



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**
REGION II
245 PEACHTREE CENTER AVENUE NE, SUITE 1200
ATLANTA, GEORGIA 30303-1257

December 14, 2011

Mr. Michael D. Skaggs
Senior Vice President
Nuclear Generation Development and Construction
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

**SUBJECT: WATTS BAR NUCLEAR PLANT UNIT 2 CONSTRUCTION - NRC INSPECTION
REPORT 05000391/2011612**

Dear Mr. Skaggs:

On November 18, 2011, the U.S. Nuclear Regulatory Commission (NRC) completed a team inspection of construction activities at your Watts Bar Unit 2 reactor facility. The enclosed inspection report documents the inspection results, which were discussed on November 18, 2011, with Mr. David Stinson and other members of your staff.

The NRC team performed an Electrical Distribution System Functional Inspection (EDSFI) using selected portions of NRC Temporary Instruction (TI) 2515/107. This inspection examined activities conducted under your Unit 2 construction permit as they relate to safety and compliance with the Commission's rules and regulations, with the conditions of your construction permit, and with fulfillment of Unit 2 regulatory framework commitments. The inspectors reviewed selected procedures and records, observed activities, and interviewed personnel.

Based on the results of this inspection, no findings or violations of significance were identified.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Sincerely,

/RA/

Mark S. Lesser, Chief
Construction Inspection Branch 1
Division of Construction Inspection

Docket No. 50-391
Construction Permit No: CPPR-92

Enclosure: Inspection Report 05000391/2011612 w/attachment

cc w/encl: (See page 3)

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

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PUBLICLY AVAILABLE

NON-PUBLICLY AVAILABLE

SENSITIVE

NON-SENSITIVE

ADAMS: Yes ACCESSION NUMBER: ML11348A081

SUNSI REVIEW COMPLETE FORM 665 ATTACHED

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| OFFICE | RII:DCI | RII:DCI | RII:DCI | RII:DCI | RII:DCP | RII:DCP | |
| SIGNATURE | RXM3 | GWM1 viaemail | GXC2 | CAJ via email | CJE | RCH | |
| NAME | R. Mathis | G Morris | G Crespo | C Julian | C Even | R Haag | |
| DATE | 12/8/2011 | 12/8/2011 | 12/8/2011 | 12/14/2011 | 12/12/2011 | 12/14/2011 | 12/ /2011 |
| E-MAIL COPY? | YES NO | YES NO | YES NO | YES NO | YES NO | YES NO | YES NO |

OFFICIAL RECORD COPY DOCUMENT NAME: G:\CC\DCI\CIB1\WATTS BARIWATTS BAR INSPECTION REPORT
05000391 2011612 EDSFI (DRAFT).DOCX

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Letter to Michael D. Skaggs from Mark S. Lesser dated December 14, 2011

SUBJECT: WBN NUCLEAR PLANT UNIT 2 CONSTRUCTION - NRC INSPECTION
REPORT 05000391/2011612

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PUBLIC

NUCLEAR REGULATORY COMMISSION

REGION II

Docket No.: 50-391

Construction Permit No.: CPPR-92

Report No.: 05000391/2011612

Applicant: Tennessee Valley Authority (TVA)

Facility: Watts Bar Nuclear Plant, Unit 2

Location: 1260 Nuclear Plant Rd
Spring City TN 37381

Dates: October 24 – November 18, 2011

Inspectors: Caudle Julian, Team Leader, Construction Inspection
Branch 1 (CIB 1), Division of Construction Inspection (DCI)
Region II (RII)
G. Crespo, Senior Construction Inspector, CIB1, DCI, RII
R. Mathis, Construction Inspector, CIB1, DCI, RII
C. Even, Project Inspector, Construction Projects Branch 3
(CPB 3), Division of Construction Projects (DCP), RII
G. Morris, Consultant

Approved by: Mark S. Lesser, Chief
Construction Inspection Branch 1
Division of Construction Inspection

EXECUTIVE SUMMARY

Watts Bar Nuclear Plant, Unit 2

This inspection included aspects of engineering activities performed by TVA associated with the Watts Bar Nuclear (WBN) Plant Unit 2 construction project. This report covered a two week period of inspection in the area of Electrical Distribution System Functional Inspection (EDSFI) as specified in NRC Temporary Instruction (TI) 2515/107. The inspection program for Unit 2 construction activities is described in NRC Inspection Manual Chapter (IMC) 2517. Information regarding the WBN Unit 2 Construction Project and NRC inspections can be found at <http://www.nrc.gov/reactors/plant-specific-items/watts-bar.html>.

