U.S. NUCLEAR REGULATORY COMMISSION

REGION II

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Report Nos:	50-259/99-06, 50-260/99-06, 50-296/99-06
Licensee:	Tennessee Valley Authority (TVA)
Facility:	Browns Ferry Nuclear Plant, Units 1, 2, & 3
Location:	Corner of Shaw and Browns Ferry Roads Athens, AL 35611
Dates:	September 5 - October 16, 1999
Inspectors:	W. Smith, Senior Resident Inspector J. Starefos, Resident Inspector E. DiPaolo, Resident Inspector E. Brown, Resident Inspector, Brunswick Nuclear Plant
Approved by:	P. E. Fredrickson, Chief Reactor Projects Branch 6 Division of Reactor Projects

Enclosure

EXECUTIVE SUMMARY

Browns Ferry Nuclear Plant, Units 1, 2, and 3
NRC Inspection Report 50-259/99-06, 50-260/99-06, 50-296/99-06

This integrated inspection included aspects of licensee operations, maintenance, engineering, and plant support. The report covers a 6-week period of resident inspection.

Operations

- Operators conducted routine business in a professional manner. Access controls were good, the operators responded promptly to alarms and communicated them to the unit supervisor in a clear manner, and they were alert to control panel indications (Section O1.1).

- Safety systems responded as designed following two Unit 2 reactor scrams (Section O1.2).

- Operators responded appropriately when two channels of neutron instrumentation became inoperable during a September 16, 1999, startup of Unit 2 (Section O1.3).

- During a September 18, 1999, Unit 2 startup, the point of single-notch control rod withdrawal was non-conservatively calculated because it was based on source range monitor readings taken several hours prior to the startup under different plant conditions (Section O1.3).

- Although the general material condition of the Unit 3 low pressure coolant injection system was good, a normally open valve was found closed to compensate for another leaking valve, without supporting documentation, due to poor work coordination (Section O2.1).

Maintenance

- Maintenance activities observed were conducted in a satisfactory manner and regulatory requirements were met (Section M1.1).

Engineering

- The licensee's operators, engineers, and chemists performed power suppression testing and analysis of detected Unit 3 fuel leaks in a professional manner, and obtained meaningful results (Section E2.1).

Plant Support

- A non-cited violation was identified because, upon adding solution to the Unit 3 standby liquid control system tank, the licensee failed to meet a 24-hour Technical Specification surveillance requirement to verify that sodium pentaborate enrichment was within allowable limits. (Section R8.1).

- The licensee's security officers were attentive to their posts and demonstrated alertness when they locked the West Gate turnstiles as a licensee employee prematurely crossed the "red line," thus preventing concurrent access through a turnstile that controlled access to the protected area. (Section S1.1).

Report Details

Summary of Plant Status

Unit 1 remained in a long-term lay-up condition with the reactor defueled.

Unit 2 operated at or near full power until September 15, 1999, when Unit 2 was manually scrammed in response to an electro-hydraulic control (EHC) system leak. During the startup on September 17, the unit scrammed on a turbine trip caused by a high level in the moisture separator reheater (MSR). The unit was restored to full power on September 19, where it remained until the end of the inspection period.

Unit 3 operated at or near full power until September 11, when power was reduced to 85% for approximately 7 hours for maintenance and testing. On October 1, power was reduced to 40% and the unit was placed in single recirculation loop operation to perform maintenance and testing. Power was restored to 100% on October 4. On October 6, power was reduced to 70% for power suppression testing to locate leaking fuel pins. On October 13, power was restored to 100%, where it remained until the end of the inspection period.

I. Operations

O1 Conduct of Operations

O1.1 General Comments (71707)

During the inspectors' visits to the control rooms, the operators were observed to conduct their business in a professional manner. Access controls were good, the operators responded promptly to alarms and communicated them to the unit supervisor in a clear manner, and they were alert to control panel indications.

