

November 13, 2003

Mr. David A. Christian  
Sr. Vice President and Chief Nuclear Officer  
Virginia Electric and Power Company  
Innsbrook Technical Center  
5000 Dominion Blvd.  
Glen Allen, Virginia 23060-6711

SUBJECT: NORTH ANNA POWER STATION, UNIT 2 - AMERICAN SOCIETY OF  
MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE,  
SECTION XI RELIEF REQUEST CMP-020 (TAC NO. MB7515)

Dear Mr. Christian:

During the fall 2002 refueling outage, Virginia Electric and Power Company (VEPCO) replaced the reactor pressure vessel head at North Anna Power Station, Unit 2. While conducting a preservice examination of the replacement head, VEPCO encountered interferences from the three lifting lugs and the reactor pressure vessel head-to-flange weld configuration that prevented a complete examination of this weld. Subsequently, by letter dated January 28, 2003, as supplemented by letter dated May 12, 2003, VEPCO requested relief from certain requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI for the third 10-year inservice inspection (ISI) interval at North Anna, Unit 2. This relief has been identified as CMP-020.

The Nuclear Regulatory Commission (NRC) staff, with technical assistance from its contractor, the Pacific Northwest National Laboratory, has reviewed and evaluated the information provided. The NRC staff's evaluation of Relief Request CMP-020 is enclosed.

The NRC staff concludes that the ASME Code-required examination is impractical to perform for the subject reactor pressure vessel head-to-flange weld. Additionally, the NRC staff concludes that the proposed alternative provides reasonable assurance of structural integrity of the subject component. Therefore, Relief Request CMP-020 is granted pursuant to Title 10 of the *Code of Federal Regulations* Section 50.55a(g)(6)(i) for the third 10-year ISI interval at North Anna, Unit 2. 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.

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This completes the NRC staff's activities associated with TAC No. MB7515.

Sincerely,

***/RA/***

John A. Nakoski, Chief, Section 1  
Project Directorate II  
Division of Licensing Project Management  
Office of Nuclear Reactor Regulation

Docket No. 50-339

Enclosure: As stated

cc w/encl: See next page

This completes the NRC staff's activities associated with TAC No. MB7515.

Sincerely,

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John A. Nakoski, Chief, Section 1  
Project Directorate II  
Division of Licensing Project Management  
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Docket No. 50-339

Enclosures: As stated

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

THIRD 10-YEAR INSERVICE INSPECTION INTERVAL

RELIEF REQUEST CMP-020

NORTH ANNA POWER STATION, UNIT 2

VIRGINIA ELECTRIC AND POWER COMPANY

DOCKET NO. 50-339

1.0 INTRODUCTION

During the fall 2002 refueling outage, Virginia Electric and Power Company (the licensee) replaced the reactor pressure vessel head at North Anna Power Station, Unit 2. While conducting a preservice examination of the replacement head, the licensee encountered interferences from the three lifting lugs and the reactor pressure vessel head-to-flange weld configuration that prevented a complete examination of this weld. Subsequently, by letter dated January 28, 2003, as supplemented by letter dated May 12, 2003, the licensee requested relief from certain requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI for the third 10-year inservice inspection (ISI) interval at North Anna, Unit 2. This relief has been identified as CMP-020.

The NRC staff, with technical assistance from Pacific Northwest National Laboratory (PNNL), has reviewed and evaluated the information provided by the licensee.

2.0 REGULATORY REQUIREMENTS

ISI of the ASME Code Class 1, 2, and 3 components is performed in accordance with Section XI of the ASME Code and applicable addenda as required by 10 CFR 50.55a(g), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). 10 CFR 50.55a(a)(3) states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee demonstrates that: (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 (ISI) of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The

Enclosure

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) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The applicable Code of record for the third 10-year ISI for North Anna Power Station, Unit 2 is the 1995 Edition including the 1996 Addenda of the ASME Code, Section XI.

