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

August 14, 2003

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)

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"

References: 1) TVA letter to NRC dated February 27, 2003, "Response to Issuance of Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel (RPV) Heads at Pressurized Water Reactors (PWRs) for Sequoyah Nuclear Plant (SQN) Units 1 and 2; and Watts Bar Nuclear Plant (WBN) Unit 1"

2) NRC letter to TVA dated February 11, 2003, "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 reporting requirements listed in Section IV, Paragraph E of NRC Order EA 03-009 dated February 11, 2003. TVA consented to the Order for SQN in the Reference 1 letter. The results of the inspections required by Section IV, paragraphs C and D of the Order are provided as enclosures 1 and 2. These inspections were performed on SQN Unit 1 during the Unit 1 Cycle 12 refueling outage (spring 2003).

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Since the SQN Unit 1 RPV head has a low susceptibility to primary water stress corrosion cracking as defined by Section IV, Paragraph B of the Order, the inspections consisted of a bare metal visual of 100 percent of the RPV head surface including 360 degrees around each RPV head penetration nozzle. Based on the results of these inspections, TVA confirmed that there are no indications of RPV degradation or primary water stress corrosion cracking of the Alloy 600 penetration nozzles for Unit 1.

Enclosure 1 provides the inspection results. Enclosure 2 provides before-cleaning and after-cleaning photographs of the Unit 1 head inspection.

This letter is being sent in accordance with NRC RIS 2001-05. No commitments have been made as a result of this letter. Please direct questions concerning this issue to me at (423) 843-6672 or Pedro Salas at (423) 843-7170.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 14th day of August, 2003.

Sincerely,

James D. Smith
Licensing Supervisor

Enclosures
cc (Enclosures):
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ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY (TVA)
SEQUOYAH NUCLEAR PLANT (SQN)
UNIT 1
60-DAY RESPONSE TO NRC ORDER EA 03-009

The following information details the inspection results for SQN Unit 1 that was performed during the Unit 1 Cycle 12 (U1C12) refueling outage. The U1C12 refueling outage was the first outage following issuance of the Order. The inspection was performed in accordance with NRC Order EA-03-009, Section IV, paragraph C(3) and is summarized below:

C(3) For those plants in the Low category, RPV head and head penetration nozzle inspections shall be performed as follows. An inspection meeting the requirements of 3(a) must be completed at least every third refueling outage or every five (5) years, whichever occurs first. If an inspection meeting the requirements of 3(a) was not performed during the refueling outage immediately preceding the issuance of this Order, the Licensee must complete an inspection meeting the requirements of 3(a) within the first two (2) refueling outages following issuance of this Order.

Paragraph (3)(a) states:

(a) Bare metal visual examination of 100% of the RPV head surface (including 360° around each RPV head penetration nozzle).

In addition to the above, the U1C12 inspection complied with Section D of the NRC Order as summarized below:

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.

The U1C12 inspection results are reported in accordance with Section E of the NRC Order as described below:

E. For each inspection required in Paragraph C, the Licensee shall submit a report detailing the inspection results within sixty (60) days after returning the plant to operation. For each inspection required in Paragraph D, the Licensee shall submit a report detailing the inspection results within sixty (60) days after returning the plant to operation if a leak or boron deposit was found during the inspection.

INTRODUCTION

During the SQN Unit 1 Cycle 12 refueling outage that began on March 17, 2003, remote visual examinations (VT) and supplemental nondestructive examination (NDE) was scheduled and performed on the reactor pressure vessel (RPV) closure head and penetrations. Initial examinations were performed on the RPV outside surfaces of the head from March 22 through 24, 2003. Follow-up postcleaning examinations were performed from May 3 through May 4, 2003. Examinations were performed by the TVA Inspection Services Organization (ISO) and Vistas Corporation. Supplemental NDE of suspect penetrations was performed by Framatome Advanced Nuclear Power (ANP).

TECHNICAL DISCUSSION

Remote VT Equipment

TVA utilized remote VT equipment to examine the RPV head penetrations. The work was performed in accordance with TVA's Section XI Augmented Examination Program. The remote examinations were performed with a magnetic crawler device, outfitted with twin high-resolution color cameras, each having adjustable light emitting diode (LED) lighting arrays. The cameras were located on the front and rear of the remote crawler.

