VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

November 5, 2001

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

Serial No. 01-490A
NL&OS/GDM R3
Docket No. 50-338
License No. NPF-4

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNIT 1
NRC BULLETIN 2001-01 CIRCUMFERENTIAL CRACKING OF REACTOR VESSEL HEAD PENETRATION NOZZLES

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 for North Anna Unit 1 were performed during the recently completed Fall 2001 refueling outage. No circumferential cracking or through-wall flaws were identified in the welds or in the tubes of any of the RVHP nozzles; however, indications were identified on nine penetrations. One non-service induced flaw (crater crack) and four indications in the cladding were discovered on one penetration (Penetration 50). The non-service induced flaw was successfully excavated, and since the other four indications were non-recordable, they did not require repair. The indications associated with the remaining eight penetrations (i.e., Penetration Nos. 3, 11, 31, 33, 52, 57, 60, 66) were evaluated by fracture mechanics, and it was determined that these indications would not compromise structural integrity. Periodic inspection of the indications associated with these eight penetrations will be performed during subsequent refueling outages, as required by ASME Section XI, to minimize the probability of a rapidly propagating

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fracture of the pressure boundary. Specific inspection information and the disposition of the indications associated with these nine penetrations are provided in the attachment.

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

Very truly yours,

Leslie N. Hartz
Vice President – Nuclear Engineering

Attachment

Commitments made in this letter:

1. Periodic inspection of the indications associated with these eight penetrations (i.e., Penetration Nos. 3, 11, 31, 33, 52, 57, 60, 66) will be performed during subsequent refueling outages, as required by ASME Section XI, to minimize the probability of a rapidly propagating fracture of the pressure boundary.

cc: U.S. Nuclear Regulatory Commission
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Docket No.: 50-338
Subject: NRC Bulletin 2001-01

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 5th day of November, 2001.

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

North Anna Power Station Unit 1

NRC BULLETIN 2001-01
REACTOR VESSELHEAD PENETRATION NOZZLES INSPECTION RESULTS
NORTH ANNA POWER STATION UNIT 1

A summary of the reactor vessel head inspections for each penetration with confirmed axial indications and their disposition is provided below. No circumferential cracking was identified during the course of the inspections.

Key to Acronyms:		
	VT-2	Visual Inspection
	E/C OD	Eddy Current Outer Diameter
	E/C ID	Eddy Current Inner Diameter
	UT ID	Ultrasonic Testing Inner Diameter
	LP OD	Liquid Penetrant Outer Diameter

Penetration #3

VT-2: Relevant indication was identified - A VT-2 inspection by a Level III qualified inspector reported evidence of boric acid leakage originating at another location that may mask leakage from the annulus region. Therefore, additional NDE inspection was scheduled.

E/C OD: No Recordable Indications – An E/C inspection was performed on the outside diameter of the penetration attachment weld under the vessel head, and there was no evidence of a recordable flaw.

E/C ID: Two Recordable Axial Indications – An E/C inspection was performed on the inside diameter of the penetration in the area of the attachment weld under the vessel head, and the following two indications were reported:
Indication #1, 14 mm
Indication #2, 26 mm

UT ID: A UT inspection was performed at the ID of the weld to confirm the indications found with eddy current. The following results were reported:
Indication #1, 9 mm length, < 1 mm depth
Indication #2, no detectable indication

Evaluation: Inspection results for this vessel head penetration demonstrate that there is no evidence of a through-wall leak that penetrates the pressure retaining membrane. Using methodology obtained from WCAP-14552, the shallow indications that were detected have been evaluated under calculation CE-1569 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. The results of the flaw tolerance evaluations are presented in terms of simple charts that graphically indicate the time required to reach the "allowable" flaw size, which represents the additional service life allowed before repair. This evaluation projects an allowed operating time of 8.1 years for this penetration. Periodic inspection of the indication during refueling outages will minimize the probability of a rapidly propagating fracture of the pressure boundary. For these reasons, this penetration is deemed acceptable.