O1.2 Unit 2 Reactor Scrams

a. Inspection Scope (71707)

The resident inspectors observed and/or reviewed the actions of control room operators and plant performance in response to two Unit 2 reactor scrams.

b. Observations and Findings

At 5:58 p.m. on September 15, 1999, the Unit 2 control room received an EHC reservoir level low alarm. Operators commenced lowering reactor power and attempted to maintain EHC reservoir level. Operators in the plant identified that the cause of the lowering EHC reservoir level was a leak from an instrument line on the EHC header. Operator attempts to isolate the leak and raise EHC reservoir level were unsuccessful. At 6:25 p.m. operators inserted a manual scram from 54% power in preparation for removing the EHC system from service. The transient resulted in a minimum reactor vessel water level of -28.6 inches which resulted in primary containment isolation system Groups 2, 3, 6, and 8 isolations. The inspectors reviewed the transient data and concluded that all safety systems responded as designed.

The licensee determined that the EHC leak was caused by the failure of an instrument sensing line off one of the four turbine control valve EHC accumulators. The accumulators had been installed on EHC piping during the recent Unit 2 Cycle 10 refueling outage as part up the 5% power uprate project and to reduce EHC system pressure fluctuations which have contributed to plant transients and servo-valve leakage in the past (see Section E2.1 of NRC Inspection Report 50-259,260,296/97-11). The licensee determined that the sensing line broke due to fatigue failure at the heat-affected zone of the weld between the tubing and the connection fitting. The licensee plugged the connection, since the pressure indication was used for information only. Inspections of other similar configurations (tubing to connection fitting weld) in the system were determined to be satisfactory.

A reactor startup commenced on September 16, 1999. The inspectors observed portions of the control rod pull to criticality and power escalation (see Section O1.3, below). On September 17, 1999, while recovering from the previously discussed scram, Unit 2 experienced an automatic reactor scram when the turbine tripped because of a high moisture separator level. The cause of the high level was due to a malfunction of the moisture separator high level controller. At the time of the scram, the unit was at nearly 30% power. The licensee determined that all challenged safety systems responded as designed; however, the licensee also determined that the operator actions to troubleshoot the high level indications in the moisture separator warranted further evaluation. This issue was documented separately in PER 99-010301-000. The licensee commenced restart of Unit 2 on September 18, 1999. A problem evaluation report (PER 99-010180-000) was initiated to address this scram.

c. Conclusions

Safety systems responded as designed following two Unit 2 reactor scrams.

O1.3 Startup Observations

a. Inspection Scope (71707)

The inspectors observed the control rod withdrawal to criticality and portions of the power escalation during the Unit 2 startup of September 16, 1999. Also, portions of the subsequent Unit 2 startup of September 18 was observed.

b. Observations and Findings

The operators displayed professionalism, appropriate formality, and good communications during the approach to criticality. After criticality was achieved during the startup commencing on September 16, intermediate range monitor (IRM) Channel H failed downscale, resulting in a second inoperable IRM channel (Channel B was declared inoperable prior to startup, based on observed spiking), which placed the unit in a 12-hour Technical Specification (TS) Limiting Condition for Operation (LCO). Operators secured from rod withdrawal, stabilized reactor power at the point of adding heat, and made preparations to insert control rods to bring the reactor subcritical. The

inspectors reviewed the applicable TS requirements and concluded that the correct LCO was entered and that the operators' response to the condition was appropriate. Subsequently, IRM Channel B was returned to operable status and power escalation resumed.

During review of Procedure 0-GOI-100-1A, Unit Startup and Power Operation, Revision 85, the inspectors found that operators had recorded source range neutron monitor (SRM) count rates approximately 9 hours and 7 hours prior to commencing the control rod withdrawals for the September 16 and September 18 reactor startups, respectively. These data were used to determine when single-notch control rod withdrawal was required and to provide operators an aid in anticipating criticality. The inspectors questioned the appropriateness of taking SRM data so far in advance of commencing rod withdrawal because plant condition changes could affect SRM count rates.

