10CFR50.73

Virginia Electric and Power Company North Anna Power Station P. O. Box 402 Mineral, Virginia 23117

January 8, 2002

U. S. Nuclear Regulatory Commission Attention: Document Control Desk Washington, D. C. 20555-0001 Serial No.: 02-001 NAPS: JHL Docket No.: 50-339 License No.: NPF-7

Dear Sirs:

Pursuant to 10CFR50.73, Virginia Electric and Power Company hereby submits the following Licensee Event Report applicable to North Anna Power Station Unit 2.

Report No. 50-339/2001-003-00

This report has been reviewed by the Station Nuclear Safety and Operating Committee and will be forwarded to the Management Safety Review Committee for its review.

Very truly yours,

D. A. Heacock, Site Vice President North Anna Power Station

Enclosure

Commitments contained in this letter: None

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

Mr. M. J. Morgan NRC Senior Resident Inspector North Anna Power Station



NRC FORM 366 (7-2001)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

APPROVED BY OMB NO. 3150-0104

EXPIRES 7-31-2004

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FACILITY NAME (1)

NORTH ANNA POWER STATION, UNIT 2

DOCKET NUMBER (2)

PAGE (3)

TITLE (4) Reactor Vessel Head Nozzle Through-Wall Leakage Due to Lack of Weld Fusion During Original Fabrication **REPORT DATE (7) OTHER FACILITIES INVOLVED (8)** LER NUMBER (6) EVENT DATE (5) DOCUMENT NUMBER FACILITY NAME SEQUENTIAL REVISION MONTH DAY YEAR YEAR MONTH DAY YFAR 05000-NUMBER NUMBER DOCUMENT NUMBER FACILITY NAME 2002 2001 2001 -- 003 --00 01 08 11 13 05000-THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply) (11) OPERATING 50.73(a)(2)(ix)(A) 50.73(a)(2)(ii)(B) 20.2203(a)(3)(ii) 20.2201(b) MODE (9) 6 50.73(a)(2)(x) 50.73(a)(2)(iii) 20.2201(d) 20.2203(a)(4) POWER 73.71(a)(4) 50.73(a)(2)(iv)(A) 50.36(c)(1)(i)(A) 20.2203(a)(1) LEVEL (10) 0 % 73.71(a)(5) 50.36(c)(1)(ii)(A) 50.73(a)(2)(v)(A) 20.2203(a)(2)(i) OTHER 50.73(a)(2)(v)(B) 20.2203(a)(2)(ii) 50.36(c)(2) 50.73(a)(2)(v)(C) Specify in Abstract below or 50.46(a)(3)(ii) 20.2203(a)(2)(iii) in NRC Form 366A 50.73(a)(2)(v)(D) 50.73(a)(2)(i)(A) 20.2203(a)(2)(iv) 50.73(a)(2)(vii) Х 50.73(a)(2)(i)(B) 20.2203(a)(2)(v) 50.73(a)(2)(viii)(A) 20.2203(a)(2)(vi) 50.73(a)(2)(i)(C) X 50.73(a)(2)(ii)(A) 50.73(a)(2)(viii)(B) 20.2203(a)(3)(i) LICENSEE CONTACT FOR THIS LER (12) TELEPHONE NUMBER (Include Area Code) NAME (540) 894-2101 D. A. Heacock, Site Vice President COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13) COMPONENT MANUFACTURER REPORTABLE MANUFACTURER CAUSE SYSTEM COMPONENT REPORTABLE SYSTEM CAUSE TO EPIX TO FPIX Yes AB **RPV** R380 В MONTH DAY YEAR SUPPLEMENTAL REPORT EXPECTED (14) EXPECTED SUBMISSION XINO YES (If yes, complete EXPECTED SUBMISSION DATE). DATE (15)

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On October 28, 2001, North Anna Unit 2 was shutdown to perform a qualified, visual barehead inspection of the reactor vessel head penetrations for evidence of leakage as required by NRC Bulletin 2001-01. On November 13, 2001, with Unit 2 in Mode 6, an apparent through-wall leak on penetration number 63 was identified based on the presence of boric acid deposited at the base of the penetration and the results of a subsequent liquid penetrant examination of the associated J-groove weld area. A non-emergency 8-hour notification was made to the NRC, at 0859 hours, on November 13, 2001, in accordance with 10CFR50.72(b)(3)(ii)(A). The event is also reportable in accordance with 10CFR50.73(a)(2)(i)(B). The cause of the event was hot-short cracking, which occurred during original fabrication of the reactor vessel head. Repairs to the welds were performed in accordance with NRC verbally approved relief requests to eliminate any leakage path. No significant safety consequences resulted from this event since RCS unidentified leakage was well below TS limits. An evaluation also determined that a complete lack of fusion in the zone between the weld and the head would not result in rod ejection accident because the weld to the tube would prevent it. The health and safety of the public were not affected at any time during this event.

