



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

Report Nos.: 50-390/84-34 and 50-391/84-29

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

Docket Nos.: 50-390 and 50-391

License Nos.: CPPR-91 and CPPR-92

Facility Name: Watts Bar 1 and 2

Inspection Date: May 1-4, 1984

Inspection at TVA Engineering Design Office, Knoxville, Tennessee

Inspectors: W. C. Liu 5/21/84  
W. C. Liu Date Signed

W. P. Ang 5-21-84  
W. P. Ang Date Signed

Approved by: J. J. Blake 6/7/84  
J. J. Blake, Section Chief Date Signed  
Engineering Branch  
Division of Reactor Safety

SUMMARY

Scope: This routine unannounced inspection involved 42 inspector-hours at TVA Engineering Design Office, Knoxville, Tennessee, in the areas of pipe support base plate designs using concrete expansion anchor bolts (IE Bulletin 79-02), seismic analysis for as-built safety-related piping systems (IE Bulletin 79-14), licensee action on previous enforcement matters, and licensee identified items.

Results: Of the areas inspected, no violations or deviations were identified.

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## REPORT DETAILS

### 1. Persons Contacted

#### Licensee Employees

- \*R. M. Pierce, OEDC Project Manager
- \*J. C. Standifer, Design Project Manager, ENDES
- \*R. O. Barnett, Chief, Civil Engineering Branch, ENDES
- \*R. O. Hernandez, Head Civil Engineer, ENDES
- \*W. A. English, Head Civil Engineer, Eng. Mechanics, ENDES
- \*E. G. Beasley, Assistant to Manager, OEDC
- \*D. Williams, Senior Nuclear Engineer, ENDES
- \*E. D. Mysinger, Principal Mechanical Engineer, ENDES
- \*J. E. McCord, Supervisor, Mechanical Engineer, ENDES
- \*M. A. Cones, Civil Engineer, ENDES
- \*G. R. Owens, Licensing Engineer, ENDES/NEB
- \*J. Worthy, Licensing Engineer, ENDES/NEB

\*Attended exit interview

### 2. Exit Interview

The inspection scope and findings were summarized on May 4, 1984, with those persons indicated in paragraph 1 above. The licensee was informed of the inspection findings listed below. The licensee acknowledged the inspection findings with no dissenting comments.

(Open) Unresolved Item 390/84-34-01, 391/84-29-01, IE Bulletin 79-02, Shear Force Distribution to Concrete Expansion Anchor Bolts, paragraph 6.

### 3. Licensee Action on Previous Enforcement Matters

- a. (Open) Violation 390, 391/84-05-03, Failure to Follow Procedure - Civil Design Standard (DS-C1.7.1). TVA letter of response dated April 2, 1984, has been reviewed and determined to be acceptable by Region II. The inspector held discussions with licensee representatives and examined the corrective actions as stated in the letter of response. As a result of these discussions, the inspector determined that the licensee had not performed an adequate evaluation to show that base plates were designed in accordance with IE Bulletin 79-02 and TVA's Design Standard (DS-C1.7.1) requirements. Pending further examination, this item remains open.
- b. (Open) Violation 390, 391/84-05-04, Failure to Follow Procedures for Pipe Support and Base Plate Design Calculations. TVA letter of response dated April 2, 1984, has been reviewed and determined to be acceptable by Region II. The inspector held discussions with licensee representatives and examined the corrective actions as stated in the letter of response. As a result of these discussions, the inspector noted licensee's design standard C1.7.1 allows shear loads to be

distributed to anchors in inverse proportion to tensile load in the anchor. This method of distributing shear force to concrete anchors is not conservative in terms of satisfying IE Bulletin 79-02 requirements. Furthermore, additional discrepancies were identified during the review of the following design calculations:

| <u>Support No.</u>            | <u>Piping System</u>        |
|-------------------------------|-----------------------------|
| 47A450-17-1, Rev. 3           | Essential Raw Cooling Water |
| 1-63-070, Rev. 908            | Safety Injection            |
| N3-67-A-01A (stress analysis) | Safety Injection            |

The above design calculation/stress analysis in the areas of safety-related pipe support and piping systems were reviewed for conformance to analysis criteria, applicable code, NRC requirements and licensee commitments.

