

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

Report No.: 50-390/88-09

Licensee: Tennessee Valley Authority  
6N11 B Missionary Place  
1101 Market Street  
Chattanooga, TN 37402-2801

Docket No.: 50-390

Licensee No.: CPPR-91

Facility Name: Watts Bar 1

Inspection Conducted: November 28 - December 2, 1988

Inspectors:

G. A. Walton, Team Leader

2/28/89  
Date Signed

H. Garg, Senior Electrical Engineer

2/28/89  
Date Signed

R. E. Shewmaker, Senior Structural Engineer

2/28/89  
Date Signed

Approved by:

K. P. Barr, Section Chief  
Projects Section 3  
TVA Projects Division  
Office of Nuclear Reactor Regulation

2/28/89  
Date Signed

SUMMARY

Scope: Team inspection of the licensee's contractor, Sargent and Lundy Engineers, (S&L) Chicago, Illinois, to assess the methodology of the engineering verification portion of the Vertical Slice Review.

Results: The team inspection concluded the contractor's methodology for assessing the design adequacy of selected systems is adequate. The inspection also confirmed the contractor's documentation and transmittal of results is adequate. The significance of the VSR findings and final resolution of the results were not evaluated at this time. The primary focus of this inspection was the engineering verification of the VSR. Although some records were reviewed, the construction and records verification portions of the VSR were not evaluated at

this time. Two items remained unresolved (URI) from this inspection; the contractor's practice of using the latest design documents for assessing the design adequacy while accepting the construction adequacy which may not be based on the latest design documents, and the licensee control of commitments in response to the VSR findings. Both will require further review to assure adequate control for implementation.

\*URI's are matters about which more information is required to determine whether they are acceptable or may involve violations or deviations.

## REPORT DETAILS

### 1. Persons Contacted

#### Licensee Employees

- \*T. Dean, TVA, Compliance/Licensing
- \*F. Denny, TVA, Engineering Assurance Support
- \*W. Horn, TVA, Watts Bar Program Team
- \*E. Branch, S&L, Mechanical Design Director
- \*D. Demoss, S&L, Mechanical Project Engineer
- \*B. Erler, S&L, Project Director
- \*R. Heider, S&L, Project Manager
- \*R. Humphreys, S&L, QA/QC Records Verification Manager
- \*R. Johnson, S&L, QA Coordinator
- \*A. Morcos, S&L, Quality Assurance
- \*T. Ryan, S&L, Structural Engineer
- \*L. Stensland, S&L, Internal Review Committee Member
- \*A. Singh, S&L, Structural Design Director
- \*H. Taylor, S&L, Chairman, Internal Review Committee
- \*J. Wittenauer, S&L, Electrical Project Engineer

\*Attended exit interview

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

### 2. Vertical Slice Review (VSR) Objectives and Status

The NRC team members met with S&L and TVA management personnel on the first day of the inspection to discuss the objectives and status of the Watts Bar VSR.

The licensee stated that the VSR was established to provide additional assurance that the design and construction of the WBNP meets licensing requirements through 1) an engineering verification (EV) of the technical adequacy of selected systems and the design process, 2) a construction verification (CV) of the as-constructed plant for selected systems, and 3) a records verification (RV) of the QA/QC records for selected systems to demonstrate the records adequately reflect the design and installed plant hardware. The VSR was primarily performed on two systems selected by the VSR team and accepted by the Watts Bar Program (WBPT). The VSR also included selected portions of other systems that were given a limited horizontal review. The selection of these systems was intended to ensure sampling of essential plant systems, components, and structures or identify nonconforming conditions.

This work has been divided into six major subtasks:

- a. Overall Task Administration and General Activities
- b. Engineering Verification Review
- c. Construction Verification Review
- d. QA/QC Records Verification Review
- e. Internal Review Committee Activities
- f. Trend Analysis and Final Report

The licensee selected S&L Engineers of Chicago, Illinois to perform the VSR effort. S&L contracted Fluor Daniels, Inc., to perform the on-site construction verification (CV) effort. The rest of the effort was done by S&L. The licensee criteria for selecting S&L was based on the following:

- ° Full scope Architect Engineering firm
- ° Independent from:
  - Original design and construction of Watts Bar
  - Ongoing Watts Bar production work
- ° Previous IDR/IDVP experience
- ° Strong management team.

The systems selected for the VSR were:

- ° Component Cooling Water System
- ° 6900 - volt shutdown power system and 480 - volt shutdown power system.
- ° Horizontal Review of:
  - High-energy line break effects
  - Fire protection
  - Control room habitability
  - Containment concrete structure
  - Buried pipe design
  - Heating Ventilating and Air Conditioning

The criteria used by the licensee for system selection was based on the following:

- The system must be safety-related, essential to plant safety.
- The system should involve a cross-section of engineering and design disciplines within the TVA design organization
- The concept and implementation of the system design should be by TVA
- The system should be generally representative of safety-related features of other systems
- The system should be reasonably complex, requiring several modes of operation involving redundancy and single failure considerations

The licensee excluded five items from the VSR review which are identified as special programs that are being addressed separately by the licensee. The five items excluded from the VSR are:

- Large bore and Class 1 small bore pipe stress analysis and support design, their construction, and associated QA/QC records.
- Installation of plant welds and associated QA/QC records.
- Concrete Quality.
- Environmental qualifications per 10 CFR 50.49 (electrical and instruments only).
- Control room human factors design, construction, and associated QA/QC records.

