Tennessee Valley Authority, Post Office Box 2000, Soddy-Daisy, Tennessee 37384-2000

February 20, 2007

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

Gentlemen:

In the Matter of	)	Docket No. 50-328
Tennessee Valley Authority	)	

SEQUOYAH NUCLEAR PLANT (SQN) - UNIT 2 RESPONSE TO NRC ORDER EA 03-009, "ISSUANCE OF ORDER ESTABLISHING INTERIM INSPECTION REQUIREMENTS FOR REACTOR PRESSURE VESSEL HEADS AT PRESSURIZED WATER REACTORS"

This letter provides the SQN Unit 2 60-day response to the reporting requirements listed in Section IV, paragraph E of the first revised NRC Order EA 03-009 dated February 20, 2004. The results of inspections required by Section IV, paragraphs C and D of the Order are provided in the enclosures. These inspections were performed during the Unit 2 Cycle 14 refueling outage that was completed in December 2006.

SQN Unit 2 reactor pressure vessel (RPV) head has a low susceptibility to primary water stress corrosion cracking as defined by Section IV, paragraph B of the Order. Based on the results of the RPV head inspections, TVA confirmed that there are no indications of RPV head degradation or primary water stress corrosion cracking of the Alloy 600 penetration nozzles for Unit 2. There is also no evidence of cracking or recent boron leakage.

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Enclosure 1 provides the visual inspection results.
Enclosure 2 provides the nonvisual inspection results.

No commitments have been made as a result of this letter. Please direct questions concerning this issue to me at (423) 843-7170.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 20th day of February, 2007.

Sincerely,

Glenn W. Morris

Glenn W. Morris
Manager, Site Licensing and
Industry Affairs

Enclosures
cc (Enclosures):
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Visual Examination Results

A remote visual enhanced VT-2 examination was performed on the outside surface of the reactor pressure vessel (RPV) closure head and penetrations. To augment the remote examination, a direct visual examination was also performed from the periphery of the penetrations to the flange.

A total of 83 penetrations were examined, including 78 control rod drive mechanisms (CRDM's), 4 upper head injection lines (UHI), and 1 vent line. The examination aimed at determining whether boric acid deposits were emanating from the annulus of the penetrations and identifying the presence of boric acid deposits on the RPV head. The combination of these examinations satisfies the bare metal visual inspection requirements specified in Section IV, paragraph C.(5)(a) of NRC Order EA-03-009 for the RPV head penetration nozzles and surrounding head surface.

Some penetrations had restricted viewing in the area of the annulus on the up-hill side due to insulation seal rings that had moved down the penetration and resting on the penetration to head area. Although the CRDM housing region was partially restricted, the restriction did not limit the VT-2 examination for the detection of boron leakage.

Several CRDM's and areas of the bare-metal had boron residue that was not related to leakage from the annulus. The boron residue was above the annulus area and was attributed to conoseal and canopy seal weld leakage discovered during previous outages.

No degradation to the vessel head was identified.

No evidence of cracking or recent boron leakage was detected.

ENCLOSURE 2

TENNESSEE VALLEY AUTHORITY (TVA)
SEQUOYAH NUCLEAR PLANT (SQN)
UNIT 2
REACTOR PRESSURE VESSEL (RPV) HEAD
NONVISUAL NONDESTRUCTIVE EXAMINATION (NDE) RESULTS

The requirement to perform nonvisual NDE examinations (ultrasonic and dye penetrant) is provided in the first revised NRC Order EA-03-009, Section IV, paragraphs C.(3) and C.(5)(b).

Section IV,C.(3):

"...The requirements of paragraph IV.C(5)(b) must be completed at least once prior to February 11, 2008 and thereafter, at least every 4 refueling outages or every 7 years, whichever occurs first."

Section IV,C.(5)(b):

"For each penetration, perform a nonvisual NDE in accordance with either (i), (ii) or (iii):

(i)

Ultrasonic testing of the RPV head penetration nozzle volume (i.e., nozzle base material) from 2 inches above the highest point of the root of the J-grove weld (on a horizontal plane perpendicular to the nozzle axis) to 2 inches below the lowest point at the toe of the J-groove weld on a horizontal plane perpendicular to the nozzle axis (or the bottom of the nozzle if less than 2 inches [see Figure IV-1]; OR from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 1.0-inch below the lowest point at the toe of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level (including all residual and normal operating stresses) of 20 ksi tension and greater (see Figure IV-2). In addition, an assessment shall be made to determine if leakage has occurred into the annulus between the RPV head penetration nozzle and the RPV head low-alloy steel.

