



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
REGION II  
SAM NUNN ATLANTA FEDERAL CENTER  
61 FORSYTH STREET SW SUITE 23T85  
ATLANTA, GEORGIA 30303-8931

March 27, 2003

Virginia Electric and Power Company  
ATTN: Mr. David A. Christian  
Sr. Vice President and  
Chief Nuclear Officer  
Innsbrook Technical Center - 2SW  
5000 Dominion Boulevard  
Glen Allen, VA 23060-6711

SUBJECT: NORTH ANNA POWER STATION - NRC SPECIAL INSPECTION REPORT  
NO. 50-339/03-09

Dear Mr. Christian:

On February 10, 2003, the NRC completed a special inspection of reactor vessel head replacement activities at your North Anna Power Station, Unit 2. The enclosures document the inspection findings which were discussed on February 10, 2003, with Ms. L. Hartz and other members of your staff. Enclosure 1 documents on-site inspection of reactor vessel head replacement activities and Enclosure 2 documents NRC review of your reconciliation of the as-built head with the ASME Code.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspectors reviewed selective procedures and records, observed activities, and interviewed personnel. Based on the results of this inspection, no findings of significance were identified.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Sincerely,

**/RA/**

Mark S. Lesser, Chief  
Engineering Branch 2  
Division of Reactor Safety

Docket Nos.: 50-339  
License Nos.: NPF-7

Enclosures: (See page 2)

- Enclosures: 1. NRC Special Inspection Report No. 50-339/03-09  
w/Attachment: Supplementary Information
2. Memorandum From John A. Nakoski to Mark S. Lesser, dated March 17, 2003, Subject: North Anna, Unit 2, Reactor Pressure Vessel Head Replacement Reconciliation Inspection

cc w/encls:  
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PUBLIC DOCUMENT	YES NO						

U.S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket No.: 50-339  
License No.: NPF-7

Report No.: 50-339/03-09

Licensee: Virginia Electric and Power Company (VEPCO)

Facilities: North Anna Power Station, Units 1 & 2

Location: 1022 Haley Drive  
Mineral, Virginia 23117

Dates: December 16, 2002 through February 10, 2003

Inspectors: B. Crowley, Senior Reactor Inspector  
J. Lenahan, Senior Reactor Inspector  
S. Vias, Senior Reactor Inspector

Accompanying  
Personnel: J. Fuller, Nuclear Safety Intern

Approved by: M. Lesser, Chief  
Engineering Branch 2  
Division of Reactor Safety

Attachment: Supplementary Information

## SUMMARY OF FINDINGS

Inspection Report No. 05000339-03-09; Virginia Electric and Power Co.; on 12/16/2002 - 02/10/2003; North Anna Power Station Unit 2; Special Inspection of Reactor Vessel Head Replacement.

The inspection was conducted by regional inspectors and Headquarters personnel. No findings of significance were identified. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 3, dated July 2000.

A. Inspector Identified Findings

None

B. Licensee Identified Violations

None

## Report Details

### Background

During the Unit 2 refueling outage (RFO), which started September 8, 2003, the licensee performed inspections of the Unit 2 reactor pressure vessel head (RPVH) in accordance with the provisions of Bulletin 2002-02, "Reactor Pressure Vessel Head and Vessel Head Penetration Inspection Program." North Anna, Unit 2, was categorized as a high susceptibility plant. During this inspection, nondestructive examination indications were identified in 64 of the 65 vessel head penetration (VHP) nozzle J-groove welds. Most of these indications would require repair in accordance with the ASME Code. In addition, at several of the VHP nozzles there was evidence of through wall leakage. However, none of the indications were of a size or location to cause a concern with the structural integrity of the welds.

To address the indications, the licensee decided to accelerate its plans to replace the RPVH to eliminate the need for extensive inspections and repairs each refueling outage. A new RPVH (No. 28R), fabricated by Framatome ANP for French Utility Electricite de France (EdF), was procured for the replacement. The replacement RPVH was manufactured in 1998 to the 1993 Edition, through the 1996 Addenda, of the French RCC-M Code as part of the French program of replacing RPVHs at its pressurized water reactors (PWRs) to address concerns with primary water stress corrosion cracking (PWSCC).

This inspection included review of the licensee's process for reconciling the RPVH fabricated under the RCC-M Code to the ASME Code, and inspection of site activities associated with installation of the replacement RPVH and repair of the temporary access opening in the containment.