The engineering verification (EV) was conducted at the S&L office in Chicago. The construction verification (CV) was performed on-site and the records verification (RV) was also performed on-site at Watts Bar. The findings from the EV, CV, and RV were reviewed and dispositioned from the Chicago office.

Nonconforming conditions found by the VSR are being analyzed for their significance based on the following definitions:

- Observation - A design, construction, or records-related condition which is perceived by a reviewer or inspector to be in nonconformance with the licensing or other documents imposing safety-related requirements (e.g., FSAR, drawings, specifications, appropriate codes and standards).
- Nondiscrepant Observation - An observation which is confirmed, after a review, to be in conformance with the licensing or other documents imposing safety-related requirements.

- Discrepancy - An observation which is confirmed, after a review, to be in nonconformance with the licensing or other documents imposing safety-related requirements.
- Design-Significant Discrepancy - A design, construction, or records related discrepancy which, after engineering evaluation, is found to be in nonconformance with the appropriate code, standard, or licensing requirements.
- Safety-Significant Discrepancy - A Design Significant Discrepancy which, if remained undetected, could result in the loss of capability of the affected system or structure to perform its intended safety function. For this evaluation credit is not allowed for redundancy at system or train level.

The identification, transmittal, and resolution of identified nonconforming conditions is occurring as follows:

- The reviewer completes a checklist for each review performed. That checklist also identifies the reviewer's findings.
- For those facts established by the checklist which provide sufficient basis for an observation, the reviewer will prepare and sign an Observation Report (OR) documenting the potential discrepancy.
- The OR is reviewed by the S&L Internal Review Committee (IRC). The IRC determines if the observation is a discrepancy or a nondiscrepant observation. If the IRC determines it is a valid discrepancy, a Discrepancy Report (DR) will be issued by the IRC.
- The IRC formally transmits the DR by letter to the TVA Watts Bar line organization Technical Manager for resolution and for a design/safety significance determination.
- The TVA line organization completes the determination of the design/safety significance of the discrepancy and proposes a resolution within five days of its receipt. For each DR reviewed the line organization is required to determine the following:
  - o The effect of the discrepancy on other components and the extent/bounds of the problem.
  - o Significance of discrepancy and basis of significance.
  - o Action necessary to correct the discrepancy.

For those DRs which are design significant, safety significant, and other generic non-design or safety significant DRs, the response will also address:

- o Probable root cause as to why the discrepancy exists, i.e., the process which should have prevented it, and why the process did not prevent the discrepancy.

- ° Action necessary to prevent recurrence.
- TVA responds to S&L by formal transmittal of a Resolution Report (RR).
- S&L reviews the Line Organizations proposed discrepancy resolution and design/safety significance determination.
- S&L then issues a Completion Report (CR) to TVA and either accepts TVA's resolution and significance or identifies the RR as unacceptable which would require resubmittal of a revised RR and S&L review and reissuance of a revised CR.
- S&L performs trend analysis of all identified discrepancies. The trend analysis will involve the review of all discrepancies to ascertain the nature, significance, and frequency of occurrence of each discrepancy. The discrepancies will also be evaluated collectively to determine if there are any generic implications which result in the identification of programmatic deficiencies. The results of these activities will be assembled and analyzed to determine what conclusions can be drawn regarding systems, structures, and components which were not reviewed during the VSR program.

A summary list of discrepancies will be prepared and analyzed for trends and possible generic implications.

If the trend analysis results in the identification of adverse trends, additional work may be required to assess those trends and implement the proposed resolution. Any such work is outside the scope of the VSR program.

- S&L will formally transmit by letter the assessment of the TVA line organization's proposed resolution for DRs and any significant trends found by the trend analysis. The trending matrix will segregate the discrepancies in one or more of twenty one different groups.
- S&L will prepare and issue a final report to TVA which includes the following:
  - ° All observations, discrepancies, and corresponding TVA and subcontractor responses, where applicable, shall be incorporated into the final report.
  - ° The report shall document the review findings, the collective significance, and the conclusion reached.

S&L has completed the review of the CV, RV and EV. A categorization of the identified DRs is shown in Table 1. A total of 632 DRs have been identified to date.

S&L has received 245 resolution reports from TVA as of November 29, 1988. Based on the line organization's review and submittal of additional information, S&L has determined that 41 of the discrepancy reports are now considered nondiscrepant. Thirty one resolution reports were returned to TVA line organization requiring additional action. The rest of the DRs were in the review process.

### 3. NRC Team Inspection Effort

The inspectors review primarily addressed the Engineering Verification (EV) process, although some selected reviews of DR's generated by the Construction Verification (CV) and Records Verification (RV) were also performed. The EV review included selected attributes to evaluate the adequacy of the design review process. The significance of the DR identified discrepancies for the items not reviewed by TVA was not evaluated by the team at this time. The resolution reports and completion reports, where completed, were reviewed for safety significance. Selected checklists of the electrical, structural, and instrumentation disciplines were reviewed to determine the adequacy of the EV review.

