June 9, 2008

Mr. David A. Christian
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 NOS. 1 AND 2, THIRD 10-YEAR INSERVICE INSPECTION INTERVAL RELIEF REQUESTS CMP-023 AND CMP-024 (TAC NOS. MD6081 AND MD6082)

Dear Mr. Christian:

By letter dated July 13, 2007, Virginia Electric and Power Company (the licensee) submitted Relief Requests CMP-023 and CMP-024 for the third 10-year inservice inspection (ISI) interval at North Anna Power Station, Unit Nos. 1 and 2 (North Anna 1 and 2), respectively. In Relief Requests CMP-023 and CMP-024, the licensee proposed an alternative to the examination requirements of the American Society of Mechanical Engineers (ASME), *Boiler and Pressure Vessel Code* (Code), Section XI for specified regenerative heat exchanger and residual heat removal heat exchanger vessel welds at North Anna 1 and 2 during the units' third 10-year ISI intervals. The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of these relief requests, and the NRC staff's evaluation and conclusions are contained in the enclosed safety evaluation.

The NRC staff found that compliance with the specified ASME Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety and that to impose the ASME Code requirements would be a hardship on the licensee. The NRC staff also concludes that the licensee's proposed alternative will provide reasonable assurance of continued structural integrity for the subject welds at North Anna 1and 2. Therefore, the licensee's proposed alternative in Relief Requests CMP-023 for North Anna 1 and CMP-024 for North Anna 2 is authorized pursuant to Title 10 of the *Code of Federal Regulations*, Part 50, Section 50.55a(a)(3)(ii) for the North Anna 1 and 2 third 10-year ISI interval. All other requirements of ASME Code, Section XI for which relief has not been specifically requested remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Sincerely,

/RA/

Siva P. Lingam, Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-338 and 50-339

Enclosure: Safety Evaluation

cc w/encl: See next page

June 9, 2008

Mr. David A. Christian
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 NOS. 1 AND 2, THIRD 10-YEAR INSERVICE INSPECTION INTERVAL RELIEF REQUESTS CMP-023 AND CMP-024 (TAC NOS. MD6081 AND MD6082)

Dear Mr. Christian:

By letter dated July 13, 2007, Virginia Electric and Power Company (the licensee) submitted Relief Requests CMP-023 and CMP-024 for the third 10-year inservice inspection (ISI) interval at North Anna Power Station, Unit Nos. 1 and 2 (North Anna 1 and 2), respectively. In Relief Requests CMP-023 and CMP-024, the licensee proposed an alternative to the examination requirements of the American Society of Mechanical Engineers (ASME), *Boiler and Pressure Vessel Code* (Code), Section XI for specified regenerative heat exchanger and residual heat removal heat exchanger vessel welds at North Anna 1 and 2 during the units' third 10-year ISI intervals. The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of these relief requests, and the NRC staff's evaluation and conclusions are contained in the enclosed safety evaluation.

The NRC staff found that compliance with the specified ASME Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety and that to impose the ASME Code requirements would be a hardship on the licensee. The NRC staff also concludes that the licensee's proposed alternative will provide reasonable assurance of continued structural integrity for the subject welds at North Anna 1and 2. Therefore, the licensee's proposed alternative in Relief Requests CMP-023 for North Anna 1 and CMP-024 for North Anna 2 is authorized pursuant to Title 10 of the *Code of Federal Regulations*, Part 50, Section 50.55a(a)(3)(ii) for the North Anna 1 and 2 third 10-year ISI interval. All other requirements of ASME Code, Section XI for which relief has not been specifically requested remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Sincerely,

/RA/

Siva P. Lingam, Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-338 and 50-339

Enclosure: Safety Evaluation

cc w/encl: See next page

DISTRIBUTION: Public
LPL2-1 R/F
RidsNrrDorlLpl2-1 (MWong)
RidsNrrPMSLingam (hard copy)
RidsNrrAdes
RidsAcrsAcnw&mMailCenter
RidsNrrDciCvib (MMitchell)
RidsOgcRp
MCox, EDO Rgn II
RidsRgn2MailCenter (EGuthrie)
RidsNrrDciCvib (CSydnor)
RidsNrrLAMO'Brien (hard copy)
RidsNrrOd

ADAMS Accession No.: ML081440014

*transmitted by memo dated

OFFICE	NRR/LPL2-1/PM	NRR/LPD2-1/LA	NRR/DCI/CVIB/BC	OGC	NRR/LPL2-1/BC
NAME	SLingam	MO'Brien	MMitchell	BMizuno	MWong
DATE	5/28/08	6/9/08	4/18/08*	6/4/08	6/9/08

