November 1, 2005

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: SURRY POWER STATION, UNIT 2 - AMERICAN SOCIETY OF MECHANICAL ENGINEERS FOURTH 10-YEAR INSERVICE INSPECTION (ISI) INTERVAL, RELIEF REQUEST SPT-008 (TAC NO. MC7013)

Dear Mr. Christian:

By letter dated May 20, 2005, as supplemented by letter dated August 4, 2005, Virginia Electric and Power Company (VEPCO) submitted Relief Request SPT-008 to use certain requirements of the American Society of Mechanical Engineers (ASME), Section XI Boiler and Pressure Vessel Code (Code) at Surry Power Station, Unit 2. Specifically, VEPCO proposed to examine selected welds using ultrasonic and surface testing requirements specified in ASME, Section III, instead of performing radiography testing. The Nuclear Regulatory Commission (NRC) staff has completed its review of this relief request and our evaluation and conclusion is contained in the enclosed Safety Evaluation.

The NRC staff has reviewed Relief Request SPT-008 and concludes that VEPCO's proposed alternative provides reasonable assurance of structural integrity. In addition, the NRC staff has determined that the ASME Code-required examination would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety. Therefore, Relief Request SPT-008 is authorized pursuant to Title 10 of the *Code of Federal Regulations* Section 50.55a(a)(3)(ii) for the fourth 10-year ISI interval at Surry, Unit 2.

Sincerely,

***/RA/***
Evangelos Marinos, Chief, Section 1
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-281

Enclosure: As stated

cc w/ encl: See next page

November 1, 2005

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: SURRY POWER STATION, UNIT 2 - AMERICAN SOCIETY OF MECHANICAL ENGINEERS FOURTH 10-YEAR INSERVICE INSPECTION (ISI) INTERVAL, RELIEF REQUEST SPT-008 (TAC NO. MC7013)

Dear Mr. Christian:

By letter dated May 20, 2005, as supplemented by letter dated August 4, 2005, Virginia Electric and Power Company (VEPCO) submitted Relief Request SPT-008 to use certain requirements of the American Society of Mechanical Engineers (ASME), Section XI Boiler and Pressure Vessel Code (Code) at Surry Power Station, Unit 2. Specifically, VEPCO proposed to examine selected welds using ultrasonic and surface testing requirements specified in ASME, Section III, instead of performing radiography testing. The Nuclear Regulatory Commission (NRC) staff has completed its review of this relief request and our evaluation and conclusion is contained in the enclosed Safety Evaluation.

The NRC staff has reviewed Relief Request SPT-008 and concludes that VEPCO's proposed alternative provides reasonable assurance of structural integrity. In addition, the NRC staff has determined that the ASME Code-required examination would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety. Therefore, Relief Request SPT-008 is authorized pursuant to Title 10 of the *Code of Federal Regulations* Section 50.55a(a)(3)(ii) for the fourth 10-year ISI interval at Surry, Unit 2.

Sincerely,
***/RA/***
Evangelos Marinos, Chief, Section 1
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-281

Enclosure: As stated

cc w/ encl: See next page

<u>Distribution</u>
PUBLIC
PDII-1 R/F
RidsNrrPMSMonarque
RidsNrrLACHawes
RidsNrrDlpmLpdii (EHackett)
RidsNrrDlpmLdpii1 (EMarinos)
RidsNrrAcrsAcnwMailCenter
RidsOgcRp
RidsRgn2MailCenter (KLandis)
RidsNrrDlpmDpr
TChan
DNaujock
BWetzel

ADAMS Accession No: ML053040203 NRR-028

| OFFICE | PM/PDII-1 | LA/PDII-2 | SC/EMEB | OGC | SC/PDII-1 |
|---|---|---|---|---|---|
| NAME | SMonarque | CHawes | TChan | GLongo | EMarinos |
| DATE | 10/17/2005 | 10/14/2005 | 09/12/2005 | 10/27/2005 | 11/ 01 /05 |

**OFFICIAL RECORD COPY**

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE FOURTH 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM

SURRY POWER STATION, UNIT 2

VIRGINIA ELECTRIC AND POWER COMPANY

DOCKET NO.50-281

## 1.0 INTRODUCTION

By letter dated May 20, 2005, as supplemented by letter dated August 4, 2005, Virginia Electric and Power Company (the licensee) submitted relief request SPT-008 to use certain requirements of Section XI of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) at Surry Power Station, Unit 2. Specifically, the licensee proposed to examine selected welds using ASME, Section III, ultrasonic testing (UT) and surface testing requirements in lieu of radiography testing (RT) requirements. The request is for the fourth 10-year inservice inspection (ISI) interval, which started on May 16, 2004, and is scheduled to end May 17, 2014.

