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

Report Nos. 50-390/82-27 and 50-391/82-24

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

Facility Name: Watts Bar 1, 2

Docket Nos. 50-390 and 50-391

License Nos. CPPR-91 and CPPR-92

Inspection at Office of Engineering Design and Construction in Knoxville, Tennessee, and Watts Bar Site near Spring City, Tennessee

Inspectors: C. R. McFarland — 9-10-82 Date Signed

for W. P. Ang — 9/10/82 Date Signed

J. J. Lenahan — 9/10/82 Date Signed

A. B. Ruff — 9/10/82 Date Signed

T. D. Gibbons — 9/10/82 Date Signed

J. F. Schapker — 9/10/82 Date Signed

T. L. Heatherly — 9/10/82 Date Signed

Accompanying Personnel: F. S. Cantrell, NRC Region II

Approved by: D. R. Quick, Section Chief, Division of Projects and Resident Programs — 9/10/82 Date Signed

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SUMMARY

Inspection on July 27 through August 6, 1982

Areas Inspected

This routine, announced inspection involved 485 inspector-hours on the Watts Bar site and at the Office of Engineering Design and Construction in the areas of licensee management of Architect Engineering activities, civil, electrical and piping design engineering verification, and procurement, training, and quality assurance activities.

Results

Of the seven areas inspected, no violations or deviations were identified in six areas; two deviations were found in one area (electrical engineering design review - paragraph 7).

REPORT DETAILS

1. Persons Contacted

Licensee Employees

a. Office of Engineering Design and Construction (OEDC)

*R. M. Pierce, Watts Bar Project Manager
*E. G. Beasley, Manager of Quality Assurance (QA)
*S. Duhan, Supervisor, Quality Compliance
M. Guity, QA Team Leader
*M. Martin, QA Coordinator

b. Division of Construction (CONST)

*J. E. Wilkins, Assistant Manager
*G. Wadewitz, Watts Bar Project Manager (WBNP)
H. J. Fischer, Assistant Construction Engineer
V. Powell, Construction Engineering Section Leader
F. Smith, Civil Engineering Unit Supervisor (CEU)
V. Thomas, Instrumentation Engineering Unit Supervisor (IEU)
G. Lubinski, Electrical Engineering Unit Supervisor (EEU)
E. Austin, QC Inspection Supervisor
*T. W. Hayes, Nuclear Licensing Supervisor, WBNP
A. W. Rogers, Site QA Unit Supervisor, QAU
H. G. McFarland, Lead Engineer, QA Audit Group, QAU
W. M. Copeland, Lead Engineer, QA Programs Group, QAU
J. A. Thompson, Procedures and Training Unit

c. Division of Engineering Design (EN DES)

J. C. Standifer, Sequoyah and Watts Bar Design Project Manager (SWP)
*E. H. Cole, Assistant to Project Manager, SWP
D. W. Wilson, Head Nuclear Engineer, Nuclear Engineering Branch (NEB)
*J. A. Raulston, Nuclear Engineering Branch Chief, NEB
J. R. Lyons, Assistant to the Branch Chief, NEB
*J. F. Cox, Supervisor, Nuclear Licensing Section, NEB
*R. O. Barnett, Civil Engineering Branch Chief, CEB
R. D. Guthrie, Principal Civil Engineer, CEB
*J. A. Ellis, Senior Civil Engineer, CEB
D. Carlin, Senior Civil Engineer, CEB
*W. A. English, Engineering Analysis Group Head, CEB
*A. Jonsson, Civil Design Project Engineer, SWP
*H. B. Rankin, Electrical Design Project Engineer, SWP
J. L. Dorris, Instrumentation & Controls Supervisor
*J. D. Collins, Conduit & Cable Supervisor, SWP
*T. C. Cruise, Principal Mechanical Engineer, Mechanical Engineering Branch, MEB

J. E. McCord, Senior Mechanical Engineer, MEB
J. W. Warren, Senior Mechanical Engineer, MEB
*J. C. Key, Mechanical Project Engineer, SWP
J. L. Purkey, Piping Systems Design Supervisor, SWP
L. M. Chacon, Technical Supervisor, SWP
*R. M. Costner, Quality Assurance Branch Chief, QAB
J. W. Mabee, QA Audit Section Supervisor, QAB
A. H. Ritter, Jr., QA Auditor, QAB
D. A. Valentine, QA Training, QAB
J. L. Parris, Quality Engineering Branch Chief, QEB
D. L. McLean, Quality Control (QC) Supervisor, QEB

d. Other

*J. W. Anderson, Manager, Corporate QA
*H. N. Culver, Director of Nuclear Safety Review Staff (NSRS)

Other licensee employees contacted included QA personnel, design engineers, construction engineers, QC inspectors, and training and management personnel at the Knoxville offices and Watts Bar site.

*Attended exit interview

2. Exit Interview

The inspection scope and findings were summarized on August 6, 1982, at the Knoxville offices with those persons identified in paragraph 1 above.

The problems identified by the inspectors are related to conditions adverse to quality previously identified by the NRC, TVA Nuclear Safety Review Staff, and the internal reviews and audits by TVA design and QA personnel. Significant progress is apparent with respect to the 1982 OEDC Action Plan goals. If this trend continues to the point of adequate and timely implementation of those corrective actions designed to resolve both the specific and generic aspects of the identified root cause concerns, recurring problems should be precluded. That being the case, it appears at this time that the TVA design control process should ensure that the Watts Bar plant will be constructed in accordance with TVA's commitments to the NRC. Continued Action Plan progress as well as the results of the independent verification of design and construction activities at WBNP as proposed by TVA, will be subjects of future NRC inspections.