### 3.0 TECHNICAL EVALUATION

The licensee's request has been reviewed by the NRC staff with assistance of its contractor, PNNL. The Technical Letter Report (TLR) providing PNNL's evaluation of Relief Request CMP-020 is attached. The NRC staff has reviewed the TLR and adopts the evaluations and recommendations for granting relief.

For Request for Relief No. CMP-020, the NRC staff determined that the configuration of the Reactor Vessel Head-to-Flange Weld No. 1 makes the Code-required examination impractical to perform on the reactor pressure vessel head-to-flange weld. Performance of the Code-required examinations to the extent required by the Code would be a significant burden on the licensee because the reactor pressure vessel head would require design modifications. The licensee obtained approximately 66-percent volumetric coverage and essentially 100 percent of the surface examination. While the licensee cannot meet the Code-required 100-percent volumetric examination, the limited examinations that have been performed establish a reasonable basis for comparison with future inservice examinations and should have detected any significant conditions that might challenge the structural integrity of the subject welds. Therefore, the licensee's proposed alternative provides reasonable assurance of structural integrity of the subject component.

### 4.0 CONCLUSION

The NRC staff concludes that for Request for Relief No. CMP-020, Code examination coverage requirement is impractical to perform on the subject reactor vessel head-to-flange weld. Furthermore, the NRC staff concludes that the proposed alternative provides reasonable assurance of structural integrity of the subject component. Therefore, Relief Request CMP-020 is granted pursuant to 10 CFR 50.55a(g)(6)(i) for the third 10-year interval. 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. All other requirements of the ASME Code, Section III and XI for which relief has not been specifically requested remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Attachment: PNNL's TER

Principal Contributor: Tom McLellan, NRR

Date: November 13, 2003

**TECHNICAL LETTER REPORT**  
**ON THE THIRD 10-YEAR INTERVAL INSERVICE INSPECTION**  
**REQUEST FOR RELIEF NO. CMP-20**  
**FOR**  
**VIRGINIA ELECTRIC AND POWER COMPANY**  
**NORTH ANNA POWER STATION, UNIT 2**  
**DOCKET NUMBER: 50-339**

## **1.0 INTRODUCTION**

By letter dated January 28, 2003, the licensee, Virginia Electric and Power Company , submitted revised request for relief CMP-20, seeking relief from requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, *Rules for Inservice Inspection of Nuclear Power Plant Components*. This request is for the third 10-year inservice inspection (ISI) interval at North Anna Power Station, Unit 2 (North Anna 2). The Pacific Northwest National Laboratory (PNNL) has evaluated the subject request for relief in the following section.

## **2.0 REGULATORY REQUIREMENTS**

Inservice inspection of the ASME Code Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel Code (B&PV Code), and applicable addenda, as required by 10 CFR 50.55a(g), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). The regulation at 10 CFR 50.55a(a)(3) states that alternatives to the requirements of paragraph (g) may be used, when authorized by the U.S. Nuclear Regulatory Commission (NRC), if the licensee demonstrates that (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 preservice examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection (ISI) 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, which was incorporated by reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The code of record for the North Anna 2 third 10-year interval inservice inspection program, which began on December 14 , 2001, is the 1995 Edition of Section XI of the ASME Boiler and Pressure Vessel Code, including the 1996 Addenda.

### 3.0 EVALUATION

The information provided by Virginia Electric and Power Company in support of the request for relief from Code requirements has been evaluated and the basis for disposition is documented below.

#### 3.1 Request for Relief CMP-20, Examination Category B-A, Item B1.40, Pressure Retaining Welds in Reactor Vessel, Closure Head-to-Flange Weld, Preservice Examination

Code Requirement: ASME Section XI, Paragraph IWB-2200(c) requires preservice examinations to be performed on all Class 1 components that are replaced, added, or altered during the service lifetime of a plant. Preservice examinations are performed to establish a baseline for comparison with future inservice examinations of these components. As such, preservice examinations must be conducted in accordance with the requirements of Table IWB-2500, which lists inservice examination requirements for all Class 1 components. ASME Section XI - 1995 Edition through 1996 Addenda, Examination Category B-A, Item B1.40, requires volumetric and surface examination, as defined by Figure IWB-2500-5, of essentially 100% of the weld length of the reactor pressure vessel (RPV) closure head-to-flange weld. "Essentially 100%", as clarified by ASME Code Case N-460, is greater than 90% coverage of the examination volume, or surface area, as applicable.