## 2.0 REGULATORY REQUIREMENTS

The ISI of the ASME Code Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(g), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). As stated, in part, in 10 CFR 50.55a(a)(3), 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 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) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The Code of Record for Surry, Unit 2 for the fourth 10-year ISI interval is the 1998 Edition through 2000 Addenda of Section XI of the ASME Code. The components (including supports) may meet the requirements set forth in

subsequent editions and addenda of the ASME Code incorporated by reference in 10 CFR 50.55a(b) subject to the limitations and modifications listed therein and subject to commission approval.

## 3.0 SAFETY EVALUATION - Relief Request SPT-008

### 3.1 Identification of Components

The components affected by this request for relief are the branch connection welds:

| Component | Drawing Number | Weld Number |
|---|---|---|
| 30"-SHP-101-601/ 6"SHP-145-601 | 11548-WMKS-103A2-1 | 2-01BC |
| 30"-SHP-102-601/ 6"SHP-146-601 | 11548-WMKS-103A2-2 | 2-01BC |
| 30"-SHP-103-601/ 6"SHP-147-601 | 11548-WMKS-103A2-3 | 2-01BC |

### 3.2 Code Requirements

The licensee is using the 1998 Edition through the 2000 Addenda of the ASME Code, Section XI for the fourth 10-year ISI interval.

IWA-4540(a)(2)(a) states, “The nondestructive examination methodology and acceptance criteria of the 1992 Edition or later of Section III shall be met prior to return to service.”

### 3.3 Licensee’s Proposed Alternative

In lieu of the 1998 Edition with 2000 Addenda, ASME Code, Section III required RT examination, the licensee proposed the following for the three subject welds:

1) Perform a surface examination of the root pass, mid-wall pass, and final pass.

2) Perform an UT examination to the maximum extent achievable to the requirements of ASME, Section V with the acceptance criteria to ASME Section III, NC-5330.
The procedures and examiners are qualified in accordance with ASME Section XI, Appendix VIII, Supplement 3, and the recording and acceptance criteria of ASME Section XI are also utilized.

These welds were scanned to the extent possible in four directions with 45E and 60E transducers. Coverage was limited in all four directions due to the joint configuration resulting in a combined coverage for the 45E transducer of 48 percent with coverage of the weld root in only one direction. For the 60E scans the combined total of 58.7 percent coverage was attained, and the root was examined from one direction.

For scans searching for circumferentially oriented flaws using the 45E transducer, coverage of 5.3 percent was achieved in one direction and 84 percent coverage was achieved in the other direction.

For scans searching for circumferentially oriented flaws using the 60E transducer coverage of 41 percent was achieved in one direction and 91 percent coverage was achieved in the other direction. Coverage of the root and lower 1/3 of the weld was excellent for both the 45E and 60E transducers from one direction. For scans searching for axially oriented flaws, coverage was 51.3 percent with both the 45E and 60E transducers in both directions and was predominantly in the upper one-half of the weld.

3) A system leakage test will be performed in accordance with IWA-5000.

4) These welds are ASME Section XI, IWC-2500-1, Examination Category C-F-2, Item C5.81. The licensee will include one of the three welds in an Augmented Inspection Plan and will perform a surface and best effort volumetric examination once per period for the next three periods.

3.4 Licensee's Basis for the Alternative

The licensee replaced the 6-inch main steam trip valve bypass lines at Surry, Unit 2. Under IWA-4540, any ASME Section XI repair/replacement activity that involves welding requires either 1) a system hydrostatic test or 2) a system leakage test along with all nondestructive examination requirements of the 1992 or later Edition of ASME, Section III and all Owner's requirements prior to return-to-service.

The original Construction Code for Surry, Unit 2 is the 1967 Edition of American National Standards Institute B31.1. ASME, Section III requires an RT examination of these welds; however, neither the original Construction Code nor present Owner's specifications would require an RT.

The system hydrostatic test required by IWA-4540(a)(1) is not practical, as no isolation valve exists between the subject components and the steam generator. The alternative to the system hydrostatic test, permitted by IWA-4540(a)(2), requires the use of nondestructive examination methodology and acceptance criteria of the 1992 Edition of ASME, Section III.
ASME Section III requires RT examination to be performed on the welds. RT of the three weldolets would require approximately 48 exposures for each weld and installation of gamma ports into the 30-inch piping to facilitate the RT process. Furthermore, a double wall RT is not feasible with the weldolet configuration, and even with the large number of exposures, 100 percent coverage would not be attained. The RT would result in unusual difficulty without a compensating increase in the level of quality and safety.