The licensee reviewed SRM count rate history for the two periods in question using integrated computer system data. The changes in SRM count rates for the reactor startup of September 16 were negligible. However, the data for the reactor startup of September 18 revealed a noticeable, non-conservative reduction between the recorded count rates and the actual count rates just prior to commencing the rod withdrawal. SRM count rate data changed as follows: SRM A was recorded at 100 counts per second (cps), but was 60 cps just prior to rod withdrawal (100/60), SRM B was 80/50, SRM C was 45/31, and SRM D was 35/21. The licensee determined that the change in SRM count rates was primarily due to the increase in reactor vessel water temperature (from approximately 320°F to 470°F) as a result of a plant heatup.

Step 5.32 of Procedure 0-GOI-100-1A required that single-notch control rod withdrawal be commenced when pre-startup SRM count rate increased by a factor of 16. This requirement along with close monitoring of neutron monitoring instrumentation assured a slow, controlled, approach to criticality. During the reactor startup of September 18, operators commenced single-notch control rod withdrawal prior to actual pre-startup SRM count rates increasing by a factor of 16 due to rod worth minimizer and other procedural controls. Because these controls instituted single-notch withdrawal early, there were no consequences as a result of the reduction in SRM readings. Therefore, no violation of regulatory requirements occurred. However, calculating reactivity management aids based on SRM readings taken several hours prior to actual withdrawal of control rods was considered a poor practice. This was because SRM count rates could change due to the delay time or changes in plant conditions as demonstrated during the reactor startup on September 16. The licensee initiated PER 99-010348-000 to address the issue.

c. Conclusions

Operators responded appropriately when two channels of neutron instrumentation became inoperable during the September 16 startup. A poor practice was identified with the application of reactivity management aids prior to control rod withdrawal to criticality, in that during the September 18 startup, the point of single-notch control rod withdrawal

was non-conservatively calculated because it was based on SRM readings taken several hours prior to the startup under different plant conditions.

O2 Operational Status of Facilities and Equipment

O2.1 Unit 3 Low Pressure Coolant Injection System Walkdown

a. Inspection Scope (71707)

The inspectors performed a detailed walkdown of the Unit 3 low pressure coolant injection (LPCI) portions of the residual heat removal system. The inspectors reviewed the Final Safety Analysis Report (FSAR), TS, and plant procedures in preparation for the inspection.

b. Observations and Findings

The material condition of equipment was generally good. The inspectors reviewed system periodic valve lineup procedures and verified that licensee procedures satisfied the TS surveillance requirements.

All system valves were found to be in the required position consistent with applicable system drawings and lineup procedures with one exception. Valve 3-FCV-074-0150, a LPCI loop cross tie valve, was found in the closed position; however, the normal position, as indicated on FSAR drawings and plant procedures, was open. The valve was caution-tagged in the closed position because the other valve in the line, 3-FCV-074-0046, exhibited seat leakage. This condition had existed since 1995. The LPCI loop cross tie line fulfills no current safety function and at least one of the LPCI loop cross tie valves is required to be closed in accordance with TS. The inspectors found that the work order to repair valve 3-FCV-074-0046 had been recently canceled.

The licensee initiated PER 99-010675-000 and explained that the original work order was canceled because a planned design change, to change the normal position of valve 3-FCV-074-0150 to the closed position, would have resolved the condition. Subsequently, the design change was inappropriately canceled. The licensee reinitiated a work order to repair the seat leakage on valve 3-FCV-074-0046 at the earliest opportunity, which was consistent with the guidance in Generic Letter 91-18, Information to Licensees Regarding NRC Inspection Manual Section on Resolution of Degraded and Nonconforming Conditions, Revision 1.

c. Conclusions

Although the general material condition of the Unit 3 LPCI system was good, the inspectors found a normally open valve in the closed position to compensate for another leaking valve, without supporting documentation, due to poor work coordination.

