



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

Report Nos.: 50-259/88-12, 50-260/88-12, and 50-296/88-12

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 1, 2, and 3

Inspection Conducted: May 2-6, 1988

Inspectors: Rich C. Chou 6-15-88
 R. C. Chou Date Signed

R. P. Carrion 5-16-88
 R. P. Carrion Date Signed

Approved by: J. J. Blake 6/20/88
 J. J. Blake, Chief Date Signed
 Materials and Processes Section
 Division of Reactor Safety

SUMMARY

Scope: This routine, announced inspection was in the areas of Mark I Containment Long Term Program Modification, IEB 79-02, and IEB 79-14.

Results: No violations or deviations were identified.

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REPORT DETAILS

1. Persons Contacted

Licensee Employees

J. Beason, Principal Engineer
*R. V. Baird, Civil Engineer
*B. D. Burke, Task Engineer
*B. B. Caldwell, Task Engineer
*J. W. Davenport, Operations
J. Emens, Associate Electric Engineer
J. Foster, QC Inspector
E. Gaines, Principal Engineer
J. Gaines, QC Inspector
*M. Hammond, Supervisor of QA Surveillance Walkdown
*C. S. Hsieh, Compliance Licensing Engineer
S. M. Kane, Regulatory Licensing Engineer
*J. D. Martin, Assistant to Plant Manager
J. Pawlik, Plant System Engineer
*J. Savage, Compliance Licensing Manager
*C. N. Simms, Lead Civil Engineer
T. Temple, Nuclear Engineer
J. G. Walker, Plant Manager

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

Other Organization

Stone and Webster Engineering Corporation

G. Byrnes, QC Manager
*K. E. Conrad, Assistant QC Manager
D. Hanley, Field Engineer
W. Hurt, QC Inspector

NRC Region II

*K. P. Barr, Acting Assistant Director for Inspection Programs, TVA Project
*A. Johnson, Project Engineer, Browns Ferry

NRC Resident Inspectors

*E. F. Christnot, Resident Inspector
*G. L. Paulk, Senior Resident Inspector

*Attended exit interview

2. Mark I Containment Long Term Program Modification (25585, TI 2515/85)

(Open) TI 2515/85, Unresolved Safety Issue A-7. This is the sixth inspection on Mark I Containment Long Term Program (LTP) Modification. The previous inspectors did inspections on welding, pipe supports, and/or status reports. Inspection Report No. 50-259,260,296/81-20 documented welding inspections on stiffener plates, ring girders, and vent header restraints of the Torus Modification; Inspection Report No. 50-259,260,296/85-26 reinspected seven pipe supports associated with torus modifications, six on the RHR line and one on the Core Spray line. Inspection Report No. 50-259,260,296/85-30 reported a reinspection of seven supports in Drywell and Torus Purge System associated with the torus modification; Inspection Report No. 50-259,260,296/85-41 documented the status report which stated the licensee reinspected 564 pipe supports associated with torus modifications in Unit 3 and found 431 supports with discrepancies; and Inspection Report No. 50-259,260,296/87-07 reported a reinspection of eight supports of "Torus Attached External Pipings" with three discrepancies.

