



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

Report Nos.: 50-259/85-41, 50-260/85-41, and 50-296/85-41

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: August 12-16, 1985

Inspector: W. C. Liu
 W. C. Liu

9/19/85
 Date Signed

Approved by: J. J. Blake
 For J. J. Blake, Section Chief
 Engineering Branch
 Division of Reactor Safety

9/19/85
 Date Signed

SUMMARY

Scope: This routine, unannounced inspection involved 34 inspector-hours on site in the areas of safety-related cable tray supports, mechanical maintenance associated with safety-related pipe support and restraint systems resulting from the torus modifications, and pipe support baseplate designs using concrete expansion anchor bolts (IE Bulletin 79-02).

Results: Two violations were identified - Inadequate design controls for safety-related cable tray supports, paragraph 5.b.; Inadequate corrective actions for safety-related cable tray systems, paragraph 5.c.

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REPORT DETAILS

1. Persons Contacted

Licensee Employees

- *R. Lewis, Plant Manager, BFNP
- *J. Swindell, Superintendent, Operations/Engineering
- *G. Hall, Design Service Manager
- *J. Marshall, Civil Design Project Engineer
- *E. Gaines, Section Supervisor, CEB
- *J. Carlson, Quality Assurance Supervisor
- *T. Cosby, Electrical Maintenance Supervisor
- *J. Traglia, Mechanical Modifications
- *J. Genung, Design Service
- *B. Morris, Compliance, BFNP
- *B. Caldwell, Civil Engineer, OE
- *B. Burke, Civil Engineer, OE
- *L. Coots, Compliance, BFNP

Other licensee employees contacted included engineers, technicians, and office personnel.

NRC Resident Inspectors

- *G. Paulk, Senior Resident Inspector
- *C. Patterson, Resident Inspector
- *C. Brook, Resident Inspector

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on August 16, 1985, with those persons indicated in paragraph 1 above. The inspector described the areas inspected and discussed in detail the inspection findings. No dissenting comments were received from the licensee.

(Open) Violation 259, 260, 296/85-41-01, Inadequate Design Controls for Safety-Related Cable Tray Supports, paragraph 5.b.

(Open) Violation 259, 260, 296/85-41-02, Inadequate Corrective Actions for Safety-Related Cable Tray Systems, paragraph 5.c.

(Open) Unresolved Item 259, 260, 296/85-41-03, Verification of Installed Concrete Anchor Bolts for Cable Tray Supports, paragraph 5.d.

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 are matters about which more information is required to determine whether they are acceptable or may involve violations or deviations. One new unresolved item identified during this inspection is discussed in paragraph 5.d.

5. Safety-Related Cable Tray Support Systems

a. Cable Tray Support Status

The inspector held discussions with licensee representatives with regard to the general status of cable tray support designs. The licensee provided the following information based on a preliminary estimate.

<u>Location</u>	<u>No. of Supports</u>	<u>Reference Drawing</u>
Control Bay Units 1, 2, and 3	400 ---	48N1040, 48N1041 48N1042, 48N1046
Reactor Building Units 1, 2, and 3	678	48N800 series 48N1100 series 48N1043
Diesel Generator Building Units 1, 2, and 3	124	48N897-10 48N897-11 48N897-12
Cable Tunnel Units 1, 2, and 3	135	18N217 18N218 18N219
Intake Pumping Station Units 1, 2, and 3	96	35N800 38N314, 38N315
Total number of supports for three units	<u>1500</u>	

b. Design Calculations Review

The inspector reviewed portions of the design calculations in the areas of control bay, reactor building, and diesel generator building. These design calculations with respect to the cable tray support systems were reviewed for conformance to analysis criteria, NRC requirements and the licensee commitments. Furthermore, these design calculations were evaluated for thoroughness, clarity, consistency, and accuracy. In



general, the calculations appeared to be inadequate in terms of using design input, assumptions, references, equations, and tables. During the review, the inspector identified the following discrepancies:

- (1) Cable tray supports in the control bay area were not seismically designed. As a result, these supports may not be able to serve their intended function during a seismic event.
- (2) Cable tray supports in the Diesel Generator Building were improperly designed in that the seismic loads used in the design calculations were obtained from the seismic analysis for the Reactor Building. The design calculations were performed in 1973. The Design Specification for seismic analysis for the Diesel Generator Building (DGB) was issued in February 1969. Therefore, the seismic information for the DGB was available and should have been used in the design calculation. In accordance with licensee's preliminary evaluation, the seismic loads obtained from the DGB were greater than that obtained from the Reactor Building. As a result, the existing cable tray supports were not adequately designed with respect to seismic requirements.
- (3) Cable tray support design calculations in the Reactor Building showed a lack of thoroughness, clarity, consistency, and accuracy. The following are examples of problems identified:
 - A design sketch shown on sheet B2 with an assumption that a support was located 4 ft. below the ceiling while the actual calculations were performed based on the support that was located 4'-9" below the ceiling. As a result, the moments and forces acting on the structural members were less conservatively calculated.
 - The seismic loads at elevation 593'-0 had been utilized in the design calculations. These seismic loads were smaller and less conservative when compared with the seismic loads at elevation 621'-3 that should have been used.
 - No weld calculations to determine the adequacy of the welds that were specified on the typical cable tray support drawings for which the structural members were welded to the baseplates.
 - The determination of the baseplate thickness was incomplete. The calculations shown on sheet A106 did not cover the determination of the baseplate thickness for a six bolt baseplate-alternate, an eight bolt baseplate-alternate, and a ten bolt baseplate-alternate cases. As a result, some of the baseplates might be inadequately designed.

The inspector noted that the aforementioned design calculations were used to qualify the typical cable tray supports that had actually been used in the installation.



- (4) Design verifications had not been implemented in an acceptable manner in that numerous design calculations which were utilized to qualify many typical cable tray supports, were either not checked or in some cases were not signed by the designer. The following were the few examples that were identified during the inspection:

<u>Location</u>	<u>Design Calculation</u>
Control Bay	Sheet numbers VI-10 thru VI-20 were not checked.
Reactor Building Battery Board	Sheet numbers VI-21 thru VI-47 were not checked.
Control Room Battery Rack	Sheet numbers VII-1 thru VII-5 were not signed by the designer and checker.
Reactor Building	Sheet numbers B1 thru B9; C1 thru C14 were not checked.

Paragraph 5.6 of the Browns Ferry Technical Specification requires that the station class I structures and systems be designed to withstand a design basis earthquake. The Browns Ferry Final Safety Analysis Report (FSAR) and the design drawings specify that cable trays, required for essential systems in the diesel generator building, the reactor building, and the control building, shall be adequately designed to meet class I seismic criteria requirements.

Discrepancies identified from the aforementioned paragraphs (1), (2), (3), and (4) indicate that portions of the cable tray supports had not been adequately designed and verified in accordance with the above licensee commitments and the NRC requirements. As a result, these cable tray supports may not be able to perform their intended function during a seismic event. This is a violation of 10 CFR 50, Appendix A, General Design Criteria 1 and 2, and is identified as Violation 259, 260, 296/85-41-01, Inadequate design controls for safety-related cable tray supports.

c. Corrective Action on Safety-Related Cable Tray Systems

On February 18, 1981, licensee representatives identified a nonconformance and initiated Corrective Action Report (CAR) No. 81-035 in accordance with Browns Ferry Standard Practice 10.3, Corrective Action Program. The nonconformance dealt with overfilled cable trays and cable penetrations in the cable spreading rooms. The root cause determination and corrective action associated with this nonconformance was delinquent and inadequate until the CAR was upgraded to a significant status on July 9, 1985. Initially the cause of the overload cable trays and penetrations was attributed to the immense modification program over the past years and the application of fire retardant coating (flamemastic). Various corrective actions were



initiated over the period from February, 1981 to July, 1985, none of which succeeded in correcting or evaluating the overloaded condition of the cable trays. These actions consisted of:

- (1) Forwarding the information to Engineering Design for resolution on March 10, 1981.
- (2) Initiation of a design change request in September, 1982 to install new cable trays and electrical penetrations to prevent the possibility of overflowing additional cable trays.
- (3) Revising drawings in October 1984 to include a note which requires the field to submit as constructed drawings so that cable tray fill status could be maintained.
- (4) Revising Modifications/Additions Instruction (MAI) 13, Control, Power and Signal Cables, to require verification that cable trays are not overloaded prior to adding new cables.