Additionally, TVA and S&L audits of the VSR effort were reviewed. Also, personnel qualifications of selected reviewers were audited.

#### a. Review of Structural Engineering Verification (SEV) Activities Performed For The VSR.

The inspector selected four SEV checklists and associated DRs from the civil-structural engineering verification effort. The entire distribution of DRs in this discipline is subdivided in 10 subgroups. The sample selected for review represented three of the ten subgroups with the higher number of DRs. Each sample was reviewed for adequacy of the checklist and the use of the checklist on a specific element within that subgroup.

##### - SEV-1601-003, Associated with DR 104

This checklist, SEV-1601, was developed to address the design of concrete structures and was applied to nine specific concrete structural elements which were reviewed by S&L in the VSR. These elements included walls, slabs, columns and one penetration. SEV-1601-003 was developed to address a concrete slab in the auxiliary building within a given boundary at elevation 737'-0", DR 104 was issued as a result of a series of six discrepancies found between the calculations and the FSAR design criteria or between the calculations and two referenced industry documents.

TVA has fully described the potential for each of the six items becoming a design significant deficiency but, at the time of the inspection, no replies were available. That is, the Resolution Report (RR) was not yet available from TVA. The inspector's

review of the checklist, SEV-1601, defined several areas of questions and concerns which were explained by S&L personnel who developed the checklist. With these explanations the checklist was determined to be fully adequate for performing a design review and evaluation against the licensing commitments. The implementation of the checklist on the slab at Elevation 737'-0" was also determined to be adequate.

The impact of the DR remains unknown pending the TVA response and subsequent review by S&L in the form of an RR. The scheduled resolution date for DR 104 was December 14, 1988.

- SEV-0901-002, Associated with DR 025

This checklist, SEV-0901, was developed to address the design of instrumentation line supports and was applied to three specific supports which were reviewed by S&L in the VSR. The specific element associated with the implementation of this checklist was an instrument line support in the 47A051 series. As a result of the S&L review during the VSR, a discrepancy report was generated as DR 025. This addressed the apparent lack of either a support unique calculation or generic calculation on which to base any conclusion relative to the structural adequacy or capacity for the support.

TVA has responded to this DR with an RR, which cited the previously known problem of missing support calculations which was captured by a Significant Condition Report, SCR WBNCEB0531. Additionally, TVA provided their justification for the conclusions contained in the RR which included the fact that calculations had now been performed.

S&L had an opportunity to review the TVA RR and had prepared a CR. A total of five issues were identified in the new calculations and on that basis S&L indicated additional work was still needed in order to resolve the items.

Based on the review of the checklist, SEV-0901, the inspector determined that the checklist was adequate and that it had been properly utilized to evaluate the design of instrument line support known as type 47A051 to be used at a specific location.

The final resolution and completion for this DR remains open pending action by TVA and S&L.

- SEV-1301-002, Associated with DR 115.

This checklist, SEV-1301, was developed to address the design of Mechanical Auxiliary Support Steel and was applied to six specific small bore pipe support elements which were reviewed by

S&L in the VSR program. The specific element reviewed for SEV-1301-002 consisted of a typical small bore pipe in the 47A053 Series, designated 47A-053-145. As a result of the S&L review of this specific sample element, a discrepancy report was generated as DR 115. The issue defined in the DR related to the as-built conditions not reflecting the as-designed conditions and were on the unconservative side.

Based on the review of the checklist, SEV-1301, the inspector determined that the checklist was adequate and that it had been properly implemented on element 47A-053-145 in order to evaluate the engineering design of a small bore piping support.

The impact of the DR remains unknown pending the TVA response in a RR and the review by S&L and the issuance of a CR. The scheduled date for the RR from TVA was November 9, 1988, but as of November 30, 1988, the RR had not been issued.

- SEV-1702-003, Associated with DR 038.

This checklist, SEV-1702, was developed to address the design of equipment foundations and was applied to five specific pieces of safety equipment treated as elements in the VSR by S&L. The specific element reviewed for SEV-1702-003 consisted of the foundations for the Component Cooling Water System (CCW) surge tank A. As a result of the S&L review of this specific sample element, a discrepancy report was generated as DR 038. Several issues were incorporated into this DR and included questions as to whether all loads were adequately considered, limitations on the use of double studs as concrete anchors, the consideration given to prying action on anchor bolt loads and the release of design drawings for construction prior to approved calculations.

Based on the review of the checklist, SEV-1702, the inspector determined that the checklist was adequate and that it had been properly implemented on the CCW surge tank A in order to evaluate the engineering design of the tank foundations.

The impact or significance of the DR is unknown pending the TVA response in a RR and the review by S&L and the issuance of a CR. The scheduled date for the RR from TVA was October 7, 1988, but as of November 30, 1988, the RR had not been issued.

b. Review of Electrical Engineering Verification (EEV) Activities Performed For The VSR.

The inspector selected four EEV checklists and six associated DRs on electrical equipment to review the EV adequacy, and to determine if adequate identification and disposition of nonconforming conditions had occurred.