a. Background

The Browns Ferry Units 1, 2, and 3 containment systems are one of the first generation General Electric (GE) Boiling Water Reactor (BWR) nuclear steam supply systems housed in a containment structure designated as the Mark I Containment System. The original design of the Mark I Containment System included pressure and temperature loads associated with a Loss-of-Coolant Accident (LOCA), seismic loads, dead loads, jet-impingement loads, hydrostatic loads due to water in the suppression chamber, overload pressure test loads, and constructions loads. Due to additional hydrodynamic loads, which were discovered later resulting from the dynamic effects of drywell air and steam being rapidly forced into the suppression pool (torus) during a postulated LOCA and from suppression pool response to Safety Relief Valve (SRV) operation generally associated with plant transient operating conditions, the NRC required licensees to have a detailed reevaluation of the Mark I containment System. The resolution of this issue was divided into a short-term program and a long-term program. The Short-Term Program (STP) provided a rapid assessment of the adequacy of the containment to maintain its integrity and functional capability when subjected to the loads induced by a design-basis LOCA, and used NUREG-0408 as a guideline. The NRC had approved the Brown Ferry's STP. The long-term program was to maintain a margin of safety when the MARK I containment structures and piping systems are subjected to additional hydrodynamic loads and was identified by NRC as Unresolved Safety Issue (USI) A-7, Mark I Containment Long Term Program which would use NUREG-0661 as the design criteria. The licensee, based on detailed testing, analytical work and modifications completed by 1983, summarized and submitted the result to the NRC as a Plant Unique Analysis Report (PUAR) dated January 3, 1984. The NRC reviewed the licensee's PUAR for the pool dynamic and structural load aspects against the design criteria, NUREG-0661 and approved the PUAR on May 6, 1985.

This inspection and the subsequent inspections to come later are to verify that the licensee had modified the plant with appropriate procedures, design, analysis, calculations and in accordance with the licensee commitments stated in the PUAR. The inspectors held discussions with the licensee's responsible engineers. The walkdown reinspection areas included torus external and internal structure modifications, drywell to wetwell differential pressure system, vacuum breaker, temperature monitoring system, and attached external piping systems. The structural modifications inside the torus and below the torus water line such as safety relief valve quenchers (T-Quencher) and supports were also discussed. Unit 2 is first to prepare for restart after the three units were shut down for almost three years. Therefore, most of the walkdown reinspection was performed in Unit 2. To verify the licensee commitment and performance, the inspectors randomly selected the following restraints and structural components that had been QC final inspected to see if they complied with commitments and as-built drawings. The restraints and structures were reinspected with the assistance of the licensee's QC inspectors, engineers, and craftsmen.

b. Torus Exterior Modifications

A walkdown was conducted to examine the exterior modifications made to the Unit 2 Torus as committed to in the PUAR. Specifically, the following items were inspected: torus tiedowns, external ring girder reinforcement beams, cradle reinforcement plates, torus dynamic restraint snubber assemblies, and the torus shell reinforcement at each ECCS header torus penetration. These items were compared to those illustrated on the following engineering drawings:

<u>Drawing</u>	<u>Revision</u>
48W1246-2	5
48W1248-1	17
48W1248-3	9
48N1253-1	5
48W1265-1	4

The outside (farthest from the drywell) torus tiedown assemblies of ring girders #11 and #13 as well as the inside (closest the drywell) assembly of ring girder #13 were checked. In addition, the external ring girder reinforcement beams and the cradle reinforcement plate were checked at these locations. No discrepancies between the drawings and as-built condition of these items were identified. Bent plate $1\frac{1}{4}$ " x 12" and 1" web plate for reinforcement beams and cradle flange scab plates $1\frac{1}{2}$ " x $6\frac{1}{2}$ " conform to Figures 5-1 and 5-2 of the PUAR.

The torus dynamic restraint snubber assembly and its associated wall-mounted plate at ring girder #13 were reviewed and found to conform to the engineering drawings and Figure 5-1 of the PUAR.

The torus shell reinforcement for ECCS header torus penetration No. X-204D was checked. 5/8" bent plates were found to conform to the Drawing No. 48N1253-1 and paragraph No. 5.2.6 of the PUAR.

c. Torus Interior Modification

A walk-down of the Unit 2 torus interior was done to review modifications resulting from commitments made in the PUAR. The following drawings were reviewed:

<u>Drawing</u>	<u>Revision</u>
47W401-5	18
-7	6
-8	7
-11	3
-12	3
47W403-1	14
-2	18
48N1218-4	13
48W1218-7	13
-8	8
-9	9
48N1218-10	8
48W1218-11	1
-12	2
48N1240-1	6
48N1245-2	5
-4	2
-5	1
48N1247-1	6
48N1249-1	7
48N1250-1	6
-2	4
48W1251-1	10
-2	6
-3	7
-4	2
48W1257-1	8
48W1259-1	7
-2	7
48W1260-3	2
48N1261-1	9
-2	6
48N1262-1	6

Because water was in the torus to approximately elevation 535"-0", it was not possible to see the modifications made in the lower portion of the torus, including the T-Quenchers and their respective supports, the horizontal downcomer tie bar and its attachment details,

the lower attachment details of the vent header restraints, the attachment details of the HPCI turbine exhaust pipe restraints, and the attachment details of the RHR pump test line restraint.

Although it was not possible to closely inspect (i.e., measure member dimensions, welds, etc.) the modifications above the water level due to their distance (and, therefore, inaccessibility) from the walkway, a visual accounting of the major components, including their configuration and general physical condition, was completed.

The main steam relief valve vent piping and associated supports and restraints were checked for conformance to Drawing Nos. 47W401-5, -7, -8, -11, and -12. In particular, the "stiffener boxes," where the main vent piping penetrates the vent header in groups of two or three, the attachments to the vent piping itself (including rigid restraints, clevises, etc.), and the ring girder attachments and end attachments of the restraints were reviewed.

The vent header reinforcement plate around the four center downcomers of the non-vent bays, as described in paragraph 6.11.3 of the PUAR, was reviewed against Drawing No. 48N1240-1 for drawing conformance.

The diagonal bracing for the downcomer tie bars and their attachment to the downcomers via the bent plate and over-sized pipe arrangement was checked for drawing conformance and found to be acceptable.

The torus spray header supports, as described in paragraph 8.7.1 of the PUAR, were verified as conforming to the engineering drawing Nos. 48W1259-1 and -2, including attachments to the spray header and torus ring girder, plus associated stiffener and gusset plates.

The torus walkway and access platforms for the vacuum breakers and their associated supports, as described in paragraphs 9.1 and 9.2 and figures 9-1, 9-2, and 9-3 of the PUAR, were reviewed for drawing conformance against Drawing Nos. 48W1251-1, -2, -3, and -4, noting in particular the design features intended to mitigate effects of seismic and hydrodynamic events, including slotted holes, bolted connections, and physical separations (between the walkway, which is supported from the ring girder, and the vacuum breaker access platforms, which are suspended from the vent header). No discrepancies were identified.

d. Torus Attached External Piping Modifications

Nine new/modified external piping supports for Unit 2 were checked for drawing compliance. The following supports were reviewed:

<u>Support</u>	<u>System</u>	<u>Drawing</u>	<u>Revision</u>
R-27	HPCI	47B455-118	6
R-28	HPCI	47B455-120	2
R-64	HPCI	47B455-121	1
H-9	RHR	47B452-705	2
H-10	RHR	47B452-986	3
H-11	RHR	47B452-463	4
R-92	RHF	47B452-892	2
R-93	RHR	47B452-962	3
R-96	RHR	47B452-970	1
R-96	RHR	47B452-971	0

With the exception of H-9, all supports met the acceptance criteria. H-9 deviated slightly from the drawing. The attachment lugs (shown in detail A705) are specified to be 1/2" thick and were measured to be 3/8" thick. A review of the calculations determined that the 3/8" thick plate is adequate for the loading conditions. Pending the licensee actions to review and revise the calculations and drawing, this new open item is identified as IFI 50-260/88-12-01.

3. (Open) Pipe Support Base Plate Designs Using Concrete Expansion Anchor Bolts - IEB 79-02 (25528)

TVA performed anchor bolt pullout test and inspection for IEB 79-02. Repair work was done for the oversized bolt holes on base plates. A few modifications for anchor bolts were performed which might be combined with the modification requirements for IEB 79-14. See Paragraph 4 for the additional information.