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NARRATIVE (If more space is required, use additional copies of NRC Form 366A) (17)

1.0 DESCRIPTION OF THE EVENT

On October 28, 2001, North Anna Unit 2 was shutdown to perform a qualified, visual barehead inspection of the reactor pressure vessel (EIIS-RPV) head penetrations (EIIS-PEN) for evidence of leakage as required by NRC Bulletin 2001-01, Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles. On October 31, 2001, with Unit 2 in Mode 5, this inspection resulted in three penetrations (51, 62 and 63) being identified as rejectable due to existence of boric acid on the reactor pressure vessel barehead surface. The other 62 penetrations were determined to be acceptable based on this inspection. On November 13, 2001, with Unit 2 in Mode 6, further review identified an apparent through-wall leak on penetration number 63 due to evidence of boric acid deposited at the base of the penetration and a liquid penetrant indication near the Jgroove weld for that penetration. A portion of the J-groove weld, approximately two and three-fourths (2 3/4) inches long, containing the indication, was excavated to a depth of approximately one (1) inch. A liquid penetrant examination of this excavation on penetration 63 showed that the indication located in the outside edge of the weld almost the full length of the excavation remained and that it turned into the weld at the uphill and downhill ends of the excavation. Based on the apparent through-wall leak, a nonemergency 8-hour notification was made to the NRC, at 0859 hours, on November 13, 2001, in accordance with 10CFR50.72(b)(3)(ii)(A), any event or condition that results in the condition of the nuclear power plant, including its principal safety barriers, being seriously degraded. This event is reportable per 10 CFR 50.73(a)(2)(ii)(A), for any event or condition that resulted in the condition of the nuclear power plant, including its principal safety barriers, being seriously degraded.

In addition, Technical Specification (TS) 3.4.6.2 prohibits reactor coolant system (RCS) (EIIS-AB) pressure boundary leakage in Modes 1 through 4. Although the apparent leakage was identified in Mode 6, it is reasonable to assume that the leakage occurred during Modes 1 through 4. Therefore, this event is also reportable in accordance with 10CFR50.73(a)(2)(i)(B) for a condition prohibited by TS.

A summary of NDE inspection results for penetration 63 and penetrations 51 and 62 that also had rejectable indications due to existence of boric acid on the reactor barehead surface is provided below.

Penetration # N2-63:

LP: Liquid Penetrant (LP) examination of the entire weld surface revealed twelve indications at the toe of the weld, which appeared to be contained in the cladding material. No indications were noted on the weld surface. Six of the recorded indications were parallel to the weld, and six were transverse.

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E/C ID:	The thermal sleeve was removed to Current (E/C) inspection on the inside of the attachment weld under the millimeter (mm) long axial indication w	o facilitate ir diameter (ID vessel head vas reported.	nspection of the tube. Eddy) of the penetration in the area was performed, and one 31				
UT ID: A Ultrasonic Test (UT) examination of the ID was performed to confirm and determine the depth of the indication found using E/C. The depth of the indication was <1 mm, and the length was 14 mm.							
UT OD	UT OD: A UT examination using pulse echo probes inside the tube (45° forward/up and 45° backward/down) was performed focusing on the outside diameter (OD) of the tube. There were no reportable indications using this method.						
Penetra	ation #N2-51:						
LP: LP examination of the entire weld surface revealed twelve indications at the toe of the weld, which appeared to be contained in the cladding material. No indications were noted on the weld surface. Five of the indications were parallel to the weld, and seven were transverse.							
E/C ID:	This thermocouple penetration does not the ID of the penetration in the area of was performed, and six axial indication	ot have a the the attachme is were report	rmal sleeve. E/C inspection on ent weld under the vessel head ted.				
UT ID:	UT examination of the ID of the tube w depth of the indications found using E the exception of #3, that had a dept determined using UT:	vas performe E/C. All indic th of <2 mm	d to confirm and determine the ations were <1 mm deep with . The following lengths were				
	Indications #1 and #2, 24 mm long clus	ter (craze cra	icking)				
	Indication #3, 10 mm long						
	Indication #4, 6 mm long						
	Indication #5, 12 mm long	ىمىرى دىرىكى					

