UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30303

Report Nos.: 50-259/85-10, 50-260/85-10, and 50-296/85-10

Licensee: Tennessee Valley Authority
500A Chestnut Street
Chattanooga, TN 37401

Docket Nos.: 50-259, 50-260 and 50-296 License Nos.: DPR-33, DPR-52, and DPR-68

Facility Name: Browns Ferry 1, 2, and 3

Inspection Conducted: February 19 - 22, 1985

Inspector: for W. J. Ross 3/8/85
Date Signed

Approved by: J. J. Blake, Section Chief 3/8/85
Date Signed
Engineering Branch
Division of Reactor Safety

SUMMARY

Scope: This routine, unannounced inspection entailed 32 inspector-hours on site in the areas of plant chemistry and inservice testing of pumps and valves.

Results: No violations or deviations were identified.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*G. T. Jones, Plant Manager
J. R. Clark, Chemistry Unit Supervisor, Engineering
R. McPherson, Engineering and Testing Unit Supervisor, Engineering
*D. C. Mims, Assistant Supervisor, Engineering
K. Richards, Laboratory Supervisor/Chemistry Unit

Other licensee employees contacted included three chemistry technicians.

NRC Resident Inspectors

*G. L. Paulk
*C. A. Patterson

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on February 22, 1985, with those persons indicated in paragraph 1 above. The licensee described the areas inspected and discussed in detail the inspection findings listed below.

(Closed) Inspector Followup Item 50-259, 260, 296/84-13-1, Revised Water Chemistry Program - Paragraph 5.b.

The licensee did not identify as proprietary any of the materials provided to or reviewed by the inspector during this inspection.

3. Licensee Action on Previous Enforcement Matters

This subject was not addressed in the inspection.

4. Unresolved Items

Unresolved items were not identified during this inspection.

5. Plant Water Chemistry (92706)

The inspector assessed the ability of the licensee to protect the integrity of the reactor coolant boundary and reactor fuel elements from degradation from chemical induced corrosion. This followup of an earlier inspection (see Inspection Report Nos. 259, 260, 296/84-13, April 1984) consisted of three efforts: a review of the operational history of the three Browns

Ferry Units since the previous inspection; an evaluation of the licensee's revised water chemistry program that is based on guidelines recommended by the BWR Owners Group (BWROG) and the Electric Power Research Institute (EPRI); and an audit of licensee activities that have been taken to implement the new water chemistry program.

a. Assessment of the Design and Operation of Components Associated with the Reactor Coolant System

During this inspection Units 1 and 3 were at power while Unit 2 was in a refueling outage (since September 1984). Unit 1 had operated, with several outages lasting a week or more, throughout 1984 while Unit 3 remained shutdown most of the past year for major maintenance. The inspector was informed that the only integrity problems that were encountered were associated with minor failures of condenser tubes in Units 1 and 2 and air inleakage through the Unit 2 main turbine. However, considerable corrosion and blockage of other systems (Firewater and Emergency Equipment Cooling Water) that provide flow for river water has been observed.

The inspector was informed that the operation of the condensate demineralizers had been improved to the extent that service runs of 10 to 15 days are now being achieved. Leakage of resin fines into the feedwater of Unit 1 was encountered during 1984 but was attributed to the poor quality of the resin. Also, erratic removal of silica in the water treatment plant during part of 1984 was attributed to the degraded condition of the mixed-bed demineralizers.

During the current outage for Unit 2, the licensee determined that more than fifty fuel rods had deteriorated until they had become 'leakers' of fission products. The inspector was informed that, at this time, the cause of the deterioration is not known. Also, during this inspection, the licensee observed evidence of a through-wall crack in a weld region of one recirculating water loop. This failure is considered to be further evidence of intergranular stress corrosion in the welds.

b. Scope and Adequacy of the Licensee's Water Chemistry Program

The inspector reviewed selected sections of the licensee's revised Radiochemical Laboratory Manual (TI-38). This new manual was designed to upgrade the plant's water chemistry program and to implement the administrative and technical guidelines for a BWR water chemistry control program that were developed by BWROG/EPRI. Through this review the inspector established that the following key elements of the program had been completed and approved by plant management.

- Responsibilities for managers, supervisor, analysts, and quality control personnel (§1500).