4. (Open) Seismic Analysis for As-Built Safety-Related Piping Systems - IEB 79-14 (25529)

a. Units 1 and 3

All three units were shut down almost three years due to the safety concerns. The vast majority of site activity is currently concentrated on Unit 2. The licensee plans to resume the modification work and other activities in Units 1 and 3 after Unit 2 is restarted. All long term code requirements and compliances for Units 1 and 3 for IEB 79-02 and IEB 79-14 will be met before they are restarted.

b. Unit 2

A seismic technical issues meeting was held between TVA, Stone and Webster, and NRC-OSP at NRC's White Flint Office on February 29, 1988. The purpose of this meeting was to reach a common understanding of the Browns Ferry Nuclear Plant (BFN) seismic technical issues and direction of the program for the resolution of these issues. The programs will involve the modifications and calculations on Civil Structures which include torus integrity, 79-14/79-02 program, cable

tray supports, conduit supports, HVAC, small bore piping, CRD piping, drywell steel platforms, penetrations, equipment qualification, etc. The 79-14/79-02 program is a part of the seismic design program. The 79-14/79-02 program will include approximately 30 systems, 240 stress problems and 4000 supports for Unit 2 and common area. TVA had completed 20 stress problems and 500 supports which were included in torus attached piping and CRD piping systems. The remaining 79-14 (including 79-02) program will include 220 stress problems and 3500 supports. TVA requested the NRC approval at a meeting for (a) 3-phase plan and schedule for implementation of 79-14/79-02 program, and (b) use of Sequoyah interim operability criteria (1.2 Sy and 0.7 Su for steel allowable and Factor of Safety = 2 for anchors) for phase II modifications which will be completed before restart. All phase III modifications will meet the long term code requirements. Unit 2 restart is scheduled on December 1, 1988. The NRC is currently reviewing the proposal. TVA also presented the current status and proposal for 79-14/79-02 program as shown below based on the 3-phase plan:

Phase I (Completed before April 1988)

- Completed walkdowns
- Developed data base of supports
- Assembled data packages
- Identified Approximate 600 discrepancies (3 Units)
 - 510 Acceptable or Minor
 - 90 Modifications
- Resolving audit findings

Phase II (To be completed by December 1, 1988)

- Initiated verification walkdowns
- Initiated analyses and calculations (40% to be completed before restart)
- Continuing data base activities

Phase III (Next outage from June 1, 1990 to February 1, 1991)

- Installing all modifications

After TVA finished Phase I walkdown inspection for IEB 79-14 and IEB-79-02, the NRC's inspectors and TVA QA audit personnel frequently revealed the discrepancies between as-built drawings and as-built conditions and concluded that the Phase I walkdown inspection was inadequate. TVA has hired Stone and Webster Engineering Corporation as its A/E firm to finish Phases II and III. The current status of Phase II is that Stone and Webster has completed its walkdown inspection of 952 supports, 11200 ft on piping, and 38 packages.

(1) Activity Observation

After the inspectors learned that TVA hired Stone and Webster Engineering Corporation to perform Phase II verification walk-downs for the IEB 79-14/79-02 program, the inspectors decided to observe the performance of the Stone and Webster Walkdown Inspection Team during a detailed inspection of a piping system. A typical inspection team consists of one field engineer and one certified QC inspector. Each serves to verify the other person's work.