3. Licensee Action on Previous Inspection Findings

This inspection was specifically intended to expand the NRC examination of the licensee's design control process and supplements the inspection work performed June 14-25, 1982, reported in Region II reports 50-390/82-05 and 50-391/82-03.

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. New unresolved items identified during this inspection are discussed in paragraphs 6, 7, and 9.

5. Licensee Management of Architect Engineering Activities

This inspection is applicable to the organizations within TVA which perform the functions of the Architect Engineer (AE) and are responsible for the engineering, design, procurement and construction management for the Watts Bar Nuclear Plant (WBNP or WB) as identified in the Final Safety Analysis Report (FSAR) and the QA Topical Report TVA-TR75.1 Revision 5. The AE work inspected included work by the Office of Engineering Design and Construction (OEDC), the Division of Engineering Design (EN DES) and the Division of Construction (CONST) at the Knoxville offices and, as applicable, at the WBNP.

The inspectors reviewed engineering procedures (EP), design criteria (DC), drawings, specifications, engineering change notices (ECN), field change requests (FCR), nonconformance reports (NCR), and procurement, training and quality assurance (QA) activites. To provide a cross section of the TVA design and construction process the inspectors examined work related to the Auxiliary Feedwater System (AFW) and the Engineered Safety Features Actuation System (ESFAS) as applicable to the EN DES and CONST work.

Overall, it appears that TVA has a lot of significant problems relating to the design and construction of Watts Bar. The inspectors concluded that TVA has identified most of these problems and has programs underway that should ensure that the completed plant will meet NRC requirements. The inspectors have some findings that are exceptions to the above general statement. The findings are discussed in the subsequent paragraphs.

The documents listed below are generic to the inspection work described in the subsequent paragraphs. These documents and those listed in the subsequent paragraphs are representative of the applicable TVA EN DES documents that were examined to verify the systematic management of the total design process and to assure that they met requirements of the accepted QA Program. The inspectors verified the following aspects of the program:

- Procedures have been established for control of design and modification change requests.

- Procedures and responsibilities for design control have been established.

- Administrative controls for design document control have been established.

- Administrative controls assure that design changes are incorporated into procedures, training, and the updating of drawings.

- Controls have been developed that define channels of communication between design and responsible organizations.

- Administrative controls require that design documentation and records be collected and stored.

- Controls require that implementation of approved design changes be in accordance with approved procedures.

EP1.01	R10	Preparation and Processing of EN DES Engineering Procedures
EP1.02	R12	Preparation and Processing of Branch/Design Project EP's
EP1.26	R4	Nonconformances - Reporting and Handling by EN DES
EP3.01	R4	Design Criteria Documents - Preparation, Review and Approval
EP3.04	R11	EN DES Construction Specifications - Preparation Review and Approval
EP3.10	R4	Design Verification Methods and Performance of Design Verification
EP4.01	R6	Signatures/Initials for Preparation, Review and Approval of EN DES Drawings
EP4.02	R11	Engineering Change Notices - Handling
EP4.03	R7	Field Change Requests
EP4.04	R7	Squadcheck Process
EP4.14	R3	EN DES Typical Drawings and Standard Drawings - Preparation, Review, Approval, Distribution and Revision
EP4.16	R4	Configuration Control by Use of Drawings and Drawing Lists
EP4.18	R3	Design Change Requests (DCRs)-Processing Reviewing and Approving
FSAR Section 7.3		Engineered Safety Features Actuation System (ESFAS)
FSAR Section 10.4.9		Auxiliary Feedwater System (AFW)

Within the areas examined, no violations or deviations were observed.

6. Civil Engineering Design Review

The inspector reviewed design calculations, control of design changes, and the as-built review of completed structures for components of AFW and ESFAS to verify that civil design activities were being accomplished in accordance with the design control procedures listed in paragraph 5 above and FSAR commitments. Details of this area of the inspection are listed in the paragraphs below.

a. Cable Tray Support Design

The inspector examined design criteria and design calculations of supports for cable trays carrying control and power cables for AFW Pump 1A. Documents examined were as follows:

Design Criteria WB-DC-20-21.1, Category I Cable Tray Supports

EDS Report - Seismic Analysis of the Auxiliary - Control Building - Watts Bar Nuclear Plant, Units 1 and 2, dated May, 1974

Civil Design Guide DG-C1.6.2, Seismic Design and Qualification of Cable Trays and Tray Support Systems for Nuclear Plants

EN DES EP 3.12 Cable Trays - Design and Requisition Responsibilities

Design Calculations for Cable Tray Supports Numbered MK-1L, MK-2W, MK-263, MK-301, MK-302, MK-336 and MK-349

Drawing numbers 48W1297, Sheets 3, 8, 9, 41, 42 and 53,

Field Change Request (FCR) numbers EE-1194 R1, EE-1194 R3, EE-1549, EE-2255, and EE-2365 R1

Engineering Change Notices (ECN) number ECN 2224 and EE2276

Review of the above design calculations, drawings, FCRs and ECNs and discussions with design engineers disclosed the following unresolved item:

Revisions to cable tray support construction details are made through FCRs, ECNs, NCRs and variances approved by design engineers. Review of the design calculations and discussions with design engineers disclosed that the design calculations are not normally revised when the revision requested by the FCR, ECN, NRC or variance will only result in a minor change to the support. These changes are approved by a designer by use of engineering judgement whenever, in the opinion of the designer, the revision will not invalidate the original calculations. After the FCR, ECN, NCR or variance is approved by the designer, another designer or engineer makes an independent review of the change prior to its issuance by EN DES. The inspector questioned the designers concerning the possible cumulative effect of several minor revisions to a support on the adequacy of the original design. The inspector noted that the design changes affecting a particular support are not tabulated for review by a designer when approving additional revisions to that support. Therefore, potential exists that numerous minor revisions to supports may invalidate the original design calculations and result in inadequately designed and constructed cable tray supports. This apparent lack of an adequate procedure for control of the cumulative effect of minor revisions on the design adequacy of cable tray supports

was identified to the licensee as Unresolved Item 390/82-27-01 and 391/82-24-01, Cumulative Effect of Minor Revisions to Cable Tray Supports on Validity of Design Calculations, pending further review by NRC.

b. As-built Review of Cable Tray Supports

The inspector, accompained by licensee field engineers, made a walkdown inspection of supports for cable trays carrying control and power cables for AFW Pump 1A and verified that the supports were constructed in accordance with details shown on design drawings, FCRs, and ECNs. Supports examined by the inspector during the walkdown inspection were supports numbered MK1L, MK2W, MK-10b, MK301, MK302, MK321, MK336, and Detail A-6.

The as-built review of support number Detail A-6 disclosed that a Nonconformance Report, number NCR 3517R, has been written to document that surface mounted support plates (those mounted to concrete surfaces by use of drilled in expansion anchors or grouted in anchor bolts) for cable tray supports have not been installed in accordance with bolt spacing tolerances specified on the design drawings. This NCR addresses all surface mounted plates on the elevation 357 level of the auxiliary building. Disposition of this NCR will require reinspection of all surface mounted plates on this level of the auxiliary building and documentation of those not meeting bolt spacing and installation tolerance for review by EN DES. The inspector discussed the applicability of this NCR to other levels in the auxiliary building and other structures with responsible engineers. These discussions disclosed that the licensee will inspect surface mounted plates in other areas to confirm bolts or anchors for plates in these areas were installed properly. Disposition of NCR 3517R will be reviewed by NRC in a subsequent inspection. This was identified to the licensee as Inspector Followup Item (IFI) 390/82-27-02 and 391/82-24-02, Bolt Spacing Tolerances for Surface Mounted Plates.

c. Design of Embeddment Plates

The inspector examined design criteria and design calculations for embeddment plates used to support piping, mechanical and electrical equipment, and cable trays in the auxiliary building. Documents examined were as follows:

Civil Design Standard DS-C6.1, Concrete Anchorage

CEB Report 79-18, Welded Stud Anchorages - Effect of Plate Flexibility on Stud Capacity

CEB Report 78-210, Anchorage Tests of Load Transfer Through Flexible Plates

Watts Bar Design Calculations for Typical Embeddment Plates

Drawing numbers 48 N 1223 1 though 8, and 48 N 1225 1 through 9,

d. Auxiliary Building Reinforced Concrete Design

The inspector examined design criteria and design calculations for the auxiliary building. Documents examined were as follows:

Design Criteria WB-DC-20-1, Concrete Structure

Design Criteria WB-DC-20-8, Auxiliary - Control Building Concrete Structure

Civil Design Standard DS-C1.3.1, Dead Loads

Civil Design Standard DS-C1.3.2, Live Loads

Civil Design Standard DS-C1.3.4, Extreme Wind and Tornado Wind Forces or Structures

Civil Design Guide DS-C1.5.3, Concrete Deflections

Watts Bar Procedure for Evaluation of Category I Structures

EDS Report - Seismic Analysis of the Auxiliary - Control Building - Watts Bar Units 1 & 2 dated May, 1974

Design calculations for Elevation 729 spreading room, for elevation 708 control bay, and for A-1 and A-15 line walls.

Drawing numbers 41 N 704, 41N477-1 through 41 N 480-2, 41N313-1 through 3, and 41 N314-1 through 3.

e. Program to Control Cutting of Concrete Reinforcing Steel

The inspector examined the program for approval, documentation, and evaluation of cutting of reinforcing steel which occurs during installation of various types of supports and penetration in reinforced concrete structures. The inspector discussed the methods site personnel obtain approval from EN DES for cutting of reinforcing steel with the site Civil QC supervisor. These discussions disclosed that the procedure currently in use requires EN DES approval either via an ECN or FCR prior to cutting the reinforcing steel. Previously, verbal approval was obtained fron EN DES structural engineers via a telephone call prior to cutting the rebar. Whenever a rebar is cut prior to obtaining EN DES approval, an NCR is initiated by site QC and sent to design for dispositic The inspector reviewed the methods being used by EN DES structural engineers to evaluate and document cutting of reinforcing steel. This review disclosed that the locations of cut rebar has been shown on several sets of design drawing being maintained by individual designers. However, the location of cut rebar have not been documented on a master set of drawings. Therefore, the cumulative

effect of various rebar cuts on the structure may not be able to be properly evaluated by the individual design engineers when they approve additional rebar cutting. This was identified to the licensee as Unresolved Item 390/82-27-03 and 391/82-24-03, Evaluation and Documentation of Cutting of Reinforcing Steel, pending further review by NRC.

Within the areas examined, no violations or deviations were observed.

