VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

January 2, 2002

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Serial No.	01-490C
NL&OS/GDM	R2'
Docket No.	50-280
	50-281
License No.	DPR-32
	DPR-37

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 AND 2
NRC BULLETIN 2001-01 CIRCUMFERENTIAL CRACKING OF REACTOR VESSEL HEAD PENETRATION NOZZLES - INSPECTION RESULTS

In a letter dated August 31, 2001 (Serial No. 01-490), Virginia Electric and Power Company (Dominion) responded to NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head (RVHP) Penetration Nozzles." Item 5 of the Requested Information section of the Bulletin requested licensees to provide the following information within 30 days after plant restart following the next refueling outage:

"a. a description of the extent of VHP nozzle leakage and cracking detected at your plant, including the number, location, size, and nature of each crack detected;

b. if cracking is identified, a description of the inspections (type, scope, qualification requirements, and acceptance criteria), repairs, and other corrective actions you have taken to satisfy applicable regulatory requirements. This information is requested only if there are any changes from prior information submitted in accordance with this bulletin."

The requested reactor vessel head penetration (RVHP) nozzle inspections have been completed for Surry Units 1 and 2. Consistent with the inspection requirements provided in the Bulletin, bare-head visual inspections of the RVHP nozzles were performed on Surry Units 1 and 2. The following provides a summary of the Unit 1 and 2 results.

Surry Unit 1 was shutdown for refueling on October 14, 2001. During the refueling outage a bare-head visual inspection was performed. Based on the results of the bare-head visual inspection, additional examinations were required for sixteen (16) penetrations. Of these sixteen penetrations, six penetrations required repair. A discussion of the RVHP inspections and repairs performed on Surry Unit 1 is provided in the attachment.

A088

Surry Unit 2 was shutdown on November 20, 2001 to perform a bare-head visual inspection of the reactor vessel head penetrations. No indication of leakage was identified on any of the Surry Unit 2 RVHPs. Consequently, no additional inspection or repair efforts were required for any of the RVHPs on Unit 2. The Unit 2 head was found sufficiently clean to perform a qualified visual inspection. Any loose debris was easily removed with low-pressure air. No additional cleaning was required or performed.

If you have any questions or require additional information, please contact us.

Very truly yours,

Leslie N. Hartz
Vice President – Nuclear Engineering

Attachment

<u>Commitments made in this letter:</u>

1. None

cc: U.S. Nuclear Regulatory Commission
Region II
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW
Suite 23 T85
Atlanta, Georgia 30303-8931

Mr. R. A. Musser
NRC Senior Resident Inspector
Surry Power Station

Mr. R. Smith
Authorized Nuclear Inspector
Surry Power Station

SN: 01-490C
Docket Nos.: 50-280/281
Subject: NRC Bulletin 2001-01 – Inspection Results

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Leslie N. Hartz, who is Vice President - Nuclear Engineering, of Virginia Electric and Power Company. She has affirmed before me that she is duly authorized to execute and file the foregoing document in behalf of that Company, and that the statements in the document are true to the best of her knowledge and belief.

Acknowledged before me this 2nd day of January, 2002.

My Commission Expires: March 31, 2004.

Maggie McClure
Notary Public

(SEAL)

Attachment

NRC Bulletin 2001-01, Circumferential Cracking of Reactor Pressure Vessel Head (RVHP) Penetration Nozzles

Reactor Vessel Head Penetration Nozzles Inspection Results
Surry Power Station Unit 1

Virginia Electric and Power Company
(Dominion)

NRC BULLETIN 2001-01
REACTOR VESSEL HEAD PENETRATION NOZZLES INSPECTION RESULTS
SURRY POWER STATION UNIT 1

Unit 1 Inspection Results

The inspection and repair effort for the Surry Unit 1 reactor vessel head penetration (RVHP) nozzles began with a qualified bare-head visual inspection, which was performed on all sixty-five (65) reactor head CRDM penetrations plus the head vent penetration. The inspection involved the use of remote examination equipment. Each penetration nozzle was examined a full 360°. This initial visual inspection resulted in three penetrations being initially rejected and twenty-four (24) penetrations considered to be "masked" by debris, thus requiring additional inspection.