The inspectors randomly selected NI-201-5R and 6R from Isometric Drawing No. 47W400-200 for the Static, Thermo, Dynamic Analysis of Main Steam Drain Piping. The inspectors observed the inspection and records taken for support No. MDH-1A and the piping segment (3" ϕ sch. 160) from Support No. MDH-4 thru MCH-3 and MDH-1A to the connection of the 26" ϕ Main Steam Line D. The phase II Verification Walkdown Team measured and verified dimensions, pipe size, pipe schedule, elbow size, elbow schedule, support location, support identification, branch, reduced tee, etc., and recorded discrepancies for pipe. They measured member size, pipe wall thickness (when used as a support member) with D-Meter (pocket sized ultrasonic equipment), connection, weld size, irregular weld, weld length, plate size, general dimensions, paint thickness, spring can details, the attached member details, etc., and recorded the discrepancies for Support No. MDH-1A. Overall, the team members performed the detail inspection per the walkdown inspection procedures. The inspectors raised questions such as gap, interference with other members, measurement tolerances, etc., to evaluate their knowledge about the procedure's requirements. After observing the team inspection, the inspectors questioned why the attached support member was not cross-referenced and why there was no mention about paint being chipped off of the spring can nor about rust on the bottom flange (plate) on support No. MDH-1A. The verification team members answered that the attached member was a miscellaneous Civil Structural member. Neither the Civil Structural member nor the chipped paint with rust were required to be recorded on the drawing, per the walkdown inspection procedures. Actually, the attached Civil Structural member is part of a tower which supports an approximately 30" ϕ pipe. The inspectors discussed the above two concerns of the cross reference and defects with the licensee responsible engineers and Stone and Webster managers (including QA). They agreed to review the procedures and set standards for these concerns.

(2) Procedures Reviewed

The inspectors reviewed the following procedures for adequacy. No major concerns were found except the above cross reference and defect recording problems.

- (i) WDP SWEC-003, SDSP-9.8, Piping Walkdown Procedure, TVA
- (ii) BFEP PI 87-49, Pipe Support Verification Program, TVA
- (iii) BFPP 8-8, Technical Procedure for 79-14/02 Piping and Pipe Support Qualification, Task S012, Stone and Webster Engineering Corporation.

(3) Audit Program for Phase II Walkdown Inspection

Stone and Webster did not have an audit program or procedure to verify the performance and accuracy of 79-14/79-02 Phase II walkdown inspections. TVA does have activities and procedures for vendor performance verification. The licensee's responsible supervisor told the inspectors that TVA has two means to verify the accuracy of the Stone and Webster's walkdown inspections. First, the licensee QA engineers can observe the walkdown inspection activities performed by the Stone and Webster team members. Second, the licensee QA engineers can perform a reverification check on the piping or supports for which the reinspection has been completed by the Stone and Webster Walkdown Team Members. The licensee has performed about eleven surveillance observations on between 40 to 50 supports. Six to eight supports have been rechecked independently by the licensee QA inspectors. They only found two dimension discrepancies with 3-1/2" and 3" differences. The licensee plans to check 10% of the total walkdown reinspection pipings and supports. The licensee agreed with the inspector's request to reduce dramatically the surveillance observations and increase the independent recheck to assure the accuracy and performance of Stone and Webster walkdown team inspections. The Procedure No. SDSP-3.3, Quality Assurance Surveillance Monitoring was received in the region office and is currently being reviewed.

(4) Walkdown Reinspection for IEB 79-14 Modifications

As part of the IEB 79-14 review, two hangers were checked to assure the licensee performance on support modifications. These hangers are designed to support the Unit 1 control rod drive return line and are found on Drawings 47B1600-S0001, Rev. 0 and 47B1600-S0002, Rev. 0. These two hangers were selected from a group on which all work had been completed, including QC inspection. The field walk-down of these hangers determined that installation was correctly executed; the as-built configuration, including dimensions, piece marks, and welds satisfactorily met acceptance criteria. No violations or deviations were identified in this inspection.

5. Exit Interview

The inspection scope and results were summarized on May 6, 1988, with those persons indicated in paragraph 1. The inspectors described the areas inspected and discussed in detail the inspection findings.

Dissenting comments were not received from the licensee. The following new item was identified during this inspection:

Inspector Followup Item (IFI) 50-260/88-12-01, Size Discrepancy at End Attachment in Torus External Pipe Support. See paragraph 2(d).

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