7. Electrical Engineering Design Review

Engineering Procedures (EP) listed in paragraph 5 as they relate to Electrical Engineering Design and the following documents were examined.

EP 3.12, R1	-	Cable Trays - Design and Requisition Responsibility
Westinghouse Equip Specification 952142, R4	-	Process Instrumentation and Control Equipment and Control Equipment and System Design
Westinghouse Design Specification 955270, RO	-	Class 1E Instrument Design and Test Requirements
Westinghouse Drawing 108D408	-	Process Control Block Diagram Sheet 22
Drawing 7246D11	-	Interconnecting Diagram Sheet 23
WB-DC-30-4, R2	-	Design Criteria for Separation of Electric Equipment and Wiring
WB-D6-40-18	-	Design Criteria for Auxiliary Feedwater System
General Construction Specifications G-40 R2	-	Installation of Electrical Conduit Systems and Conduit Boxes
47B601 - 30, R19		Electrical Instrument Tabulation
47B601 - 3, R10		Electrical Instrument Tabulation
47 W610 - 3-3, R7 System		Electrical Control Diagram Auxiliary Feedwater
SD-E-15.3.4, R2		Electrical Standard Drawing, Conduit, Cable and Wire Identification Tags
47 W600-14, R2	-	Mechanical Instruments and Controls

47W600-18, R7, -23R1, -26R11, -27R10, -29R7, and -89R7,	Electrical Instruments and Controls Drawings
QCP-3.05 R14	Installation, Inspection and Testing of Insulated Control, Signal and Power Cables
45N1635-87 R8 -33 R2 -80 R10 -11 R7	Wiring Diagram Local Instrument Panels Connection Diagrams
47W427-4 R16	Mechanical Piping AFW
45W1614-10 R2 -11 R6	Wiring Diagrams AFW Pump & Turbine Connection Diagrams
45W822-15 R9	Conduit and Grounding EL692.0 Details Sheet 5

Applicable sections of the Electrical Design Manunal.

Field Change Requests I501 - I625 and E3100 - E3274

The EP's were examined to insure the electrical design process program for Watts Bar factored applicable codes, standards, and SAR commitments into the electrical design. The review of the drawings and specification verified this action. The drawings and specifications were also used in a construction verification inspection of selected instruments, cables and panels that are associated with the ESAFS and the AFW system.

This construction verification inspection was to assure that equipment was installed in accordance with EN DES requirements which includes location, identification, mounting, separation, cable type, routing and termination; sampling audit of scaling, calibration, set points, span and range of several instruments and associated circuits.

During the onsite inspection, it was noted that some of the steam generator (SG) level transmitters were removed and those that were installed had their high and low pressure ports tubed up opposite to that shown on the drawings. The licensee stated that NCR 4199A, "Hot calibrated range by calculations exceeds the factory calibrated range of the transmitter" was issued to remove instruments to correct the factory calibrated range. The Systems Engineer at W.B. stated that the transmitters were reverse acting and therefore, the hookup to the high and low pressure ports does not agree with installation plan but that a Field Change Request was being prepared to make the installation and drawing agree.

The tubing inside the containment for the SG level transmitters is still in the process of being fabricated and installed, and the cable terminations associated with these instruments at several panels, were not complete.

Drawing 47W600-14 describes a typical panel for instrumentation that is used throughout the plant. A 10" X 36" plate at the bottom section of the panel requires a fillet weld on both the front and back side of the plate. The examples reviewed by the inspectors which are associated with the panels for SG level transmitters and were welded only on the front side. The licensee considered that this additional fillet weld was added by a revision to the plan after the panel were purchased. This item requires further investigation and is identified as Unresolved Items 50-390/82-27-04 and 50-391/82-24-04, "Fillet Weld Requirements on Instrumentation Panel".

The inspector identified an apparent deviation from a commitment to the NRC. The licensee responded by letter to an infraction identified in Region II's report 50-390/79-20 and 50-391/79-76 on June 25, 1979. The licensee's response states that "Field Instruction WBFI-E7, Cable Auditing by Use of Signal Tracer, was written and issued on May 17, 1979...Safety-related cables will be inspected 100%...This policy began during the week of June 4, 1979. Revision 9 to procedure WBNP-QCP 3.5 will incorporate this change."

Revision 14 of WBNP-QCP-3.05 dated July 19, 1982 has superceded WBNP-QCP-3.5 and has deleted this commitment. During discussion it became apparent that the commitments made to answer enforcement correspondence are not tabulated or tracked and that management is not fully aware of changes to procedures or new procedures that could jeopardize the intent of these commitments. If properly informed, management could notify NRC as required, of changes to these previous commitments.

This apparent deviation will be identified as deviation 390/82-27-05, 391/82-24-05, Changes in Enforcement Commitments Not Identified to Licensee Management and the NRC.

A similar example, although not an answer to enforcement correspondence, related to a 10 CFR 50.55(e) item titled "Loose Electrical Terminations in the Diesel Generator Control Panels" (NCR-W-20-P). The commitment to resolve this item stated that a detailed inspection in various areas, would be added to procedures to assure that these areas would be complete. During revisions to procedures, the requirement for tamperproof painting of junction boxes, conduiets, and other equipment access covers was dropped from the procedures and it is not evident that management was fully aware that this action changed commitments made to the NRC.

This apparent deviation will be identified as deviation 390/82-27-06, 391/82-24-06, Changes in 10 CFR 50.55(e) Commitments Not Identified to Licensee Management and the NRC.

