



UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

Report Nos.: 50-259/89-18, 50-260/89-18, and 50-296/89-18

Licensee: Tennessee Valley Authority
6N 38A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

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

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

Facility Name: Browns Ferry Units 1, 2, and 3

Inspection at Browns Ferry Site near Decatur, Alabama

Inspection Conducted: February 10 - May 22, 1989; June 12-14, 1989

Inspector: *[Signature]*
D. R. Carpenter, NRC Site Manager

7/13/89
Date Signed

Accompanied by: K. Ivey, Resident Inspector
A. Long, Project Engineer

Approved by: *[Signature]*
W. S. Little, Section Chief
Inspection Programs,
TVA Projects Division

7/13/89
Date Signed

SUMMARY

Scope:

This special reactive inspection was performed to follow-up on the findings identified in NRC Inspection Report (IR) 89-04 and to review and evaluate the licensee's response to those findings.

Results:

As a result of this inspection, three violations were identified

260/89-18-01: Failure to Comply with 10 CFR 50.59 (paragraph 2).

260/89-18-02: Inadequate refueling procedures (paragraph 4).

259, 260, 296/89-18-04: Failure to provide cross disciplinary review (paragraph 7).

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The inspection verified weaknesses in the areas of fuel loading procedures and operations, and programs for preparation, review and approval of procedures.

An unresolved item on the adequacy of station and administrative procedures was identified.



REPORT DETAILS

1. Persons Contacted

Licensee Employees:

- O. Kingsley, Jr., Senior Vice President, Nuclear Power
- C. Fox, Jr., Vice President and Nuclear Technical Director
- J. Bynum, Vice President, Nuclear Power Production
- *O. Zeringue, Site Director
- *G. Campbell, Plant Manager
- J. Hutton, Operations Superintendent
- *D. Mims, Technical Services Supervisor
- J. Lewis, Reactor Engineering
- *P. Carier, Site Licensing Manager
- J. Savage, Compliance Supervisor
- T. Bradish, Plant Reporting Section
- *N. McFall, Compliance Engineer
- *S. Rudge, Site Programs Engineer
- *P. Salas, Licensing Engineer

*Attended exit interview

Other licensee employees or contractors contacted included licensed reactor operators, compliance and engineering personnel.

NRC Resident Inspectors:

- *D. Carpenter, Site Director
- *C. Patterson, Restart Coordinator
- *W. Bearden, Resident Inspector
- *E. Christnot, Resident Inspector
- *K. Ivey, Resident Inspector

NRC Personnel:

- *B. Wilson, Assistant Director for Inspection Programs
- *W. Little, Section Chief
- A. Long, Project Inspector

Acronyms used throughout this report are listed in the last paragraph.

2. Unreviewed Safety Question Determination

NRC Inspection Report (IR) 260/89-04 concluded that the loading of 74 fuel assemblies into the Unit 2 core without adequate core monitoring constituted a potential unreviewed safety question (USQ), as defined by 10 CFR Part 50.59.

The licensee's response to IR 89-04, issued March 1, 1989, stated that the unmonitored core loading did not constitute a USQ, in that the probability or consequences of an accident were not increased, and no margin of safety was reduced. This was based on TVA's determination, after reloading was

stopped that an inadvertent criticality was not a credible event due to core design and interlocks and rod blocks which prevented control rod withdrawal. As documented in paragraph 3, the NRC confirmed that the interlocks and rod blocks were operable.

The NRC has reviewed TVA's position and still concludes that the unmonitored core loading did constitute a USQ, in that the margin of safety as defined in the TS Bases was decreased. The Basis for TS 3.10.A clearly states that during core alterations the margin of safety is provided by both refueling interlocks and operational procedures. For the reasons documented in paragraph 4 of this report, the procedures controlling refueling were inadequate. Based on TVA's evaluation after refueling was stopped the NRC agrees that the reduction in safety margin was slight and this will be considered in determining the severity level of the violation.