O8 Miscellaneous Operations Issues (92901)

O8.1 (Closed) Licensee Event Report (LER) 50-296/1999-001-000: Unit 3 High Pressure Coolant Injection (HPCI) Inoperable as a Result of an Oil Leak on the Stop Valve. This event was discussed in Section M1.2 of NRC Inspection Report 50-259,260,296/98-09. The oil leak was a result of an overload failure of one of the four stud bolts which attach the pilot relay valve to the stop valve cylinder. The stud bolt, and one other installed on the valve, were subsequently determined to be fabricated from improper material which has been in place since the original installation. Additionally, the licensee later observed that the subject valve opened erratically during system startup. This may have contributed to the overload failure of the stud bolt. The licensee attributed the erratic movement of the valve to an out-of-adjustment valve steam balance chamber pressure. This was a known industry problem associated with the HPCI stop valve and was the subject of General Electric Service Information Letter 352. The licensee is continuing to address the stop valve erratic movement. The inspectors verified that the stud bolts on the Unit 2 HPCI system stop valve were also replaced.

O8.2 (Closed) LER 50-260/1999-009-000: Manual Reactor Scram Due to an EHC Leak. This issue is documented in Section O1.2. Upon reviewing the LER, no additional issues were identified.

II. Maintenance

M1 Conduct of Maintenance

M1.1 Maintenance Observations

a. Inspection Scope (62707)

The inspectors observed portions of the following work orders (WO):

- WO 99-010352-000, Troubleshoot and Repair Temperature Switch 3-TS-73-2S
- WO 99-010130-000, Troubleshoot and Repair Unit 2 IRM H
- WO 98-015290-000, MOVAT Test and Rebuild Valve 3-FCV-023-46, Residual Heat Removal Heat Exchanger 3B Service Water Outlet Valve

b. Observations and Findings

Maintenance activities performed on September 22, 1999, in accordance with WO 99-010352-000 on temperature switches for the HPCI system were completed satisfactorily. Applicable procedures were available, were the correct revision, and were in use at the job site. The technicians were knowledgeable of the procedure requirements and test equipment used.

During the Unit 2 reactor startup of September 16, the inspectors observed good troubleshooting techniques by instrument mechanics on the Channel H IRM which had failed downscale (see Section O1.3). The instrument mechanics quickly discovered that

the signal pre-amplifier had failed and required replacement. Because the estimated time to replace the signal pre-amplifier was about 8 hours, attention was properly shifted to restoring the Channel B IRM to operable status in order to complete the reactor startup.

On September 30, 1999, during the rebuilding of valve 3-FCV-023-46, the inspectors noted that the majority of the valve operator gear box grease had a stiff consistency. The inspectors reviewed the maintenance history on the valve operator and found that the grease had been changed when the operator was upgraded to environmental qualification (EQ) status in 1995. The inspectors found that the current interval for checking grease quality on this valve was 5 years. The inspectors questioned whether the interval between the checks should be reviewed due to the condition of the grease found in valve 3-FCV-023-46, in view of the fact that the preventive maintenance (PM) interval had not yet been reached. The licensee initiated PER 99-011183-000 on October 8, 1999, to evaluate whether a different type of grease should be used for the application and to determine whether the PM interval needed to be revised.

c. Conclusions

Maintenance activities observed were conducted in a satisfactory manner and regulatory requirements were met.

M1.2 Surveillance Observation (61726)

The inspectors observed portions of surveillance procedure (SP) 3-SR-3.3.6.1.3(3D): HPCI Steam Line Space High Temperature Calibration, Revision 0A. The testing was conducted in a professional manner. The procedure was present at the work site, of the proper revision, and performed with the appropriate level-of-use. The inspectors verified that the procedure was performed within the specified TS-required frequency. The technicians were knowledgeable of the procedure requirements and test equipment used during the calibration.

M1.3 Standby Liquid Control (SLC) Surveillance Testing

a. Inspection Scope (61726)

The inspectors observed portions of Surveillance Instruction (SI) 2-SI-4.4.A.1, Standby Liquid Control Pump Functional Test, Revision 41.

