UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA ST., N.W., SUITE 3100
ATLANTA, GEORGIA 30303

Report Nos. 50-259/79-16, 50-260/79-16, and 50-296/79-16

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

Facility Name: Browns Ferry Nuclear Plant

Docket Nos. 50-259, 50-260, and 50-296

License Nos: DPR-33, DPR-52, and DPR-68

Inspection at Browns Ferry Nuclear Plant Site near Athens, Alabama

Inspector: C. Julian — 6/18/79
C. Julian — Date Signed

Approved by: [signature] — 6-28-79
R. D. Martin, Section Chief, RONS Branch — Date Signed

SUMMARY

Inspection on May 30 - June 1, 1979

Areas Inspected

This special, unannounced inspection involved 23 inspector-hours onsite in the areas of review of the short period events occuring during reactor startups during the period 5/26-29/79.

Results

Of the areas inspected, one apparent item of noncompliance was found.

DETAILS

1. Persons Contacted

Licensee Employees

*J. G. Dewease, Plant Superintendent
*H. L. Abercrombie, Assistant Plant Superintendent
*R. G. Metke, Results Section Supervisor
*J. B. Studdard, Operations Supervisor
*J. L. Harness, QA Supervisor
R. Hunkerpillar, Assistant Operations Supervisor
*J. L. Lewis, Acting Reactor Engineer
B. E. Baggett, Shift Engineer
A. Abercrombie, Shift Engineer
R. Erickson, Nuclear Engineer

NRC Resident Inspector

*R. F. Sullivan

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on June 1, 1979 with those persons indicated in Paragraph 1 above. The inspector discussed the item of noncompliance described in Paragraph 7 below. Licensee representatives acknowledged the finding. The inspector stated his concerns described in Paragraph 6 over the lack of administrative control of rod-withdrawal sequences and stated that the items would be unresolved pending the inspectors review of the alarm typer data for the startup of 5/20/79. Licensee representatives stated that they felt the item was not noncompliance and stated they would provide the alarm typer data. The inspector discussed with the licensee representatives the open items discussed in paragraphs 6 and 8. These will be reviewed during a later inspection.

3. Licensee Action on Previous Inspection Findings

Not inspected.

4. Unresolved Items

Unresolved items are matters about which more information is required to determine whether they are acceptable or may involve noncompliance or deviations. New unresolved items identified during this inspection are discussed in Paragraph 6.

5. Summary of Short Period Startup Events

Through review of various logs and records and discussions with various licensee employees and the NRC resident inspector, the following sequence of events was determined to have occurred at the Browns Ferry Unit 2 between 5/26 and 5/29/1979.

1. On 5/26/79 at 1928 hours during a startup of Unit 2 a scram occurred due to high flux on the intermediate range nuclear instrumentation (IRM). The high flux scram was caused by a rapid power spike beginning in the source range resulting from a substantial positive reactivity addition caused by the continuous movement of control rod 26-27 three notches from position 02 to position 08. The resulting positive reactor period was estimated by the licensee to be approximately 5.5 seconds and the corresponding positive reactivity insertion was estimated to be approximately 0.287% delta K/K.

   The actual cause of the sudden three notch withdrawal has not been determined but two probable explanations exist. Operator error was considered as just before the scram the control room lighting was interrupted due to a shift in power source. It was postulated that during this distraction the operator could have mistakenly used notch override to withdraw the rod 3 notches. The inspector interviewed the operator who stated he did not think this was the case. The operator stated that he was withdrawing the rod a notch at a time as prescribed by the control rod withdrawal sequence and that the 3 notch withdrawal occurred as he was attempting to go from position 02 to 04. He further stated that when he saw the sudden rise on the source range monitor (SRM) nuclear instrumentation he placed the rod control switches in "insert" and "emergency in" positions to try to avoid the scram.