- EEV-0101-001, Associated DR 07, DR 13 and DR 28.

This checklist was developed to address the design of electrical cable supports.

DR 07 identified two discrepancies associated with cable supports.

- (1) Design Criteria WB-DC-30-5 (Section 6, Page 8) states that cable support systems (conduit and cable tray) in Category I structures shall have Category I Seismic Supports. The weight of cables is supported directly by the raceway or cable tray for horizontal runs. However, supplemental means of cable support may be required in vertical runs.
- (2) Specification G-38, Section 3.2.1.8.2 states that cable support spacing shall be in accordance with NEC Article 300-19. Article 300-19, does not, however, address the seismic support of cables in vertical raceways. Article 318-8(b) also does not address the seismic support of cables in vertical tray risers. Therefore, the seismic adequacy of the cable support design in vertical raceways and tray risers cannot be verified.

TVA responded with a RR stating that this is a previously identified discrepancy and its design or safety significance has not been determined. TVA has previously identified this problem in NCR-W-262-P in 1985 and a CAQR (WBP-88-0564-P) was written on September 9, 1988. S&L has not completed a CR for this item.

DR 13 identified two discrepancies associated with cable sizing calculation.

- (1) Cable sizing/selection calculations which address ampacity, voltage drop, short circuit withstand, and derating factors, are not available for non-safety related cables 1PP-100R, 1PP-101R and 1PP-102R. Required calculations for these cables have been identified for preparation/revision as a part of the "Group B" electrical calculations program. The methodology and acceptance criteria are appropriately defined in Technical Instructions EEB-TI-4, EEB-TI-7, and EEB-TI-13.
- (2) Document PM86-02 (Reference A, Attachment A) identifies calculations for non-safety related cables as not being required prior to fuel loading. These cables however, must be appropriately sized to insure that the offsite power system meets the licensing basis relative to GDC-17 as stated in the SER Section 8.2.2. The scope of document PM86-02 should therefore be revised to include calculations for these cables prior to fuel loading.

TVA responded with a RR stating that this is a previously identified discrepancy and its' design or safety significance has not yet been

determined. TVA has committed to do the required calculation which is scheduled to be completed by September 30, 1989. S&L completed a CR and stated that they agree with the future action proposed by TVA.

DR 28 identified the following discrepancy regarding the sidewall pressure calculation.

- Specification G-38, Section 3.2.1.6 addresses the requirement for calculating expected sidewall pressure when pulling cables in conduit. It does not, however, address power assisted cable pulls through cable tray. SRN-26, Section 3.2.1.6.2 revises Spec. G-38 and addresses all cable pulls (not limited to conduit) relative to calculating expected sidewall pressure. SRN-26 is dated April 29, 1988, which is past the cut-off date of the VSR document review scope, and it also was not in effect when existing cables were pulled.

TVA responded with a RR stating that this is a nondiscrepant condition because no mechanically (power) assisted cable pulls were used for cable installation in cable trays at WBN. S&L completed a CR and stated they agree with TVA based on the fact that TVA has not used any mechanical assisted pull for cable trays.

The inspector's review found that the activities associated with this EEV including the checklist, DR, RR, and CR were adequate except for the following:

- (1) The engineering review is performed based on the latest design documents available as of April 22, 1988. The inspector was concerned about how S&L applied this review to the as installed condition. The inspector reviewed the checklist ECV-0101-001 for cables and was informed by S&L that for CV, S&L verified that construction was conducted in accordance with design documents used at the time of construction. However, the inspector was unable to confirm that a review is done either by EV or CV to verify that the design documents in effect at the time of construction resulted in acceptable hardware installation. Subsequent to the exit interview, the team leader was provided with the following information on this issue.

- o Goal of Engineering Verification

The intent of the EV is to show that the latest approved design documents are technically adequate and comply with the licensing commitments and other design basis documents.

- o Design Process Review

The design process review was performed independently to assure that there were published procedures, policies, and practices during the time of the original design process

which were in compliance with the licensing commitments at the time.

DR's were prepared if a required procedure either did not exist or was inadequate.

° Engineering Verification vs Construction Verification Interface

The as-constructed condition for the representative sample of components are reviewed against the latest design output drawings and specifications.

If a difference between the design output document and the as constructed component is identified, a DR is prepared.

At times, during the resolution process TVA has identified inactive notes as the applicable acceptance criteria for the subject work. Inactive notes are notes that no longer apply to new construction activities but are still in affect for work performed prior to the note being placed in the inactive category. When TVA identifies an inactive note as a resolution to a DR and the inactive note was made inactive after the completion of the construction activity, the CV DR would be dispositioned as non-discrepant provided proper engineering evaluation is made to justify the variance from the current design output document. If the current note is less conservative than the inactive note, no further evaluation is required. However, if the current note is more conservative than the inactive note, the effect of applying the inactive note must be evaluated to justify the variance from the current design output documents.

This item is identified as unresolved item 390/88-09-01, "Installed Hardware Compliance With Latest Design Documents In Effect As Of April 22, 1988", pending further review of this item by the licensee and NRC.

