10 CFR 50.54(f)

CP&L
A Progress Energy Company

Serial: RNP-RA/02-0175
DEC 1 3 2002

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23

SUBMITTAL OF RESULTS OF REACTOR
PRESSURE VESSEL HEAD AND VESSEL HEAD PENETRATION
NOZZLE INSPECTIONS PERFORMED DURING REFUELING OUTAGE 21

Ladies and Gentlemen:

NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles," and NRC Bulletin 2002-02, "Reactor Pressure Vessel Head and Vessel Head Penetration Nozzle Inspection Programs," requested that licensees provide the results of inspections of the reactor pressure vessel (RPV) head and vessel head penetration (VHP) nozzles within 30 days after plant startup following the next scheduled refueling outage. H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2, completed Refueling Outage (RO)-21 on November 13, 2002. Inspections performed during RO-21 included a bare-metal qualified visual examination of the RPV head surface and non-destructive examination (NDE) of the 69 VHP nozzles. The purpose of this letter is to provide the results of those examinations.

The bare-metal qualified visual examination of the RPV head and head penetration nozzles did not identify evidence of VHP nozzle leakage or cracking.

The NDE of the RPV head penetrations found no evidence of service-related degradation. One recordable indication was identified that did not require repair. An engineering analysis of this indication has been completed, and the crack growth model associated with this analysis shows that the applied stress intensity factor for the indication is below the threshold for crack propagation. The engineering analysis further concluded that the indication is most likely a scratch or other surface anomaly resulting from the manufacturing process, and there is no concern for this indication during future service. Attachment IV provides a figure that shows the general size, location, and orientation of the indication.

Attachment I provides an Affirmation in accordance with the provisions of Section 182a of the Atomic Energy Act of 1954, as amended, and 10 CFR 50.54(f).

Attachment II provides the results of the RPV head and VHP nozzle examinations performed during RO-21. Additionally, Attachment III includes the detailed NDE results for the examination of the VHP nozzles and J-groove welds.

Robinson Nuclear Plant
3581 West Entrance Road
Hartsville, SC 29550

A088
A096

If you have any questions concerning this matter, please contact Mr. C. T. Baucom.

Sincerely,

B. L. Fletcher III
Manager - Support Services - Nuclear

CTB/ctb

Attachments:

I. Affirmation
II. Results of Reactor Pressure Vessel Head and Vessel Head Penetration Nozzle Inspections Performed During Refueling Outage 21
III. Detailed Results of Reactor Pressure Head Penetration Nozzle Non-Destructive Examinations
IV. Drawing of Penetration Number 47 Recordable Indication

c: Mr. L. A. Reyes, NRC, Region II
Mr. R. Subbaratnam
NRC Resident Inspector

AFFIRMATION

The information contained in letter RNP-RA/02-0175 is true and correct to the best of my information, knowledge and belief; and the sources of my information are officers, employees, contractors, and agents of Carolina Power and Light Company. I declare under penalty of perjury that the foregoing is true and correct.

Executed on: DEC 1 3 2002

C. L. Burton

C. L. Burton
Director - Site Operations, HBRSEP, Unit No. 2

H.B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

RESULTS OF REACTOR PRESSURE VESSEL HEAD AND VESSEL HEAD PENETRATION NOZZLE INSPECTIONS PERFORMED DURING REFUELING OUTAGE 21

NRC REQUESTED INFORMATION

NRC Bulletin 2001-01, Requested Information – Item No. 5

"5. Addressees are requested 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 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."

NRC Bulletin 2002-02, Requested Information, Item No. 2

"(2) Within 30 days after plant restart following the next inspection of the RPV head and VHP nozzles to identify the presence of any degradation, all PWR addressees are requested to provide:

A. the inspection scope and results, including the location, size, extent, and nature of any degradation (e.g., cracking, leakage, and wastage) that was detected; details of the NDE used (i.e., method, number, type, and frequency of transducers or transducer packages, essential variables, equipment, procedure and personnel qualification requirements, including personnel pass/fail criteria); and criteria used to determine whether an indication, "shadow," or "backwall anomaly" is acceptable or rejectable.