   A second postulated cause of the 3 notch withdrawal is a mechanical failure of the control rod drive mechanism allowing it to drive three notches when only one was demanded electrically. This was thought to be caused by a higher than normal control rod drive hydraulic pressure existing at the time of this occurrance. The CRD pressure was intentionally adjusted higher than normal to aid in the initial movement of the rods from their full inserted position. The inspector determined through discussions with several licensee employees that it is common practice at Browns Ferry to adjust the CRD pressure greater than the 250 psi normal value during cold plant startups. This is said to be nccessary to allow some of the rods to move the first notch from fully inserted. After the first notch movement, all rods will perform normally with a CRD pressure of 250 psi. On 5/27/79 at 0105 a test was performed to try to repeat a triple notch movement of rod 26-27. With all other rods inserted the rod was repeatedly withdrawn with the CRD pressure adjusted higher than normal. On three occasions, the rod was observed to move 2 successive notches but the postulated three notch withdrawal step did not occur.

2. After management review the reactor was restarted on 5/27 achieving criticality on notch 06 of rod 26-27 with a 43 second positive period. At 0327 the reactor was taken subcritical to repair a malfunctioning turbine bypass valve.

3. At 0906 on 5/27 the reactor was again being taken critical by withdrawing rod 26-27, when withdrawal of one notch from position 06 to 08 resulted in another short period and abrupt power rise. Instrumentation indicated the period to be of the order of 9 seconds but with later review the licensee estimated the period to be about 15.5 seconds. The operator was able to avert a scram by rapid rod insertion. The reactor was maintained subcritical while management reviewed the situation.

4. It was decided to reverse the order of withdrawal of the group 3 control rods in the rod withdrawal sequence, pulling the less reactive peripheral rods of group 3 first. In the original rod withdrawal sequence, rod 26-27 was the first group-3 rod to be withdrawn and was anticipated to be of high reactivity worth due to its central core location. The reactor was again taken critical using the modified sequence on notch 18 of rod 18-51, the ninth rod of group 3, with a 53.8 second positive period. The reactor remained in operation until 2214 on 5/28 when it scrammed due to high flux on the IRM channels. The high flux was caused by positive reactivity resulting from the injection of cooler feedwater due to a malfunction of the reactor feedwater system.

5. At 0200 on 5/28/79 the reactor was again taken critical using the modified withdrawal sequence. Criticality was achieved on notch 08 of rod 18-35 with a positive period of 88 seconds. It remained in operation until 0623 of 5/29 when another scram occured due to low reactor water level. Difficulties occurred in controlling feedwater flow.

6. At 0910 on 5/29 another reactor startup was undertaken but the original rod withdrawal sequence, withdrawing the high worth rods first in group 3, was inadvertantly used. The reactor obtained criticality on notch 12 of rod 34-35, the second rod of group 3.

   During heatup, while moving rod 34-35 from notch 10 to 12 an abnormally large reactivity insertion resulted in an observed positive period of approximately 20 seconds. After review of all data the licensee estimated the period averaged 28.9 seconds. The reactor was then made subcritical by the insertion of ten control rods. In subsequent discussion with NRC resident inspector the on-duty Unit-2 shift engineer stated that he was provided the original high worth rod withdrawal sequence by a nuclear engineer who had just come on duty. He further stated that he did not verify that the sequence was the correct one because he was not fully aware of the recent short period occurrences.

7. The reactor was restarted at 1233 on 5/29 with the modified withdrawal sequence. A controllable reactivity insertion resulted.

6. Log and Record Review

This sequence of events was verified by the inspector by review of the Shift Engineer's log, Assistant Shift Engineer's log, Unit Operator's log and the Nuclear Engineer's log for the dates of 5/26-30/79. The inspector reviewed all available completed copies of Data Sheet 4.3.B.1.a - B, the "Sequence B1-No. 1" rod withdrawal sequence for the time period of interest. This is the form which the Nuclear Engineer prepares for the Shift Engineer to specify the control rod withdrawal sequence. The Shift Engineer signs this form noting its receipt as required by step II.B.2 "Cold Startup" of general operating instruction BF-GOI-100-1. The performing operator times, dates and initials each step as completed.

