produces a high transitional angle between the flange and the curved head. Scanning from the flange side does not provide the necessary angular orientation to provide full examination coverage. Examination is limited to 0.5 inches from the weld toe due to the flange configuration. The reactor vessel closure head is a [low alloy] steel vessel with stainless steel cladding on the inside surface. Therefore, a

full-V examination is also not possible. Radiographic examination of this weld from the inside is not practical due to the anticipated dose associated with high radiation levels from the inside surface of the head. The reduced volumetric coverage is expected to be similar to the preservice examination which is detailed in Table PRT-001-1[1]. Figures PRT-001-1 through PRT-001-5[2] are also provided detailing the configuration limitations experienced during the preservice examination.

Furthermore, the three lifting lugs are located 120° apart. Each lug obstructs the volumetric examination for approximately 8 inches, resulting in obstruction of 2 of the 45 feet of total weld length. This limits access to approximately 4 percent of the weld length. However, these lifting lugs result in only a 0.8 percent obstruction during the magnetic particle examination which should result in a 99 percent surface examination.

Examination of the reactor head-to-flange weld performed from the flange face is also not a practical examination to perform due to radiation dose and limited coverage issues. Once the head is set on the head stand, access is limited due to the seal ring and the stand obstructing the required scan surface. To access the area under the head to perform scanning of the flange face would involve entering a high radiation area. In addition, the examination of the head-to-flange weld from a flange face is intended to interrogate the examination volume with the sound beam(s) oriented essentially perpendicular to the weld axis. As shown in Figure 2500-5 in the 1995 Edition/1996 Addenda of the ASME Code, the curvature of the head and the location of the examination volume limit effective examination coverage when performing the examination from the flange face surface.

The inservice examination coverage on the head-to-flange will be completed to the extent practical as required by the ASME Code, but coverage similar to the preservice is expected. Full ASME Code-required coverage is impractical for the head-to-flange weld without a design modification. The limited volumetric examination and the surface examination should detect any general patterns of degradation that may occur in the areas covered, therefore, providing reasonable assurance of the continued structural integrity of the subject weld.

Full ASME Code-required coverage is impractical for the head-to-flange weld due to the design of the head. It would be impractical to redesign the head.

Dose rates at the flange face of the reactor head are expected to be 500-600 mRem/hr. With an expected time for the inspection of six person-hours the dose for the job is estimated to be 3.0 - 3.6 person-rem. In addition, the curvature of the head and the location of the examination volume limit effective examination coverage when performing the examination from the flange face surface.

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1. Table PRT-001-1 is not included in this safety evaluation (SE) and may be found in the licensee's letter dated March 23, 2007.

2. Figures PRT-001-1 through PRT-001-5 are not included in this SE and may be found in the licensee's letter dated March 23, 2007.

Licensee's Proposed Alternative Examination (As Stated)

> The reactor pressure vessel head-to-flange weld will be examined in the third period to the extent permitted by the configuration of the reactor pressure vessel closure head as detailed in the enclosed figures and no examinations will be performed from the flange face.

NRC Staff's Evaluation

The ASME Code, Section XI, Table IWB-2500-1, Examination Category B-A, Item Number B1.40 requires volumetric and surface examinations, as defined by Figure IWB-2500-5, of essentially 100% of the weld length of the RPV closure head-to-flange weld. The licensee is unable to obtain the ASME Code examination requirements on the basis that conformance to the ASME Code is impractical as it would require extensive modifications to the RPV head.

The ASME Code requires that the RPV closure head-to-flange weld and the adjacent base metal be examined using ultrasonic traducers with nominal angles of 45 and 60 degrees and a straight beam. The licensee noted that four basic scan directions are required for the angle beams; two perpendicular to the weld axis (axial scan) from opposite directions and two parallel to the weld axis (circumferential scan) from opposite directions which apply for each of the 45- and 60-degree angle beams used. Each of the 45- and 60-degree angle beams are required to pass through all of the weld volume in the four basic scan directions.