B. the corrective actions taken and the root cause determinations for any degradation found."

RESPONSE

Summary

Refueling Outage (RO)-21 for the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2, was conducted during the time period of October 12 to November 13, 2002. During RO-21, a bare-metal qualified visual examination of the reactor pressure vessel (RPV) head and head penetration nozzles was performed for the detection of leakage. This examination did not identify evidence of vessel head penetration (VHP) nozzle leakage or cracking. More specific details regarding the results of the bare-metal qualified visual examination are provided below.

In addition, HBRSEP, Unit No. 2, performed non-destructive examination (NDE) of the 69 VHP nozzles and J-groove welds for the purpose of identifying the presence of primary water stress corrosion cracking (PWSCC) on the accessible outer and inner diameter surfaces of the VHP nozzles and partial penetration J-groove welds. A plan for these examinations was provided to the NRC staff by HBRSEP, Unit No. 2, letter dated August 12, 2002, and this plan constituted a key element of the HBRSEP, Unit No. 2, response to NRC Bulletin 2002-02 that was submitted by letter dated September 9, 2002. NDE of the 69 VHP nozzles and J-groove welds found no evidence of service-related degradation, and no repairs were required. More specific details regarding the results of the RO-21 NDE examinations are provided below.

Bare-Metal Qualified Visual Examination

Examination Scope and Techniques

During RO-21, HBRSEP, Unit No. 2, performed a bare-metal qualified visual examination of the RPV head and head penetration nozzles in accordance with Special Procedure (SP)-1500, "Visual Examination of RPV Head Penetration Nozzles." SP-1500 required that personnel performing examinations be qualified VT-2 Level II or greater, and further specified that the responsible engineer should be present during the examinations. The examination procedure also states that, prior to conducting the examinations, the examination team should review the latest revision of the Electric Power Research Institute (EPRI) Report 10006296, "Visual Examination for Leakage of PWR Reactor Head Penetrations on Top of RPV Head."

To perform the examination, the plant equipment was placed in a condition that allowed access to the entire top surface of the RPV head and 360 degrees of each penetration, and the RPV head insulation was removed. SP-1500 instructs that during removal of insulation and/or debris to facilitate the examination, caution must be taken to not wipe off, smear, or disturb any boric acid deposits that may be present on the RPV head without first determining their source and relevance. A systematic approach, including the use of detail drawings, was used to ensure that the region of interest surrounding each penetration was inspected for 360 degrees of its circumference. Each penetration-to-head interface (annulus) was closely scrutinized to determine if boric acid deposits were present in, or around, the penetration annulus. Penetrations were visually accepted based on the absence of boric acid deposits in the annulus area and the results documented in SP-1500.

Examination Results

The results of the bare-metal qualified visual examination determined that the 69 VHP nozzles were acceptable with no degradation, cracking, or leakage identified. During the initial examination, small amounts of boric acid residue were identified at the intersection of the VHP nozzle and RPV head on 12 penetrations (penetration numbers 26, 30, 31, 36, 38, 39, 46, 50, 51, 58, 62, and 63). This residue was considered to be masking the areas of interest. The residue was easily vacuumed and determined to be from a source other than the respective penetration annulus. Re-examination after vacuuming found the penetrations to be acceptable. The source of boric acid residue was determined to be canopy seal weld leakage above and in the vicinity of these penetrations. Some of that loose boric acid residue was determined to have fallen from the RPV head insulation to the RPV head surface during insulation removal. Canopy seal weld repairs were completed and the boric acid residue removed prior to plant startup from RO-21.

Non-Destructive Examination of VHP Nozzles and J-Groove Welds

Examination Scope and Techniques

The scope of NDE for the HBRSEP, Unit No. 2, RO-21 examinations of RPV head penetrations included:

- Eddy current examinations of the 69 J-groove welds and penetration tube outer diameter (OD) surfaces,
- Eddy current and ultrasonic examinations of the seventeen open penetration tubes from the penetration tube inner diameter (ID) surfaces, and,
- Eddy current examinations of 45 penetration tubes with thermal sleeves and seven penetration tubes with part length drive shafts from the penetration tube ID surfaces.

The approach used for the detection of PWSCC involved the application of eddy current examination techniques to examine the critical "wetted surfaces" of the OD and ID surfaces of the RPV head penetrations and J-groove welds. For open penetration tubes, eddy current examinations were supplemented by ultrasonic testing.