In June 1985, an in-depth study into the cable tray loading problem identified many deficiencies and a preliminary plan of attack was developed. Some of the significant deficiencies identified were as follows:

- All seismic loads were not considered in the design of supports.
- Many hold down clips which attach trays to support brackets have missing bolts.
- Cable and fire retardant coating plus miscellaneous junction boxes and conduit exceed the design weight of the cable tray.
- Cable ampacity ratings are questionable due to the excessive fire retardant coating.
- Relative motion capability of cables to trays is questionable since no slack exists (this is further aggravated by the rigid fire retardant coating).

The conclusion of the study was that the inspected cable trays cannot be seismically qualified for either interim or long-term operation without additional inspections and evaluations. In July 1985 an inspection plan and evaluation approach was developed for interim operation. This plan provides acceptance criteria required to assure minimum requirements are met for plant startup. The criteria were based upon reasonable, but in some instances, unverified assumptions and



therefore could not be considered adequate for long-term operation. The following chronology summarizes the history of CAR 81-035:

CAR 81-035 HISTORY

<u>Date</u>	<u>Event</u>
Undated	Memo from Engineering Design to Plant Manager requesting mark-up of drawings to show cable tray space remaining or full trays. To be completed by January 30, 1981 for U-1 and February 27, 1981 for U-2.
2/18/81	Noncompliance item discovered in that cable trays and cable penetrations in spreader rooms are overfull. Corrective Action Report (CAR) 81-035 submitted on 3-4-81. Cause attributed to "immense modification program over the past years and the application of Flamemastic". Information transmitted to Engineering Design (EN DES) for resolution on 3/10/81.
9/07/82	Design change request (DCR) issued to install new cable trays in control building and reactor building in areas where possible overfilled conditions may occur. DCR approved on 10/29/82.
1/07/83	Estimated completion date of CAR changed from 3/10/81 to 1/30/84.
10/05/84	CAR extension request granted, interim corrective action consisted of revising Dwg. 48W832-1 to require field to submit as constructed Dwgs. to EN DES so they can design future cable routings to avoid overfilled trays. Extension necessary to allow revision of MAI-13 to require verification that cable trays are not overfull prior to adding new cables (among other revisions). Estimated completion date within 90 days of 10/2/84. (e.g. 1/2/85).
1/09/85	CAR extension request granted due to delay in MAI-13 revision. New estimated completion date 3/6/85.
3/13/85	CAR extension request granted due to continuing delay in revising MAI-13. New estimated completion date 3/30/85.
4/17/85	CAR extension request granted due to MAI-13 revision delay. New estimated completion date 5/30/85.
5/30/85	CAR extension request approved due to delay in OE development of criteria for loading of cable trays. This input was necessary for MAI-13 revision. New completion date 6/28/85.



- 6/28/85 Memo from Design Services documenting evaluation of cable tray overloading condition based upon multi-disciplinary involvement (Civil, Electrical, Design) and inspections. Conclusion was that the inspected U-3 cable trays "cannot be seismically qualified for either interim or long term operation". Additionally inspections needed to determine the complete extent of the problem. Problems found include: 1). All seismic loads not considered in design of supports; (2). Many hold down clips which attach trays to support brackets have missing bolts; (3) Cable and coating plus miscellaneous junction boxes and conduit exceed design weight; (4) Cable Ampacity Ratings questionable due to excessive Flamemastic application; (5) Relative motion capability of cables to trays questionable since no slack exists (also aggravated by application of rigid fire retardant).
- Note: Background comments in this memo state that CAR 81-0350 was transmitted to Design Services on 4/11/85.
- 7/01/85 Four hour Red Phone Report made informing NRC of cable-tray seismic problem.
- 7/09/85 CAR upgraded to significant status.
- 7/12/85 Memo from Design Services identified acceptance criteria for interim operation intended to establish minimum requirements for U-3 restart (criteria based upon "reasonable but, in some instances, unverified assumptions").
- 7/30/85 LER 85-26 submitted describing problem. Event date was stated to be 7/1/85 in the LER.