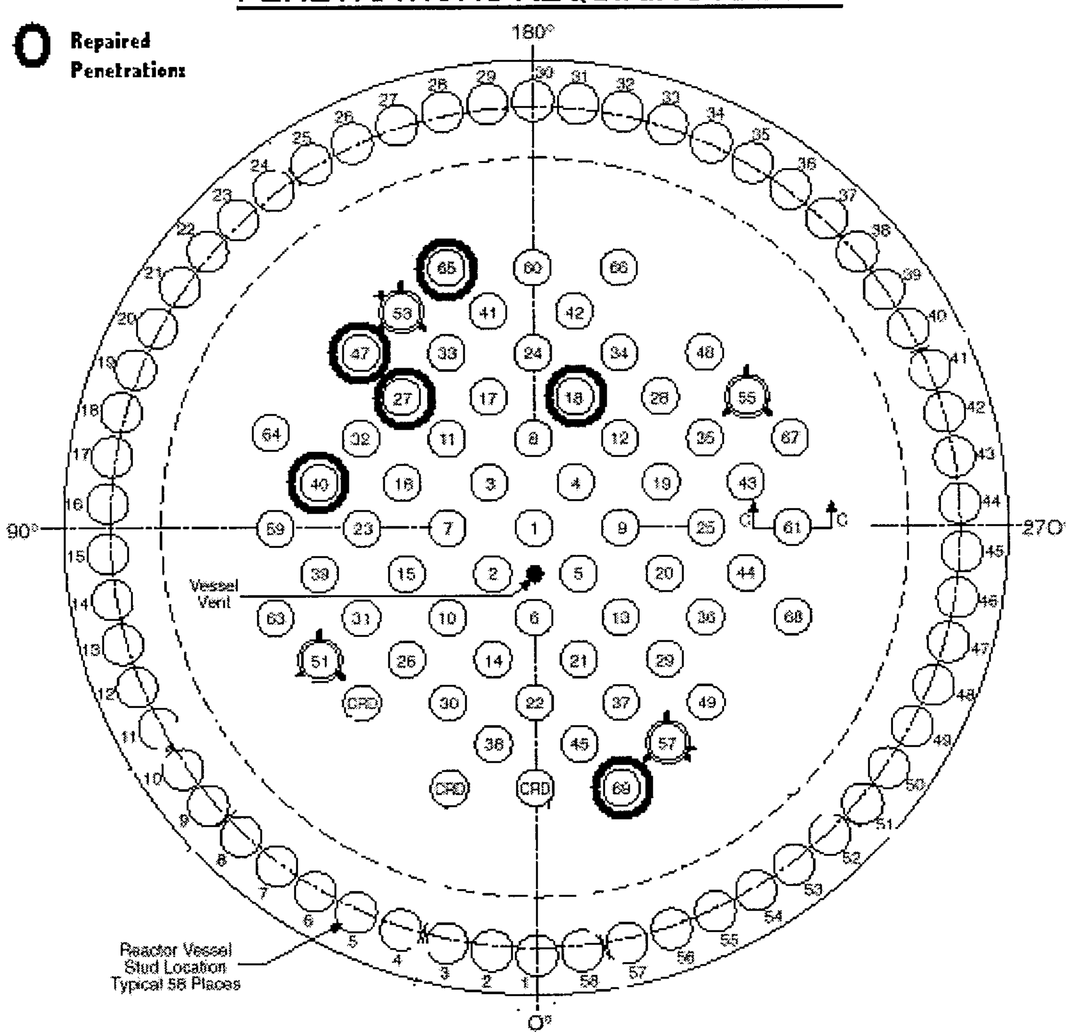
A supplemental bare-head inspection was performed, using low-pressure air at 40 psi, on the accessible penetrations to remove loose debris that typically had collected on the high side of the penetration. At the conclusion of this supplemental inspection, fourteen (14) penetrations remained suspect (three rejected and 11 masked) and required further evaluation.