- (2) Checklists EEV-0101-001 and ECV-0101-001, did not include any attributes for the acceptability of the cables concerning cable pullbys, cable jamming, splices, mid run flexible conduits, etc. However, the inspector was informed by TVA that these items are covered by a Corrective Action Plan (CAP) for cables that will be submitted to the NRC for review.
- (3) CR 13 accepted the licensee's proposed future action for the closure of DR 13. However, the inspector is concerned that there is no mechanism in the VSR program to prevent TVA from modifying the proposed action in the future or not completing the proposed action prior to licensing.

Items that are closed by S&L based on commitments made by TVA that future actions will be performed to correct the deficiency is identified as URI 390/88-09-02, "Commitment Compliance", pending the licensee's resolution of a mechanism that assures commitments made to the VSR are accomplished as committed.

- (4) CR 28 accepted the TVA statement that they have not used mechanical assisted pulls for cable trays. S&L did not require further action to verify the basis of the statements. S&L stated that since the mechanical assisted pulls has not been used, no basis exists for the DR and therefore this goes beyond the scope of the program. S&L advised the objective of the program was to verify the acceptability of what has been done at WBN and not to verify what has not been done at WBN. Although the inspector agrees with the S&L position, further reviews were performed on site by the inspector. The licensee advised S&L they had confirmed that mechanical assist pulls were not used in installing cable in cable trays through interviews with Quality Control Inspectors and craftpersons involved in cable pulling. The onsite review by the inspector determined two QC and two craftpersons were interviewed by TVA to reach the conclusion cables were not mechanically pulled in trays during installation. The inspector interviewed both QC inspectors onsite and ascertained they were onsite and participating in cable pulling operations during much of the time that cable was being pulled in cable trays. Both inspectors confirmed that mechanical assists were not used during pulling of cable in trays. The inspector had no further questions on this matter.

- MEV-0704-002/003, Associated DR 14.

This checklist was developed to address the design adequacy of electrical cable separation.

DR 14 identified the following discrepancy regarding the cable separation.

Divisional and non-divisional instrumentation and control cables (associated with level switches) have been terminated in Auxiliary Instrument Room Panels 1-R-127 and 1-R-131 on the same terminal blocks next to each other without adequate separation. Separation Design Criteria WB-DC-30-4 provides reference for separation of internal panel wiring on terminal blocks to Design Criteria WB-DC-40-25, which was inactivated on February 27, 1979. Reference to applicable design drawings 47W605 series is not valid since Dwg. 47W605-1 thru -43 do not provide any clarification on separation criteria either.

TVA has not responded to this DR.

The inspector questioned that the checklist did not identify any requirement for verifying the response time of the instrument. S&L provided the TVA document which identified that instrument response time is evaluated together with instrument setpoint and accuracy calculation. Based on this, the inspector's review found the activities associated with this MEV including the checklists and DR were adequate.

- EEV-0405-025, Associated DR 119.

This checklist was developed to address the design of electrical controls.

DR 119 identified the following discrepancy regarding the excitation, regulation and/or control equipment:

In FSAR, Section 8.3.1.1 (Page 8.3.11) all automatic and emergency diesel generator start-signals will operate a lock out relay that removes all manually operated signals except emergency stop, and all protective relaying circuits except generator differential voltage.

Contrary to this, TVA drawing 45W760-211-4 indicates in the trip circuit for the emergency feeder breakers, 1912, 1914, 1922, and 1924, that a contact from lockout relay 86/GA will activate to trip these breakers on generator overcurrent. The subject DR identifies a discrepancy with the note on the drawing and the actual circuits which are designed correctly to meet the FSAR requirement.

TVA responded with a RR stating that this is a VSRT identified discrepancy but the discrepancy is not design or safety significant. TVA has issued a DCN-P-02231-A on October 25, 1988 to remove the conflicting notes on drawing 45 W760-211-4.

S&L completed a CR and stated that they agree with the future action proposed by TVA.

The inspector's review found the activities associated with this Electrical Engineering Verification, the DRs, RRs and CRs were adequate.

- EEV-2102-001, Associated DR 298

This checklist was developed to address the design adequacy of cable separation.

DR 298 identified the following discrepancy regarding the electrical separation:

FSAR Section 8.3.1.4.6, Page 8.3-52, states that a minimum of 6 inches of air space or a metal barrier separate redundant Class 1E wiring within control panels. Panels 1-R-47 and 1-R-50 contain redundant wiring, and Drawings 45N1676-3 and 45N1677-3 state that the wiring should be separated but the 6-inch air space or metal barrier requirement is not included, therefore, it cannot be verified that the separation criteria is being met.

TVA has not responded to this DR.

The inspector's review found the activities associated with this EEV, including the checklist and DR were adequate.

The final resolution and completion for this DR remains open pending actions by TVA and S&L.

c. Review of Mechanical Engineering Verification (MEV) Activities (Instrumentation, HVAC Supports) For The VSR.

The inspector selected six MEV checklists and associated DR's on instrumentation to review for EV adequacy, and to determine if adequate identification and disposition of nonconforming conditions had occurred.

- MEV-0702-004, Associated DR 91

This checklist was developed to address the design of instrument installation on local panels.

