April 2, 2002 10 CFR 50.54(f)

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
11555 Rockville Pike
Rockville, Maryland 20852

Gentlemen:

| | | |
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| In the Matter of | ) | Docket Nos. 50-327 |
| Tennessee Valley Authority | ) | 50-328 |

**SEQUOYAH NUCLEAR PLANT (SQN) UNITS 1 AND 2 - RESPONSE TO NRC BULLETIN 2002-01, "REACTOR PRESSURE VESSEL HEAD DEGRADATION AND REACTOR COOLANT PRESSURE BOUNDARY INTEGRITY," DATED MARCH 18, 2002**

This letter provides TVA's 15-day response to the subject bulletin for SQN, which requested information pertaining to the integrity of the reactor coolant pressure boundary including the reactor pressure vessel head and the event to which inspections have been undertaken to satisfy applicable regulatory requirements. In accordance with the bulletin, Enclosure 1 provides TVA's response to the requested information in Item 1 for SQN.

In accordance with the requested information for Item 2 contained in the subject bulletin, TVA plans to submit the required response to this item for SQN Units 1 and 2 within 30 days after each plant restart following the next inspection of the reactor pressure vessel head to identify any degradation.

In accordance with the requested information for Item 3 contained in the subject bulletin, TVA plans to submit the required response for the remainder of the reactor coolant pressure boundary for SQN Units 1 and 2 within 60 days of the date of the subject bulletin.

Enclosure 2 contains the commitments contained in this letter. If you have any questions about this change, please contact me at (423) 843-7001.

Sincerely,

*Original signed by*

R. T. Purcell

Subscribed and sworn to before me
on this 2nd day of April 2002

Penny D. Walker
Notary Public

My Commission Expires May 9, 2005

Enclosures
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**ENCLOSURE 1**

**TENNESSEE VALLEY AUTHORITY**
**SEQUOYAH NUCLEAR PLANT (SQN)**
**UNITS 1 AND 2**

**RESPONSE TO NRC BULLETIN 2002-01, "REACTOR PRESSURE VESSEL HEAD DEGRADATION AND REACTOR COOLANT PRESSURE BOUNDARY INTEGRITY"**

The following provides the response for SQN on the subject bulletin dated March 18, 2002, for Item 1.

1. Within 15 days of the date of this bulletin, all PWR addresses are required to provide the following:

   A. ***a summary of the reactor pressure vessel head inspection and maintenance programs that have been implemented at your plant,***

   **TVA'S RESPONSE:**

   SQN has been performing visual inspections of control rod drive mechanism (CRDM) reactor pressure vessel (RPV) head penetrations since 1994, which include examination for evidence of boric acid leakage. The inspections are performed in accordance with site procedures and Preventative Maintenance (PM) Instructions to inspect for any signs of boric acid residue, corrosion, or active leaks. The inspections are based on the Nuclear Steam Supply System designer recommendations for inspection of peripheral areas of the head cooling shroud for evidence of leakage and boric acid corrosion. Procedure requirements include visual inspection of susceptible areas for leakage, which encompasses accessible head periphery penetrations, CRDM columns/canopy seal welds, conoseals, reactor vessel level instrumentation system lines, "O" ring monitoring tubes and head vent lines. The PM instructions are inspection documents based on Generic Letter 88-05. A summary of reactor head inspection results is provided in Tables 1 and 2. Bare metal inspections of the reactor head were performed during the Units 1 and 2 Cycle 6 outages.

B. ***an evaluation of the ability of your inspection and maintenance programs to identify degradation of the reactor pressure vessel head including, thinning, pitting, or other forms of degradation such as the degradation of the reactor pressure vessel head observed at Davis-Besse,***

**TVA'S RESPONSE:**

The boric acid inspections and site reactor pressure vessel maintenance procedures implemented at each refueling outage would likely identify degradation on top of the reactor vessel including thinning, pitting, or forms of degradation such as that observed at Davis-Besse.

The SQN Units 1 and 2 inspection and maintenance programs have monitored the reactor head vicinity for evidence of boric acid leakage and prevented boric acid accumulations that potentially could degrade the RPV head. During each refueling outage, the control rod drive canopy seals, conoseals, and areas above the head insulation are inspected for the presence of boric acid. SQN has lifted the reactor head insulation exposing the outer periphery rows of CRDM penetrations and the periphery general areas under the insulation.

Inspections conducted on SQN Unit 1 have identified prior evidence of boric acid leaks. Repairs of the leakage source were implemented, the head cleaned, and inspected at the time of leakage identification.