Penetration #11

VT-2: Relevant indication was identified - A VT-2 inspection by a Level III qualified inspector reported evidence of boric acid leakage originating at another location

that may mask leakage from the annulus region. Therefore, additional NDE inspection was scheduled.

E/C OD: No Recordable Indications – An E/C inspection was performed on the outside diameter of the penetration attachment weld under the vessel head, and there was no evidence of a recordable flaw.

E/C ID: Three (multiple axial) Craze Crack Indications – An E/C inspection was performed on the inside diameter of the penetration in the area of the attachment weld under the vessel head, and the following indications were reported:
Indication #1, 53 mm
Indication #2, 23 mm
Indication #3, 65 mm

UT ID: A UT inspection was performed at the ID of the weld to confirm the indications found with eddy current. The following results were reported:
Three indications 2 mm length, <1 mm depth

Evaluation: Inspection results for this vessel head penetration demonstrate that there is no evidence of a through-wall leak that penetrates the pressure retaining membrane. Using methodology obtained from WCAP-14552, the shallow indications that were detected have been evaluated under calculation CE-1569 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. The results of the flaw tolerance evaluations are presented in terms of simple charts that graphically indicate the time required to reach the "allowable" flaw size, which represents the additional service life allowed before repair. This evaluation projects an allowed operating time of 8.1 years for this penetration. Periodic inspection of the indication during refueling outages will minimize the probability of a rapidly propagating fracture of the pressure boundary. For these reasons, this penetration is deemed acceptable.

Penetration #31

VT-2: Relevant indication was identified - A VT-2 inspection by a Level III qualified inspector reported that boric acid was evident at the vessel head to CRDM housing interface. It could not be readily determined if the penetration was the source of the leakage. Therefore, additional NDE inspection was scheduled.

E/C OD: No Recordable Indications – An E/C inspection was performed on the outside diameter of the penetration attachment weld under the vessel head, and there was no evidence of a recordable flaw.

E/C ID: Three Recordable Axial Indications – An E/C inspection was performed on the inside diameter of the penetration in the area of the attachment weld under the vessel head, and the following indications were reported:
Indication #1, 16 mm
Indication #2, 55 mm
Indication #3, 37 mm

UT ID: A UT inspection was performed at the ID of the weld to confirm the indications found with eddy current. The following results were reported:
Indication #1,18 mm indication < 1 mm deep
Indication #2, 44 mm indication 3.27 mm deep
Indication #3, 36 mm indication 2.4 mm deep

Evaluation: Inspection results for this vessel head penetration demonstrate that there is no evidence of a through-wall leak that penetrates the pressure retaining membrane. Using methodology obtained from WCAP-14552, the shallow

indications that were detected have been evaluated under calculation CE-1569 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. The results of the flaw tolerance evaluations are presented in terms of simple charts that graphically indicate the time required to reach the "allowable" flaw size, which represents the additional service life allowed before repair. This evaluation projects an allowed operating time of 4 years for this penetration. Periodic inspection of the indication during refueling outages will minimize the probability of a rapidly propagating fracture of the pressure boundary. For these reasons, this penetration is deemed acceptable.

Penetration #33

VT-2: Relevant indication was identified - A VT-2 inspection by a Level III qualified inspector reported evidence of boric acid leakage originating at another location that may mask leakage from the annulus region. Therefore, additional NDE inspection was scheduled.

E/C OD: No Recordable Indications – An E/C inspection was performed on the outside diameter of the penetration attachment weld under the vessel head, and there was no evidence of a recordable flaw.

E/C ID: Two Recordable Axial Indications – An E/C inspection was performed on the inside diameter of the penetration in the area of the attachment weld under the vessel head, and the following indications were reported:
Indication #1, 56 mm
Indication #2, 155 mm

UT ID: A UT inspection was performed at the ID of the weld to confirm the indications found with eddy current. The following results were reported:
Indication #1, 60 mm length, <3 mm depth
Indication #2, 58 mm length, <3 mm depth

Evaluation: Inspection results for this vessel head penetration demonstrate that there is no evidence of a through-wall leak that penetrates the pressure retaining membrane. Using methodology obtained from WCAP-14552, the shallow indications that were detected have been evaluated under calculation CE-1569 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. The results of the flaw tolerance evaluations are presented in terms of simple charts that graphically indicate the time required to reach the "allowable" flaw size, which represents the additional service life allowed before repair. This evaluation projects an allowed operating time of 5.1 years for this penetration. Periodic inspection of the indication during refueling outages will minimize the probability of a rapidly propagating fracture of the pressure boundary. For these reasons, this penetration is deemed acceptable.