DR 91 identified that radiation recorder 1-RR-90-123 is located on panel 0-M-12 above other safety-related equipment and there is no indication it is mounted seismically to prevent it from falling on other safety-related equipment.

TVA has not responded to this item.

The inspector's review found the activities associated with this MEV, including the checklist and DR were adequate.

The final resolution and completion for this DR remains open pending action by TVA and S&L.

- SEV-0901-003, Associated DR 52.

This checklist was developed to address the design of pipe and instrumentation supports.

DR 52 identified that the adequacy of calculations for pipe support anchor details shown on drawing 47A051-42, 42A, 42B, and

43C cannot be verified because of inconsistency between drawing details and design calculation.

TVA has not responded to this item.

The inspectors review found the activities associated with this SEV, including the checklist and DR were adequate.

The final resolution and completion for this DR remains open pending action by TVA and S&L.

- MEV -0705-001, 002, Associated DR 92

DR 92 identified that instrument lines are not separated as required.

TVA has not responded to this item.

The inspectors review found the activities associated with this MEV, including the checklist and DR were adequate.

The final resolution and completion for this DR remains open pending action by TVA and S&L.

- SEV -0901-01, Associated DR 26.

This checklist was developed to address the design of instrumentation supports.

DR 26 identified three discrepancies associated with instrumentation supports.

- a) The impact of self weight excitation, if ignored, may result in stress above code allowables.
- b) In the design of this expansion anchor plate, ignoring the effect of shear due to torsional loading and direct shear, may result in inadequate design.
- c) If the corner effect for all around welds is considered, the length and section modules of the welded connections are reduced by 5% to 6%. This may result in weld stresses exceeding the design allowables.

TVA has not responded to this item.

The inspector's review found the activities associated with this SEV, including the checklist and DR were adequate.

The final resolution and completion for this DR remains open pending action by TVA and S&L.

- MEV-2101-001, Associated DR 262.

This checklist was developed to address the design of HVAC systems.

DR 262 identified that a failure of manual damper 0-31-2114 to function as required during an accident would prevent the Control Building Emergency Pressurization Fan from delivering the necessary outside airflow to maintain the control room at positive pressure required for habitability of the control room. TVA could not provide copies of the contracts and vendor data/drawings for this damper.

TVA responded with a Resolution Report (RR) stating this is a nondiscrepant condition because the records were found. This isolation valve was transferred from the cancelled Hartsville Nuclear Plant.

S&L completed a Completion Report (CR) and stated the condition is nondiscrepant because TVA has provided all necessary documentation for the subject valve.

The inspector's review found the activities associated with this MEV, including the checklist, DR, RR, and CR, were adequate.

- MEV-1515 Associated DR 260

This checklist was developed to address the design of instruments, including flow controls.

DR 260 identified that the Control diagram shows that flow indicating switch FIS-70-81 provides a control signal to thermal barrier isolation valves FCV-70-133 and -134. Contrary to this, the loop elementary diagram shows that the thermal barrier isolation signal comes from differential flow switches FDS-70-81B and -81E. FIS-70-81 has not been shown on either the loop elementary diagram or the Instrument Tabulation.

TVA responded with a RR stating this is a nondiscrepant condition because the cited drawings do have consistency and it appears S&L made some assumptions regarding logic ties that are incorrect.

S&L completed a CR and stated they agree this is a nondiscrepant condition and TVA has clarified the logic ties on the referenced drawings.

The inspector's review found the activities associated with this MEV, including the checklist, DR, RR, and CR were adequate.

d. Review of Construction Verification (CV) Activities For the VSR

The inspector selected two CV checklists and associated DRs on instrumentation to review for CV adequacy, and to determine if adequate identification and disposition of nonconforming conditions had occurred.

- MCV-0702-003, Associated DR 97.

This checklist was developed to address the construction installation adequacy of instruments.

DR 97 identified that the mounting installation of the instrument is not as required by the referenced drawings. TVA has not responded to this item.

The inspector's review found the activities associated with this MCV, including the checklist and DR were adequate.

The final resolution and completion for this DR remains pending action by TVA and S&L.

- MCV-0702-004, Associated DR 98.

This checklist was developed to address the construction installation adequacy of instruments.

DR 98 identified the numerical units identification for the range of this instrument was not imprinted on the face of the instrument as required. TVA has not responded to this item.

The inspector's review found the activities associated with this Mechanical Construction Verification, including the checklist and DR were adequate.

The final resolution and completion for this DR remains pending action by TVA and S&L.

e. Review of Records Verification (RV) Activities For The VSR

The inspector selected one RV checklist and associated DR on instrumentation to review for RV adequacy, and to determine if adequate identification and disposition of nonconforming conditions had occurred.

- MRV-0801-001, Associated DR 137.

This checklist was developed to address the retrievability and accuracy of construction records.

DR 137 identified the installed quality of this instrument line is indeterminate because there is no indication installation inspection was performed.

TVA responded with a RR and stated this appears to be a nondiscrepant condition because instrument line inspections were performed in accordance with the procedures in effect at the time of installation.

S&L completed a CR and stated TVA's response is unacceptable and TVA should provide a revised copy of QCP 3.11 and document verification of pipe attributes, and address the extent of the condition.