Access to the examination area was obtained by lifting the insulation shroud approximately five inches from the vessel head. The remote crawler was installed on the head surface and guided between the rows of penetrations.

The examinations were recorded on Digital 8 video cassettes for archival and off-line review. Examination coverage was 100 percent of the penetration annulus areas and the head surface area. The examinations were digitally recorded.

Supplemental NDE

Six of the seven suspect nozzles with indications of boron like deposits in the annular area (see Table 2 below) were examined by Framatome ANP using the remote "Blade Probe" technique. TVA plans to perform a visual examination of penetration No. 78 next refueling outage because this penetration is a thermocouple column, and the UT probe for that configuration was not available. The six examinations were performed from beneath the vessel head using the "U.S. Blade Tool" in conjunction with Framatome ANP "ACCUSONEX™" automated data and analysis system.

In addition to the ultrasonic test (UT) examination, a manual liquid penetrant (PT) examination was performed on the control rod device (CRD) penetration No. 3 weld and adjacent base material.

Procedure/Documentation

TVA's ISO provided American Society for Nondestructive Testing (ASNT) Level III certified inspectors to review and evaluate data on-line. The acquired data also had an independent review by certified Level III examination personnel. Examination protocol was designed to incorporate the recommendations of the Electric Power Research Institute's (EPRI's) Technical Report, entitled "Visual Examination for Leakage of PWR Reactor Head Penetrations on Top of RPV Head, Revision 2 of 1006296, Including 2002 Inspection Results."

The initial and postcleaning visual examination process utilized enhanced VT-2 methodology with camera resolution established on characters less than or equal to 0.044 inches high, representative of VT-1 sensitivity.

Supplemental NDE was performed in accordance with Framatome ANP procedures and personnel. The results were reviewed and approved by the TVA ASNT Level III personnel.

Examination Process

An examination scan plan was developed in order to ensure that visual examinations were performed in a logical sequence, while minimizing radiation exposure and validating positional accuracy. A raster pattern was chosen as the most effective method for performing the examinations and consisted of 22 separate scans.

A total of 323 sequences were performed to examine all penetrations. With the exception of the outer scan rows, each

penetration was examined during two scans which consisted of examining four 90-degree segments of each penetration to ensure 100 percent coverage of the annulus area. The outer scan rows, that included the peripheral penetrations, were examined using two scans that covered 180 degrees of the penetration that resulted in 100-percent coverage. During the examination of each penetration, the head area adjacent to the penetrations was also visually examined for boron deposits.

The data acquisition equipment staging area was located in an adjacent low-dose area. The total radiation dose received by examination personnel was 152 millirem. This figure does not include the dose received by support personnel while raising and lowering the shroud ring.

Data acquisition and data analysis for the UT examination (Framatome ANP) was performed remotely outside containment. The nozzles were scanned to the fullest extent possible, the maximum achievable distance below the weld to a minimum of two inches above the weld on the upper side. Poor probe contact was experienced on some of the nozzles due to a combination of clearance, weld shrinkage, ovality, and surface conditions. Whenever these conditions were encountered, rescanning of the trouble area was performed. The rescan data was analyzed separately.

RESULTS

General information relative to the results of the examinations is provided below:

Canopy Seal Weld Leak

Prior to the commencement of examinations, the examination team was informed of a previous canopy seal weld leak detected in 1995 during Cycle 7. The canopy seal weld was located above control rod drive (CRD) penetration No. 73 and was identified as "A-5." Initially in 1995, the remaining boron from this leak prevented an effective examination of CRD penetration No. 73 and the adjacent penetrations (CRD penetration Nos. 72 and 78) from being performed.

Due to the indeterminate condition of these penetrations from boron buildup, these penetrations were identified for further evaluation. These areas were subsequently cleaned, and it was determined that no leakage was found to occur from these CRD penetrations. The penetrations were found acceptable by subsequent visual examination.

Insulation Ring Interference

Visual examination of some penetrations was restricted but did not obstruct an adequate inspection for boron. Insulation support collars (thin sheet metal) were resting on the upper side of the CRD penetration. Although visibility in the annulus region was partially restricted, no evidence of boron was found outside the insulation collar. Where physical access permitted, the insulation support collars were moved to allow additional examination coverage. Although the insulation rings were present in isolated cases, they did not limit the VT-2 examination for the detection of boron leakage.