The following discussion explains the anticipated weld quality. The low hydrogen controls on filler metal, 400 EF preheat, and continuous preheat maintenance leading directly into postweld heat treatment (PWHT) ensures that hydrogen assisted cracking cannot occur. Welding using stringer beads produces the smallest possible weld puddle. This reduces the risk of incomplete fusion fabrication defects usually caused by carrying too large a weld puddle. Stringer beads additionally reduce the risk of trapped slag. Also, weld heat inputs per pass are lower than for weave beads and the greater number of beads may give a more uniform tempered metallurgical structure to the weld deposit. Final PWHT ensures that the resulting weld will have a microstructure free from untempered martensite. The principal flaws that might be reasonably postulated will be circumferential in nature. These flaws would be expected to be either incomplete fusion or trapped slag. The maximum through thickness dimension of a

fabrication flaw occurring while welding would be associated with the weld deposit thickness per pass (approximately 1/8-inch). The larger number of weld beads needed to fill the groove when using stringer beads decreases the risk that postulated flaws through thickness would become larger aligned interbeads flaws. The probable location for large aligned postulated flaws to occur is at the base metal fusion lines. Since magnetic particle testing (MT) inspection was performed on the root pass, at mid thickness, and final weld surfaces, the maximum through thickness flaw resulting from postulated aligned lack of fusion (LOF) or slag inclusions would be less than 1/2-inch measured from the root surface outward to just below the midwall MT surface. Similarly, the maximum through thickness flaw resulting from postulated aligned LOF or slag inclusions measured from the midwall thickness MT surface to the face of the reinforcing fillet weld would be under 1/2-inch to 1-inch. It would be unreasonable to expect that a through wall construction flaw would exist. Flaws of the magnitude described above are extremely unlikely to occur.

The weld location was evaluated with a through-wall flaw and with a flaw depth equal to half the wall thickness. The flaws were subjected separately to operating basis earthquake (OBE) and design basis earthquake (DBE) loadings in addition to pressure, dead weight, and thermal expansion loadings. A 5.75-inch long flaw with a depth equal to half of the component wall thickness will remain stable in the normal operating plus OBE condition with a factor of safety of 2.77, and in the normal operating plus DBE condition with a factor of safety of 1.39. A limit load analysis was also performed for both kinds of flaws with flow stress in the material equal to 36,000 pounds per square inch, and the results show there is significant margin against ductile rupture.

3.5 <u>NRC Staff Evaluation</u>

The licensee performed the repair using the 1998 Edition with 2000 Addenda of ASME Code, Section XI, IWA-4540, “Pressure Testing of Class 1, 2, and 3, Items.”

IWA-4540(a) states “Unless exempt by (b) below, repair/replacement activities performed by welding or brazing on a pressure-retaining boundary shall include (a)(1) or (a)(2) below.

(1) A system hydro test shall be performed in accordance with IWA-5000 prior to, or as part of, returning to service.
(2) The following requirements shall be met.
    (a) The nondestructive examination methodology and acceptance criteria of the 1992 Edition or later of Section III shall be met prior to return to service.
    (b) The Owner’s Requirements shall be met prior to return to service.
    (c) A system leakage test shall be performed in accordance with IWA-5000.”

The construction welds attaching the nozzles to the steam generator were originally installed and examined to the requirements of the 1967 Edition of ANSI B31.1, which only required a system hydrostatic test. The licensee supplemented the original requirements with a surface examination. For the repair, the licensee had the option of performing the original examination requirements or using the 1992 Edition of ASME, Section III or later editions of the ASME Code plus any additional owner requirements and a system leakage test.

The licensee stated that the ASME Class 2 nozzle to main steam line pipe weld is not easily isolated for a system hydrostatic test. In its letter dated August 4, 2005, the licensee stated that the system hydrostatic test would require filling the steam generator with water to the main

steam isolation valves outside containment, as well as blanking or gagging the five main steam safety valves. The main steam lines would need additional supports to carry the added weight of the water.