OFFICIAL RECORD COPY

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUESTS CMP-023 AND CMP-024

VIRGINIA ELECTRIC AND POWER COMPANY

NORTH ANNA POWER STATION, UNIT NOS. 1 AND 2

DOCKET NOS. 50-338 AND 50-339

1.0 INTRODUCTION

By letter dated July 13, 2007 (Agencywide Documents Access and Management System Accession No. ML071980142), Virginia Electric and Power Company (the licensee) submitted Relief Requests CMP-023 for North Anna Power Station, Unit No. 1 (North Anna 1) and CMP-024 for North Anna Power Station, Unit No. 2 (North Anna 2) associated with the inspection of several welds of Regenerative Heat Exchangers (RHXs) 1-CH-E-3 and 2-CH-E-3 and Residual Heat Removal Heat Exchangers (RHRHXs) 1-RH-E-1A, 1-RH-E-1B, 2-RH-E-1A and 2-RH-E-1B for the third 10-year inservice inspection (ISI) intervals. In these Relief Requests, the licensee requested an alternative to the requirements of the American Society of Mechanical Engineers (ASME), *Boiler and Pressure Vessel Code* (Code), Section XI pertaining to the examination of specified welds of RHXs and RHRHXs.

2.0 REGULATORY EVALUATION

ISI of 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 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 Nuclear Regulatory Commission (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 applicable ASME Code of record for the North Anna 1 third 10-year interval ISI Program which began on May 1, 1999, and scheduled to end on April 30, 2009, is the 1989 edition of Section XI of the ASME Code, without any addenda. The applicable ASME Code of record for the North Anna 2 third 10-year interval ISI Program, which began on December 14, 2001, and scheduled to end on December 13, 2010, is the 1995 edition of Section XI of the ASME Code, through the 1996 addenda.

3.0 TECHNICAL EVALUATION

3.1 Component Identification

Relief Requests CMP-023 and CMP-024 address the following ASME Code, Section XI, Examination Categories and Item Numbers covering examinations of Class 1 RHX welds and Class 2 RHRHX welds at North Anna 1 and 2. These Examination Categories and Item Numbers are from Tables IWB-2500-1 and IWC-2500-1 of the 1989 edition (North Anna 1) and 1995 edition through 1996 addenda (North Anna 2) of ASME Code, Section XI.

RHX 1-CH-E-3 (North Anna 1)

Weld Nos.	Description	Examination Category	Item No.	Class
3, 7, 11	Tubesheet-to-Head Weld	B-B	B2.60	1
2, 6, 10	Tubesheet-to-Shell Weld	B-B	B2.80	1
1, 4, 5, 8, 9, 12	Circumferential Head Weld	B-B	B2.51	1
13, 14, 15, 16, 17, 18, 23, 24, 25, 26, 27, 28	Nozzle-to-Vessel Weld	B-D	B3.150	1
13, 14, 15, 16, 17, 18, 23, 24, 25, 26, 27, 28	Nozzle Inside Radius	B-D	B3.160	1

RHX 2-CH-E-3 (North Anna 2)

Weld Nos.	Description	Examination Category	Item No.	Class
8, 10, 12	Tubesheet-to-Head Weld	B-B	B2.60	1
7, 9, 11	Tubesheet-to-Shell Weld	B-B	B2.80	1
1, 2, 3, 4, 5, 6	Circumferential Head Weld	B-B	B2.51	1
13, 14, 15, 16, 17, 18, 23, 24, 25, 26, 27, 28	Nozzle-to-Vessel Weld	B-D	B3.150	1
13, 14, 15, 16, 17, 18, 23, 24, 25, 26, 27, 28	Nozzle Inside Radius	B-D	B3.160	1

RHRHX 1-RH-E-1A and B (North Anna 1) and RHRHX 2-RH-E-1A and B (North Anna 2)

Weld Nos.	Description	Examination Category	Item No.	Class
1	Head Circumferential Weld	C-A	C1.20	2
2	Shell Circumferential Weld	C-A	C1.10	2
3A, 3B, 4A, 4B	Reinforcing Plate Welds to Nozzle and Vessel	C-B	C2.31	2

3.2 NRC Staff's Evaluation

The 1989 edition and 1995 edition through the 1996 addenda of the ASME Code, Section XI, Articles IWB-2500 and IWC-2500 require that components be examined and tested as specified in Tables IWB-2500-1 and IWC-2500-1 of ASME Code, Section XI. For Class 1 welds, Table IWB-2500-1, Examination Category B-B requires a volumetric examination of all pressure-retaining welds in the RHX, with essentially 100 percent volumetric coverage of the examination volume specified in Figures IWB-2500-2 and IWB-2500-6 of the ASME Code, Section XI for the entire length of the weld. Table IWB-2500-1, Examination Category B-D requires a volumetric examination of all nozzle-to-vessel welds in the RHX, with essentially 100 percent volumetric coverage of the examination volume specified in Figure IWB-2500-7 of ASME Code, Section XI for the entire length of the weld. For Class 2 welds, Table IWC-2500-1, Examination Category C-A requires a volumetric examination of all pressure-retaining welds in the RHRHX, with essentially 100 percent volumetric coverage of the examination volume specified in Figures IWC-2500-1 and IWC-2500-2 of ASME Code, Section XI for the entire length of the weld. Table IWC-2500-1, Examination Category C-B, Item No. C2.31 requires a surface examination of all reinforcing plate welds in the RHX, with essentially 100 percent coverage of the examination surface specified in Figure IWC-2500-4(c) of ASME Code, Section XI, for the entire length of the weld.