Inspections conducted on SQN Unit 2 have not identified any boric acid leakage in the reactor head vicinity. Minor boron residue was identified during one inspection, the area cleaned, and a follow up inspection did not identify any additional boron residue.

In the Westinghouse 4 Loop Design Plants, the periphery penetrations are in the highest stress state and, per the manufacturers analysis, are the most prone to CRDM reactor head penetration cracking described in NRC Bulletin 2001-01. Both SQN units have been implementing the limited periphery reactor head nozzle inspection since mid-1990 and no boric acid leakage associated with the penetrations was present. SQN Units 1 and 2 CRDM nozzle penetrations are ranked in the lowest susceptibility group to cracking.

C. ***a description of any conditions identified (chemical deposits, head degradation) through the inspection and maintenance programs described in 1.A that could have led to degradation and the corrective actions taken to address such conditions,***

**TVA RESPONSE:**

Except for examinations performed during Unit 1 Cycles 6 and 7 outages and Unit 2 Cycle 6 outage, visual examination was limited to a best effort visual examination. This examination consisted of lifting the head shroud and insulation approximately 2 inches and visually looking for evidence of leakage around the penetrations and the general vicinity of the head using a flashlight and other visual aids as warranted.

The inspections were limited to a best effort examination of the two outer periphery rows of the RPV penetrations (which are the most susceptible in four loop Westinghouse units). The inspection affords close examination of the two outer peripheral row penetrations, with 100 percent of the first row circumference being accessible for bare metal examination and approximately 75 percent coverage of the second row penetration circumference. The present technique of examination allows visual bare metal evaluation of at least 50 percent of the RPV base metal for evidence of corrosion or staining due to external leakage.

Examinations performed during the Units 1 and 2 Cycle 6 outages provided a complete overview of the head base metal. Approximately 50 to 100 percent of the penetration circumferences was accessible for examination depending on the location. The Unit 1 Cycle 7 examination allowed for up to 75 percent of the head base metal surface and penetrations because of insulation removal due to lower canopy seal weld leakage and repairs at CRDM penetration locations A5, E13, and L13.

**Unit 1**

The reactor vessel has residual boron staining throughout the head. This condition was the result of inadvertent activation of the containment spray system on two occasions during construction and prior to the initial plant start-up. The staining residue is minor in nature and has not been cleaned off the head. There

has been no indication of change in conditions that would indicate active boron leakage.

In Cycle 6 boron residue was noted around CRDM penetration location A5. Evaluation of the leakage path indicated that the boron was due to a conoseal mechanical joint leak. The conoseal was repaired and returned to service. No further evidence of conoseal leakage was identified. The boron residue was removed from the RPV head and the base material was assessed for corrosion damage. The base material showed no evidence of degradation or material wastage.

During Cycle 7 inspections, boron residue was observed near the edge of the head shroud. Further investigation of the leakage path indicated a through wall leak at the lower canopy seal weld for CRDM penetration location A5. Additionally, two other canopy seal welds were identified as leaking at CRDM penetration locations E13 and L13. The seal welds were repaired and the reactor head was cleaned to remove any evidence of boron due to canopy seal weld leakage. There was no evidence of degradation or material wastage in the areas cleaned. There were no other indications of boron leakage on the remainder of the head.

SQN Unit 1 experienced another canopy seal weld leak at CRDM penetration location J1 during the Cycle 10 outage. This leakage was minor and did not result in any boron deposits on the head. The seal weld was repaired. Subsequent best effort inspections of the Unit 1 head since 1995 (Cycle 7) has not indicated any pressure boundary leakage.

The inspection during the Unit 1 Cycle 11 outage noted white particles were scattered throughout the head that resembled boron. The particles were removed from various areas of interest for further investigation and were identified as remnants of fiber insulation. The insulation was apparently left from a previous CRDM canopy seal weld repair at penetration location J1, during the Cycle 10 outage. Small particles of boron were identified at the CRDM to head interface at penetration locations E1 and D14. The particles were localized and less than 1/32 inch in diameter and did not indicate a condition that would implicate head penetration leakage.

Minor boron residue was noted on the outer periphery of the reactor pressure vessel head around the

penetrations between Stud Hole No. 43 and Stud Hole No. 10 and around penetration locations L15, R11, and R9. These conditions are the result of previous CRDM canopy seal weld or conoseal leakage identified during previous outages and have been previously evaluated by Metallurgical Engineering. There was no evidence of significant boron build up or obvious leakage staining at the penetrations that is indicative of industry identified Primary Water Stress Corrosion Cracking pressure boundary leakage.