#### **4. OTHER ACTIVITIES**

4OA3 Replacement of North Anna Unit 2 RPVH (93812)

##### **.1 North Anna RPVH Reconciliation Plan**

To reconcile the RPVH built to the RCC-M Code in accordance with Article IWA-4000 of ASME Code, Section XI, the licensee and its contractor, Framatome ANP, compared the actual fabrication and inspection requirements to the requirements of the ASME Code, Section III, 1995 Edition with Addenda through 1996. The reconciliation of the requirements was reviewed by the Office of Nuclear Reactor Regulation (NRR). The details of the review are documented in Enclosure 2 to this report.

##### **.2 Engineering Preparation and Implementation for the Reactor Pressure Vessel Head Replacement Project (RPVHRP)**

###### **a. Inspection Scope**

The inspectors reviewed engineering preparations including: selected Design Change Packages (DCPs), engineering calculations, analyses, drawings, and Work Plan and Inspection Reports (WPIRs) for the Dominion RPV Head Replacement Project (RPVHRP), in order to assess adequacy and completeness. The inspectors also held

discussions with RPVHRP project management to obtain a greater understanding of the entire project scope.

b. Findings

No findings of significance were identified.

.3 Review of RPVHRP Lifting and Transportation Program Activities

a. Inspection Scope

The inspectors reviewed applicable sections of the North Anna FSAR and various scope documents and identified applicable Code Sections and Editions for lifting and movement activities for the RPVHRP, which are listed in the Attachment.

The inspectors reviewed the adequacy of the RPVHRP lifting program, to determine that it was prepared in accordance with regulatory requirements, appropriate industrial codes, and standards and to verify that the maximum anticipated loads to be lifted would not exceed the capacity of the lifting equipment and supporting structures. In addition the inspectors examined the RPVHRP lifting equipment including the Over-the-Road Transporter, Liebherr LTM1300 Crane, and Demag AC1200 Crane. The inspection included review of the following RPVHRP lifting documents and procedures that control these activities:

- Analysis of Work Platforms & Support Structure, Rigging International (RI) Calculation - C-2655-18 , Rev. 1
- Bechtel Calculation - 24841-120-C-003, Evaluation of Closure Package Components for the North Anna ORPVH, Rev. 2
- Bechtel Calculation - 24841-120-C-004, Evaluation of Crane Wall, Beams and Floor Slab at EL. 291'-10", Rev. 0
- Bechtel Calculation - 24841-120-C-005, Evaluation of Buried Utilities along the ORPVH and RRPVH Haul Routes , Rev. 0
- Bechtel Calculation - 24841-120-C-007, Evaluation of RPVH for Sliding and Tipping , Rev. 0
- WPIR No. R-RIG-02, Reactor Head Rigging, Rev. 1
- WPIR No. R-SHP-01, RRPVH Rigging Packaging, and Hauling, Rev. 1
- DCP 02-017, Rigging and Transport of Reactor Pressure Vessel Heads / NAPS/ Unit 2

In addition, the inspectors reviewed the adequacy of the transport programs, procedures, work packages and load test records, to assure that they had been prepared and tested in accordance with regulatory requirements, appropriate industrial codes, and standards.

The inspectors observed the loading of the RRPVH from the air transport to the Over-the-Road Transporter using the Liebherr LTM1300 Crane. The inspectors also observed the Original Reactor Pressure Vessel Head (ORPVH) being lifted from the outside runway and work platform to the transfer cart and the Replacement Reactor Pressure Vessel Head (RRPVH) from the transfer cart to the outside runway and work

platform. During these observations the inspectors performed visual inspections of the Demag AC1200 Crane. For the task of rigging and movement of the ORPVH and RRPVH, the inspectors reviewed the DCPs for content, technical adequacy and to verify that appropriate line items had been signed off and that required pre-lift equipment inspections had been performed and documented in the enclosures provided. This review was also to verify that Industry Operating Experience was utilized and reflected in the procedures.

The inspectors also reviewed the licensee's analyses for buried piping located beneath the transport path as documented in Bechtel Calculation - 24841-120-C-005, Evaluation of Buried Utilities along the ORPVH and RRPVH Haul Routes , Rev. 0, Bechtel Calculation - 24841-120-C-007, Evaluation of RPVH for Sliding and Tipping , Rev. 0 and DCP 02-017, Rigging and Transport of Reactor Pressure Vessel Heads / NAPS/ Unit 2.

b. Findings

No findings of significance were identified.

.4 Containment Restoration Activities

a. Inspection Scope

The inspectors reviewed containment (CNTMT) restoration activities associated with the temporary construction opening, which was approximately 13 feet by 17 feet in the containment liner and 20 feet by 25 feet at the face of the concrete wall, as detailed in the licensee's Design Change DCP 02-018, Restoration of Temporary Construction Opening in the Containment Structure for Reactor Pressure Vessel Head Replacement / North Anna Power Station / Unit 2.