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Indication #6_6 mm long		
UT OD: A UT examination using pulse 45° backward/down) was perfo no reportable indications using	echo probes inside rmed focusing on th this method.	e the tube (45° forward/up and ne OD of the tube. There were
Penetration # N2-62:		
LP: LP examination of the entire we the weld, which appeared to be were noted on the weld surface the weld, and six were transvers	eld surface revealed contained in the cla e. Two of the record se.	d eight indications at the toe of adding material. No indications ded indications were parallel to
E/C ID: The thermal sleeve was rem inspection on the inside diamet weld under the vessel head (craze cracking) were reported.	noved to facilitate ter of the penetratio was performed, an	inspection of the tube. E/C n in the area of the attachment d two axial cluster indications
UT ID: A UT examination of the ID was the indications found using E/C. was <1 mm deep. The following	s performed to conf Indication #1 was g lengths were deter	irm and determine the depth of <2 mm deep, and Indication #2 rmined using UT:
Indication #1, 74 mm long		
Indication #2, 42 mm long		
UT OD: A UT examination using pulse 45° backward/down) was perfo no reportable indications using	e echo probes inside ormed focusing on the this method.	e the tube (45° forward/up and he OD of the tube. There were
2.0 SIGNIFICANT SAFETY CONSEQUEN	CES AND IMPLICA	TIONS
Reactor Coolant System leakage, incl hours per TS 3.4.6.2. Prior to the Un inspection, unidentified leakage was inleakage was measured at 0.06 gpm.	uding unidentified l nit 2 shutdown to po measured at 0.04	eakage, is quantified every 72 erform the reactor vessel head gpm and containment sump

WCAP-14552, "Structural Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operation: North Anna and Surry Units," was prepared to support determination of appropriate corrective actions. The WCAP documents that as much as

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83.9% of the weld may be unfused, and the allowable stress limits can still be met. Even a complete lack of fusion in the zone between the weld and the head would not result in rod ejection because the weld to the tube would prevent it. Therefore, catastrophic failure of a penetration is unlikely. The health and safety of the public were not affected at any time during this event.

3.0 <u>CAUSE</u>

The root cause of the reportable PT indication was hot-short cracking, which occurred during original fabrication of the reactor vessel head. The hot-short cracking was due to the presence of low melting point contaminants in the weld metal. The reactor vessel head may not have been sufficiently cleaned prior to welding in the area around penetrations # 51, 62 and 63, which would indicate a lapse in process control. The hot-short cracking was not detected during the final PT of the finished J groove weld, because the indications were likely subsurface prior to startup. The cracking probably did not extend to the wetted weld surface until sometime later in North Anna Unit 2 reactor vessel head's operating life. Inconel Alloy 82/182 welds are prone to cracking when subject to staress at elevated temperatures.

4.0 IMMEDIATE CORRECTIVE ACTION(S)

Based on the qualified, visual barehead inspection results, additional NDE examinations were initiated to characterize the nature of the indications.

5.0 ADDITIONAL CORRECTIVE ACTIONS

Evaluations of the eddy current and ultrasonic inspection results for the vessel head penetrations were performed to demonstrate that there is no evidence of a flaw propagating from the OD of the penetration or the penetration to weld fusion zone toward the ID and around the penetration circumferentially. Using methodology obtained from WCAP-14552, the shallow indications detected at the ID of the penetration tube have been evaluated to determine the additional service life allowable before repair. This approach began with detailed stress analyses of the vessel head penetrations. The results of the stress analysis provided input that was applied directly to crack growth analyses. This evaluation determined an allowed operating time of 8.1 years for penetration 63 and 5.6 years for penetrations 51 and 62 with indications at the ID of these penetrations.

A boat sample of the weld material from penetration 62 at a location where indications were identified by the LP exam was removed and sent to Westinghouse for laboratory analysis. This sample is considered representative of the indications found in the welds for penetrations 51 and 63 because they all are similarly located at the junction of the J-

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groove weld and the butter layer. Also, all of the indications are circumferential in nature with a similar appearance from LP. Analysis of the sample confirmed that the indications found using LP were most likely associated with original fabrication.

Relief requests were submitted to the NRC to allow alternative repair techniques for reactor vessel head penetrations that exhibited flaws. During a phone call with the NRC on November 16, 2001, North Anna was given verbal approval to use these repair techniques.

Repairs to the three vessel head penetration welds were performed in accordance with the above mentioned, NRC verbally approved relief requests.

Additional information related to the structural integrity of the reactor pressure vessel head penetration nozzles, including the extent of the leakage and indications, and the inspections and repairs undertaken to satisfy regulatory requirements will be provided in the written response to NRC Bulletin 2001-01.

6.0 ACTIONS TO PREVENT RECURRENCE

Further corrective actions will be provided in our response to NRC Bulletin 2001-01.

7.0 SIMILAR EVENTS

LER 50-339/94-005-00 documents leakage on a nozzle weld on the seal injection line entering the "B" RCP thermal barrier housing. This line is part of the RCS pressure boundary leakage.

LER 50-338/91-011-001 documents a unit shutdown due to failure of a disc pressurization line for the "B" cold leg stop valve, which exceeded the TS Limit for RCS pressure boundary leakage.

8.0 MANUFACTURER/MODEL NUMBER

Rotterdam Dockyard Company/Serial Number 30662

9.0 ADDITIONAL INFORMATION

North Anna Unit 1 performed reactor pressure vessel head penetration inspections during the Fall 2001 refueling outage and no through-wall leaks were identified.