**Unit 2**

During the Cycle 9 outage, in 1999, boron residue was noted either at CRDM penetration locations A5 or B5. There was no obvious leakage path identified to determine the source of leakage. The area was cleaned of residue and base material was examined for material degradation. There was no evidence of material degradation or wastage. The area was noted and inspected the following outage (Cycle 10) and showed no boron residue. Best effort exams of the head base material and the peripheral penetrations after Cycle 6 and prior to Cycle 9 did not show any indication of pressure boundary leakage. No history of boric acid leakage in the reactor head vicinity has been identified.

D. ***your schedule, plans, and basis for future inspections of the reactor pressure vessel head and penetration nozzles. This should include the inspection method(s), scope, frequency, qualification requirements, and acceptance criteria, and***

**TVA RESPONSE:**

SQN will perform a remote under insulation inspection of the reactor head at the next refueling outage for each SQN unit for evidence of boric acid leakage or leakage associated with CRDM penetration nozzles. This inspection will be a 100 percent head surface remote camera inspection to the extent achievable using current crawler technology. In addition, a best effort CRDM nozzle penetration examination will be performed. These inspections will be performed by a VT-2 Certified Inspector, any questionable indications or evidence of boron will also be inspected by a Metallurgical Engineer.

SQN will continue to perform limited reactor pressure vessel head bare metal examinations on periphery nozzle penetrations and approximately 50 percent of the general head vicinity for evidence of leakage during each unit's refueling outage consistent with current site practices. If future above the head boric acid leakage occurs, SQN will follow the site programs for identification and repair of leakage. During each unit's refueling outage, the control rod drive canopy seals, conoseals, reactor flange, and areas above the reactor vessel head insulation will be inspected for the presence of boric acid. Any evidence of boric acid leakage will require further investigation, removal, and evaluation as required by ASME Section XI, IWB-3142.

A minimum of 25 percent of the reactor vessel head penetration nozzles will be inspected in each 10-year interval specified in the ASME Code, Section XI, In-service Inspection.

E. ***your conclusion regarding whether there is reasonable assurance that regulatory requirements are currently being met (see the Applicable Regulatory Requirements, above). This discussion should also explain your basis for concluding that the inspections discussed in response to Item 1.D will provide reasonable assurance that these regulatory requirements will continue to be met. Include the following specific information in this discussion:***

(1) ***If your evaluation does not support the conclusion that there is reasonable assurance that regulatory requirements are being met, discuss your plans for plant shutdown and inspection.***

***(2) If your evaluation supports the conclusion that there is reasonable assurance that regulatory requirements are being met, provide your basis for concluding that all regulatory requirements discussed in the Applicable Regulatory Requirements section will continue to be met until the inspections are performed.***

**TVA RESPONSE**:

SQN performed an inspection of a minimum of 25 percent of the head penetrations on both units within a 10-year interval required by ASME, Section XI, which is the code specified by 10 CFR 50.55a. SQN has procedures

and instructions in place for identifying, evaluation, and correcting conditions which would adversely effect the reactor coolant pressure boundary and supporting systems; and which would provide for compliance with 10 CFR 50 Appendix B, Criterion V, *Instructions, Procedures, and Drawings*, Criterion IX, *Control of Special Process*, and Criterion XVI, *Corrective Action*. In addition, SQN has an operating head temperature which puts it in the least susceptibility category of greater than 30 effective full power years (EFPY) using the Oconee 3 model and each of the SQN units have operated for less than 15 EFPY.

TVA's evaluation concluded with reasonable assurance that the regulatory requirements outlined in NRC Bulletin 2002-01, Applicable Regulatory Requirements Section, are currently being met and concludes the inspections identified in Section 1D of TVA's response will provide reasonable assurance that these regulatory requirements will continue to be met. This conclusion is based on the fact that SQN has established programs and procedures to implement the required inspections, evaluations, repairs, and analysis of systems and components to maintain integrity of the reactor coolant system pressure boundary. Additionally, although SQN reactor pressure vessel CRDM nozzle cracking susceptibility is one of the lowest in the industry, the commitment made to perform an inspection of the entire head during the next refueling outage will provide increased confidence that boric acid degradation problems experienced at other plants have not occurred at SQN.

