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

December 20, 2007

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

Gentlemen:

In the Matter of) Docket No. 50-327
Tennessee Valley Authority (TVA))

SEQUOYAH NUCLEAR PLANT (SQN) - UNIT 1 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 1 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 1 Cycle 15 refueling outage that was completed in November 2007.

SQN Unit 1 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 including cracking of the Alloy 600 penetration nozzles for Unit 1.

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NRR

Enclosure 1 provides the visual inspection results.
Enclosure 2 provides the nonvisual inspection results.
Enclosure 3 provides the AREVA Examination Report Summary.

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 December, 2007.

Sincerely,

James D. Smith
Manager, Site Licensing and
Industry Affairs

Enclosures
cc (Enclosures):
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ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY (TVA)
SEQUOYAH NUCLEAR PLANT (SQN)
UNIT 1
REACTOR PRESSURE VESSEL (RPV) HEAD
VISUAL INSPECTION RESULTS

The following information details the visual inspection results for SQN Unit 1 that was performed during the Unit 1 Cycle 15 (U1C15) refueling outage. The inspection was performed in accordance with the first revised NRC Order EA-03-009, Section IV, paragraph C.(5)(a) and paragraph D as summarized below:

C.(5)(a)

"Bare metal visual examination of 100 percent of the RPV head surface (including 360° around each RPV head penetration nozzle). For RPV heads with the surface obscured by support structure interferences which are located at RPV head elevations downslope from the outermost RPV head penetration, a bare metal visual inspection of no less than 95 percent of the RPV head surface may be performed provided that the examination shall include those areas of the RPV head upslope and downslope from the support structure interference to identify any evidence of boron or corrosive product. Should any evidence of boron or corrosive product be identified, the licensee shall examine the RPV head surface under the support structure to ensure that the RPV head is not degraded."

D.

"During each refueling outage, visual inspections shall be performed to identify potential boric acid leaks from pressure-retaining components above the RPV head. For any plant with boron deposits on the surface of the RPV head or related insulation, discovered either during the inspections required by this Order or otherwise and regardless of the source of the deposit, before returning the plant to operation the Licensee shall perform inspections of the affected RPV head surface and penetrations appropriate to the conditions found to verify the integrity of the affected area and penetrations."

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 control rod drive mechanism (CRDM) duct shroud to the vessel flange.

A total of 83 penetrations were examined, including 78 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 RPV head 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. Additionally, the conoseal associated with CRD penetration 75 was identified as leaking immediately after plant shut-down. Boron deposits from this leak were found on CRD penetrations 68, 69, 75, UPIW-25, and the adjacent head surfaces. These areas were cleaned to remove the boron deposits. A corrective action document was initiated to address and evaluate this leakage.

No degradation to the RPV head was identified.

ENCLOSURE 2

TENNESSEE VALLEY AUTHORITY (TVA)
SEQUOYAH NUCLEAR PLANT (SQN)
UNIT 1
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 operation 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 51-9064077-000). 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 1

AREVA REPORT
NUMBER 51-9064077-000

AREVA

Tennessee Valley Authority
Sequoyah
U1Cycle15

RPVH Penetration Examination Report Summary

Document Number: 51-9064077-000

Prepared By: John Touhalisky

Date: 10/18/2007

Reviewed By: Hrvoje Bezlaj

Date: 10/18/2007

AREVA

TVA

Examination Summary

Introduction

During the Sequoyah Unit 1, 2007 refueling outage (U1Cycle15), AREVA NP performed a comprehensive examination of the reactor pressure 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 outside surface (OD) 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 and in 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/TCC nozzles. 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. Two ID surface indications were observed on vent line penetration and are characterized as shallow surface volumetric irregularities. Wear indications were observed above J-groove weld on CRDM nozzles 1 through 5.

All of these indications were recorded for reference for future examinations and are identified in the Examination Summary table included in Section A, Tab 3 of this report, as well as in the corresponding data sheet.

CRDM/TCC Penetration Examinations

CRDM penetrations 1 through 73 (not including 63) were examined with the blade probe in accordance with NDE examination procedure 54-ISI-603-003, "Automated Ultrasonic Examination of RPV Closure Head Penetrations Containing Thermal Sleeves". TCC penetrations 74 through 78 and CRDM 63 which contained a funnel were examined with the rotating probe in accordance with NDE examination procedure 54-ISI-604-004, "Automated

Ultrasonic Examination of Open Tube RPV Closure Head Penetrations" with SDCN 30-9035469-002, SDCN 30-9037310-001, and SDCN 30-9063103-000. 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 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 inside surface (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 index 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 blade probe uses a 5 MHz, circumferentially oriented, time of flight diffraction (TOFD) beam in the tube for examination. The rotating probe-head houses four 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 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

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-604-004, "Automated Ultrasonic Examination of Open Tube RPV Closure Head Penetrations" with SDCN 30-9035469-002, SDCN 30-9037310-001, and SDCN 30-9063103-000. 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 index 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-605-04, "Automated Ultrasonic Examination of RPV Closure Head Small Bore Penetrations". 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.

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 scanning was performed using the immersion technique with the probe designed to allow the examination of the bend region of vent line.

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 index 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-200-08, "Color Contrast Solvent Removable Liquid Penetrant Examination of Components". 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 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