Irrelevant Indications

In isolated cases, several CRD penetrations displayed light "streaking" on the sides of the penetrations, away from the annulus area. These faint areas were either horizontal or vertical with origination from above. The streaked areas were identified as boron deposited by high velocity air in the plenum that originated from above the penetration due to previous canopy seal weld leaks. The condition was not associated with boron originating from a penetration.

OTHER EXAMINATIONS AND TESTING

In an attempt to eliminate other potential sources of boron in the upper head region, two VT-2 certified examiners performed a visual examination on March 27, 2003, of the upper coil stacks of the RPV head to determine if boron was present in the areas of the CRD lifting eye bolts. The examination revealed no presence of boron.

On March 28, 2003, a VT-2 certified examiner utilized a "Firefly" camera affixed to a pole to perform a visual examination in the area above CRD penetration No. 3 and the vent nozzle to determine if boron was leaking from any of the conoseals. The examination was limited to a 4-foot radius around the vent nozzle with access through the ventilation duct opening in the plenum. No indication of boron leakage was noted. In addition, a previous examination of the conoseals was performed in the outage with no detectable boron noted.

Upon completion of the initial planned examinations, additional samples of suspected boron deposits were retrieved for chemical analysis in the area of the No. 3 CRD penetration and head areas adjacent to the vent line. The samples were obtained on March 29, 2003, using the crawler outfitted with a metal pick and a

vacuum system to capture the sample. The representative sample of the substance at the penetration to head interface indicated the presence of boron. Further sampling of these accumulations and some residue near penetration No. 78 were taken. Isotopic analysis (Cesium 134/137 ratio) of the residue indicated that boron accumulations were from the reactor coolant system and could be dated back 10 to 12.5 years. A canopy seal on penetration No. 78 experienced leakage during cycle 6 operation that occurred 10 to 11.4 years ago. TVA determined that the canopy seal penetration No. 78 leakage was the likely source for these deposits.

Cleaning

A concerted effort was made to remove the indications of previous boron leakage. Cleaning of the RPV head and the associated penetrations was accomplished by a controlled warm-water wash. The cleaning process concentrated on the crevice areas around the penetrations and the adjacent RPV and penetration base material. The head area under the CRD cooling shroud received a complete warm-water wash in all accessible areas.

Penetrations Requiring Further Evaluation

The penetrations listed in Table 2 required additional engineering evaluation. The following description provides an overview of the evaluation approach for the penetrations listed in Table 2.

The CRD penetration No. 3 was scheduled for ultrasonic and PT examination for detection of a suspected leak path. The remainder of the penetrations were masked and judged indeterminate. These penetrations required cleaning and/or volumetric examination.

TABLE 2

CRD Penetration. No.	Fig. Nos.	Exam Recommendations	Comments
3	1A, 1B	UT & PT (performed)	Suspected leaker-boron in annulus and on head with VT-2 exam
53	2A, 2B	UT (performed)	Masked from debris and boron - indeterminate
64	3A, 3B	UT (performed)	Masked from heavy debris - indeterminate
65	4A, 4B	UT (performed)	Masked from heavy debris - indeterminate
72	5A, 5B	UT (performed)	Masked with boron and heavy debris - indeterminate
73	6A, 6B	UT (performed)	Masked from boron - indeterminate
78	7A, 7B	(TVA plans to perform a visual examination next RFO)	Masked from boron - indeterminate

Supplemental UT examination showed no evidence of a leakage path signature on any of the Table 2 CRD penetrations. In addition, no recordable PT indications were found on CRD penetration No. 3. The penetration No. 78 could not be examined by UT due to thermocouple restrictions and is planned to be VT examined next refueling outage (cycle 13). A UT examination of all penetrations is scheduled for Unit 1 Cycle 15 refueling outage.

CONCLUSION

TVA conducted the required examinations in accordance with NRC Order EA-03-009, "Interim Inspection Requirements for Reactor Pressure Vessel Heads At Pressurized Water Reactors." The intent of the examination was to identify potential boric acid leakage from pressure-retaining components on the RPV head. This was accomplished through visual inspection and NDE methods.