Licensee's Code Relief Request: In accordance with 10CFR50.55a(g)(5)(iii), the licensee requested relief from 100% volumetric examination coverage for RPV closure head-to-flange Weld 1, as shown on drawing 12050-WMKS-RC-R-1.2.

#### Licensee's Basis for Relief Request (as stated):

The ultrasonic examination of the Reactor Vessel Head-to-Flange Weld is conducted in accordance with Section XI, Appendix I of the ASME Code, 1995 Edition through the 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.

Article 4, Section V of the ASME Code, 1995 Edition, 1996 Addenda requires the weld and adjacent base metal to be examined using 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 angle beams used (i.e., 45 and 60 degrees). 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 examination volume for the Reactor Head-to-Flange Weld is defined in Figure IWB-2500-5. The examination volume can be scanned along the weld axis from two directions. However, due to the extreme angle of the transition from the curvature of the

head base material to the flange (See figure 1 below)<sup>1</sup>, access for scanning perpendicular to the weld axis is restricted to only the head side of the weld.

Scanning from the flange side of the weld is limited to 0.5 inches from the weld toe due to the flange configuration.

The Reactor Vessel Closure Head (RVCH) is a carbon steel vessel with stainless steel cladding on the inside surface. Due to this cladding, the ultrasonic beam cannot be “bounced” from the inside clad surface to increase the examination coverage. Therefore, a full-V examination from one side is not possible. Radiographic examination of this weld, following its use inservice, will not be feasible due to the projected radiation levels (approximately 1-2 R/hr) at the inside surface of the head.

In addition, three lifting lugs are located approximately 120° apart and each lug obstructs the volumetric scanning for approximately 4% of the weld length.

Licensee’s Proposed Alternative Examination (as stated):

One third of the reactor pressure vessel Vessel Head-to-Flange weld will be examined each period to the extent permitted by the configuration of the reactor pressure vessel closure head and radiation conditions.

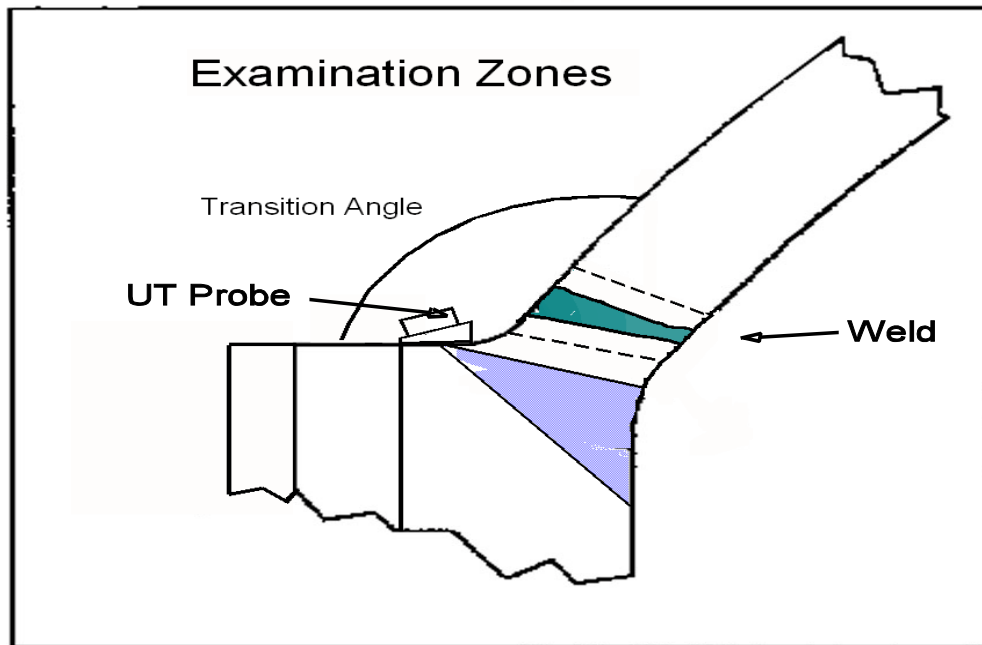
Evaluation: ASME Section XI requires that a preservice examination on components that are replaced, added, or altered during the service lifetime of a plant be performed prior to placing the component in operation. The licensee replaced the RPV head for North Anna 2. One of the objectives of the preservice examination is to establish a baseline for comparison with future examinations, therefore, the preservice examination must conform to the same requirements as are listed in the Code for inservice examinations. The Code requires essentially 100% volumetric coverage of RPV closure head-to-flange Weld 1 at North Anna 2. The volumetric examinations are required to be performed by using several ultrasonic sound beams (at the proper angles within the material) that are directed both perpendicular and parallel to the weld. The ultrasonic scans are performed from the outside surface of the component, and should be conducted from each side of the weld, and across the surface (crown) of the weld. The intent of these requirements is to increase the likelihood of flaw detection by interrogating the component with multiple sound fields in order to find potential service-induced degradation.