**Table 1**

**SUMMARY OF SQN REACTOR HEAD INSPECTION RESULTS**
**UNIT 1**

| RFO | Inspection Date | Comments |
|---|---|---|
| 6 | 2/3/94 | Performed during first ten year ISI exam - Head shroud was raised to perform ISI penetration exams on UHI penetrations - this provided a complete overview of the reactor head base metal. Approximately 50 to 100% of the CRDM penetration circumference was accessible, depending on location. Boron residue was noted around CRDM penetration location A5. Leakage path indicated source as conoseal leak at mechanical joint. Other extraneous boron residue was noted and attributed to the inadvertent actuation of the containment spray system during construction and prior to initial plant start up. |
| 7 | 11/1/95 | Head shroud was raised as a result of lower canopy seal weld leakage at CRDM penetration locations A5, E13, and L13. Boron residue was noted around the A5 penetration base metal. The area was cleaned. There was no evidence of degradation or material wastage in the areas cleaned. There were no other indications of boron leakage on the remainder of the head and no change in the head condition noted in the previous outage. |
| 8 | 3/30/97 | The shroud plate was raised approximately 2 inches providing 100% visual access to the first row outer periphery penetrations and partial visual access to the second row penetrations. No change in head condition since last inspection was noted. |
| 9 | 9/16/98 | The shroud plate was raised approximately 2 inches providing 100% visual access to the first row outer periphery penetrations and partial visual access to the second row penetrations. No noted change in head condition since last inspection. |
| 10 | 2/28/00 | The shroud plate was raised approximately 2 inches providing 100% visual access to the first row outer periphery penetrations and partial visual access to the second row penetrations. No noted change in head condition since last inspection. CRDM Canopy Seal Weld leak noted at CRDM penetration location J1. No extraneous boron residue was attributed the J1 canopy seal, leakage was minor. |
| 11 | 10/27/01 | The shroud plate was raised approximately 2 inches providing 100% visual access to the first row outer periphery penetrations and partial visual access to the second row penetrations. Minor boron residue was noted, evaluated, and documented under PM WO 00-007281-000 (PM 040851000). There was no significant change in head conditions since the last inspection. |

**Table 2**

**SUMMARY OF SQN REACTOR HEAD INSPECTION RESULTS**
**UNIT 2**

| RFO | Inspection Date | Comments |
|---|---|---|
| 6 | 7/28/94 | Performed during first ten year ISI exam - Head shroud was raised to perform ISI penetration exams on UHI penetrations - this provided a complete overview of the base reactor head base metal. Approximately 50 to 100% of the CRDM penetration circumference was accessible, depending on location. No indication of boron leakage at the pressure boundary components was noted. |
| 7 | 4/27/96 | The shroud plate was raised approximately 2 inches providing 100% visual access to the first row outer periphery penetrations and partial visual access to the second row penetrations. No noted change in head condition since last inspection. |
| 8 | 10/13/97 | The shroud plate was raised approximately 2 inches providing 100% visual access to the first row outer periphery penetrations and partial visual access to the second row penetrations. No noted change in head condition since last inspection. |
| 9 | 4/23/99 | The shroud plate was raised approximately 2 inches providing 100% visual access to the first row outer periphery penetrations and partial visual access to the second row penetrations. Minor boron residue was noted around CRDM penetration locations A5 or B4. The area was cleaned and no material degradation was observed. No other noted change in head condition since last inspection. |
| 10 | 10/29/00 | The shroud plate was raised approximately 2 inches providing 100% visual access to the first row outer periphery penetrations and partial visual access to the second row penetrations. No noted change in head condition since last inspection. Area around CRDM penetration locations A5 and B4 showed no change since the last inspection. |

**ENCLOSURE 2**

**TENNESSEE VALLEY AUTHORITY**
**SEQUOYAH NUCLEAR PLANT (SQN)**
**UNITS 1 AND 2**

**NRC BULLETIN 2002-01, "REACTOR PRESSURE VESSEL HEAD DEGRADATION AND REACTOR COOLANT PRESSURE BOUNDARY INTEGRITY"**

**COMMITMENT**

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SQN will perform a remote under insulation inspection of the reactor head at the next refueling outage for each SQN unit for evidence of boric acid leakage or leakage associated with CRDM penetration nozzles. This inspection will be a 100 percent head surface remote camera inspection to the extent achievable using current crawler technology. In addition, a best effort CRDM nozzle penetration examination will be performed. These inspections will be performed by a VT-2 Certified Inspector, any questionable indications or evidence of boron will also be inspected by a Metallurgical Engineer.