- (1) Support No. 47A450-17-1, Rev. 3, in the Essential Raw Cooling Water (ERCW) System was examined. It was noted that sheet No. 1A and sheet No. 1B of the design calculations did not have checker's signature. It could not be determined whether these design calculations were reviewed by a qualified checker. This support package was approved on January 23, 1984. The design calculations were performed by the designer on October 20, 1983.
- (2) Support No. 1-63-070, Rev. 908 in the safety injection system was inspected. It was found that the design engineer had improperly used the design equation for base plate calculation. In accordance with licensee's pipe support design manual (Section 7.18), the allowable bending stress should be used in determining required base plate thickness. A review of three base plate calculations (at joints 18, 15, and 7) revealed that actual bending stresses were used in the calculation of base plate thickness. This improper use of design equation in determining required base plate thickness led the inspector to believe that both the design engineer and the checker showed a lack of understanding of the intent of the design equation. In addition, base plate sketch in sheet 6 of the design calculation showed that  $F_y = 3815$  kips. This should be 3815 pounds. The above support design calculations were performed and approved on November 21, 1983.
- (3) Stress analysis package N3-67-A-01A in the safety injection system was partially reviewed. It was noted that computer calculation sheets 105, 119 and 122 thru 130 showed no designer's and checker's signatures. It could not be determined whether these computer calculation sheets were properly reviewed for adequacy. This analysis package was performed and approved on May 18, 1983.

Portions of the aforementioned pipe support/stress calculations were not implemented in accordance with ENDES-EP 3.03, Design Calculations; and Pipe Support Design Manual (Section 7.18). These are a violation of 10 CFR 50, Appendix B, Criterion V. Pending more corrective actions to be implemented, this item remains open.

- c. (Open) Unresolved Item 390, 391/84-05-01, Factors of Safety for Concrete Expansion Anchor Bolts. This item involves IE Bulletin 79-02 requirements with regard to factors of safety for concrete expansion anchor bolts during performance of base plate designs. The inspector held discussions with licensee representatives and reviewed related documents. It was noted that the licensee had evaluated a sample of 300 expansion - anchored pipe supports. Concrete expansion anchor bolts in 12 pipe supports showed factors of safety less than five as a result of the evaluation. It was also noted that the factors of safety reported by the licensee had been adjusted to account for increased concrete strength with age and TVA allowable loads versus manufacturer's loads. Since IE Bulletin 79-02 requires that a minimum factor of safety of five has to be met for shell type anchor bolts under faulted condition, this item remains open.
- d. (Open) Unresolved Item 390, 391/84-05-02, Pipe Support Base Plate Design Consideration (IE Bulletin 79-02). Discussions with licensee representatives indicated that about 80% of the previously designed rigid base plates do not meet either IE Bulletin 79-02 rigidity requirements or licensee design standard DS-C1.7.1 requirements. Pending further evaluation in this area, this item remains open.
- e. (Open) Unresolved Item 390, 391/84-05-05, Friction Force Consideration for Pipe Support Design. Watts Bar pipe support group, so far, has not considered friction force into the designs. The inspector held discussions with licensee representatives and reviewed related documents. It was noted that licensee could not ensure that all safety-related pipe supports were designed under the faulted condition. Pending further evaluation in this area, this item remains open.
- f. (Open) Unresolved Item 390/82-27-09, Analytical Techniques Used in Piping Analysis. This item identified analytical techniques used in piping analysis that had not been reviewed and approved by the NRC. The licensee had prepared an FSAR change to identify the techniques for NRC review and approval. However, the FSAR change had not yet been submitted to the NRC. Pending review and approval of the noted techniques, this item remains open.

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 6.

5. Licensee Identified Items (10 CFR50.55(e)) (92700)

a. (Closed) LII 390/83-63, Defective PSCO Shock Arrestor Capstan Spring Tang

The final report was submitted on November 10, 1983. A memorandum was issued on April 18, 1984, from G. Wadewitz (Project Manager) to J. Standifer (Project Manager - Design) with regard to the subject item. The report and the memorandum have been reviewed and determined to be acceptable by Region II. The inspector held discussions with responsible licensee representatives and reviewed supporting documentation to verify that the corrective actions identified in the report and the memorandum have been completed. This item is closed.

b. (Closed) LII 390/82-58, Concrete Anchorage Free Edge Violation

The final report was submitted on September 15, 1983. The report identified that concrete expansion anchor bolts for supports of various systems were installed too close to concrete free edges. This report has been reviewed and determined to be acceptable by Region II. The inspector held discussions with the responsible licensee representative and reviewed supporting documentation to verify that the corrective actions identified in the report have been completed. This item is closed.