Penetration #50

VT-2 The VT-2 inspection of the vessel head under the insulation by a Level III qualified inspector initially characterized Penetration 50 as having evidence of "significant leakage." Therefore, this penetration was aggressively pursued with every NDE inspection technique available to the station.

E/C OD: E/C inspection at the OD of the "J groove" weld at Penetration 50 yielded one non-recordable rounded indication 4.3 mm in length.

E/C ID: E/C at the ID was performed with 98% of the weld covered, and there were no detectable indications.

LP OD: LP examinations were performed over the entire weld surface of Penetration 50, and five indications were observed near the toe of the weld. One non-service induced flaw (crater crack) was discovered that was successfully excavated. The other four indications were in the cladding and consequently did not require repair.

UT ID: A partial UT inspection at the ID of the weld was performed from 196° to 293° at altitudes between 44 mm and 184 mm. No defects were observed during the UT inspection. To gain access to the ID of the CRDM housing above the thermal sleeve centering ring, a portion of the thermal sleeve was cut out and removed. Subsequent UT and E/C of 100% of this area revealed no defects.

Evaluation: Since thorough NDE inspection resulted in no recordable indications, it is concluded that the boric acid deposits reported at this penetration are attributable to other sources. Therefore, this penetration was deemed acceptable.

Penetration #52

VT-2: Relevant indication was identified - A VT-2 inspection by a Level III qualified inspector reported that boric acid was evident at the vessel head to CRDM housing interface. It could not be readily determined if the penetration was the source of the leakage. Therefore, additional NDE inspection was scheduled.

E/C OD: One Recordable Radial Indication – An E/C inspection was performed on the OD of the penetration and one 9 mm indication was found. Further inspection of this penetration was performed using LP techniques. These inspections confirmed that the indications were in the cladding material.

E/C ID: Six Recordable Axial Indications. E/C inspection on the inside diameter of the penetration in the area of the attachment weld under the vessel head was performed, and the following indications were reported:
Indication #1, 14 mm
Indication #2, 39 mm
Indication #3, 32 mm
Indication #4, 14 mm
Indication #5, 6 mm
Indication #6, 29 mm

UT ID: A UT inspection at the ID of the weld was performed to confirm the indications found with eddy current. The following results were reported:
Indications #1 and 2; 38 mm length, <2 mm deep
Indications #3, 4 and 5; 32 mm length, <2 mm deep
Indication #6; 22 mm length, <2 mm deep

LP OD: LP inspection of the entire surface of the attachment weld was performed with the following results:
Indication #1, 1 inch circumferential indication at toe of weld, and 3/4 inch radial indication into cladding from toe of weld. The circumferential indication was a weld overlap, and the radial indication was a short indication in the cladding.
Indication #4, two indications approximately 1/2 inch each. These indications were determined to be pitting.
Other indications: at roughly 100°, 1-1/2 inch long indication which was determined to be undercut; and at roughly 20° showing a dot which was determined to be porosity.

Evaluation: Inspection results for this vessel head penetration demonstrate that there is no evidence of a through-wall leak that penetrates the pressure retaining

membrane. Using methodology obtained from WCAP-14552, the shallow indications that were detected have been evaluated under calculation CE-1569 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. The results of the flaw tolerance evaluations are presented in terms of simple charts that graphically indicate the time required to reach the "allowable" flaw size, which represents the additional service life allowed before repair. This evaluation projects an allowed operating time of 5.9 years for this penetration. Periodic inspection of the indication during refueling outages will minimize the probability of a rapidly propagating fracture of the pressure boundary. For these reasons, this penetration is deemed acceptable.