Due to the cross-sectional geometry of the RPV head-to-flange weld, there is a high transitional angle between the flange and the curved head. This configuration does not provide the necessary angular orientation to permit full scanning from the flange side and limits examination coverage. As a result the volumetric examination is limited to 0.5 inches from the weld toe due to the flange configuration. In addition there are three lifting lugs that are located 120 degrees apart which obstruct the volumetric examination for approximately 2 feet of the 45 feet of the total weld length. The subject lifting lugs limit access to approximately 4% of the weld length. The licensee also considered a full-V examination of the subject weld; however, the RPV closure head is a low alloy steel vessel with stainless steel cladding on the inside surface which makes this type of examination impractical. The licensee considered radiographic (RT) examination of the subject weld from the inside surface of the head; however, due to the anticipated dose rates associated with high radiation levels the RT would be impractical.

The licensee considered examining the RPV head-to-flange weld from the flange face and noted it was also not a practical examination to perform due to estimated radiation dose and limited coverage issues. In order for the licensee to access and perform the volumetric examination from under the RPV head, the technician would be exposed to a high radiation field. The licensee estimated the dose rates at the flange face of the reactor head to be 500-600 mRem/hr and with an expected time for the inspection of six person-hours. The dose for the job was estimated to be 3.0 - 3.6 person-rem. When the RPV head is placed onto the head stand, access is limited by the RPV head seal ring and the stand obstructing the required scan surface area. Requiring the licensee to perform the ASME Code examinations would cause a burden on the licensee because the RPV head-to-flange weld would have to be

redesigned. Therefore, the staff determined that based on the drawings and descriptions of obstructions provided by the licensee, the ASME Code requirements are impractical.

For the surface examination, the licensee noted that although the lifting lugs obstruct portions of the magnetic particle (MT) examination, coverage of 99% should be obtained during the surface examination of the subject weld. As an alternative to the ASME Code-required volumetric examination, the licensee proposed that the examination coverage on the subject RPV head-to-flange weld will be to the extent practical. The licensee expects to obtain coverage similar to the preservice examination which was an aggregate coverage of 63.7%. The staff determined that the licensee's proposed alterative volumetric examination (and the essentially 100% surface examination) should detect any patterns of degradation that may occur in the areas examined, therefore, providing reasonable assurance of the continued structural integrity of the subject weld.

The licensee also requested that the subject examination be performed in the third inspection period of the third 10-year ISI interval instead of the second inspection period of the third 10-year ISI interval as required by the ASME Code. Note 4 of ASME Code, Section XI, Table IWB-2500-1, Examination Category B-A, Item Number B1.40 states that deferral is not permissible for the head-to-flange weld. However, during the first and second periods, the examination need only be performed from the flange face, provided these same portions are examined from the head during the third period.

In the second inspection period of the third 10-year ISI interval, the licensee was unable to schedule the RPV head-to-flange weld 1 inspection due to a bare metal visual examination of the RPV head surface. In addition, volumetric examinations were performed on the head penetrations under the RPV head. These examinations were performed in the spring of 2007. The license informed the staff that RPV head-to-flange weld 1 will be examined during the unit's fall 2008 outage. This would be approximately 18 months between when the examinations were required and when the subject welds will be examined.

A preservice volumetric examination was performed on the subject weld in the fall of 2002 when the RPV head was installed as replacement for the old RPV head. Therefore, there will be no more than 10 years between preservice and first inservice examination. The staff determined that requiring the licensee to perform the examinations as scheduled by the ASME Code would be a hardship without a compensating increase in quality and safety. The other examinations performed in the second and third periods of the third 10-year ISI interval should detect any patterns of degradation that may occur in the areas examined, therefore, providing reasonable assurance of the continued structural integrity of RPV head-to-flange weld 1.

4.0 CONCLUSION

The NRC staff has reviewed the licensee's submittal and concludes that the ASME Code requirements are impractical and that the licensee's proposed alternative to volumetrically examine RPV head-to-flange weld 1 to the extent practical provides reasonable assurance of the structural integrity of the subject weld. Therefore, relief is granted pursuant to 10 CFR 50.55a(g)(6)(i) for the North Anna 2 third 10-year ISI interval.

The NRC staff has determined that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) for the limited examination of the RPV head weld 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.

Furthermore, the staff concludes that for the licensee to perform the ASME Code-required examination in the second period of the third 10-year ISI interval it would be a hardship without a compensating increase in quality and safety. Therefore the licensee's proposed alternative to perform the ASME Code-required examination in the third inspection period of the third 10-year ISI interval is authorized pursuant to 10 CFR 50.55a(a)(3)(ii) for the North Anna 2 third 10-year ISI interval.

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

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Date: September 18, 2007

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