6. IE Bulletin 79-02, Pipe Support Base Plate Designs Using Concrete Expansion Anchor Bolts - Units 1 and 2 (25528)

The inspector held various discussions with the licensee's responsible personnel in the areas of previously identified enforcement matters. The inspector reviewed portions of the pipe support calculations, base plate designs and licensee's Civil Design Standard DS-C1.7.1 to determine whether they comply with analysis criteria, applicable code, NRC requirements and licensee commitments. Discrepancies resulting from this review have been identified in paragraph 3.b of this inspection report.

During the inspection, the inspector noted that the licensee's Civil Design Standards DS-C1.7.1, General Anchorage to Concrete; DS-C6.1, Concrete Anchorages - General, allow shear loads to be distributed to anchor bolts in inverse proportion to the tensile load in the anchor bolt. In other words, the shear load can be reduced to zero when the actual tensile load for the

anchor bolt approaches the allowable value. This method of distributing shear force to concrete anchor bolts during (rigid) base plate analysis is not conservative in terms of satisfying the intent of tension-shear interaction equation as specified in IE Bulletin 79-02 documents. Pending proper actions to be taken by the licensee with regard to the above concerns, this matter is identified as Unresolved Item 390/84-34-01, 391/84-29-01, IE Bulletin 79-02, Shear Force Distribution to Concrete Expansion Anchor Bolts.

7. IE Bulletin 79-14, Seismic Analysis for As-Built Safety-Related Piping Systems, Unit 1 (25529)

The inspector held discussions with licensee representatives in the area of piping stress analysis to verify that the seismic analysis input information conforms to the actual configuration of safety-related piping systems. Stress analysis problem no. 0600200-09-02 in the safety injection system was partially reviewed for conformance to design specification, NRC requirements, and the licensee commitments. This analysis was also evaluated for thoroughness, clarity, consistency, and accuracy. The inspector reviewed portions of the seismic inputs to be used in the stress analysis. These seismic inputs in terms of period/frequency versus acceleration from the corresponding floor response spectra curves under OBE and SSE conditions were partially verified for accuracy. Damping values used in the seismic analysis were found to be conservative.

Support loads generated from the aforementioned stress analysis were partially reviewed and verified with the corresponding pipe support design calculations. The inspector verified design loads for six pipe supports calculations and found that these design loads were consistent with those loads generated from the stress analysis.

Seismic anchor movement and valve orientations were discussed with the responsible personnel to ensure that these considerations were included in the stress analysis.

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

8. Essential Raw Cooling Water Piping System (ERCW)

The inspector held discussions with the licensee representatives in the area of piping stress analysis and pipe support design pertaining to ERCW system to ensure that the system was constructed to Quality Group C standard and to Seismic Category 1 design requirements.

| <u>Stress Problem No.</u> | <u>Pipe Support No.</u> | <u>Pipe Classification</u> | <u>Seismic Classification</u> |
|---------------------------|-------------------------|----------------------------|-------------------------------|
| N3-67-9A                  | 47A450-3-76, R3         | Class C                    | Category 1                    |
| N3-67-13A                 | 47A450-17-1, R4         | Class C                    | Category 1                    |
| N3-82-A02DG               | 17A586-1-20             | Class C                    | Category 1                    |
| N3-67-A-01A               | 47A053-136              | Class C                    | Category 1                    |

The above piping system with supports was verified for conformance to NRC requirements and licensee commitments.

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

9. Black and Veatch (B&V) Independent Review

From September 1982 through February 1984, B&V performed an independent review of the auxiliary feedwater system to determine if the as-built system met the FSAR commitments. This review resulted in 479 findings which were subsequently dispositioned by TVA. The B&V independent review findings and TVA action regarding the findings were discussed with the licensee. Portions of the B&V report and a listing of the findings were reviewed. The information obtained will be further reviewed for the need for additional NRC inspection on this subject.

No violations or deviations were identified.