Penetration #57 (#4 Conoseal)

VT-2: Relevant indication was identified - A VT-2 inspection by a Level III qualified inspector reported evidence of boric acid leakage originating at another location that may mask leakage from the annulus region. Therefore, additional NDE inspection was scheduled.

E/C ID: One Recordable Axial Indication – An E/C inspection was performed on the inside diameter of the penetration in the area of the attachment weld under the vessel head, and one 9 mm indication was found. This thermocouple penetration has a guide funnel attached to the bottom of the penetration that prevented access for an OD inspection with the available equipment.

Evaluation: Inspection results for this vessel head penetration demonstrate that there is no evidence of a through-wall leak that penetrates the pressure retaining membrane. Using methodology obtained from WCAP-14552, the shallow indications that were detected have been evaluated under calculation CE-1569 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. The results of the flaw tolerance evaluations are presented in terms of simple charts that graphically indicate the time required to reach the "allowable" flaw size, which represents the additional service life allowed before repair. Assuming an indication depth ½ of the length, this evaluation projects an allowed operating time of 5.1 years for this penetration. Periodic inspection of the indication during refueling outages will minimize the probability of a rapidly propagating fracture of the pressure boundary. For these reasons, this penetration is deemed acceptable.

Penetration #60

VT-2: Relevant indication was identified - A VT-2 inspection by a Level III qualified inspector reported evidence of boric acid leakage originating at another location that may mask leakage from the annulus region. Therefore, additional NDE inspection was scheduled.

E/C OD: No Recordable Indications – An E/C inspection was performed on the outside diameter of the penetration attachment weld under the vessel head, and there was no evidence of a recordable flaw.

E/C ID: Two Recordable Axial Indications – An E/C inspection was performed on the inside diameter of the penetration in the area of the attachment weld under the vessel head, and the following indications were reported:
Indication #1, 56 mm

Indication #2, 61 mm

UT ID: A UT inspection at the ID of the weld was performed to confirm the indications found with eddy current. The following results were reported:
Indication #1, 44 mm length, <1 mm depth, cluster
Indication #2, 46 mm length, <1 mm depth, cluster

Evaluation: Inspection results for this vessel head penetration demonstrate that there is no evidence of a through-wall leak that penetrates the pressure retaining membrane. Using methodology obtained from WCAP-14552, the shallow indications that were detected have been evaluated under calculation CE-1569 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. The results of the flaw tolerance evaluations are presented in terms of simple charts that graphically indicate the time required to reach the "allowable" flaw size, which represents the additional service life allowed before repair. This evaluation projects an allowed operating time of 8.1 years for this penetration. Periodic inspection of the indication during refueling outages will minimize the probability of a rapidly propagating fracture of the pressure boundary. For these reasons, this penetration is deemed acceptable.

Penetration #66

VT-2: Relevant indication was identified - A VT-2 inspection by a Level III qualified inspector reported evidence of boric acid leakage originating at another location that may mask leakage from the annulus region. Therefore, additional NDE inspection was scheduled.

E/C OD: No Recordable Indications – An E/C inspection was performed on the outside diameter of the penetration attachment weld under the vessel head, and there was no evidence of a recordable flaw.

E/C ID: One Recordable Indication – An E/C inspection was performed on the inside diameter of the penetration in the area of the attachment weld under the vessel head, and one 13 mm indication was found.

Evaluation: Inspection results for this vessel head penetration demonstrate that there is no evidence of a through-wall leak that penetrates the pressure retaining membrane. Using methodology obtained from WCAP-14552, the shallow indications that were detected have been evaluated under calculation CE-1569 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. The results of the flaw tolerance evaluations are presented in terms of simple charts that graphically indicate the time required to reach the "allowable" flaw size, which represents the additional service life allowed before repair. Assuming an indication depth ½ of the length, this evaluation projects an allowed operating time of 9 years for this penetration. Periodic inspection of the indication during refueling outages will minimize the probability of a rapidly propagating fracture of the pressure boundary. For these reasons, this penetration is deemed acceptable.