Another reason that the reload scheme should have been considered an unreviewed safety question is that the analyses on which TS 3.10.B.1.b.2 is based do not bound the Cycle 6 reload conditions. A review of the NRC safety evaluation for the TS dated October 11, 1979, and the bases for TS 3.10.B.1.b.2 should have led TVA to this conclusion. Pertinent statements in these documents include:

- o " . . . especially during core loading, it is necessary to monitor flux levels. In this manner, there is reasonable assurance that any approach to criticality would be detected. . . ." (NRC Safety Evaluation for TS 3.10.B.1.b.2)
- o The NRC Safety Evaluation was based on reload following a normal refueling outage. (Reloading with reconstituted fuel after a four year outage is not normal.)
- o The basis for TS 3.10.B.1.b.2 states that, "A large number of fuel assemblies will not be required to maintain three counts per second." (TVA knew that the cycle 6 reload scheme would require >200 assemblies to be loaded before 3 cps would be reached.)
- o "The minimum count rate requirement in the Technical Specifications accomplishes three safety functions: (3) it provides assurance that the SRM detectors are close enough to the array of fuel assemblies to monitor core flux levels." (NRC Safety Evaluation for TS 3.10.B.1.b.2).
- o The NRC Safety Evaluation assumed that with a SRM about two feet away from 16 or more fuel assemblies that the loss in sensitivity would be at most one decade. TVA conservatively estimated that the sensitivity loss would be at least two decades per foot between the core and the detector. The NRC analysis assumed the SRMs were much more sensitive than actually appeared to be the case.



TVA's response to IR 89-04 indicated that since the TS LCO is written such that the limit is less than a specified value, then they are relieved of the responsibility for determining an acceptable operational limit needed to accomplish the TS objective, which in this case was core monitoring, and that any SRM count rate below three was acceptable, even zero. This is not an acceptable practice.

It is concluded that a violation of 10 CFR 50.59 did occur in that TVA chose to use a core loading scheme that was not bounded by previous evaluations, and the procedures for the core reload scheme were not adequate. This resulted in a reduction of the margin of safety described in the basis for TS 3.10. This was not identified by TVA, a written safety evaluation was not prepared, and the NRC was not notified as required by 10 CFR 50.59. Violation 89-04-01 is closed and this issue is identified as Violation 260/89-18-01.

3. Operability of Refueling Interlocks

Based on discussions with licensee personnel and reviews of documentation, the inspector determined that the SRM downscale rod block function was operable, as required during the Unit 2 core reload, and no control rods could have been manually withdrawn with SRM readings of less than 3 cps.

The SRMs provide signals to the Reactor Manual Control System (RMCS) for various control rod blocks, including a downscale rod withdrawal block. TS 3.2.C., "Control Rod Block Actuation", and associated Table 3.2.C, provide the limiting conditions for operation for the instrumentation that initiates rod blocks. This TS requires a SRM downscale rod block with a trip level setting of greater than or equal to 3 cps. A minimum of three channels are required to be operable. This function is to be in place at all times except the following:

- SRMs A and C downscale functions are bypassed when IRMs A, C, E, and G are above range 2. SRMs B and D downscale functions are bypassed when IRMs B, D, F, and H are above range 2.
- The function is bypassed when the mode switch is placed in RUN.

The system readiness review, and the surveillance instruction (SI) which verified the operability of this function were performed prior to beginning fuel loading. Surveillance test, 2-SI-4.2.C-4 (A-D), "Instrumentation that Initiates Rod Blocks/Scrams SRM Calibration and Functional Test," was performed for channel A on December 14, 1988; Channel B on December 16, 1988; Channel C on December 13, 1988, and Channel D on December 15, 1988.

No violations or deviations were identified.