The cross-sectional geometry of the component at Weld 1 produces a high transition angle between the flange and the domed head. As illustrated in Figure 1, scanning from the flange side of the weld is severely limited due to location of the weld and the transition angle. In addition, the location of three closure head lifting lugs further restrict access for ultrasonic examination. For these reasons, the component configuration does not allow the licensee to obtain the full Code-required volumetric coverage from both sides of the weld. For the licensee to achieve 100% volumetric coverage, the RPV closure head would have to be redesigned and modified. This would place a significant burden on the licensee, thus the Code-required 100% volumetric examination is impractical for Weld 1.

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<sup>1</sup>1. The drawings provided by the licensee are proprietary and not included in this report.





Cross-sectional view of head-to-flange Weld 1 showing the required inspection volume (within dashed lines), weld and UT beam. The figure illustrates that inspection from the flange side is severely limited due to transition angle and location of weld.

As shown on the sketches and technical descriptions<sup>2</sup> provided by the licensee, a substantial amount (approximately 66%) of the Code-required examination volume can be obtained with the perpendicular, parallel and 0° ultrasonic scans performed from the head side of the weld. For both the 45° and 60° scans, the licensee was able to achieve the Code-required coverage from a single side. Apart from the Code volumetric examinations, the licensee also performs a separate 65° shear wave ultrasonic inspection from the head side of the weld to produce a sound field nearly perpendicular to the weld/base metal interface, as recommended by NRC Regulatory Guide 1.150, *Ultrasonic Testing of Reactor Vessel Welds During Preservice and Inservice Examinations*, Rev.1, February 1983. In addition to the volumetric examinations of this weld, the licensee was able to obtain essentially 100% of the Code-required surface examinations performed on the outside of the component. The examinations completed by the licensee establish a reasonable basis for comparison with future inservice examinations and should have detected any significant conditions that might challenge the structural integrity of the subject welds. Therefore, pursuant to 10 CFR 50.55a(g)(6)(i), it is recommended that relief be granted.

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2) Drawings and descriptions provided by the licensee are not included in this report.

#### 4.0 CONCLUSION

PNNL staff reviewed the licensee's submittal and concluded that the Code examination coverage requirements are impractical for the RPV closure head-to-flange weld listed in Request for Relief CMP-20. Further, reasonable assurance of the structural integrity of the subject components has been provided by the examinations that were performed. Therefore, for this request, it is recommended that relief be granted pursuant to 10 CFR 50.55a(g)(6)(i).

Mr. David A. Christian  
Virginia Electric and Power Company

North Anna Power Station  
Units 1 and 2

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