b. Observations and Findings

On October 4, 1999, the inspectors observed operating personnel as they conducted flow testing of SLC pumps 2A and 2B in accordance with the above referenced SI. In general, the operators demonstrated care to ensure that the procedure was followed and each section was signed off in a timely manner to keep an accurate record of progress and completion. However, there were minor problems with the test. In Step 7.6.8, the procedure directed the operator to open the demineralized water supply valve and flush

the piping until approximately 22 gallons of water were used. Although, Step 7.6.8 was silent as to which valve to close in order to terminate the flush; the operators decided to close the supply valve, opened earlier in the step. This became a problem in Step 7.6.18, which expected a steady flow of water into the test tank. With the water supply valve shut, there was no water flow. As directed by the supervising senior reactor operator, the operator opened the water supply valve and proceeded with the test. The intent of the procedure was to leave the water supply valve open until Step 7.9, which returned the system to normal. This SI was designated to be "Continuous Use," meaning the procedure steps were to be followed as written. Failure to comply with of SI 2-SI-4.4.A.1 by inappropriately closing the water supply valve in Step 7.6.8 instead of Step 7.9 is a violation of TS 5.4.1.a. However, there was no impact on the outcome of the test, and the licensee entered this problem into the corrective action program under PER 99-010899-000. This failure constitutes a violation of minor significance and is not subject to formal enforcement action.

During the SLC pump 2A functional test, the operator throttled the SLC pump discharge pressure gauge isolation valve in order to obtain a readable pump discharge pressure, as permitted by Note (1) in Step 7.7. However, during the pump 2B run, the operator throttled the isolation valve for the discharge pressure transmitter, contrary to the procedure. While there were no safety consequences or adverse test results from throttling the transmitter isolation valve, the inspectors noted that the operator throttling the wrong valve was a second violation of the SI. The licensee entered this problem into the corrective action program under PER 99-011024-000. This failure constitutes a violation of minor significance and is not subject to formal enforcement action.

c. Conclusions

The operators performing the SLC pump functional test demonstrated poor attention to detail by shutting the water supply valve prematurely and by throttling the wrong instrument isolation valve.

III. Engineering

E2 Engineering Support of Facilities and Equipment

E2.1 Unit 3 Reactor Fuel Leak

a. Inspection Scope (37551)

The inspectors monitored the licensee's actions in response to a fuel cladding leak detected in Unit 3.

b. Observations and Findings

On October 1, 1999, the licensee noted indications of a potential fuel cladding leak, based on samples of the Unit 3 pre-treatment off-gas. PER 99-010892-000 was initiated. The leak appeared to be very small. The TS 3.4.6 limit for dose equivalent

iodine was 26 microcuries per milliliter (uC/ml), and the licensee's sample results were in the order of E-04, or less than one ten-thousandth of the limit. The licensee continued to monitor for leak degradation while developing a plan to address the leak.

From October 6 through October 10, the licensee conducted power suppression testing to determine the location of the leak in the core in accordance with Technical Instruction TI-307, Power Suppression Testing, Revision 5. The reactor operators performed this test with Reactor Engineering and Chemistry. Test results revealed leaks from possibly one or more twice-exposed GE 11 fuel pins, located near the center of the core, in the vicinity of Control Rods 30-31 and 30-35. Fully inserting these two control rods appeared to suppress the local power to the extent that the leak was minimized to a tolerable level such that the unit could continue full power operation to the scheduled refueling outage on April 16, 2000.

The test participants performed in a professional manner and methodically reached a sound conclusion as to the location and severity of the fuel leak. Good reactivity management practices were observed by the inspectors. The inspector reviewed completed test documentation and found it to be well-organized and legible.

c. Conclusions

The licensee's operators, engineers, and chemists performed power suppression testing and analysis of detected fuel leaks in a professional manner, and obtained sound results.

IV. Plant Support

R8 Miscellaneous Radiological Protection and Chemistry Issues (92904)

R8.1 (Closed) LER 50-296/1999-005-000: Surveillance Requirement for Standby Liquid Control Sampling Was Not Met. On September 30, 1999, the licensee submitted this LER describing an August 9, 1999, failure to verify the sodium pentaborate enrichment of the Unit 3 SLC system tank within the 24-hour period following chemical addition, as required by TS. After adding chemicals on August 9, it was not until September 1 that the licensee discovered this condition. The inspectors discussed the incident with plant staff and management. The licensee determined that the root cause was a deficient procedure for chemical addition to the SLC tank. The inspectors noted that additional factors contributed to the cause of the failure, such as procedural compliance. Procedural compliance issues were also addressed by the Chemistry Department in the corrective action plan for PER 99-009422-000. Upon performance of the required verification and sample analysis, the licensee determined that the sodium pentaborate enrichment met established limits.