The inspector reviewed all available printout from the process computer alarm typer for the time period of interest. The alarm typer records the time of each control rod movement as sensed by the rod position information system.

In comparing the alarm typer with the completed rod sequence data sheets, some discrepancies were noted. Two instances were found for 5/27 in which data sheets were completed for inserting two rods to take the reactor subcritical for a period but no sheets were completed for withdrawal of the same rods later to return to criticality.

The alarm typer data for 5/26/79 states that the order of pull of two group 2 rods (46-39 and 46-23) was reversed during the startup. The data sheet 4.3.B.1.a-B, the rod withdrawal sequence, for that date however has time entries made sequentially, thus failing to reflect the reversal of pull order.

The alarm typer data showed two instances, on 5/26 and 5/27, where an out of sequence group 4 rod was selected and withdrawn to position 4 and then reinserted. These moves were not documented on the rod withdrawal sequence form. The alarm data for 5/26/79 from 1925 hours through time of the reactor trip on IRM high level were not found in the file, and the licensee was not able to locate the data. The inspector stated this item would remain unresolved until the missing data could be reviewed (Unresolved Item 79-13-06).

On 5/30/79 the inspector was shown a revised copy of the B-1, No. 1 rod withdrawal sequence which called for withdrawing the outermost rods of each rod group first. The licensee representative stated that this revised sequence would be the one used in the future to minimize high worth rods. The inspector noted that the new form had no revision number or revision date and thus could be easily confused with the original sequence which resulted in the short period events. After discussion the licensee representatives stated that all preprepared rod withdrawal sequence forms will be clearly identified in the future (Open Item 79-13-01).

The inspector discussed the status of the rod withdrawal sequence with several licensee representatives. Procedure BF-GOI-100-1 calls for the nuclear engineer to provide a control rod withdrawal sequence to the shift engineer prior to startup. These short period events have demonstrated that the sequence is an important document to startup safety, and thus, it appears it should be reviewed and approved as required by Technical Specification 6.3.A.1. The inspector stated that there does not appear to be adequate document control as to revision and approval of preprepared sequences, control and preservation of completed sheets as a complete record of an evolution important to reactor safety, and that no criteria are specified as to the delegated authority to make "on-the-spot" changes or for deviation from the sequence provided. The sheets are signed bythe Nuclear Engineer when provided and signed by the shift engineer noting receipt but not treated as a reviewed and approved procedure. Administrative controls should exist to provide proper control of this document.

The inspector stated that this item would be unresolved until reviewed with NRC Region II management (Unresolved Item 79-13-02).

7. Improper Shift Turnover

As described above, on 5/29/79 the reactor was started up with a rod withdrawal sequence that had been superceded two days previous. The use of this sequence had very high potential for the repetition of the short period events of 5/26 and 5/27. The cause of the use of an improper rod withdrawal sequence was improper shift turnover. The Nuclear Engineer who provided the incorrect sequence had not taken proper action to become aware of the short period events of previous days. The Shift Engineer who authorized use of the improper sequence also was not aware of the previous short period events.

Reviewed and approved procedure BF 12.7 specifies that oncoming operating personnel will "acquaint themselves with plant conditions with special emphasis on abnormal or unusual conditions. . . . and review journal entries back to the persons last shift or back five days". Oncoming personnel other than operators are required to acquaint themselves with abnormal or unusual conditions, and "acquaint themselves with instructions from their supervisor or shift engineer."

The inspector stated that failure to follow this procedure is an item of noncompliance (79-13-03).

8. Open Items for Future Review

The inspector discussed with licensee representatives the causes and possible methods to prevent "double notching" of control rods. The licensee stated that this matter would be investigated and corrective action taken to prevent future double notching of control rods. (Open Item 79-13-04). The inspector stated that actions taken will be reviewed at a later inspection.

Licensee representatives stated that the short period event of 5/26/79 will be reported to the NRC as a Licensee Event Report. The inspector stated that corrective action taken to prevent recurrence will be reviewed at a later inspection (Open Item 79-13-05).