The VT examinations were performed to address the integrity of the RPV closure-head penetrations. A total of 83 penetrations were examined, including:

- 78 control rod drive penetrations
- 4 upper head injection penetrations
- 1 vent line

The CRD penetration No. 3 was identified as a potential "leaker" during the initial bare metal head examination and was subsequently scheduled for volumetric and surface examination. Supplemental UT examination showed no evidence of a leakage path signature on CRD penetration No. 3.

Results of the additional examinations performed by Framatome identified no detectable flaws that would indicate a leakage path to the outside surface of the RPV head. No other penetrations indicated boron leakage in the area of the annulus associated with inside surface CRD weld cracking. In addition, no boron was noted on the head surface with the origination point being from the penetration(s). Based on the results of these inspections, TVA confirmed that there are no indications of RPV degradation or primary water stress corrosion cracking of the Alloy 600 penetration nozzles for Unit 1.

ENCLOSURE 2

TENNESSEE VALLEY AUTHORITY (TVA)
SEQUOYAH NUCLEAR PLANT (SQN)
UNIT 1
PHOTOGRAPHS (IDENTIFIED AS FIGURES)

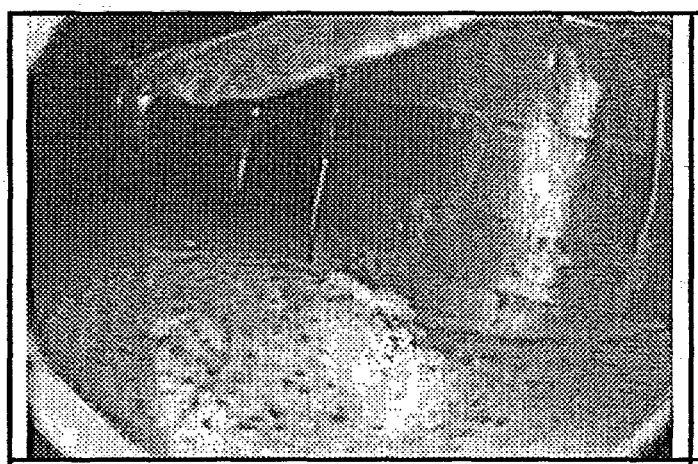

FIG. 1A - CRD 3 BEFORE CLEANING

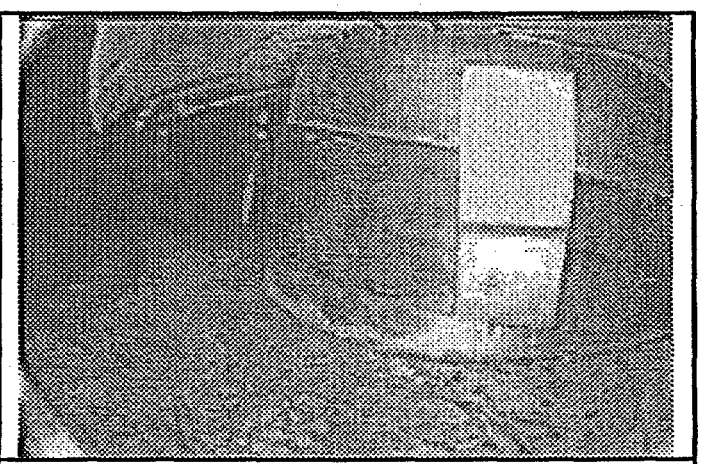

FIG. 1B - CRD 3 AFTER CLEANING

FIG. 2A - CRD 53 BEFORE CLEANING

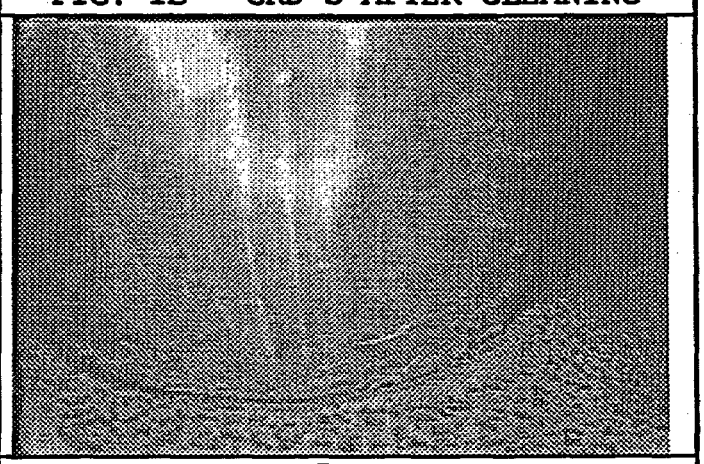

FIG. 2B - CRD 53 AFTER CLEANING

FIG. 3A - CRD 64 BEFORE CLEANING

FIG. 3B - CRD 64 AFTER CLEANING

FIGURES (Continued)