The inspector examined all electrical Design Information Requests (DIR) which were issued. The site has a procedure WBNP-QCP-1.27 "Design Information Request". This document defines that the DIR is to be used to request clarification or interpretation of a requirement from the design organization. EN DES does not have a procedure for handling DIR's to assure that the applicable design controls are applied to the disposition issued to

construction. D.R E9 was dispositioned to construction on May 22, 1979, which allowed a tie down value of 50 percent of the pulling radii as established by Electrical Design Standard. Revision 1 to DIR E9 issued by EN DES incorporated the Insulated Cable Engineers Association (ICEA) training radius table which requires tie down radius that is larger than the 50% of the pulling radius identified in the initial response. Two unresolved items are identified as follows: 390/82-27-07, 391/82-24-07, EN DES Procedure for Handling DIR's, and 390/82-27-08, 391/82-24-08, Reinspection of Cable Installed Under DIR E9 Prior to the Issue of Revision 1.

Within these areas no violations were observed. Two deviations are discussed above.

8. Piping System Design Verification

An inspection was performed to verify the design adequacy of Watts Bar's piping systems. Prior to the inspection, the licensee had identified numerous piping analysis and pipe support calculation discrepancies in construction deficiency reports WBRD-50-390/82-52, WBRD-50-390/82-57 and in potential CDR reports dated December 14, 1981, June 21, 1982, June 29, 1982, and July 14, 1982. Discussions with the licensee at the start of the inspection revealed the licensee had formed two teams to review a significant number of nonconformances being identified regarding both rigorous and alternate piping analysis. A third team was also formed to provide an independent review of the work performed by the first two teams. The reports of the teams identified a lack of procedures, training, independent verification, incorrect input data (response spectra, operating modes, valve weights) and support designs that did not satisfy analysis results. Discussions with the licensee further revealed that corrective action had been initiated and will be implemented (procedures being prepared, 100 percent verification of piping analysis to be performed, independent verification of piping analysis being considered, technical QA audits being considered, etc.).

Specifically, the piping analysis and pipe support calculations for the steam supply piping to the turbine driven auxiliary feedwater pump shown on TVA drawing M47W427-204 Revision 2, was selected and inspected. The inspection confirmed the findings of the TVA review teams. Three unresolved items were identified as follows:

a. Analytical Techniques Used in Piping Analysis

(1) The licensee generated E-W seismic response spectra for various sections of the auxiliary building and utilized them in the piping analysis in lieu of an envelope seismic response spectra for the whole floor. Due to eccentricity of the building and the effects of torsion, a 40% difference exists at some locations. The E-W spectra generated for the various sections of the auxiliary building had not had documented review and approval nor had it been formally issued. Pending formal issuance of the spectra and

subsequent reinspection, this was identified as an unresolved item.

(2) The licensee uses an overlap modeling technique. No Watts Bar piping analysis procedure was available for this technique. The licensee indicated that the overlap modeling criteria of Bellefonte Procedure MA3 Analysis Handbook Section P-2 was similar to Watts Bar's criteria. The Bellefonte MA-3 Section P-2 criteria does not meet NUREG/CR-1980 BNL-NUREG51357 in that the seismic response spectra of both problems being overlapped are not required to be enveloped. Support loads are enveloped but are not increased by ten percent. The licensee indicated that a benchmark of the technique had been performed but was no longer available. Pending confirmation by the licensee by benchmark analysis that the technique is conservative, and subsequent formal issuance of the criteria, this was identified as an unresolved item.

(3) Watts Bar piping analysis uses multiple seismic response spectra within individual piping stress problems rather than enveloping the spectra. Pending further NRC review (NRR/RII), this was identified as an unresolved item.

The above items are identified as Unresolved Item 390/82-27-09, Analytical Techniques Used in Piping Analysis.

b. Piping Analysis Discrepancies

(1) As noted previously, the licensee had reported numerous piping analysis discrepancies in construction deficiency reports WBRD 50-390/82-52 and 82-57. In addition, these discrepancies and their programatic implications were reviewed by teams formed by TVA's engineering design's Watts Bar Project and the Civil Engineering Branch. The resolution of the reported discrepancies, and implementation of corrective action resulting from the TVA review team recommendations on their July 26, 1982 report, were identified as a part of this unresolved item.

(2) The operating temperature used in the piping analysis for the Auxiliary Feedwater Turbine Driven Pump Steam Supply stress problem N3-3-7A, was 547°F. The stress isometric required 557°F. In addition, the analysis documentation did not agree with the stress isometric drawing design modes. This condition was similar to the TVA reported discrepancies regarding erroneous analysis operating modes and was identified as an unresolved item pending implementation of corrective action for the construction deficiency reports.

(3) The valve and operator weights used in the analysis for valves FCV-1-15 and FCV-1-16 varied slightly from the valve manufacturers drawings (365 pounds vs 370 pounds). Although the variation was small, the source of the weights used in the analysis could not be

readily determined. This condition was similar to the TVA review teams findings regarding valve modeling errors and was identified as an unresolved item pending implementation of corrective action for the construction deficiency reports.

(4) Stress problem N3-3-7A models an anchor at the flange connection to the AFW turbine driven pump. The stress problem does not model the trip and throttle valve immediately upstream of the pump and support 47A-427-1-R1 attached to it. The licensee indicated that analysis for the trip and throttle valve and the pipe support was considered to be part of the pump analysis since they were supplied as a unit. This analysis was not available at Knoxville. In addition, an analysis to show the adequacy of modeling the trip and throttle valve as an anchor was also not available. Pending availability of the noted analysis and further inspection, this was identified as an unresolved item.