Inspection Results

The inspectors assessed the capability of the Electrical Distribution System (EDS) to perform its intended safety function during plant operating and accident conditions. The inspectors reviewed electrical calculations and analyses associated with cable ampacity, voltage analysis, load flow, transformer sizing, circuit protection & coordination, vital battery system, and emergency diesel generator loading. The inspectors interviewed responsible engineering staff to confirm understanding of records. The inspectors determined that in general the calculations were complete, understandable, and technically adequate.

No violations of regulatory requirements were identified.

REPORT DETAILS

II. Management Oversight and Control

E.1 Engineering Activities

E.1.1 (Closed) EDSFI Temporary Instruction (TI) 2515/107

a. Inspection Scope

Background: In 1979, the NRC published Generic Letter (GL) 79-36 to ask licensees to examine undervoltage protection of safety related electric equipment for potential damage as a result of sustained degraded voltage from the offsite electric grid system. This generic letter was issued in response to events at a number of operating nuclear plants that brought into question the conformance of the station electric distribution system to 10 CFR 50, Appendix A – General Design Criteria – 17, Electric Power Systems. TI 2515/107 – EDSFI was issued on October 19, 1990 to provide a comprehensive NRC team inspection focused primarily on the EDS at operating nuclear plants to address the concerns raised by the Safety System Functional Inspections performed between 1986-1990 and Generic Letter 79-36. This inspection performed a portion of TI 2515/107 at Watts Bar 2.

Using the guidance of TI 2515/107, the inspectors examined the electrical distribution system with focus on the path supplying Shutdown Board 2B-B. The inspectors reviewed available design basis information and conducted plant walk-downs as necessary to assess the capacity of the electrical distribution system to perform its safety functions.

The inspectors assessed the capability of the EDS to perform its intended safety function during plant operating and accident conditions and reviewed design basis calculations for the EDS to evaluate whether they were coherent, accurate, and complete for supporting dual unit operation. The inspectors reviewed the calculations documenting the loading on various electrical sources such as emergency diesel generators, batteries, and shutdown boards. Specifically the inspectors performed detailed review of 11 electrical calculations focusing on cable ampacity, voltage analysis, load flow, transformer sizing, circuit protection & coordination, vital battery system, and diesel generator loading. The complete list of electrical calculations reviewed is included in the supplemental information at the end of this report. The inspectors also reviewed Final Safety Analysis Report (FSAR) descriptions, design specifications, drawings, system descriptions, and other design documents to support the assessment of the EDS design. The inspectors reviewed selected referenced supporting calculations to confirm selected design inputs and assumptions. The inspectors interviewed responsible personnel, performed field walk-downs, and observed software analysis. The supplemental information attachment also includes a list of the documents reviewed in support of the inspection.

The inspection team reviewed the design inputs used in TVA's Electrical Transient Analyzer Program (ETAP) from the emergency diesel generators (EDGs) loading calculation to verify that the ETAP program matched the assumptions and conclusions of the calculation in dealing with the time zero loads in the EDG loading sequence. The

inspection team's review of the EDG design calculation focused on the loads that are started at time zero in the loading sequence to verify that all design loads were appropriately captured and analyzed in ETAP. The inspectors took a sample of the time zero components and performed walk-downs of those components to gather nameplate data to verify that the components modeled in ETAP were the same as the components in the plant.

The inspectors interviewed responsible engineering staff to address questions generated from the review of the engineering documentation. The inspectors also reviewed surveillance and test procedures for the 125V DC vital power system and the 125V DC diesel generator system.