Pursuant to 10 CFR 50.55a(a)(3)(ii), Relief Request CMP-023 proposed an alternative to the requirements of the ASME Code, Section XI, Table IWB-2500-1, Examination Categories B-B and B-D pertaining to specified welds in RHX 1-CH-E-3, and Table IWC-2500-1, Examination Categories C-A and C-B pertaining to specified welds in RHRHXs 1-RH-E-1A/B at North Anna 1. Pursuant to 10 CFR 50.55a(a)(3)(ii), Relief Request CMP-024 proposed an alternative to the requirements of ASME Code, Section XI, Table IWB-2500-1, Examination Categories B-B and B-D pertaining to specified welds in RHX 2-CH-E-3, and Table IWC-2500-1, Examination Categories C-A and C-B pertaining to specified welds in RHRHXs 2-RH-E-1A/B at North Anna 2. In these requests, the licensee specifically requested authorization to use the alternative provisions of ASME Code Case N-706, Rev. 0, "Alternative Examination Requirements of Table IWB-2500-1 and Table IWC-2500-1 for PWR Stainless Steel Residual and Regenerative Heat

Exchangers, Section XI, Division 1," for performing the third ISI interval examinations of the subject RHX and RHRHX welds at North Anna 1 and 2 in lieu of the ASME Code-required volumetric and surface examinations discussed above. ASME Code Case N-706 allows for these welds to receive a VT-2 visual examination while undergoing the system leakage test, as required by Examination Categories B-P and C-H, to be performed every refueling outage, in lieu of volumetric and surface examinations required by Examination Categories B-B, B-D, C-A, and C-B. These alternative provisions are listed in Table 1 of the Code Case for each of the examination categories that may be considered for application of the Code Case provisions. All of the subject welds for which the licensee requested application of the alternative are included in Table 1 of the Code Case.

ASME Code Case N-706 states that the alternative provisions of the Code Case may not be applied to any heat exchanger, nor to any heat exchanger design or configuration, that has experienced a through-wall leak, such as heat exchangers with an inner shell. The Code Case specifies that the plant owner shall evaluate industry experience to determine which heat exchanger designs or configurations have leaked. If any leakage is detected, the Code Case specifies that its use shall be discontinued for that heat exchanger design or configuration, and the affected heat exchanger, as well as all others of the same design or configuration, shall be examined in accordance with the requirements of the ASME Code, Section XI, Table IWB-2500-1 or Table IWC-2500-1, as applicable. Additionally, Note (2) of Table 1 of the Code Case states that all welds shall have previously received at least one volumetric examination, and that the pre-service or construction code volumetric examination may be used to meet this requirement. The licensee stated in Relief Requests CMP-023 and CMP-024 that there have been no through-wall leaks in these heat exchangers at North Anna 1 and 2 or in heat exchangers of similar design. Furthermore, each of the subject welds has received the requisite pre-service volumetric examination. Therefore, the alternative provisions allowed by Code Case N-706-1 are applicable to the subject welds at North Anna 1 and 2.

ASME Code Case N-706 has been approved by the ASME Boiler and Pressure Vessel Standards Committee. The technical justification for the elimination of the volumetric examinations required by ASME Code, Section XI, Table IWB-2500-1 for RHRHXs and RHXs was provided under the Westinghouse Owner's Group (WOG) project, "Technical Basis for Revision of Inspection Requirements for Regenerative and Residual Heat Exchangers," August 2004. The RHRHXs and RHXs at North Anna 1 and 2 are typical of the heat exchangers described in the WOG report. The WOG report noted that these heat exchangers were designed and installed before the ISI requirements of ASME Code, Section XI were required to be implemented by industry. As a result, the design of these heat exchangers does not accommodate the successful performance of meaningful ultrasonic testing (UT) examinations. The small diameter of the vessels and nozzles of these heat exchangers make it difficult to perform UT with meaningful results. The examinations are very time consuming and result in high dose rates to the personnel and technicians preparing and performing the examinations since these components are located in high radiation fields. The licensee estimated that a dose of 13 man-rem would be expended to meet the ASME Code, Section XI examination requirements for the RHXs, and a dose of 4.5 man-rem would be expended to meet the ASME Code, Section XI examination requirements for the RHRHXs. Therefore, in consideration of the limited examinations providing questionable results and dose expended, the value of performing the ASME Code-required examinations is minimal.