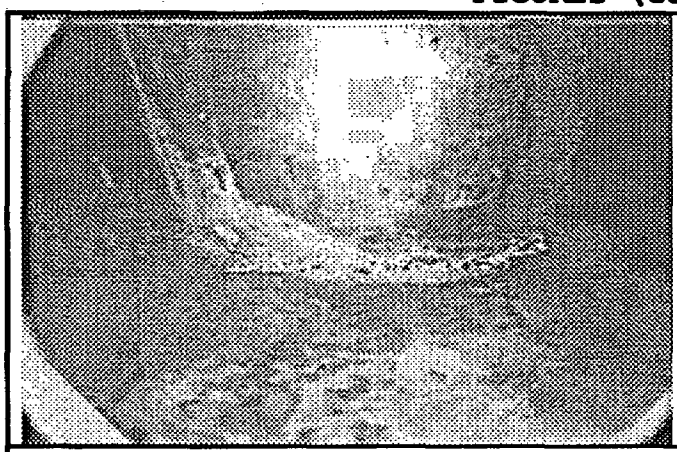

FIG. 4A - CRD 65 BEFORE CLEANING

FIG. 4B - CRD 65 AFTER CLEANING

FIG. 5A - CRD 72 BEFORE CLEANING

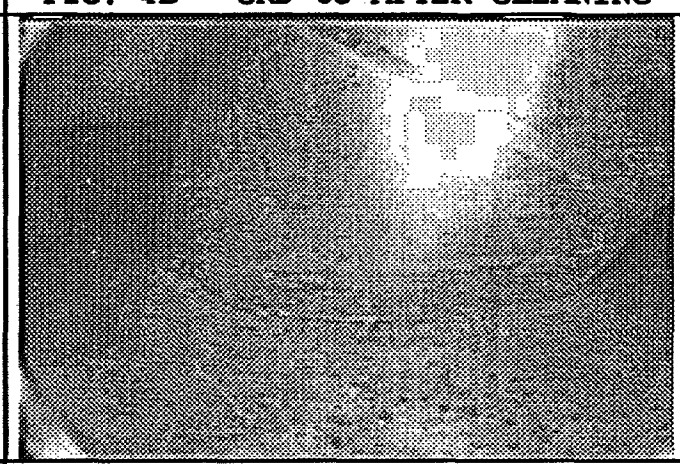

FIG. 5B - CRD 72 AFTER CLEANING

FIG. 6A - CRD 73 BEFORE CLEANING

FIG. 6B - CRD 73 AFTER CLEANING

FIGURES (Continued)

FIG. 7A - CRD 78 BEFORE CLEANING

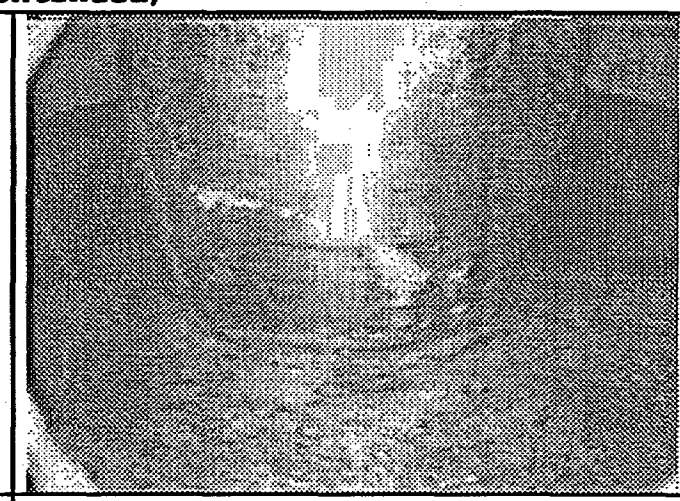

FIG. 7B - CRD 78 AFTER CLEANING