Under the head ultrasonic (UT) examinations of sixteen (16) control rod drive mechanism (CRDM) penetration nozzles (18, 26, 27, 29, 30, 31, 39, 40, 47, 51, 57, 59, 60, 63, 65 & 69) were performed. This population included the 14 penetrations considered suspect after completion of the initial visual inspection and the subsequent first low-pressure air test. Penetrations 29 and 31 were added to the fourteen penetrations noted above to support the qualification of the debris removal technique using low pressure air (i.e., these two penetrations were dispositioned as visually acceptable following air application). No rejectable flaws were found in any of the penetration tubes using qualified UT techniques. The UT techniques only inspected the penetration tube not the J-groove weld.

Following the UT examinations, a second supplemental bare-head inspection was performed using low-pressure air at 60 psi after additional insulation was removed. This allowed access to perimeter penetrations, which previously could not be reached due to interferences with the insulation. At the conclusion of the second supplemental inspection, four (4) penetrations were categorized as rejected (18, 27, 40 and 65), and six (6) penetrations continued to be categorized as masked (39, 47, 51, 59, 63 and 69).

Liquid penetrant tests over 360° of the J-groove weld surface were performed on ten (10) penetrations noted above (18, 27, 39, 40, 47, 51, 59, 63 and 65, and 69). ASME Section III, 1989 Edition, NB-5352, surface examination acceptance criteria were used to evaluate the indications found. Four of the masked penetrations (39, 51, 59, and 63) were dispositioned as acceptable following excavation and analytical evaluation. An excavation profile of an indication 3/8" deep extending continuously for 135° around the circumference of the J-groove weld was used as a model for a bounding analysis for the indications. This model was bounding relative to the actual excavations documented for penetrations 39, 51, 59, and 63. The CRDM housing stresses for the excavated geometry were shown to be within the allowable limits of the applicable design specification and design code. The remaining six (6) penetrations were determined to have rejectable indications. Penetrations 27 and 40 were rejected based on the unacceptable indications on the weld surface. Penetrations 18, 47, 65 and 69 were rejected due to unacceptable indications following partial excavation of the indications on the weld.

PENETRATIONS REQUIRING REPAIR



SECTION A-A
TOP VIEW - REACTOR VESSEL HEAD
CONTROL ROD DRIVE HOUSING WELD LOCATIONS

Unit 1 Repair Method

Penetration repairs and flaw evaluation were performed in accordance with the temperbead repair procedure and flaw evaluation criteria detailed in relief requests (SR-27 and SR- 32, respectively) submitted to the NRC in letters dated October 17 and 30, 2001 and December 3, 2001 (Serial No. 01-637, 01-637A and 01-637B). The following summarizes the repair process.

- The guide sleeve (thermal sleeve) was removed, as necessary. Then, the existing nozzle was bored out to approximately mid reactor vessel head (RVH) wall thickness. This process removed the entire lower portion of the nozzle including a portion of the nozzle to RVH J-groove weld.

- The penetration to reactor vessel head repair weld was performed with a remotely operated gas tungsten arc weld (GTAW) head using the ambient temperbead process. The final weld face was machined using a remote bottom up machine tool.

- Final inspection of the repair was performed using PT and UT examination methods.

- The J-groove weld at the bottom end of the RVH penetration was ground to limit potential flaw size for evaluation. A chamfer was ground in the remnant.

- The guide sleeves were then replaced in their original configuration.