The licensee's failure to perform TS Surveillance Requirement (SR) 3.1.7.9, which was to verify that the sodium pentaborate enrichment was within the limits established by TS SR 3.1.7.5 within the 24-hour surveillance time interval, is considered a missed surveillance. This failure also exceeded the allowed surveillance extension of 6 hours, and the TS 3.1.7 action statement of 8 hours, placing the unit in a condition prohibited by

TS. This Severity Level IV violation is being treated as a non-cited violation (NCV), 50-296/99-06-01, Failure to Perform SLC Surveillance Requirement, consistent with Appendix C of the NRC Enforcement Policy. The violation was entered into the licensee's corrective action program as PER 99-009422-000.

S1 Conduct of Security and Safeguards Activities

S1.1 Security Officer Performance

a. Inspection Scope (71750)

Throughout the inspection period, the inspectors observed security officers as they performed their functions at the West Gate, in the Protected Area, and at the Central Alarm Station.

b. Observations and Findings

In general, security officers were attentive to their posts, cognizant of their surroundings, and prepared to act if called upon. For example, on September 20, 1999, at the West Gate, the inspectors observed two licensee employees attempting to gain access into the protected area. After clearing the card reader, the first individual appropriately proceeded through the turnstile. However, the second employee, while in the same lane, proceeded past the "red line" (located approximately 10 feet in front of the turnstile), before the first individual had cleared the turnstile, contrary to the signs posted at the "red line." The inspectors heard the protected area turnstiles promptly lock and observed a security officer physically verify that each of the turnstiles was locked. The "red line" was installed by Security as an extra barrier to help prevent unauthorized entry into the Protected Area. The licensee indicated that the involved individuals were appropriately counseled concerning proper protected area access. The inspectors concluded through observation and discussion with the licensee, that all actions taken by Security were timely, appropriate, and consistent with site procedures.

c. Conclusions

The licensee's security officers were attentive to their posts and demonstrated alertness when they locked the West Gate turnstiles as a licensee employee prematurely crossed the "red line," thus preventing concurrent access through a turnstile that controlled access to the protected area.

V. Management Meetings

X1 Exit Meeting Summary

The resident inspectors presented inspection findings and results to licensee management on October 22, 1999. The licensee acknowledged the findings presented. The license did not identify any of the materials reviewed during this inspection as proprietary.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

T. Abney, Licensing Manager
A. Bhatnagar, Site Support Manager
R. Coleman, Radiological Control Manager
J. Corey, Radiation Protection and Chemistry Manager
J. Grafton, Site Quality Assurance Manager
J. Herron, Interim Site Vice President
R. Jones, Plant Manager
R. LeCroy, Site Security Manager
R. Rogers, Maintenance Superintendent
G. Little, Operations Manager
R. Moll, System Engineering Manager
W. Nurnberger, Chemistry Superintendent
D. Olive, Operations Superintendent
D. Sanchez, Training Manager
J. Schlessel, Maintenance Manager
J. Shaw, Design Engineering Manager
R. Wiggall, Site Engineering Manager

INSPECTION PROCEDURES USED

IP 37551	Engineering
IP 61726	Surveillance Observations
IP 62707	Maintenance Observations
IP 71707	Plant Operations
IP 71750	Plant Support Activities
IP 92901	Followup - Plant Operations
IP 92904	Followup - Plant Support

ITEMS OPENED AND CLOSED

Opened and Closed

50-296/99-06-01	NCV	Failure to Perform SLC Surveillance Requirement (Section R8.1).

Closed

50-296/1999-001-000	LER	Unit 3 HPCI Inoperable as a Result of an Oil Leak on the Stop Valve (Section O8.1).
50-260/1999-009-000	LER	Manual Reactor Scram Due to an EHC Leak (Section O8.2).

50-296/1999-005-000	LER	Surveillance Requirement for Standby Liquid Control Sampling Was Not Met (Section R8.1).