(5) During discussions with the licensee's piping analysis group and pipe support design group, it was indicated that a potential existed for a pipe support to be designed to loads as much as 20% lower than piping analysis generated loads. Current practice allows the pipe support group to revalidate pipe support calculation without reperforming the calculation when load changes are less than 10 percent. In addition, current practice allows the piping analysis group to not issue revised loads to the pipe support group if loads do not change by more than 10 percent.

The above items are identified as Unresolved Item 390/82-27-10, Piping Analysis Discrepancies.

c. Pipe Support Calculation Discrepancies

(1) Table B on page 7.14.3 of the Sequoyah Watts Bar Project Pipe Support Design Manual provided allowable tensile strengths for concrete expansion anchors that would provide safety factors less than the IEB79-02 required safety factor of 5. This item will be reviewed further during IEB 79-02 inspections.

(2) Design calculations for support 03B-1AFW-R84(R2) did not include shear-tension interaction for the concrete expansion anchors. Pending further review during IEB 79-02 inspections, this was identified as an unresolved item.

(3) Baseplate Analysis Program 222 used for pipe support calculations generates concrete expansion anchor loads. Discussion with the licensee indicates that the program does not provide concrete expansion anchor shear loads if tensile and friction overrides the shear load. However, limitations in the application of this condition to specific support design was not clear. In addition, the applicability of this situation upon concrete expansion anchor relaxation and when the baseplate lifts off the concrete was also

not clear. Pending further review during IE 79-02 inspections, this was identified as an unresolved item.

(4) Supports Number 8-1 and 8-2A of the 2" HPFP FCV and yard piping are bolted to the cover of a limitorque operator. The TVA pipe support designs were based on vendor provided loads. However, the documentation for the loads did not provide the source for the loads - calculations were not available at TVA. In addition the attachment of the support to the valve operator cover was approved by a Contromatics sales engineer but calculations for its design adequacy was not available. The licensee indicated that a copy of the design calculations would be obtained.

The above items are identified as Unresolved Item 390/82-27-11, Pipe Support Calculation Discrepancies.

An inspection of the as-built condition of the AFW turbine driven pump steam supply piping and pipe supports shown on TVA drawing 47W427-204 R2 was performed. The as-built condition appeared to comply with the design drawing.

Within these areas, no violations or deviations were identified.

9. Design Verification of AFW Design Features

References: Preoperational Test Instruction TVA-22, AFW System

a. The inspector reviewed the preoperational test instruction TVA-22, suggested Westinghouse system design criteria, inactivated TVA design criteria, and "as constructed" drawings. The intent of the inspection was to ensure that the designer had identified and implemented adquate design features and that these features were adequately tested to assure that the AFW system would automatically operate during normal operation and during postulated accidents.

The review of TVA-22 indicated that the test instruction did not test the air operated water valves in the discharge side of the AFW pumps to ensure that they failed safe (open) upon loss of air, nor did the test confirm that of the limitorque valves in the steam supply line to the turbine driven pump would operate under the differential pressures that may be experienced during normal operation and during postulated accidents. This will be identified as IFI 390/82-27-12 and 391/82-29-09, Preoperational AFW Valve Tests.

b. The inspector conducted a review with the licensee's AFW system designer to ensure that adequate features had been designed into the system to assure reliable starting during normal operation and automatic isolation were required to mitigate the consequences of postulated accidents. The capability of interfacing systems to isolate or initiate for support of the AFW operation was also reviewed. The inspector concluded that adequate design inputs had been identified and

implemented for the AFW system to assure its safe and reliable operation.

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

10 Observation of Procurement Activities for WB AFW System

References:

EN DES - EP 1.28	Control of Documents Affecting Quality
EN DES - EP 3.01	Design Criteria Documents, Preparation, Review, and Approval
EN DES - EP 3.05	Design Specification for ASME Boiler and Pressure Vessel Code
EN DES - EP 4.25	Design Review and Interface Coordination of Detailed Construction and Procurement Drawings
EN DES - EP 5.01	Purchase/Transfer Requisitions - Evaluation of Bids and Recommendation/Rejection of Contract Award - Revision to Contracts
EN DES - EP 5.20	Processing Procurement Request
EN DES - EP 5.30	Standard Format for Preparation of Procurement Specifications
EN DES - EP 5.33	Procurement Quality Assurance
DED-EP 14.50	Piping Systems Materials (Nuclear)
WB-DC-40-18	Design Criteria for Auxiliary Feedwater System
47W427-2 Rev. 0	Piping Bill of Materials AFW System
47W427-200 Rev. 5	System N3-3-3A Isometric AFW Turbine and Motor Driven Pump Discharge Piping for Seismic, Thermal and Static Analysis
47W427-202 Rev. 5	System N3-3-11A Isometric, AFW Turbine and Motor Driven Pump Discharge Piping for Seismic, Thermal and Static Analysis
47W427-204 Rev. 1	System N3-5A and 7A Isometric of AFW Turbine Pump 1A-S Exhaust and Main Steam Supply Piping for Seismic, Static, and Thermal Analysis
47W427-217 Rev. 3	System N3-3-18A Isometric for Static, Thermal, and Seismic Analysis for Auxiliary Feedwater