The repaired nozzles remain susceptible to PWSCC. The limiting factor in the repair life is the propagation of a flaw in the remaining J-groove weld in conjunction with a small flaw in the head. With a maximum J-groove weld of 1.00 inch remaining, the minimum expected service life is 5 years. This is not sufficient to support operation to the end of the current operating license. Therefore, additional actions will be necessary. These actions include monitoring and/or repair of the six repaired RVHP nozzles in accordance with ASME Section XI, or replacement of the RVH.

Unit 1 Penetration Inspection and Repair History

Key to Acronyms:

Visual	Visual Inspection performed by certified VT-2 Examiner
UT	Ultrasonic Testing Inner and Outer Diameter
LP Weld	Liquid Penetrant J-groove weld

<u>Penetration 18, 27, 40, 47, 65 and 69</u>

Visual — Penetrations 47, and 69 were categorized as masked after the visual examinations. Penetrations 18, 27, 40, and 65 were rejected after the visual examinations.

UT — Ultrasonic (UT) examinations were performed on the inside and outside diameter of the tube. No rejectable flaws were found (Framatome UT techniques only inspected the penetration tube, not the J-groove weld).

LP Weld — A liquid penetrant test of the J-groove weld revealed rejectable indications. Excavation was performed to determine the nature of the indications. Unsatisfactory indications remained following the weld metal removal.

Repair — Although the flaws were not confirmed as through-wall leaks, they were not acceptable under ASME Section XI, IWB-3600 and required repair. These six nozzles were repaired.

Evaluation — The limiting factor in the repair life is the propagation of a flaw in the remaining J-groove weld in conjunction with a small flaw in the head. A structural evaluation of the repair was performed. Applying a conservative number of cycles per year, the fracture mechanics analysis showed that the assumed crack would be acceptable for over a minimum of five years of operation.

<u>Penetration 39, 51, 59, and 63</u>

Visual — Categorized as masked during initial and supplemental visual examinations.

UT — Ultrasonic (UT) examinations were performed on the inside and outside diameter of the tube. No rejectable flaws were found (Framatome UT techniques only inspected the penetration tube, not the J-groove weld).

LP Weld — A liquid penetrant test of the nozzle weld revealed indications. Excavation was performed to determine the nature of the indications. No rejectable indications remained following the weld metal removal.

Evaluation — The effect of the excavations on 1) the reactor vessel head thickness and 2) the CRDM housings and their attachment to the reactor vessel head were evaluated. The excavation at these weld locations for penetrations 51, 59, 63 and 39 was found acceptable per the design specification and the ASME Boiler and Pressure Vessel Code, Section III, 1968 edition.

Repair — These penetrations were accepted based on evaluation.

Unit 1 Head Cleaning

To facilitate effective future qualified visual examinations and promote the detection of any future leakage, existing deposits on the Unit 1 RPV head were pressure washed with hot water with particular focus on sixteen (16) penetrations (18, 26, 27, 29, 30, 31, 39, 40, 47, 51, 57, 59, 60, 63, 65 and 69) initially identified with debris.

Unit 1 Conclusion

The use of the repair process discussed above did not result in any change to system capacity rating, system output, component operating requirements, component operating characteristics, or intended design function. Control rod drop testing was performed to confirm that rod drop times were not affected.

After a comprehensive visual inspection of the Surry Unit 1 RVHP nozzles, followed by the non-destructive examination of sixteen (16) nozzles, six (6) penetrations were identified as requiring repair and the requisite repairs were effected. The limiting factor in the life of the repaired reactor vessel head is the propagation of a flaw in the remaining J-groove weld in conjunction with a small flaw in the head. A structural evaluation of each repair was performed, and the results were compared to the fracture toughness requirements of ASME Section XI. Applying a conservatively assumed number of cycles per year, the fracture mechanics analysis demonstrated that each crack would be acceptable for a minimum of five years of operation (reference Article IWB-3612 of the ASME Code). Therefore, additional monitoring and/or repair of the six repaired Unit 1 RVHP nozzles in accordance with ASME Section XI must be performed in the future, or the Unit 1 RVH must be replaced.