4. Refueling Procedures

The refueling activities that began on January 3, 1989 were controlled by the following procedures:

TI-147, Rev. 3, December 16, 1988, "Fuel Loading After a Complete Core Unload"

2-GOI-100-3, Rev. 4, December 22, 1988, "Refueling Operations"

TI-14, "Special Nuclear Material Control"

NQAM, Part II, Sec. 1.1, Paragraph 3.2.2 establishes requirements for the preparation, review and approval, use and revision of plant operating instructions including fuel-handling instructions for refueling operations. Among other things the following are required to be included in the fuel-handling instructions:

3.2.2.2 "They provide for continuous monitoring of the neutron flux throughout core loading,"

3.2.2.3 "..... specific instructions shall be prepared for each refueling"

General requirements for all instructions states in paragraph 3.1.2.6 that "Limitations on the parameters being controlled shall be specified."

Based on the above TVA requirements the refueling procedures were deficient as follows:

- o None of the above refueling procedures required continuous monitoring of the neutron flux throughout core loading.
- o The refueling procedures appear to be written to try to cover all fuel loading schemes allowed by TS 3.10.B resulting in Sections 3.37 and 5.4 of 2-GOI-100-3; and Section 4.0 of TI-147 being confusing and sometimes inconsistent and conflicting. Specific instructions for the fuel loading scheme used (TS 3.10.B.1.b.2) were not provided and the refueling procedures need to be revised to address each of the schemes allowed by the TS in order to require adequate core neutron monitoring.
- o The procedure did not address specific limits or values for the minimum count rate to be expected for the SRMs (FLCs), throughout the core loading scheme selected, in order to ensure continuous monitoring of the neutron flux.

The NRC reviewed 2-GOI-100-3 and TI-147 and the following concerns and deficiencies were identified (additional concerns are identified in IR 260/89-04):

- o TI-147 did not reference NQAM, Part II, Section 1.1 and TS 3.10.A which establish requirements for fuel loading procedures.

- TI-147, Section 4.2 was not consistent with 2-GOI-100-3, Section 3.37 even though both specified criteria for halting fuel loading.
- TI-147, Section 4.2 allows fuel loading to be resumed after being stopped for the specified reasons, provided the "specific corrective action has been taken." Specific corrective action is not identified in any of the procedures, and the process, including approvals, for resuming refuel is not addressed in any of the procedures.
- TS 3.10.B requires that only two SRMs shall be operable. If only two are operable and if the two readings doubled, both TI-147, Section 4.2.8 and 2-GOI-100-3, Section 5.4 would allow refueling to continue. This is not considered to be prudent action.
- Sections 3.37 and 5.4 of 2-GOI-100-3 state that refueling shall be halted for any of the eleven reasons stated therein. One of the reasons (3.37.1) is "Unexpected subcritical multiplication (i.e., any unexplained or abnormal increase in SRM readings)." None of the procedures gave any guidance as to what could be expected for the loading scheme used, especially if the count rates were < 3cps. With the scheme used and with the SRM's one to two feet away from the fuel, the operators needed guidance as to what constituted expected or unexpected behavior of the SRMs. It is not clear what step 3.37.3 means. It appears that the "Note" is meant to modify 3.37.3, but this needs to be clearly stated so that the user of the procedure does not have to assume this is the case.

The failure to establish and implement adequate refueling procedures in accordance with TS 6.8.1.1.a and NQAM, Part 2, Section 1.1 is a violation. (VOI 260/89-18-02). The NRC is concerned that these procedures had been processed through the Procedures Upgrade Program and through screening and cross-disciplinary reviews. In response to URI 260/89-18-03 (paragraphs 5 and 8) TVA is requested to address why they believe that these reviews apparently failed and why they have confidence that the Procedure Upgrade Program has corrected the procedure problems that have existed for several years.