The inspectors confirmed that discrepancies found during this inspection were included by the applicant in their corrective action program. A list of the Problem Evaluation Reports (PERs) resulting from this inspection is included in supplemental information attached to this report.

b. Observations and Findings

No findings of significance were identified.

During the review of the DC vital power system, the inspectors found that Battery IV was degraded and there was evidence of problems from the results of the February 2011 performance test that had not been entered into the corrective action program. This issue was followed up by the Unit 1 NRC Senior Resident Inspector for operability concerns and will be appropriately documented in a subsequent inspection report for Unit 1.

The team determined that Degraded Voltage Relay settings and the associated degraded voltage analysis calculation is the subject of Open Item 30 in Appendix HH of NUREG-0847, Supplement 22. This issue will be resolved by the Office of Nuclear Reactor Regulation and was not inspected.

c. Conclusions

The inspectors determined that in general the calculations reviewed were complete, understandable, and technically adequate.

IV. OTHER ACTIVITIES

OA.1.1 (Discussed) Construction Deficiency Report (CDR) WBRD-50-391/86-13, entitled Lack of Adequate Calculations to Document Electrical System Design Basis

a. Inspection Scope

The inspectors followed up on TVA resolution of Construction Deficiency Report (CDR) WBRD-50-391/86-13, entitled Lack of Adequate Calculations to Document Electrical System Design Basis and an associated Action Item 7 in Appendix HH of SSER 22. TVA initiated PER 144072 on February 3, 1989 associated with this issue. The inspectors examined the existing inventory of issued Unit 2 electrical design calculations

and compared it to TVA NPG Standard Department Procedure NEDP-2, Design Calculation Process Control, Revision 15, Appendix E, Electrical/I&C Engineering Calculation Classifications. The purpose was to confirm that all TVA specified essential electrical and I&C calculations have been prepared and issued.

b. Observations and Findings

TVA's method of resolving the CDR was to establish a list which identifies a minimum set of Electrical and Instrumentation and Control (I&C) calculations necessary to fully document the design basis of a TVA nuclear plant. The list was first issued as a memo for electrical branch direction on July 17, 1987, and contained essential and desirable calculations. The content of that list was subsequently issued as Appendix E, Electrical/I&C Engineering Calculation Classifications of TVA NPG Standard Department Procedure NEDP-2, Design Calculation Process Control, Revision 15. TVA calculations are now organized and controlled by the Calculation Cross Reference Information System (CCRIS) computer system. The inspectors examined an index of calculations from CCRIS and found that most of the topics listed in Appendix E had corresponding calculations issued. However the inspectors could not find calculations listed for all of the topics under the headings of Raceway System Calculations or Instrumentation and Control System Calculations. TVA representatives stated that they needed to do more work on this item before it is ready for NRC review and closure and they initiated PER 458200 to track corrective action on this item. No findings of significance were identified.

c. Conclusion

TVA representatives concluded that this item requires more work before it is ready for NRC review and closure and they initiated PER 458200 to track corrective actions. Additional NRC inspection is required to close this item when TVA work is complete.

OA.1.2 (Closed) Unresolved Item 05000391/2011606-01, Ninth Example, Electrical Design Issues Requiring Additional Review

a. Inspection Scope

This unresolved item contained nine examples of electrical issues requiring further inspection to determine if a violation existed. The ninth example concerned a lack of information in calculation EDQ00099920080014, Rev. 8, Diesel Generator Loading Analysis. During this inspection inspectors reviewed Revision 14 of that calculation.

b. Observations and Findings

No findings of significance were identified

The inspectors determined that the essential information was included and the calculation was technically acceptable.

The inspectors concluded that the failure to include information in previous revisions was a minor violation.

c. Conclusion

The ninth example of this unresolved item is closed.

V. Management Meetings

X.1 Exit Meeting Summary

On November 18, 2011, the inspectors presented the inspection results to Mr. David Stinson and other members of his staff. The inspectors confirmed that no proprietary information was reviewed during this inspection or included in this inspection report.