The Westinghouse Grooveman manipulator was used to perform eddy current examinations of the 69 J-groove welds and penetration tube OD surfaces. The eddy current probe holders are designed to conform to the geometry of the J-groove welds and penetration OD surfaces, and thereby allow the probes to follow the contour of the assembly. Continuous positional and video feedback is provided to the operator to assist in achieving coverage of the weld and the penetration tube. Scanning of the penetration tube OD surface is conducted in a vertical direction and the probes are indexed in the circumferential direction. For scanning of the J-groove welds, scanning is conducted in the circumferential direction, along the weld, and the index is in a direction perpendicular to the weld.

The Westinghouse 7010 Open Housing Scanner was used to deliver an end effector containing ultrasonic and eddy current probes to perform examinations of the seventeen open penetration tubes from the penetration tube ID surfaces. The scanning motion is in the axial (vertical) direction, moving from the bottom of the penetration tube to an elevation approximately two inches above the J-groove weld. The probe is indexed in the circumferential direction. With the 7010 Open Housing Scanner, five examinations are conducted simultaneously which include:

- Eddy current inspection for identification of circumferential and axial degradation on the ID surfaces of the penetration tubes.

- Time-of-flight diffraction (TOFD) ultrasonic inspection optimized for identification of circumferentially oriented degradation on the penetration tube OD surfaces.

- TOFD ultrasonic inspection optimized for identification of axially oriented degradation on the penetration tube OD surfaces.

- High frequency, straight beam ultrasonic inspection to identify variations in the tube-to-reactor vessel head shrink fit area that might indicate a leak path.

- Low frequency, straight beam ultrasonic inspection for identification of degradation in the weld, parallel to the tube-to-weld interface.

These examinations included TOFD ultrasonic techniques demonstrated capable of detecting axial and circumferential reflectors on the penetration tube OD surfaces with PCS24 probes. Additionally, these examinations included straight beam ultrasonic techniques at 2.25 MHz to interrogate the J-groove weld zone, and at 5.0 MHz to identify possible leak paths in the shrink fit region between the RPV head penetrations and the reactor vessel head. Eddy current examinations were demonstrated capable of detecting axial and circumferential degradation on the penetration tube ID surfaces.

The Westinghouse Eddy Current Gapscanner was used to perform eddy current examination of the 45 penetration tubes with thermal sleeves and seven penetration tubes with part length drive shafts from the penetration tube ID surfaces. The Eddy Current Gapscanner is designed to position and guide eddy current "sword" probes into the annulus between the ID surface of the RPV head penetration tube and the OD surface of the thermal sleeve, and to manipulate the probe to provide the desired coverage. The nominal annulus size is 0.125 inch. The sword probe design utilizes a flexible metal "sword" on which a pair of eddy current probes is mounted in a spring configuration that enables the probes to ride on the ID surface of the penetration tubes. The scanning motion is in the vertical direction, moving from the bottom of the penetration tube to an elevation approximately two inches above the uphill side of the J-groove weld. The probes are indexed in the circumferential direction. The Eddy Current Gapscanner consists of a probe tilt and drive unit to advance and reverse the probe in the tube/thermal sleeve annulus, a turntable to rotate the probe drive around the axis of the penetration, a lifting cylinder to raise and lower the tilt and drive unit, and a centering device consisting of two clamping arms.

Examination Results

The NDE of the HBRSEP, Unit No. 2, RPV head penetrations found no evidence of service-related degradation. No indication or degradation was identified that required repair. As described in more detail below, one recordable parent tube indication was identified and dispositioned by engineering analysis. HBRSEP, Unit No. 2, letters dated August 12, 2002, and September 9, 2002, provided to the NRC the RPV head inspection plan and acceptance criteria that were used to accomplish these NDE activities.

Results from the Westinghouse Grooveman eddy current examinations of the 69 RPV head penetration J-groove welds and penetration tube OD surfaces showed no detectable degradation. There were no recordable or reportable indications in any of the J-groove welds or penetration tube OD surfaces. Additional details regarding these examinations are provided within Table 1 of Attachment III.