5. Screening Reviews of Fuel Load Procedures

Inspection Report 89-04 stated that procedures issued for the Unit 2 fuel loading did not receive adequate screening reviews in accordance with SDSP 27.1, "Evaluation of Changes, Tests, and Experiments - Unreviewed Safety Question Determination." IR 89-04 further stated that the lack of resulting safety evaluations contributed to the unmonitored core loading event. The reviewed procedures included 2-GOI-100-3, "Refueling Operations," revisions 0 through 4, TI-147, "Fuel Loading After a Complete Core Unloading," revisions 0 through 3, and MRTI, "Master Refueling Test Instruction," revisions 1 through 4.

The licensee's response admitted that administrative deficiencies existed in the documentation of the screening reviews; however, it stated that a failure to implement the technical intent of SDSP 27.1 did not occur. The response indicated that the screening reviews addressed only changes made to the procedure and not the entire procedure. The licensee concluded that the reviews were proper and the conclusions were correct.

The NRC inspectors re-reviewed the screening reviews performed for the procedure revisions referenced in IR 89-04 to determine if they had been completed in accordance with SDSP 27.1. The reviewed procedures included 2-GOI-100-3, "Refueling Operations," Revision 0 through 4; TI-147, "Fuel Loading After a Complete Core Unloading," Revision 0 through 3; and MRTI, "Master Refueling Test Instruction," Revisions 1 through 4.

The NRC inspectors determined that the procedure changes incorporated by the revisions which were reviewed for IR 89-04 were format, administrative, and clarification related changes, and did not affect the technical aspects of the procedures in a manner to require a safety evaluation. There were many administrative errors identified with the preparation of screening reviews, however none affected the determinations made from the reviews.

The review performed for 2-GOI-100-3, Revision 0, was documented as the required two-year technical review. From the procedure deficiencies identified in paragraph 4 of this report it is evident that the core loading procedure had not received a thorough, accurate technical review. It appears that the Procedures Upgrade Program did not result in a thorough technical review of the refueling procedures. Many procedure deficiencies have been identified in the past six months, bringing into question the adequacy of the Procedure Upgrade Program. This will be pursued further as Unresolved Item 260/89-18-03, Adequacy of Procedures.

One of the purposes of SDSP 27.1 was to describe the method of performing screening reviews to determine if a safety evaluation is required. Part of SDSP 27.1 is Form SDSP-147, "Screening Review Form for Documenting Applicability of a Safety Evaluation." This form is inadequate in that it does not require answering one of the questions specified in 10 CFR 50.59(a)(2): is the margin of safety as defined in the basis for any technical specification reduced?

TVA initiated Condition Adverse to Quality Report (CAQR) No. BFA890175902 on February 22, 1989 as a result of a licensee audit (No. SSA89902). This audit identified numerous screening reviews which were completed with insufficient documentation supporting the determination that no safety evaluation was required. The audit evaluated 20 screening reviews to determine if they complied with requirements and concluded that 17 of the 20 screening reviews were deficient in one or more areas. Furthermore, the audit team concluded that required safety evaluations were not performed as a result of some of the errors. Similar inadequacies were also identified by the Independent Safety Engineering Group (ISEG) in their November 1988 monthly report.

Violation 259,260,296/89-04-02 is closed and the concern about the adequacy of the screening review process, will be pursued in the closeout of URI 260/89-18-03.

6. ~~Cross-Disciplinary Review of Fuel Load Procedures Impacting Plant Safety~~

Inspection Report 89-04 stated that the fuel load procedures issued for the Unit 2 core reload did not receive required cross-disciplinary or affected section reviews. The licensee's response stated that the procedure revisions primarily involved administrative changes, and that they had received appropriate cross-disciplinary/affected section reviews.

The requirements for the qualified technical review of procedures, including cross-disciplinary reviews, were outlined in SDSP 7.4, Onsite Technical Review and Approval of Procedures. The qualified technical reviewer determines whether the procedure is technically correct, adequate for performing the task involved, and in compliance with plant administrative requirements; and determines whether additional cross-disciplinary review is required. Step 4.4 required that cross-disciplinary reviews be performed whenever steps in a procedure may affect equipment under another group's direct control; whenever another group will be required to perform physical action, not included in previously approved instructions, to allow the performance of the procedure; and in cases where parts of the procedure are outside of the reviewer's expertise.