Activities associated with CNTMT liner plate welding were reviewed and compared with the ASME Boiler and Pressure Vessel Code (B&PV), Sections III and VIII, 1968 Edition with Addenda through Summer 1969, and welding controls detailed in Bechtel Power Special Processes Manual (SPM). The inspectors reviewed controls for the full penetration liner plate welds and observed fitup (including tack welding) activities. In addition to observation of fitup and tack welding, the inspections included: review of welding procedures (including supporting procedure qualification records), review of welder qualification records, review of welding material testing and certification records, observation of welding material issue and use control, review of in-process weld records, Quality Control (QC) involvement in the welding process, review of magnetic particle (MT) examination records for the completed weld, review of a sample of radiographic (RT) film, review of pressure test records for 'leak chase" channels after re-welding containment liner, and review of QC and nondestructive examination (NDE) personnel qualification and certification records.

The inspectors reviewed activities associated with installation of CNTMT reinforced concrete and compared activities with the applicable Code, ACI 318-63, Part IV-B, Building Code Requirements for Reinforced Concrete Institute, 1963. Cadwelding splicing activities were reviewed and compared with the following applicable

requirements: Bechtel specifications for procurement and installation, equivalent to NAPS (North Anna Power Station) specifications used during original construction; the ASME B&PV Code, Section III, Division 2, 1995 Edition with 1996 Addenda, the applicable Code for splice system qualification tests; Cadweld operator qualification consistent with ASME Section III, Subsection CC-4333.4; and AWS D1.4-98, the applicable Code for welded splices.

The inspectors observed in-process Cadwelding for splices 6H9L and 6H9R; observed in-process welding and reviewed the liquid penetrant inspection report for welded re-bar splice 6H2R; observed QC inspections, including in-process and final acceptance, of Cadwelding activities, including inspection of splices 8H19L, 8H19R, and 'sister splice' T6H2L; observed qualification of Cadwelders 095, 096, and 133, including pull tests of completed qualification assemblies; and observed inservice inspection activities for completed 5<sup>th</sup> layer of diagonal rebar.

Relative to installation of concrete, the inspectors witnessed placement of concrete in the containment wall to restore the temporary construction opening. The inspectors observed the concrete forms to ensure tightness and cleanliness, and that reinforcing steel was clean. The inspectors reviewed placement activities to ensure that activities pertaining to concrete delivery time, free fall, flow distance, layer thickness and concrete consolidation conformed to industry standards established by the American Concrete Institute. Concrete batch tickets were examined to ensure that the specified concrete mix (3000 psi at 5 days with air entrainment admixture) was being delivered to the site. The inspectors also witnessed testing of the plastic concrete for slump, air, and temperature, unit weight, and molding of the concrete cylinders for testing at 3, 5, 7, and 28 days. Reviews were performed to ensure concrete testing was performed and the cylinders were molded in accordance with applicable American Society for Testing and Materials (ASTM) requirements. In addition, the inspectors reviewed activities to ensure that concrete testing was performed by qualified inspectors from an independent testing company, concrete placement activities were continuously monitored by licensee and contractor quality control and quality assurance personnel, and concrete was protected from effects of cold weather and sub freezing temperatures.

The inspectors reviewed concrete batching activities including proper storage and separation of materials, and temperature controls, which included heating the water for mixing the concrete during cold weather. The inspectors reviewed results of quality control acceptance testing performed on materials (cement, fine and coarse aggregate, and admixtures) used for batching the concrete. The inspectors also reviewed records documenting inspection of the concrete batch plant and the concrete truck mixers. Activities were reviewed to determine if the licensee's inspection of the trucks and batch plant were performed in accordance with the guidance of the National Ready Mixed Concrete Association (NRMCA); the batch plant scales were calibrated in accordance with NRMCA recommendations; and mixer efficiency tests were performed on the truck mixers in accordance with ASTM C-94. The inspectors reviewed the concrete mix data to ensure that mix proportions for delivered concrete were selected based on trial concrete mix results, that QC acceptance criteria for the plastic concrete were based on the trail mixes, and that the trail mix met concrete strength requirements.



The inspectors reviewed the procedure and the Technical Specification (3.6.1) for the local pressure test performed after repair of the containment opening.

b. Findings

No findings of significance were identified.