47W803-2 Rev. 16	Flow Diagram Auxiliary Feedwater
WBNP-DS-1925-1547-00 Rev. 2	Design Specification-Steam Turbine Driven and Electric Motor Driven Auxiliary Feedwater Pumping Units.
WB-DC-40-18 Rev. 0	Design Criteria-Auxiliary Feedwater System
WB-DC-40-31.2	Design Criteria for Seismically Qualifying Mechanical and Electrical Equipment Assemblies

The inspector selected a sample of components within the auxiliary feedwater system to verify adequacy of design input and to assure the vendor procured components were satisfactorily fabricated to the design requirements.

a. Licensee's Corporate Office - Design Engineering

The following components were selected for the review of procurement activities:

	Component	Drawing	Identification
1)	Turbine Driven Auxiliary Feedwater Pump	47W803-2 Rev. 16	1A-S
2)	Motor Driven Auxiliary Feedwater Pump	47W803-2 Rev. 16	2A-A
3)	4" Air Operated Control Valve	47W803-2 Rev. 16	LCV-3-171
4)	3" Air Operated Control Valve	47W803-2 Rev. 16	LCV-3-173
5)	4" Trip and Throttle Valve	47W803-2 Rev. 16	FCV-1-51
6)	4' Gate Valve Class 2	47W803-2 Rev. 16	3-875
7)	4" Gate Valve Class 2	47W427-4 Rev. 16	MK. 14
8)	6" Check Valve	47W427-200 Rev. 5	MK. 25
9)	Steam Supply Piping	47W427-204 Rev. 1	28 thru 33
10)	Steam Supply Piping	47W427-204 Rev. 1	68 thru 71A

The inspector reviewed applicable procurement documentation design specifications, engineering procedures and drawings for the above components at the licensee's mechanical engineering branch design section. The above documents were reviewed for adequacy of description of function of the components, specified design requirements, mechanical and operational loadings, environmental operating conditions, code

and standards classification, definitions of pressure boundries, material, operational, examination, testing and documentation requirements.

In addition procurement source selection was reviewed for evaluation by the licensee of the selected supplier for history of a satisfactory product in actual use; through experience of use of identical or similar product and past records regarding previous procurement actions and product operating experience. Audits and evaluations of the supplier's current quality records supported by documented qualitative and quantitatve information, including QA Program, manual and procedures. Procurement document control by the licensee is described in Engineering procedures, EN DES - EP 1.28 Revision 3 EN DES - EP 4.25 Revision 4, and EN DES - EP 5.33 Revision 4. These procedures were reviewed for: planning procurement document preparation, review and change control, measures included to assure that applicable regulatory requirements are included or referenced in documents for procurement, and procurement document changes are subject to the same degree of control as utilized in the preparation of the original document. The procedures provide for methods to identify scope of work to be performed by the supplier including; technical requirements, identification of test, inspections and acceptance criteria. Special instructions and requirements for activities such as: design, identification, fabrication, cleaning, packaging, handling, shipping and extended storage requirements are included. Requirements are specified for a documented QA Program by the supplier, access to the supplier's plant facilities and records for inspection or audit by the purchase, identification of required documentation to be submitted by the supplier for purchase review or approval, method for reporting and approval for nonconformances.

Procedures provide for review of procurement documents prior to release for bid and contract award to assure requirements are adequately specified. The reviews are performed by knowledgeable personnel and documented.

b. Watts Bar (WBNP)

In order to verify that the procurement contract and specification requirements were met and that the components were installed as designed, the inspector performed a walk down inspection of the above referenced components and piping. Verification of the components identification serial numbers, National Board numbers, size, code class, and the installation requirements was performed per applicable code and specification requirements. A review of onsite procedures, drawings and interface requirements between mechanical engineering on site, with design engineering at the licensee's corporate offices was made. Methods of request and approval of design changes was reviewed. In addition, the inspector reviewed receiving inspection records for the referenced components. Some minor discrepancies in these records

were identified which were dispositioned by the licensee prior to the inspector's departure.

c. Licensee's Engineering Inspection and Testing Branch

To complete the verification of procurement requirements that were met by the supplier, it was necessary to review pertinent fabrication and inspection data supplied by the manufacturer to the licensee in accordance with document requirements specified in the contract and specification requirements. This data is kept on file at the licensee's engineering inspection branch (QEB) who has the responsibility for supplier inspection surveillance to assure that the procured equipment is satisfactorily fabricated and tested to the contract and design specification requirements. The inspector reviewed such data as: Certificate of Compliance in which identification of applicable codes and standards were specified, Certified Mill Test Reports, Hydrostatic Test Reports, Nondestructive Examination Reports with appropriate qualification level of inspectors identified, Manufacturers Data Report (ASME), dimensional inspection reports including wall thickness for pressure boundary parts, weld repair documentation, heat treatment report, performance test reports (as required), and approved deviation notices.

The inspection reports and shipping release documents performed by the licensed engineering inspection and testing branch were reviewed to verify required notification by the supplier and subsequent inspections by the licensee inspectors were performed and found acceptable. Those areas which deviated were documented on deviation requests and approved by the licensee. A sample of these deviations were reviewed for adequacy of corrective action, acceptable engineering justification, and code compliance.

Within these areas, no violations or deviations were identified.