Eddy current results from penetration tube ID surface examinations with the Westinghouse 7010 Open Housing Scanner found nine penetration tubes with indications characteristic of craze cracking. This phenomenon was found typically at the 180-degree location and below the weld. The craze cracking was not detectable with the TOFD ultrasonic probes, indicating the depth of these indications is significantly less than 0.040 inch, which is the TOFD detection limit. As such, these indications are not considered to have any impact on the integrity of the RPV head penetration tubes. TOFD ultrasonic examinations with the Westinghouse 7010 Open Housing Scanner showed nine penetrations with weld interface indications and shallow parent tube indications in the weld interface region. An indication profile analysis was performed to assess the significance of these reflectors. The results of this analysis, combined with the results from the wetted surface eddy current examinations of the J-groove welds and penetration tube OD surfaces, determined that these indications are associated with the manufacturing process and are not a result of service-related degradation. Details regarding the 7010 Open Housing Scanner examinations are provided within Table 2 of Attachment III.

One recordable parent tube indication was identified in Penetration Tube No. 47. The indication was visible with the PCS24 TOFD ultrasonic testing transducer pair oriented for detection of axial indications. The indication is located wholly in the Alloy 600 penetration tube material and is axial in orientation. The bottom edge of the 0.28 inch long indication is located at 2.84 inches above the top edge of the weld at the 170-degree location, nearly at the uphill peak, with a depth less than 0.060 inch. The flaw aspect ratio is 4.7:1. An engineering analysis of this indication has been completed, and the crack growth model associated with this analysis shows that the applied stress intensity factor for the indication is below the threshold for crack propagation. The engineering analysis further concluded that the indication is most likely a scratch or other surface anomaly resulting from the manufacturing process, and there is no concern for this indication during future service. Attachment IV provides a figure that shows the general size, location, and orientation of the indication.

Eddy current results from penetration tube ID surface examinations with the Westinghouse Gapscanner showed evidence of craze cracking in seven penetrations. These indications had eddy current characteristics the same as those identified with the 7010 Open Housing Scanner in terms of low amplitude and small phase angle. Additional details regarding the Gapscanner examinations are provided within Table 3 of Attachment III.

H.B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

DETAILED RESULTS OF REACTOR PRESSURE HEAD PENETRATION NOZZLE NON-DESTRUCTIVE EXAMINATIONS

Table 1

Eddy Current Examination Results for J-Groove Weld and Penetration Tube Outer Diameter Surfaces

Penetration No.	J-Groove Weld	Penetration Tube OD
1 CRDM	NDD	NDD
2 (Capped)	NDD	NDD
3 (Capped)	NDD	NDD
4 (Capped)	NDD	NDD
5 (Capped)	NDD	NDD
6 CRDM	NDD	NDD
7 CRDM	NDD	NDD
8 CRDM	NDD	NDD
9 CRDM	NDD	NDD
10 P/L	NDD	NDD
11 P/L (Removed/Capped)	NDD	NDD
12 P/L	NDD	NDD
13 P/L	NDD	NDD
14 CRDM	NDD	NDD
15 CRDM	NDD	NDD
16 CRDM	NDD	NDD
17 CRDM	NDD	NDD
18 CRDM	NDD	NDD
19 CRDM	NDD	NDD
20 CRDM	NDD	NDD
21 CRDM	NDD	NDD
22 CRDM	NDD	NDD
23 CRDM	NDD	NDD
24 CRDM	NDD	NDD
25 CRDM	NDD	NDD
26 CRDM	NDD	NDD
27 CRDM	NDD	NDD
28 CRDM	NDD	NDD
29 CRDM	NDD	NDD
30 CRDM	NDD	NDD
31 CRDM	NDD	NDD
32 CRDM	NDD	NDD

Penetration No.	J-Groove Weld	Penetration Tube OD
33 CRDM	NDD	NDD
34 CRDM	NDD	NDD
35 CRDM	NDD	NDD
36 CRDM	NDD	NDD
37 CRDM	NDD	NDD
38 CRDM	NDD	NDD
39 CRDM	NDD	NDD
40 CRDM	NDD	NDD
41 CRDM	NDD	NDD
42 CRDM	NDD	NDD
43 CRDM	NDD	NDD
44 CRDM	NDD	NDD
45 CRDM	NDD	NDD
46 (Capped)	NDD	NDD
47 (Capped)	NDD	NDD
48 (Capped)	NDD	NDD
49 (Capped)	NDD	NDD
50 (Capped)	NDD	NDD
51 T/C	NDD	NDD
52 (Capped)	NDD	NDD
53 T/C	NDD	NDD
54 (Capped)	NDD	NDD
55 T/C	NDD	NDD
56 T/C	NDD	NDD
57 T/C	NDD	NDD
58 P/L	NDD	NDD
59 P/L	NDD	NDD
60 P/L	NDD	NDD
61 P/L	NDD	NDD
62 CRDM	NDD	NDD
63 CRDM	NDD	NDD
64 CRDM	NDD	NDD
65 CRDM	NDD	NDD
66 CRDM	NDD	NDD
67 CRDM	NDD	NDD
68 CRDM	NDD	NDD
69 CRDM	NDD	NDD