(ii)

Eddy current testing or dye penetrant testing of the entire wetted surface of the J-groove weld and the wetted surface of the RPV head penetration nozzle base material from at least 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 2 inches below the lowest point at the toe of the J-groove weld on a horizontal plane perpendicular to the nozzle axis (or the bottom of the nozzle if less than 2 inches [see Figure IV-3]; OR from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 1.0-inch below the lowest point at the toe of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level (including all residual and normal operating stresses) of 20 ksi tension and greater (see Figure IV-4).

(iii)

A combination of (i) and (ii) to cover equivalent volumes, surfaces and leak paths of the RPV head penetration nozzle base material and J-groove weld as described in (i) and (ii). Substitution of a portion of a volumetric exam on a nozzle with a surface examination may be performed with the following requirements:

1. *On nozzle material below the J-groove weld, both the outside diameter and inside diameter surfaces of the nozzle must be examined.*

2. *On nozzle material above the J-groove weld, surface examination of the inside diameter surface of the nozzle is permitted provided a surface examination of the J-groove weld is also performed."*

The ultrasonic and dye penetrant examinations were performed as required. There were no indications of cracking in any of the penetrations and there was no evidence of a leakage path along the reactor vessel head penetration shrink-fit regions. A detailed summary of the examination results are provided in Enclosure 3 of this submittal (AREVA Report 51-9038109-000). Any examination procedures, calibrations or examination data that is referenced in the AREVA report is available upon request, but is not included with the Enclosure 3 information.

ENCLOSURE 3

TENNESSEE VALLEY AUTHORITY (TVA)
SEQUOYAH NUCLEAR PLANT (SQN)
UNIT 2

AREVA REPORT
NUMBER 51-9038109-000

Sequoyah Unit 2
U2C14

RPVH Penetration Examination Report Summary

Examination Summary

Introduction

During the Sequoyah Unit 2, 2006 refueling outage (U2C14), AREVA NP performed a comprehensive examination of the reactor vessel (RPV) head penetrations for TVA to meet the First Revised NRC Order EA-03-009 issued February 20, 2004. AREVA NP performed remote ultrasonic (UT) examinations of seventy-eight (78) control rod drive mechanism/thermo couple column (CRDM/TCC) penetrations, four (4) auxiliary head adapter/upper head injection (AHA/UHI) penetrations, and one (1) vent line penetration. The vent line volumetric examination also included the region of vent line just above the RPV head OD surface to examine an area that had been bent during a previous outage. A liquid penetrant (PT) examination was also performed on the vent line J-groove weld surface. Each penetration was examined from the under-side of the reactor vessel head using "Bottom-Up Rotating" and "Blade" UT tools delivered by a newly developed positioning manipulator. Data acquisition and data analysis was performed remotely from outside the radiation controlled area using the ZETEC Ultravision software.

Results

No crack indications or UT leak path signals were detected in the 78 CRDM/TCC or the 4 AHA/UHI penetrations. No crack indications were detected in the vent line penetration including the bend region. No crack indications were detected during the vent line J-groove weld PT examination.

Minor weld fabrication indications were observed on most CRDM nozzles. One CRDM nozzle (56) and all four of the AHA/UHI nozzles contained weld fabrication indications that penetrated into the tube wall by more than 10% of the tube wall thickness. It appears that the weld fabrication indications observed on nozzle 56 are the result of a repair that was performed during fabrication. Because the repair area on nozzle 56 extended below the toe of the J-groove weld the coverage reported below the J-groove weld is relative to the lower extent of the repair area that was observed in the data. These indications were recorded for reference during future examinations and are identified in the Examination Summary table included in Section A, Tab 3 of this report.

CRDM/TCC Penetration Examinations

CRDM penetrations 1 through 73 were examined with the blade probe in accordance with AREVA NP NDE examination procedure 54-ISI-603-002, "Automated Ultrasonic Examination of RPV Closure Head Penetrations Containing Thermal Sleeves" with SDCN 30-9033201-000, SDCN 30-9033740-000, SDCN 30-9035403-000, and SDCN 30-9035372-001. TCC penetrations 74 through 78 were examined with the rotating probe in accordance with AREVA NP NDE examination procedure 54-ISI-604-001, "Automated Ultrasonic Examination of Open Tube RPV Closure Head Penetrations" with SDCN 30-9031686-000, SDCN 30-9032486-000, SDCN 30-9033174-000, SDCN 30-9035404-000, SDCN 30-9035469-001, and SDCN 30-9037310-000. The application of the techniques used for these examinations are described in more detail in the "Inspection Plan" included in Section A, Tab 2 of this report. The procedures and SDCN's are both included in Section C of this report. The UT examination data sheets are included in Section A, Tab 4 of this report.