.5 Quality Assurance (QA) Oversight

a. Inspection Scope

The inspectors reviewed licensee procedures relative to Quality Assurance oversight of contractor activities for the RPVH replacement as detailed in Dominion Procedure NOD-GL-4, Unit 2 RVHR Project Nuclear Oversight Quality Plan. In addition, the inspectors observed in-process QA oversight activities for containment restoration. The inspectors also reviewed a sample of Activity Reports and Management Summary Reports documenting QA observations and findings to ensure that adequate oversight was being applied.

b. Findings

No findings of significance were identified.

40A6 Meetings

Exit Meeting Summary

Interim meetings were held periodically with licensee personnel during the inspection period to discuss the status of the inspection.

The inspectors presented the inspection results to Ms. Hartz, Vice President, Nuclear Engineering, and other members of the licensee's staff on February 10, 2003. Proprietary documents were reviewed during the inspections, but proprietary information is not included in this report.

## **SUPPLEMENTARY INFORMATION**

### **KEY POINTS OF CONTACT**

#### Licensee

L. Carter, QA Lead Head Replacement Project  
W Corbin, Director, Nuclear Projects  
J. Crossman, Supervisor, Nuclear Engineering  
C. Funderburk, Corporate Director Nuclear Licensing  
E. Grecheck, Vice President, Nuclear Support Services  
L. Hartz, Vice President, Nuclear Engineering  
D. Heacock, Site Vice President  
J. Leberstien, Supervisor Licensing  
D. Price, Head Replacement Project Manager  
D. Sommers, Supervisor Nuclear Engineering (Licensing)  
L. Spain, Supervisor IS/MAT  
M. Whalen, Supervisor Licensing  
J. Wroniewicz, Manager Nuclear Projects

#### NRC Personnel

J. Canady, Resident Inspector  
K. Landis, Chief, Branch 5, Division of Reactor Projects  
M. Lesser, Chief, Engineering Branch 2, Division of Reactor Safety  
M. Morgan, Senior Resident Inspector

### **ITEMS OPENED, CLOSED AND DISCUSSED**

None

### **PARTIAL LIST OF DOCUMENTS REVIEWED**

#### Specifications & Procedures

P1-REBAR, Welding Procedure Specification  
P1AT-Lh(CVN-20°F), Welding Procedure Specification  
P1,FT(CVN-20°F), Welding Procedure Specification  
GWS -REBAR, General Welding Standard ARC Welding of Reinforcing Steel, Revision 5  
CP-C-2, CADWeld Rebar Splices, Revision 0  
Bechtel Nondestructive Examination Standard RT-ASME IIIICL B S69, Radiographic Examination, Revision 1  
Dominion Nuclear Oversight Department Guideline NOD-GL-4, North Anna Power Station Unit RVHR Project Nuclear Oversight Quality Plan, Revision 0  
Bechtel Welding Specification WFMC-1, Welding Filler Material Control, Revision 1  
Vendor Procedure 'Form - 84', North Anna 2 Nuclear Power Station RPV Head Replacement Project Welding, Heat Treatment and Nondestructive Examination Requirements, Revision 1

Attachment

Repair/Replacement Plan, Program Number 2002-184, Replace Concrete  
 Repair/Replacement Plan, Program Number 2002-164 R.1, Replace RV Head  
 Bechtel Special Processes Manual For North Anna 2 Nuclear Power Station RPV Head  
 Replacement Project  
 Bechtel Procedure WQ-1, Welder Performance Qualification Specification (ASME Section IX),  
 Revision 17  
 Bechtel Procedure B-GWS-1, General Welding Standard, Revision 10  
 Bechtel Procedure GWS-Structural, General Welding Standard, Revision 6  
 Bechtel Procedure GWS-REBAR, General Welding Standard Arc Welding of Reinforcement  
 Steel, Revision 5  
 Risk Release N02-147, Assembly of Reactor Head Attachments, Revision 2  
 Risk Release N02-135, Modification of Reactor Radiation Shield, Revision 0  
 Risk Release N02-156, Reactor Head Service Structure Reassembly, Revision 0  
 Design Change No. 02-018, Restoration of Temporary Construction opening in the  
 Containment Structure for Reactor Pressure Vessel Head Replacement / North Anna Power  
 Station / Unit 2  
 Specification No. 24841-120-C-321, Technical Specification for Purchase of Ready-Mix  
 Concrete Qualified as Safety Related, Rev. 5  
 Specification No. 24841-120-C-322, Technical Specification for Placement of Ready-Mix  
 Concrete Qualified as Safety Related, Rev. 1  
 Specification No. 24841-120-C-101, Technical Specification for Material Testing Services,  
 Revision 3  
 Technical Report No. CE-0109, Inservice Inspection Containment Concrete, Revision 3  
 Construction Procedure CP-C-1, Concrete Operations  
 Work Plan and Inspection Record No C-CON-08, Concrete Restoration of Reactor Containment  
 Wall  
 Procedure 2-PT-61.1, Reactor Containment Integrated Leak Rate Test, Revision 13