The licensee's response stated that only the changes to the procedures were reviewed. However, as part of the two-year review, the entire procedure should have been reviewed to address changes in the plant, requirements, FSAR, and TS, and assess whether the procedure was technically adequate to ensure that it could perform its intended purpose.

The following examples of the lack of cross-disciplinary review for refueling procedures as well as other procedures are identified:

- o 2-GOI-100-3, revision 2, added the following step:

5.20.34 When directed by the SOS, INSTALL all shorting links removed in accordance with Attachment 9, SRM RPS shorting links.

Even though revision 1 included a step for removal of the shorting links, no step was included for their reinstallation. Attachment 9 to the procedure provides a sign off for when the shorting links are installed; however, it does not include steps requiring installation of the shorting links. The addition of this step in revision 2 constituted a requirement for maintenance personnel to perform a physical action not included in a previously approved instruction. No review of the procedure revision was performed by maintenance personnel.

- o 2-GOI-100-3, revision 3, revised a "NOTE" between steps 4.17 and 4.18 to include more specific information for when two maintenance instructions (MMI-34 and EPI-0-079-CRA001) are to be performed and which specific steps of the procedures are to be performed.

The original note in revision 2 only required that the two procedures be performed weekly during fuel handling evolutions; however, the revised note in revision 3 stated that,

"MMI-34 and EPI-0-079-CRA001 shall be performed no more than 30 days before fuel handling evolutions. MMI-34, Part B and EPI-0-079-CRA001, Steps 7.2.1 through 7.2.6 and Steps 7.2.9 through 7.2.16, shall be performed weekly during fuel handling evolutions, additional sections/steps shall be performed weekly during fuel handling evolutions as designed by the maintenance supervisor."

The only review of this revision was performed by operations. The determination of specific steps to be performed in maintenance procedures appeared to be outside the reviewer's area of expertise and a maintenance review should have been performed as required by SDSP 7.4.

- o Operating Instruction 2-OI-74, Residual Heat Removal System Operating Instruction, Temporary Change (TC)-10, approved 9/19/88, incorporated steps to provide for lifting leads in the RHR system logic to allow the RHR pumps to be started with suction from the condensate system for flushing the RHR loops. Specifically, the revision added steps for maintenance personnel to install and remove jumpers; however, the procedure revision did not receive technical, cross-disciplinary, or affected section review by the maintenance organization as required by SDSP 7.4.

The failure to provide cross-disciplinary review of procedures in accordance with SDSP 7.4 is a violation of TS section 6.8.1.1.j which requires that administrative procedures for technical and cross-disciplinary reviews be implemented (VIO 259,260,296/89-18-04). Violation 259,260,296/89-04-03 is closed.

7. (Closed) Unresolved Item 259,260,296/89-04-04: Core Alteration Technical Specifications

Prior to 1979, Browns Ferry TS required a minimum detector count rate of 3 cps to ensure core monitoring during fuel loading. In the response to IR 89-04, TVA acknowledged that the safety evaluations submitted to the NRC for the 1979 and 1984 revisions to TS 3.10 were superficial and did not properly account for attenuation between the core and the detectors. Although the basis of TS 3.10 required monitoring to assure early detection of an inadvertent criticality, TS 3.10.B.1.b.2 and TS 3.10.B.1.b.3 were not supported by valid analyses to show that the SRMs would promptly detect such an event. NRC management has concluded that while the TS were not as prescriptive as might be desirable they did not relieve the licensee from the responsibility for monitoring the core neutron count rate throughout core loading. The technical specifications

are adequate, however they do require the licensee to evaluate and plan his refuel activities before hand.