During an exit meeting on August 16, 1985, the plant manager was informed that the failure to take adequate corrective action to properly address this known deficiency was a violation of 10 CFR 50 Appendix B, Criterion XVI. (259/260/296/85-41-02) Inadequate Corrective Actions for Safety-Related Cable Tray Systems.

d. Verification of Installed Concrete Anchor Bolts

During the design review, the inspector noted that Phillips Redhead concrete anchor bolts were specified in the design calculations. This was identified on sheet A107 and A145 for the typical connection calculation. A review of the corresponding drawings revealed that unit 3 threaded anchor bolts were specified for construction. The inspector held discussions with licensee representatives with regard to the above concern where it was determined that the unit 3 threaded anchor bolts were cinch anchors.

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Since the load capacity for the cinch anchors is much less than that for the Phillips Redhead anchor bolts, the use of cinch anchors for the installation appeared to be less conservative and was not qualified by the design calculation. The inspector further noted that cinch anchors were specified on the design drawings that covered the areas of the control bay and the reactor building for Units 1, 2, and 3. At the time of this inspection, the licensee could not determine the type of anchor bolts that were actually installed for the cable tray support systems. Pending further evaluation to be furnished by the licensee, this matter is identified as unresolved item 259,260,296/85-41-03, Verification of installed concrete anchor bolts for cable tray supports.

Within the areas inspected, two violations were identified.

6. Pipe Support Baseplate Designs Using Concrete Expansion Anchor Bolts (IE Bulletin 79-02)

The inspector held discussions with licensee representatives in the areas of IE Bulletin 79-02 program implementation. The status of the program was identified as follows:

- a. Baseplates for 554 supports were identified for inspection and possible repair which included Unit 3 and common systems, secondary penetrations, and service water tunnels.
- b. 427 of the 554 supports had been inspected and/or repaired.
- c. All work in Unit 3, common systems, service water tunnels, and secondary penetrations was scheduled for completion by September 16, 1985.
- d. Inspections for Unit 2 were being identified. Approximately 300 supports were to be inspected.
- e. Inspections for Unit 1 were to be identified after completion of Unit 2.

Within the areas inspected, no violations or deviations were identified.

7. Seismic Analysis for As-Built Safety-Related Piping Systems (IE Bulletin 79-14)

a. Program Status

Unit 1: Inspection	95% complete
Analysis	66% complete
Supports	38% complete

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Unit 2:	Inspection	95% complete
	Analysis	50% complete
	Supports	36% complete
Unit 3:	Inspection	95% complete
	Analysis	34% complete
	Supports	33% complete

- b. Unit 3 support reinspection associated with the torus modification.
- (1) 564 pipe supports were identified and reinspected.
 - (2) 431 supports were identified to have discrepancies.
 - (3) 700 maintenance requests (MRs) were generated for repairs.
 - (4) 365 MRs were field completed on repairs and reinspected.
 - (5) 102 supports were required to have a design review.
 - (6) the remaining 329 supports were to be deferred until Unit 3 C6 refuel outage

Within the areas inspected, no violations or deviations were identified.

8. Seismic Qualification of the Cable Tray and Conduit Support Systems

During the inspection, the inspector noted that the licensee had requested the United Engineers and Constructors to evaluate the seismic qualification of the cable tray and conduit support systems and determine both short-term modifications to support restart of Unit 2, and long-term modifications to be incorporated during the subsequent outage. The short-term evaluation was scheduled to be completed by August 30, 1985.