### Quality Records

Completed North Anna Periodic Test Procedure 2-PT-61.1M, Leak Testing Individual  
 Containment Liner Locations, Revision 2-OT01  
 Welder Qualification Test Records for Welder Symbols IW-01, IW-02, IW-03, IW-04, IW-05,  
 IW-06, IW-07, BW-01, BW-02, BW-03, BW-04, BW-05, BW-06, BW-07, BW-08, and BW-09  
 Personnel Qualification and Certification Records for 2 Cooperheat MQS NDE Examiners  
 Personnel Qualification and Certification Records 5 Bechtel Examiners  
 QA Management Summary Reports, 10/30/2002 through 1/4/2003  
 Sample of QA Activity Reports  
 Calculation CC-4333.2.3, Including ERICO Letter dated December 18, 2002, and Enclosure  
 "Splice System Qualification Test Program, dated May 30, 2002  
 Magnetic Particle Examination Reports MT-07 and MT-09 for Containment Liner Plate Weld  
 FW-1  
 RT Report and Sample of RT Film for Liner Plate Weld FW-1  
 Liquid Penetrant Examination Report PT-003 and Visual Examination Report VT-003 for  
 Inspection of Manually Welded Rebar Splice 6H2R  
 Visual Examination Report VT-001 for Rebar Splices 3H2L, 3H3L, 3H6L, 3H10L, and 3H15L  
 Welding Material Certification Records: E9018(Lot 2S223M03), ER70S2(Heat 065691),

E9018(Lot 4C226B03), E7018(Lot 2S210C01), and E7018(Lot 4D215A04)  
 National Ready Mixed Concrete Association (NRMCA) Certificate For Bechtel Rustler II Plant,  
 Truck Mix, dated 12/23/02  
 National Ready Mixed Concrete Association (NRMCA) Certificates for Concrete Truck Mixers,  
 Williams Concrete truck numbers 26, 28 & 30  
 Records for calibration of cement and aggregate scales  
 Concrete Mixer Uniformity (ASTM C-94) tests performed on truck numbers 26 & 28  
 Concrete Mix Design data, Williams Concrete Mix Code 601, 45  
 Result of testing performed on concrete materials: Lafarge cement (ASTM C-150), concrete  
 admixtures, Micro Air lot number 211151639 and Rheobuld lot number 2115780, fine  
 aggregate (ASTM C-33), and number 57 coarse aggregate (ASTM C-33)  
 Concrete placement records which included the pre-pour check list, the concrete pour card, and  
 results of testing performed on the plastic concrete  
 Bechtel nonconformance report numbers NCR - 011 and -012 testing of qualification coupons;  
 reviewed in-process Cadwelding records, reviewed results of testing of "sister" splices; and  
 reviewed vendor qualification records for the Cadwelding process.

#### Codes and Standards

AASHTO	Standard Specification for Highway Bridges (15th Edition)
AISC	Specification for Structural Steel buildings, 9 <sup>th</sup> Edition, 1989
ACI 318-02	Building Code Requirements for Structural Concrete
AITC	Timber Construction Manual, (latest edition)
ANSI B21.6/AWWA	American National Standard for Cast Iron Pipe, Centrifugally Cast C106-70 in Metals Molds, for Water and other Liquids.
ANSI B40.1	American Standard for Cast Iron Soil Pipe and Fittings
ASCE 7-98	Minimum Design Loads for Buildings and Other Structures
ASME NQA-1	Quality Assurance Requirements for Nuclear Facility Applications, Subpart 2.15, 1997 Edition
ANSI/ASME B30.9	Slings
ANSI/ASME B30	Safety Standards for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings
ANSI/AWS D1.1	Structural Welding Code (latest edition)
ANSI/ASME B30.2	Overhead and Gantry Cranes, 1996 with B30.2a-1997 Addenda
NUREG 0612	Control of Heavy Loads at Nuclear Power Plants, 1980
NRC Bulletin 96-02	Movement of Heavy Loads Over Spent Fuel, Over Fuel in the Reactor Core, or Over Safety Related Equipment, April 1996

ENCLOSURE 2

**Memorandum From John A. Nakoski to Mark S. Lesser, dated March 17, 2003, Subject: North Anna, Unit 2, Reactor Pressure Vessel Head Replacement Reconciliation Inspection. Located in ADAMS ML030760715**