Table 2					
Results of 7010 Open Housing Scanner Ultrasonic and Eddy Current Examinations					
Penetration No.	**Axial TOFD Channel 1**	**Circumferential TOFD Channel 2**	**2.25 MHz 0 Degree**	**5.0 MHz 0 Degree**	**ECT Results**
2 CRDM	NDD	NDD	NDD	NDD	CC
3 CRDM	NDD	NDD	NDD	NDD	NDD
4 CRDM	NDD	NDD	NDD	NDD	CC
5 CRDM	NDD	WII	NDD	NDD	NDD
11 CRDM	NDD	NDD	NDD	NDD	NDD
46 CRDM	NDD	PTI	NDD	NDD	NDD
47 CRDM	PTI	PTI	NDD	NDD	CC
48 CRDM	LCG	WII	NDD	NDD	NDD
49 CRDM	NDD	NDD	NDD	NDD	CC
50 CRDM	NDD	NDD	NDD	NDD	NDD
51 CRDM	NDD	NDD	NDD	NDD	CC
52 CRDM	NDD	PTI	NDD	NDD	CC
53 CRDM	NDD	PTI	NDD	NDD	CC
54 CRDM	NDD	NDD	NDD	NDD	CC
55 CRDM	NDD	PTI	NDD	NDD	CC
56 CRDM	NDD	PTI	NDD	NDD	NDD
57 CRDM	NDD	PTI	NDD	NDD	NDD

Table 3	
Results of Gapscanner Eddy Current Examinations of Penetration Tube Inner Diameter Surfaces	
Penetration No.	**Penetration Tube ID**
1 CRDM	NDD
6 CRDM	CC
7 CRDM	NDD
8 CRDM	NDD
9 CRDM	NDD
10 P/L	NDD
12 P/L	NDD
13 P/L	NDD
14 CRDM	CC
15 CRDM	NDD
16 CRDM	NDD
17 CRDM	NDD
18 CRDM	NDD
19 CRDM	NDD
20 CRDM	NDD
21 CRDM	NDD
22 CRDM	NDD
23 CRDM	NDD
24 CRDM	NDD
25 CRDM	NDD
26 CRDM	NDD
27 CRDM	NDD
28 CRDM	NDD
29 CRDM	NDD
30 CRDM	NDD
31 CRDM	NDD
32 CRDM	NDD
33 CRDM	NDD
34 CRDM	CC
35 CRDM	NDD
36 CRDM	NDD
37 CRDM	NDD
38 CRDM	NDD
39 CRDM	NDD

Penetration No.	Penetration Tube ID
40 CRDM	NDD
41 CRDM	NDD
42 CRDM	NDD
43 CRDM	CC
44 CRDM	CC
45 CRDM	CC
58 P/L	NDD
59 P/L	NDD
60 P/L	NDD
61 P/L	NDD
62 CRDM	NDD
63 CRDM	NDD
64 CRDM	NDD
65 CRDM	NDD
66 CRDM	NDD
67 CRDM	CC
68 CRDM	NDD
69 CRDM	NDD

Legend for Tables:

CC - Craze Cracking (Non-Structural, Non-Recordable)
CRDM - Control Rod Drive Mechanism
ECT - Eddy Current Testing
ID - Inner Diameter
LCG - Loss of Coupling-Geometry
NDD - No Detectable Defect
OD - Outer Diameter
P/L - Part Length
PTI - Parent Tube Indication
T/C - Thermocouple
TOFD - Time-of-Flight Diffraction
WII - Weld Interface Indication

H.B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

DRAWING OF PENETRATION NUMBER 47 RECORDABLE INDICATION