TVA committed to develop and submit TS and FSAR changes to better ensure adequate core monitoring in the future. Also, a TS assessment was initiated to evaluate TS requirements against design bases and good operating practices, and ensure that all changes to the facility license are supported by valid analyses. Unresolved Item 259, 260, 296/89-04-04 is closed and this issue will be tracked as inspector followup item 259, 260, 296/89-18-06.

8. (Closed) Unresolved Item 259, 260, 296/89-04-05: Adequacy of the Procedure Review Process (PORC Review Responsibility)

Inspection Report 89-04 questioned the adequacy of the licensee's procedure review process including the responsibilities of the Plant Operations Review Committee (PORC) for procedure reviews. Technical Specification section 6.5.1.6 lists the activities for which the PORC is responsible and allows for PORC delegation of the performance of review activities; however, it requires that the PORC maintain cognizance of and responsibility for the reviews.

The licensee's response detailed the qualified technical reviewer process which was initiated as part of the delegation of the PORC procedure review activities, and indicated that the PORC instituted an oversight review of this process to maintain cognizance of the reviews. PORC's oversight included a review of 2-GOI-100-3, Rev. 0 on December 6, 1988.

The qualified technical reviewer process and the PORC oversight of this process appear to be in accordance with TS requirements and the licensee's approved procedures and, therefore, this item does not constitute a violation and is closed. The adequate implementation of the procedure review process will be assessed during the follow-up of VIO 260/89-18-01 and URI 260/89-18-03.

9. (Closed) Unresolved Item 260/89-04-06: Adequacy of the Licensee's Reportability Determination

Inspection Report 89-04 questioned the determination that the termination of fuel loading due to a lack of monitoring was not reportable per 10 CFR 50.72, 50.73, or plant implementing procedures. TVA submitted a voluntary reportable occurrence report, BFR0-50-260/89001, to the NRC on January 26, 1989, although the licensee's response restated the position that the event was not reportable. Even though loading fuel unmonitored placed the plant in an unanalyzed condition, the safety evaluation indicated that this condition did not significantly compromise plant safety, and the inspectors agree that this event is not reportable. This item is not a violation and is closed.

10. Exit Interview

The inspection scope and findings were summarized on June 30, 1989, with those person's indicated in paragraph 1 above. The inspectors described in detail the inspection findings listed below. The licensee did not identify as proprietary any of the material provided to or reviewed by the inspectors during this inspection. Dissenting comments were not received from the licensee.

<u>Item Number</u>	
260/89-18-01	Violation - Failure to meet the requirements of 10 CFR 50.59, paragraph 2.
260/89-18-02	Violation - Inadequate refueling procedures, paragraph 4.
260/89-18-03	URI - Adequacy of procedures, paragraphs 4, 5 and 8.
260/89-18-04	Violation - Failure to provide cross-disciplinary review, paragraph 6.

11. Acronyms

BFNP	Browns Ferry Nuclear Plant
CAQR	Condition Adverse to Quality Report
FSAR	Final Safety Analysis Report
GE	General Electric
GOI	General Operating Instruction
IR	Inspection Report
ISEG	Independent Safety Engineering Group
LER	Licensee Event Report
MMI	Mechanical Maintenance Instruction
MRTI	Master Refueling Test Instruction
NOV	Notice of Violation
NPP	Nuclear Performance Plan
NRC	Nuclear Regulatory Commission
NRR	Nuclear Reactor Regulation
OI	Operating Instruction
PMI	Plant Manager Instruction
PORC	Plant Operations Review Committee
QA	Quality Assurance
RHR	Residual Heat Removal
RPS	Reactor Protection System
SDSP	Site Director Standard Practice
SER	Safety Evaluation Report
SI	Surveillance Instruction
SIL	Service Information Letter
SOS	Shift Operating Supervisor
SRM	Source Range Monitor



TACF	Temporary Alteration Change Form
TC	Temporary Change
TS	Technical Specifications
TVA	Tennessee Valley Authority
VIO	Violation
URI	Unresolved Item
USQ	Unreviewed Safety Question
USQD	Unreviewed Safety Question Determination