- Identification of key control and diagnostic chemistry parameters that must be monitored during each mode of plant operation (§800).

- Identification of sampling points and development of sampling schedules, as well as the necessary logs and worksheets for documentation and control of test results (§700).

- Procedures for sampling (§1000).

- Procedures for trending results and initiating corrective action when a parameter is out of specification (§400).

- Provision for data review and quality control (§1500).

The inspector considered that these sections of the Radiochemical Laboratory Manual are considerably more comprehensive than before and should provide the framework for a water chemistry program that is consistent with the BWROG/EPRI guidelines. Consequently, the inspector closes Inspector Followup Item 50-259, 260, 296/84-13-1, "Revised Water Chemistry Program".

The inspector also verified that the intent and goals of the BWROG/EPRI guidelines have also been factored into the operation of the plant. Operating Instruction OI-3 now requires that "the water quality shall be maintained as specified in TI-38, Section 800". This instruction also formalizes responsibility of the Chemistry Unit to monitor water quality and to notify Operations of abnormal events and make recommendations for correcting out-of-specification chemistry parameters. Similar guidance and directions are provided in OI-70 for the Reactor Building Closed Cooling Water System and in OI-69 for operation of the Reactor Water Cleanup System.

While the inspector considers that the licensee's water chemistry program follows the technical guidelines of the BWROG/EPRI guidelines, two areas of concern remain. First, several requirements are conditioned by such statements as "as soon as the resources are allocated and available" and "if plant conditions warrant". These statements indicate a lack of urgency to bring the entire program into effect. Second, the action statements in Section 800 of the Radiochemistry Manual, relative to corrective action for abnormal chemistry levels II and III, do not connote the potential for corrosion or the need for timely response to minimize the extent or duration of an abnormal chemistry situation to the extent given in the BWROG/EPRI guidelines. These concerns were discussed with the licensee in an effort to clarify the use of an "engineering review" as a means of responding to an abnormal chemistry event.

c. Implementation of the Browns Ferry Water Chemistry Program

During his previous inspection, the inspector had designated several perceived deficiencies in the implementation of an acceptable water chemistry program for followup (Inspector Followup Item 50-259, 260, 296/84-13-02). It was evident during the current inspection that, in the interim, the licensee has been attempting to upgrade the capability to control the water chemistry in the three units as well as to diagnose short and long term trends and to detect trace amounts of potentially corrosive ions.

Through reorganization of the Chemistry Unit, greater emphasis has been placed on improving the effectiveness and operational life of the condensate polisher. In addition, personnel have been dedicated to such tasks as: developing an effective quality control program, upgrading the training of engineers and analysts, developing a trending program using a computerized data base, and developing procedures for the use of ion-chromatographs for trace ion analyses and for the installation of in-line ion-chromatographs. As a consequence of these new emphases, as well as attrition within the Chemistry Unit, the staff of laboratory shift supervisors and technicians has been reduced from 26 (in April 1984) to 12. The current staff consists of four three-person crews who perform duties in radiochemistry and water chemistry on twelve-hour rotating shifts. The licensee is developing four separate programs to provide more effective training for technicians, engineers, and as many as fourteen new employees. However, the present level of staffing is an impediment to these plans. The inspector was informed that contract chemistry technicians are to be used until new employees can be hired and trained.

The laboratory technicians are implementing the new requirements of TI-38 and, thus, are performing more analyses than before as the result of increased numbers of control, diagnostic, and calibration requirements. The inspector observed some calibration results that indicated a trend toward increased accuracy and precision but he did not review any revised analytical procedures or assess the manner in which these procedures are being performed.

Through the use of graphical trends, manually and computer plotted, the inspector audited the results of analyses of key chemistry parameters for Units 1 and 2 during the periods these two units were operating in 1984. In essentially all cases the conductivity of the reactor water was documented as $\leq$0.25 umho/cm and, therefore, below the 0.3 umho/cm level that is considered by EPRI and General Electric to be a threshold for initiation of intergranular stress corrosion (IGSCC). This level of water purity was obtained principally by keeping the conductivity of the feedwater to less than 0.07 umhos/cm with the condensate demineralizers. During this time period, documented results for the concentration of dissolved oxygen in the reactor water varied from 40

to 200 ppb, but usually was between 60-100 ppb. These concentrations exceed the recommended 15-20 ppb to prevent IGSCC but are considerably less than the 150-200 ppb normally produced in a BWR by radiolysis of the coolant. This trend will be of use if the licensee implements a hydrogen chemistry program to minimize IGSCC.