The inspector's review found the activities associated with this Mechanical Records Verification, including the checklist, DR, RR, and CR, were adequate.

f. Review of Personnel Qualification For S&L Engineering Performing VSR Activities

The inspector reviewed selected individuals employed by S&L that participated in the engineering verification (EV) activities of the VSR. This review included verifying each individual had completed a questionnaire form which indicated any prior involvement of TVA's Watts Bar activities. Where prior involvement was indicated, the inspector reviewed TVA's position relative to placing restrictions or disallowing the individual to participate in the VSR. The inspector also verified the individual's area of review was consistent with his formal training and prior experience. The following listed positions were reviewed.

- Control and Instrumentation Engineer. The records indicate TVA has accepted this individual to work on the VSR with the restriction that he shall not participate as an independent reviewer in the area of electrical calculations.
- Mechanical System, Mechanical Project Engineer. The records indicate TVA accepted this individual without restrictions to participate in the VSR.
- Engineering Verification Manager. This individual served as the S&L Project Manager for the Calculation Program for TVA from March 1987 to May 1988. In this position, he provided administration of personnel who developed electrical calculation methodology and procedures, as well as training for TVA personnel in their use. Approximately 125 manhours were expended by him on this effort. This project included development of procedures and training in electrical calculations at WBN. These procedures were not implemented for engineering work that resulted in construction or installations, or their designs, which are subject to review by the vertical slice review (VSR). He also was involved in the project management for a task to perform design work in response to Reg. Guide 1.97 from March 1987 to May 1988. Approximately 125 manhours were

expended by him on this effort. This effort by S&L was terminated by TVA before completion and another approach decided upon. Therefore, results from this work have not been incorporated into designs or installations at WBN. Because the Electrical Calculations Program is subject to VSRT review as a Group B Program, the TVA and contractor determined this individual should be restricted from performing independent reviews of this program, influencing the decisions of other reviewers, or making decisions about its acceptability.

- QA Coordinator

The individual assigned to this position acquired a BSME in 1971 and has worked with S&L since then. He has been QA coordinator since early 1983 on various nuclear projects. Prior to that he has worked at various positions including mechanical project engineer, supervisor-stress analysis. He had no prior involvement with WBN. TVA has accepted this individual without any restrictions based on the questionnaire on June 23, 1988.

- Senior Electrical Project engineer

The individual assigned to this position acquired a BSEE in 1974. He has worked with S&L from 1974 to 1981 and 1985 to present. He was responsible for various aspects of electrical design for a nuclear power plant. He was also assigned to special projects responsible to address CAT inspection concerns. He has no prior involvement with WBN. TVA has accepted this individual for VSR without any restriction based on the questionnaire on June 23, 1988.

- Control and Instrumentation Project Engineer

The individual assigned to this position acquired a MSME in 1960. He has worked with S&L since 1978 on various nuclear projects. Prior to that, he worked on various mechanical system designs. He worked briefly on WBNP for RG 1.97 evaluation, however, no design work was performed. TVA has accepted this individual for VSR without any restriction based on the questionnaire on June 23, 1988.

- Project Manager, VSR

This individual's formal education was in the field of mechanical engineering with a bachelor of science degree. He has extensive experience in that field and in project management for fossil and nuclear powered electric generating facilities. Experience in nuclear plants has involved two domestic facilities and one foreign facility. He has had progressively more responsible positions and was assessed by TVA to be fully qualified for the position as the project manager for the VSR.

- Project Engineer, Special Horizontal Review Topics, VSR

The individual had formal training as a structural engineer, receiving a bachelors and masters degree in that field. He has worked his entire career on electric generation facilities including both fossil and nuclear. The nuclear involvement totals four separate plants in the midwest. During these project assignments he has shown a steady progression into the management structure both in his technical specialty as well as in the project management aspects of a large, multidisciplined project.

- Senior Structural Engineer, Design, VSR.

This individual has two doctorates in structural engineering/ structural mechanics and extensive design and analysis experience in heavy industrial fossil power plants as well as nuclear plants in the specific areas of civil-structural design.

- Structural Engineer, Special Horizontal Review Topics, VSR.

The individual received formal training in civil engineering and has worked in the area of civil engineering and structural engineering on nuclear powered facilities.

The inspector determined the individuals reviewed were qualified for the job assignments on the VSR effort.

g. Internal Quality Assurance Audits of The Vertical Slice Review

The inspector reviewed the internal QA Audits conducted by S&L Quality Assurance and TVA's Engineering Assurance of the contractors, S&L and Fluor Daniel, Inc., activities on the Vertical Slice Review. The audits listed below constitute the extent of QA Audits conducted for the Engineering Review (ER) portion of the VSR.

- (1) Sargent and Lundy QA Audit, Number A-3AC-2 was conducted on August 23-26, 29-31, 1988 at S&L Chicago, Illinois office and Watts Bar Nuclear Site. The purpose of the audit was to investigate the compliance of the Watts Bar Vertical Slice Review with, and the effectiveness of, the QA requirement documents for the current activity on the project, especially as reflected in documents contained in the Watts Bar Vertical Slice Review Project Manual, and the pertinent S&L QA procedures. No nonconformances were identified by this audit.
- (2) Sargent & Lundy QA Audit A-3AC-FD conducted on September 27-28, 1988, at the Watts Bar site. The purpose of the audit was to evaluate the implementation of the Fluor Daniel QA Program Manual, Project Procedures, particularly in application to

inspection services performed for Sargent & Lundy's Vertical Slice Review of the Watts Bar Nuclear Plant. No nonconformances were identified by this audit.