Because of the difficulties in performing a hydrostatic pressure test, the licensee chose to use the pressure test requirements of IWA-4540(a)(2) from the 1992 Edition or later endorsed editions of ASME, Section III. Besides the remaining requirements of IWA-4540(a)(2), the 1992 Edition and later endorsed editions of Section III also requires an RT examination. The licensee believes that RT would result in unusual difficulty without a compensating increase in the level of quality and safety. The weld design creates varying through-wall dimensions which necessitates approximately 48 film exposures for each weld and the installation of ports into the 30-inch steam line for inserting the radioactive source. Even with all these film exposures, the RT would not be able to completely examine the welds. In lieu of RT, the licensee proposed volumetrically examining the welds with UT.

UT and RT examinations are complementary though not directly comparable or equivalent. Depending on the flaw type (i.e., volumetric or planar) and orientation, UT examinations may be superior to RT or vice versa. RT is most effective in detection of volumetric type flaws (i.e., slag and porosity) and detection of planar type flaws (i.e., lack of fusion and cracks) that are oriented in a plane parallel to the x-ray beam. However, RT is limited in detecting planar flaws not oriented parallel to the beam. In contrast, UT is very effective in detecting planar type flaws that are not oriented in a plane parallel to the sound beam. Finally, UT is capable of detecting volumetric type flaws such as slag and porosity, but is limited, compared to RT, in ability to characterize volumetric flaws.

In the licensee's proposed alternative, the examination coverage consists of scanning with angle beam transducers in two opposite directions perpendicular to the weld axis and two opposite directions parallel to the weld axis to the extent permitted by the nozzle-to-pipe configuration. Where the scan perpendicular to the weld is limited on one side, a full V-path will be used for the second direction. The scans provide assurance that planar flaws, regardless of orientation, will be detected and non-planar, construction flaws will be easier to discern from second phase precipitates and grain boundaries.

The qualification process assures that the UT procedure contains sufficient detail and that the personnel have the necessary skills for detecting various types of flaws. The procedure was demonstrated capable of detecting and characterizing flaws in Section XI, Appendix VIII, Supplement 3 mockups. Flaws that are detected with UT will be evaluated in accordance with the acceptance criteria of NC-5330, ASME Code, Section III, which is the same criteria for crack-type flaws detected by RT.

In addition to the UT and the system pressure leakage test, the licensee performed MT on the weld root pass, weld mid-wall pass and the finished outside surface of the weld region. The MT verified that at these three locations, there were no unacceptable flaws. Any flaws that may exist would most likely be no greater than the thickness of one weld bead (one weld pass), which is approximately 1/8-inch through-wall that should be detectable with the UT. However, the licensee performed crack growth calculation using a postulated 1/2-inch through-wall crack and concluded that such a flaw would not affect the structural integrity of the weld.

The UT and MT examinations and the crack propagation calculations along with the followup augmented examinations will provide reasonable assurance of the structural integrity of the subject welds.

## 4.0 CONCLUSION

Based on the above evaluation, the NRC staff concludes that the licensee's proposed alternative SPT-008 to use UT and MT in lieu of RT for the main steam trip valve bypass lines will provide reasonable assurance of structural integrity, and that compliance with the ASME Code RT requirement would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the NRC staff authorizes request number SPT-008 for examination of the subject welds for the fourth 10-year ISI interval at Surry, Unit 2.

All other requirements of the ASME Code requirements for which relief has not been specifically requested remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: D. Nauock

Date: November 1, 2005

cc:
Ms. Lillian M. Cuoco, Esq.
Senior Counsel
Dominion Resources Services, Inc.
Building 475, 5th Floor
Rope Ferry Road
Waterford, Connecticut 06385

Mr. Donald E. Jernigan
Site Vice President
Surry Power Station
Virginia Electric and Power Company
5570 Hog Island Road
Surry, Virginia 23883-0315

Senior Resident Inspector
Surry Power Station
U. S. Nuclear Regulatory Commission
5850 Hog Island Road
Surry, Virginia 23883

Chairman
Board of Supervisors of Surry County
Surry County Courthouse
Surry, Virginia 23683

Dr. W. T. Lough
Virginia State Corporation Commission
Division of Energy Regulation
Post Office Box 1197
Richmond, Virginia 23218

Dr. Robert B. Stroube, MD, MPH
State Health Commissioner
Office of the Commissioner
Virginia Department of Health
Post Office Box 2448
Richmond, Virginia 23218

Office of the Attorney General
Commonwealth of Virginia
900 East Main Street
Richmond, Virginia 23219

Mr. Chris L. Funderburk, Director
Nuclear Licensing & Operations Support
Dominion Resources Services, Inc.
Innsbrook Technical Center
5000 Dominion Blvd.
Glen Allen, Virginia 23060-6711