Conductivity is the principal chemistry parameter that is used for controlling water chemistry. The licensee has inline conductivity meters at four key locations (hotwell pump discharge, demineralizer influent and effluent, and the Reactor Water Cleanup demineralizer 'A' effluent.) These instruments display and alarm in the Chemistry Lab. Although the inspector observed these important displays to be operable, several (four of six) other recorders were inoperable. The licensee informed the inspector that replacement of these older, less reliable recorders represented another action that will be taken 'in the future'.

During this part of the inspection, the inspector continued to find weaknesses in the manner in which the plant's water chemistry program is being implemented. However, no violations or deviations were identified.

6. Inservice Testing of Pumps and Valves (92706)

a. Testing of Pumps

The inspector reviewed the licensee's instructions (SI 3.1) for inservice testing of pumps in the following safety-related plant systems, per the requirements of Subsection IWP of the ASME Boiler and Pressure Vessel Code (the Code):

- Core Spray (CS)
- Residual Heat Removal (RHR)
- Residual Heat Removal Service Water (RHRSW)
- Emergency Equipment Cooling Water (EECW)
- High Pressure Core Injection (HPCI)
- Reactor Core Isolation Cooling (RCIC)
- Standby Liquid Control (SLC)

The test quantities measured are the same as required by Table IWP-3100-2 of the 1980 Edition of the Code; however, the licensee compares test results with a set of reference valves in an "Allowable Range" rather than in the "Alert Range" and "Required Action Range" prescribed in the Code. The licensee also has specified higher upper limits than those in the Code, for flow rate and differential pressure, to bring these ranges in line with the accuracy range of plant instruments. The basis for these changes has been documented and is allowed, per Paragraph IWP-3210 of the Code, when the limits specified by the Code cannot be met. The licensee has also requested relief from

the Code requirement that vibration amplitudes be measured with an accuracy of ±5% of full scale on the basis that the portable instrument used to measure this parameter has an accuracy of 11% of full scale. This relief request will be addressed during the NRC staff's review of the licensee's pump and valve inspection program; however, the licensee informed the inspector that the mechanical operability of pumps is also being monitored routinely by additional 'non-Code' tests that complement the Code vibration tests.

The inspector audited the results of tests performed on pumps in the seven plant systems listed above during 1985. The parameters for all pumps (except flow for SLC pump 3B in Unit 2) were within allowable limits. Although the inspector questioned the reference values and results of other tests, satisfactory explanations were provided by the licensee.

b. Testing of Valves

The inspector reviewed the licensee's instructions (SI 3.2) for inservice testing of safety-related valves per the 1980 Edition of the Code. The inspector also audited the results of valve operability tests performed, per the following subsections of SI 3.2, during 1985:

SI 3.2.1 Valves Cycled During Other Surveillance Instructions
SI 3.2.2 Motor Operated Valves Tested During Cold Shutdown

Although all valves stroke times were documented as being within specified reference limits during these tests, the inspector observed that numerous post-maintenance retests had been performed. The inspector reviewed the stroke-time test results in relation to the reference values themselves as well as the basis for the magnitude of the reference values. Stroke times have been established in three manners: times specified in the Technical Specifications (TS) for containment isolation (TS Table 3.7.A); times selected to assure proper delivery of water to the reactor vessel in a design basis accident (FSAR §§ 4.75, 7.4.3.2.5, and 7.4.3.4.4 and FSAR Appendix N6.5.10); and, finally, times based on the initial test performed per SI 3.2. The inspector noted that several valves actually required most of the time permitted by the FSAR (e.g., 74 vs 80 seconds, 28 vs 30 seconds) for the entire system to perform its safety function. Other valves opened or closed in times much shorter than their reference values. The inspector requested that the licensee review stroke times that are based on FSAR analyses to ensure that the operability tests actually provide assurance that a valve is not degrading, as well as assurance that the valve will open or close to permit a system to perform its safety-related function.

During this part of the inspection, no violations or deviations were identified. An in-depth audit of 1984 tests results will be performed during a later inspection after transfer of these data to microfilm has been completed.