- (3) Sargent & Lundy QA Audit A-3AC-2 conducted on September 27 - 30, October 3-5, 19-31, 1988, at S&L Chicago, Illinois office and Watts Bar Nuclear site. The purpose of the audit was to investigate the compliance of the Watts Bar Vertical Slice Review Program. No nonconformances were identified by this audit.
- (4) Tennessee Valley Authority EA Audit 88P-91 conducted on September 13-16, 19-21, 1988, at S&L's Chicago, Illinois office and continued at the Watts Bar facility. The purpose of the audit was to determine the adequacy of the engineering services performed by S&L in meeting the task oriented contractual requirements described in the S&L Vertical Slice Review Project Manual.

The audit identified one deficiency in the methods and completeness of filling out the Engineering Verification (EV) checklists. At the exit meeting, S&L committed to perform corrective actions that included retraining of the entire EV group that complete checklists and a re-check of all previously completed checklists to provide corrections as needed. The retraining was completed on September 16 and 21, 1988. The re-review and corrections of previously generated checklists was completed by September 28, 1988. On September 28, 1988, the audit team leader participated as an observer to the S&L internal QA audit of VSR activities at the Chicago offices and verified the satisfactory implementation of the training plan and completion of the checklists. During this audit, it was noted that three structural engineering verification checklists were not corrected to the guidelines described in the VSR checklist completion training plan dated September 19, 1988. Newly issued EV checklists are being prepared to these standardized guidelines.

TVA EA plans one additional audit at Chicago in early 1989 to verify S&L's trending and final report process and follow up on the previously identified deficiencies discussed above.

The inspector reviewed the findings of the listed audits and found the audit activities acceptable.

## 12. List of Abbreviations Unit 1 and 2

CAP	Corrective Action Program
CAT	Construction Assessment Team
CCW	Component Cooling Water

CR	Completion Report
CV	Construction Verification
DR	Discrepancy Report
EEV	Electrical Engineering Verification
ER	Engineering Review
EV	Engineering Verification
FSAR	Final Safety Analysis Report
HEV	Horizontal Engineering Review
IDR	Independent Design Review
IDVP	Independent Design Verification Program
IRC	Internal Review Committee
MEV	Mechanical Engineering Verification
MRV	Mechanical Records Verification
OR	Observation Report
OSP	Office of Special Projects
QA	Quality Assurance
RR	Resolution Report
RV	Records Verification
S&L	Sargent & Lundy
SEV	Structural Engineering Verification
URI	Unresolved Item
VSR	Vertical Slice Review
VSRT	Vertical Slice Review Team
WBPT	Watts Bar Program Team
WBNP	Watts Bar Nuclear Plant

TABLE 1

## NUMBER OF DISCREPANCY REPORTS BY CATEGORY

Results of Mechanical Engineering  
Verification (MEV)

Category	No. of DRs
CC System Function	4
Heat Exchangers	2
Piping	15
Valves	21
Tanks	5
HVAC	19
Pumps	4
Instruments	12
Equipment	13
Qualification	
Total No. of DRs	<u>95</u>

Electrical Engineering  
Verification (EEV)

Category	No. of DRs
Cable/Conduit	10
Emergency	15
Auxiliary Power	
Panel/Boards	2
DC and Inst. Power	5
Batteries	4
Inverters/Chargers	2
Switchgear/MCC	3
Separation	3
Penetrations	3
Motors/Generators	8
Transformers	2
System Design	3
Total No. of DRs	<u>60</u>

Results of Structural Engineering  
Verification (SEV)

Category	No. of DRs
Concrete Structures	10
Buried Piping	4
HVAC Ducts	3
Equipment Foundation	5
Structural Steel	4
Pipe Whip Restraints	4
Cable Tray and Conduit	6
Walls	2
Seismic Analysis	3
Piping Supports	8
Total No. of DRs	<u>49</u>

Results of Horizontal Engineering  
Review (HEV)

Category	No. of DRs
Control Room	16
Habitability	
High Energy Line	8
Break	
Fire Protection	10
Total No. of DRs	<u>34</u>

Results of Records  
Verification (RV)

Category	No. of DRs
Personnel	88
Certification/	
Qualification	
Inspections Not	16
Performed or	
Records Missing	
Noncompliance to	15
Procedures in Effect	
Total No. of DRs	<u>119</u>

Results of Construction  
Verification (CV)

Category	No. of DRs
Cable	16
Raceways and Supports	67
HVAC	30
Mechanical Equipment	28
Fire Protection	17
Structural Steel	20
Instrumentation	39
Pipe Supports	11
Electrical Equipment	33
Instrumentation	39
Pipe Supports	11
Electrical Equipment	33
Walls	4
Valves	20
Total No. of DRs	<u>285</u>

Grand Total No. of DRs - 632