The coverage obtained for all CRDM/TCC nozzles meets the requirements of the First Revised NRC Order EA-03-009 issued February 20, 2004. Consistent with the NRC Order, TVA has performed an analysis[1] to determine the distance below the J-groove weld where the operating stresses decay to 20ksi tension. The minimum required examination zone below the lowest point of the J-groove weld is the greater of the 20ksi boundary value below the weld or 1". The 20ksi boundary values below the weld at the downhill locations were determined to be less than 1".

Each CRDM/TCC penetration was scanned starting from the taper to cylinder transition at the bottom of each nozzle up to at least two inches above the highest point of the J-groove weld. An ID chamfer on the end of each nozzle precludes coverage to the very end of the nozzle. Coverage for all nozzles was obtained over a distance that includes at least 1" below the lowest point of the J-groove weld up to at least 2 inches above the highest point of the J-groove weld. A listing of the coverage obtained for each nozzle above and below the weld is provided in the "Examination Summary Table" included in Section A, Tab 3 of this report.

Scanning was performed in an up and down fashion (comb pattern) parallel to the penetration axis. Indexing of the probe-head was performed in the circumferential direction. The positive scan direction was defined to be upward, and positive index was defined to be counter-clockwise looking up from the bottom of the vessel head. The circumferential scan distance covered from 0 degrees to at least positive 365 degrees, yielding a 5-degree overlap. Demineralized water was used as the coupling agent between the transducer face and the penetration surface.

The blade probe uses a 5 MHz, circumferentially oriented, time of flight diffraction (TOFD) beam in the tube for examination. The rotating probe-head houses six ultrasonic transducers as outlined in Table 1 below. Both forward scatter, time of flight diffraction (TOFD), and backward scatter techniques are utilized. The 30°L and 45°LE transducers are configured in the forward scatter configuration, and the 60°S and 60°SE transducers in the backward scatter configuration. Each of these transducers provides detection and characterization information for (ID/OD) connected axial, circumferential, and off-axis flaws contained within the penetration wall.

[1] Dominion Engineering, Inc. Calculation No: C-3217-00-02 Rev 0 "Sequoyah 1 and 2 CRDM and Instrument Column Nozzle Stress Analysis"

Table 1 - CRDM Rotating Probe Configuration			
Angle/ Mode	Freq (MHz)	Beam Dir.	Application
0° L	5.0	N/A	Flaw detection, length sizing, and weld profiling
30° L - TOFD	5.0	Axial	Circumferential, axial, and off-axis flaw detection and characterization
60° S - Backscatter	2.25	Axial Down	Circumferential and off-axis flaw detection and characterization
45° LE - TOFD	5.0	Circ.	Axial, circumferential and off-axis flaw detection and characterization
60° SE - Backscatter	2.25	Circ. CW	Axial and off-axis flaw detection and characterization
60° SE - Backscatter	2.25	Circ. CCW	Axial and off-axis flaw detection and characterization

AHA/UHI Penetration Examinations

AHA/UHI penetrations UPIW-23 through UPIW-26 were examined with the rotating probe in accordance with AREVA NP NDE examination procedure 54-ISI-604-001, "Automated Ultrasonic Examination of Open Tube RPV Closure Head Penetrations" with SDCN 30-9031686-000, SDCN 30-9032486-000, SDCN 30-9033174-000, SDCN 30-9035404-000, SDCN 30-9035469-001, and SDCN 30-9037310-000. The application of the techniques used for these examinations are described in more detail in the "Inspection Plan" included in Section A, Tab 2 of this report. The procedures and SDCN's are both included in Section C of this report. The UT examination data sheets are included in Section A, Tab 4 of this report.

The coverage obtained for all AHA/UHI nozzles meets the requirements of the First Revised NRC Order EA-03-009 issued February 20, 2004 and includes coverage starting at least 2" below the lowest point of the J-groove weld up to at least 2 inches above the highest point of the J-groove weld. A listing of the coverage obtained for each nozzle above and below the weld is provided in the "Examination Summary Table" included in Section A, Tab 3 of this report.

Scanning was performed in an up and down fashion (comb pattern) parallel to the penetration axis. Indexing of the probe-head was performed in the circumferential direction. The positive scan direction was defined to be upward, and positive index was defined to be counter-clockwise looking up from the bottom of the vessel head. The circumferential scan distance covered from 0 degrees to at least positive 365 degrees, yielding a 5-degree overlap. De-mineralized water was used as the coupling agent between the transducer face and the penetration surface.