Two other factors presented in the WOG report for these components were considered by the ASME committee: flaw tolerance and risk assessment. Fracture evaluations were performed for the components using finite element models and fracture calculations. It was concluded that the heat exchangers have a large flaw tolerance and that significant leakage would be expected long before any failure occurred. Fatigue crack growth was determined to be extremely slow even in the most highly stressed region. The WOG report concluded that detailed volumetric examinations are not required to ensure heat exchanger integrity.

In the WOG report, a risk evaluation was performed using the accepted methodology applied for risk-informed ISI piping inspection programs. The following conclusions were made in the WOG report:

- Safety equipment required to respond to the potential event is unaffected.
- Potential for loss of pressure boundary integrity is negligible.
- No safety analysis margins are changed.
- Leakage before break is expected (no core damage consequences associated with the leakage).

The WOG report further concluded that elimination of the subject inspections would not be expected to result in a significant increase in risk.

In anticipation of proposed ASME Code Case N-706, the NRC staff previously contracted Pacific Northwest National Laboratory (PNNL) to perform a study regarding the issues of inspection and the value of continued volumetric and/or surface examinations of pressure-retaining shell welds from the exterior surface of the RHXs and RHRHXs. In the study PNNL concluded that the WOG evaluations agree with the PNNL risk evaluation to the extent that both predict relatively small contributions to risk (Core Damage Frequency of 2.38×10^{-10} or less). The PNNL study further concluded that, with respect to the RHX, the failure probability for the RHX and RHRHX shell is low; however, some nozzle locations may be sensitive to thermal fatigue and a higher failure potential would be expected. The consequence of failure for the RHX is moderate (conditional core damage probability between 1×10^{-6} and 1×10^{-4}). Ordinarily the resulting risk categorizations would suggest that some selected RHX nozzles be considered for inspection. However, the radiation burden associated with the nozzles is very high. The thermal fatigue loading was accounted for in the design of the RHX nozzles, and plant operators monitor the number of occurrences of letdown and charging design thermal transients. In addition, the number and magnitude of the actual thermal transient events seen by these nozzles is less than the conservative values assumed in the design analysis. In this light, the challenges to component integrity and inspection benefits (reductions in failure probability and risk) do not appear to offset the high radiation burden associated with performing volumetric examinations of these components.

Based on the PNNL study, the NRC staff previously determined that the technical basis for implementation of the provisions of ASME Code Case N-706 is acceptable, provided that the subject components meet all provisions specified in the Code Case. As discussed above, the licensee demonstrated that the subject welds at North Anna 1 and 2 satisfied the provisions of the Code Case. Furthermore, the licensee adequately demonstrated that performance of the ASME Code-required volumetric and surface examinations would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Therefore, the NRC staff found that the alternative examinations proposed by the licensee in Relief Requests CMP-023 and CMP-024 were acceptable.

4.0 CONCLUSION

The NRC staff concludes that the licensee's request to implement the alternative examination requirements of ASME Code Case N-706 in lieu of the requirements of ASME Code, Section XI, Table IWB-2500-1, Examination Categories B-B and B-D, and Table IWC-2500-1, Examination Categories C-A and C-B, pertaining to the specified RHX and RHRHX welds will provide reasonable assurance of continued structural integrity for the subject welds at North Anna 1 and 2. Therefore, the licensee's proposed alternative in Relief Requests CMP-023 and CMP-024 is authorized pursuant to 10 CFR 50.55a(a)(3)(ii) for the third 10-year ISI interval at North Anna 1 and 2. All other requirements of ASME Code, Section XI, for which relief has not been specifically requested and approved, remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: C. Sydnor

Date: June 9, 2008

North Anna Power Station, Units 1 & 2

cc:

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

Mr. C. Lee Lintecum
County Administrator
Louisa County
Post Office Box 160
Louisa, Virginia 23093

Ms. Lillian M. Cuoco, Esq.
Senior Counsel
Dominion Resources Services, Inc.
120 Tredegar Street, RS-2
Richmond, VA 23219

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

Old Dominion Electric Cooperative
4201 Dominion Blvd.
Glen Allen, Virginia 23060

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

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

Senior Resident Inspector
North Anna Power Station
U. S. Nuclear Regulatory Commission
P. O. Box 490
Mineral, Virginia 23117

Mr. Daniel G. Stoddard
Site Vice President
North Anna Power Station
Virginia Electric and Power Company
Post Office Box 402
Mineral, Virginia 23117-0402

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

Mr. Mark D. Sartain, Director
Nuclear Safety & Licensing
Virginia Electric and Power Company
North Anna Power Station
P.O. Box 402
Mineral, VA 23117