11. Training

References: EN DES - EP 1.16 Revision 3, QA Training Program
SWP-AI.1 Revision 1, Internal Training Program on Engineering Procedures
WBNP-QCI-1.11-3 Revision 0, Qualification Program for Engineering Functions

The inspector reviewed training and qualification requirements for representative engineering groups, i.e., SWP and MEB, at the licensee's corporate office and the construction engineering group at Watts Bar.

a. The inspector's review of EN DES - EP 1.16 and associated documents and records revealed that, although training requirements within the procedure were implemented, some weaknesses were apparent. It was noted that although the courses include a large amount of material to be covered, the length of the courses were all limited to two hours.

This would seem to indicate a cursory review as opposed to initial training. This may be satisfactory for some individuals with previous training or a background in the subjects but would not adequately indoctrinate new employees, or those without previous knowledge in these areas. It was also observed that although examinations are given for the courses, only one set of examinations is administered and the examinations are not periodically changed. Although some code and industry standards were referenced in course descriptions, no detailed indoctrination program is available in these areas for all engineers in the design groups. Some of these inadequacies were addressed in your 10 CFR 50.55(e) final report on NCR M78-5E detailed April 29, 1982. In the corrective action response to the referenced submittal, other courses are being developed and will be presented by December 31, 1982. The inspector recommends that the above comments be considered in developing additional courses. This item will be inspected at some future date and is identified as IFI 390/82-27-13 and 391/82-24-10, EN DES QA Training Program.

b. The inspector reviewed SWP-AI.1, the recently implemented training program on engineering procedures. This procedure was implemented as corrective measure to the root cause IV of the EN DES 1982 Action Plan for Quality Improvement. The objectives included: establishment of a training program to ensure that individuals are knowledgeable of procedures that govern their work; emphasis on line managers are accountable for implementation of procedures in their respective area; develop and enforce a "use or change" policy; and implement a feedback mechanism for engineering procedure users. In these areas, the licensee's program for training requirements and documentation appears to be adequate.

c. The inspector reviewed WBNP-QC 1.11-3, the qualification program for engineering functions at the WBNP site. The review of the procedure requirements together with qualification prerequisites for engineering positions and documented records of training appeared adequate for engineering functions within the construction activity.

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

12. Quality Assurance

References:

a. Engineering Procedures (EP)

1.16	R3	QA Training Program
1.28	R3	Control of Documents Affecting Quality
1.29	R3	Internal EN DES QA Audit Program
2.03	R4	Unreviewed Safety Question Determination - Handling and Preparation
2.07	R4	Licensing Commitments - Control and Tracking

2.13	R0	Initial Fuel Loading Safety Evaluation - Handling
3.23	R1	EN DES Computer Programs Requiring QA - Verifying, Documenting and Revising
4.25	R4	Design Review and Interface Coordination of Detailed Construction and Procurement Drawings
26.11		Identification and Investigation of Potential Generic Conditions Adverse to Quality

b. CONST QA WB Audits

I-78-02	Instrumentation - Local Panels and Subassemblies
I-80-01 & 03	Instrumentation - Panels and Supports; Reactor Protection System
I-81-02 & 03	Instrumentation - Sensor Lines Testing; Separation
I-82-02	Instrumentation - Sensor Lines & Support
E-80-07	Electrical - Equipment Installation
E-81-01, & 06	Electrical - Sensing Lines & Supports; Exposed Conduit
M-78-09	Mechanical - Equipment Installation
M-79-03 & 06	Mechanical - Equipment Installation, Piping Systems
M-80-08	Mechanical - Service & Control Air Systems
G-78-16	General - Diesel Auxiliary Power System
G-81-06 & 15	General - HVAC Contracts; Process Instrument Piping

c. EN DES QA Audits

SS-81-3	EN DES Procurement Process
SS-81-4	Nonconformances, Corrective Actions
SS-81-5	WB HVAC System
SS-81-11	WB Design, App. B Criteria 3,4,5,8,9,11,17
SS-82-1	ALARA
SS-82-2	WB Design, App. B. Criteria 3,5,6

d. OEDC QA Audits

M82-02	WB QA Program Implementation
M82-11	WB Implementation of Work Package Program

The CONST, EN DES and OEDC audits are being conducted in accordance with approved procedures, the program and organization as presented to the NRC April 26, 1982, and as stated in the QA topical report, TVA-TR75-1, Revision 5, approved by the NRC July 6, 1982. A corporate QA program was being developed at the time of the inspection. The QA functions of the engineering design, construction and operations divisions (and other QA functions) will be incorporated into the corporate program. The inspector reviewed the current program, procedures (see paragraphs 5 and 11A) audit schedules, trend analysis, and representative audit documentation. The audits are performed relative to work activities and related procedures rather than engineering systems such as the AFW and ESFAS. Work similar to that related to the AFW and ESFAS activities was included in the audits reviewed. The design criteria (DC) for safety related systems are

controlled documents. The DC documents are audited, but the technical input to the DC documents is the responsibility of the assigned engineering branch and is not audited by QA. The inspector discussed the audit programs and specific findings of representative audits with QA auditors and/or supervisors. Followup inspections of the corrective action programs are routinely performed and tracked by the originating group. The major findings of the audits reviewed are considered by the inspector to be examples of the findings of the TVA Nuclear Safety Review Staff (NSRS) that were reviewed previously and reported in Region II reports 50-390/82-05 and 50-391/82-03. Outstanding audit items that result in reportable items per 10 CFR 50.55(e) and/or 10 CFR 21, NRC report findings and the NSRS findings are tracked by EN DES licensing and distributed to appropriate TVA management.

Within the areas examined, no violation or deviations were observed.