The rotating probe-head used for the AHA/UHI penetrations houses six ultrasonic transducers as outlined in Table 2 below. Both forward scatter, time of flight diffraction (TOFD), and backward scatter techniques are utilized. The 45°L and 45°LE transducers are configured in the forward scatter configuration, and the 60°S and 60°SE transducers in the backward scatter configuration. Each of these transducers provides detection and characterization information for (ID/OD) connected axial, circumferential, and off-axis flaws contained within the penetration wall.

Table 2 – AHA/UHI Rotating Probe Configuration			
Angle/ Mode	**Freq (MHz)**	**Beam Dir.**	**Application**
0° L	5.0	N/A	Flaw detection, length sizing, and weld profiling
45° L - TOFD	5.0	Axial	Circumferential, axial, and off-axis flaw detection and characterization
60° S - Backscatter	2.25	Axial Down	Circumferential and off-axis flaw detection and characterization
45° LE - TOFD	5.0	Circ.	Axial, circumferential and off-axis flaw detection and characterization
60° SE - Backscatter	2.25	Circ. CW	Axial and off-axis flaw detection and characterization
60° SE - Backscatter	2.25	Circ. CCW	Axial and off-axis flaw detection and characterization

Vent Line Penetration Examination

The Vent Line was examined with both liquid penetrant (PT) and ultrasonic testing (UT) to satisfy the First Revised NRC Order EA-03-009 requirements. The vent line penetration tube was examined with UT using the vent line probe in accordance with AREVA NP NDE examination procedure 54-ISI-605-02, "Automated Ultrasonic Examination of RPV Closure Head Small Bore Penetrations" with SDCN 30-9037089-001and SDCN 30-9037433-000. The procedure and SDCN's are both included in Section C of this report. The UT examination data sheets are included in Section A, Tab 4 of this report. Separate sheets are included for the NRC Order coverage and the bend region coverage. No flaws were detected in the vent line nozzle material or the J-groove weld.

The vent line nozzle material was ultrasonically examined from the end of the nozzle up to 13.4" from the end of the nozzle with multiple scans to provide coverage of a region of the nozzle that contains a bend. The lower 5.4" was examined using a contact probe and the remaining section was examined using immersion probes in order to allow the probe to traverse the bend region of vent line. Two separate immersion probes were used due to mechanical failure of the first probe.

Scanning was performed in an up and down fashion (comb pattern) parallel to the penetration axis. Indexing of the probe-head was performed in the circumferential direction. The positive scan direction was defined to be upward, and positive index was defined to be counter-clockwise looking up from the bottom of the vessel head. The circumferential scan distance covered from 0 degrees to positive 365 degrees, yielding a 5-degree overlap. De-mineralized water was used as the coupling agent between the transducer face and the penetration surface.

The vent line J-groove weld surface was examined with the PT method in accordance with AREVA NP examination procedure 54-ISI-240-44, "Visible Solvent Removable Liquid Penetrant Examination Procedure". No indications were recorded during this examination. The PT examination data sheet is included in Section A, Tab 5 of this report.

The Vent Line contact UT probe-head houses five separate transducers as shown below in Table 3. These transducers provide detection information for (ID/OD) connected axial and circumferential flaws contained within the penetration wall.

Table 3 - Vent Line Penetration Contact Probe Configuration

Angle/ Mode	Freq. (MHz)	Beam Dir.	Application
0° L	5.0	N/A	Weld profiling
45° S Backscatter	5.0	Circ. CW	Axial flaw detection
45° S Backscatter	5.0	Circ. CCW	Axial flaw detection
70° S Backscatter	5.0	Axial Up	Circumferential flaw detection
70° S Backscatter	5.0	Axial Down	Circumferential flaw detection

The Vent Line immersion UT probe-head houses five separate transducers as shown below in Table 4. These transducers provide detection information for (ID/OD) connected axial and circumferential flaws contained within the penetration wall.

Table 4 - Vent Line Penetration Immersion Probe Configuration

Angle/ Mode	Freq. (MHz)	Beam Dir.	Application
0° L	7.5	N/A	Weld profiling
45° S Backscatter	7.5	Circ. CW	Axial flaw detection
45° S Backscatter	7.5	Circ. CCW	Axial flaw detection
45° S Backscatter	7.5	Axial Up	Circumferential flaw detection
45° S Backscatter	7.5	Axial Down	Circumferential flaw detection