SUPPLEMENTAL INFORMATION

Partial List of Persons Contacted

Applicant personnel

A. Bangalore, Electrical Design Manager, Bechtel
D. Beckley, Electrical Design Engineer, TVA Unit 2
D. Charlton, Licensing, TVA
W. Elliott, TVA Oversight
S. Hilmes, Unit 2 Lead Electrical Engineer, TVA
I. Khan, Electrical Engineer, Washington Group
G. Scott, Licensing, TVA
D. Stinson, Vice President, TVA Unit 2

Inspection Procedure Used

TI 2515/107, Electrical Distribution System Functional Inspection (EDSFI)

List of Items Opened, Closed, and Discussed

Closed

| | | |
|-------------------------|-----|--|
| 2515/107 | TI | EDSFI - Assess the capacity of the EDS to perform its intended functions during all plant operating and accident conditions. (Section E.1.1) |
| 2011606-01 (Example #9) | URI | Diesel Generator Loading Analysis - Electrical Design Issues (Section OA.1.2) |

Discussed

| | | |
|-------------|----------------------|---|
| 86-13 | CDR | Inadequate calculations to document electrical system design basis (Section OA.1.1) |
| Open Item 7 | SSER-22 (App. HH) | Inadequate calculations to document electrical system design basis (Section OA.1.1) |

List of Documents Reviewed

Problem Evaluation Reports Generated During This Inspection

PER 458200, NRC identified that not all calculations listed in NEDP-2, Appendix E can be found in CCRIS
 PER 462617, NRC identified discrepancies in calculation EDQ00299920080016, Rev. 5
 PER 464997, NRC identified unanalyzed load in calculation EDQ00099920080014, Rev. 14
 PER 463429, NRC identified "Calculation of Record" contradiction in calculation EDQ00023620070003, Rev. 12
 PER 463512, NRC identified incorrect test result value in 1-EI-82-40A
 PER 464992, NRC identified errors contained in Unit 2 protection and coordination calculations

Calculations

EDQ00299920080016, 6.9 kV Protection and Coordination Calculation, Rev. 5
 EDQ00299920080004, 480V Class 1E Protection, Coordination and Thermal Overload Heater Calculation – Unit 2, Rev. 12
 EDQ00023620070003, 125V DC Vital Battery System Analysis, Rev. 12
 EDQ00223620080011, 125V DC Vital Power Control Voltage Analysis - Unit 2, Rev. 6
 EDQ00299920080003, Class 1E MCC Control Circuit Voltage Analysis and Transformer Sizing, Rev. 4
 EDQ00299920080010, 120VAC Vital Power Load Flow and Voltage Drop Analysis, Rev. 9
 EDQ00099920080014, Diesel Generator Loading, Rev. 14
 EDQ00099920070002, AC Auxiliary Power System Analysis, Rev. 21
 EDQ00299920080006, Unit 2 Class 1E V3 Cable Ampacity, Rev. 11
 EDQ00299920080002, Unit 2 Class 1E V4 Cable Ampacity, Rev. 17
 EDQ00299920080001, Unit 2 V5 Cable Ampacity, Rev. 6
 WBNEEBMSTI070018, 120 VAC Short Circuit Coordination Study and Protection to examine the coordination and protection of 120 volt safety related circuits, Rev. 81
 WBNEEBMSTI070005, Identifies time-current curves for battery boards I-IV on sheets 84, 85 and 86 or TCC-10, 11, & 12, Rev. 49

Technical Manuals

GE Relay Instruction Manual GEK-34053G Time Overcurrent Relays IAC51.

Drawings

1-45W760-68-3, R12 - Unit 1, Wiring Diagram, Reactor Coolant System, Schematic Diagrams
 1-45W724-4, R21 – Units 1 & 2, Wiring Diagrams, 6900V Shutdown Board 2B-B, Single Line
 45B2766-2E Rev. 5, FCR Number 55769-A page 104 / EDCR Number 53287-A page 141
 45B2766-17F Rev. 3, FCR Number 55769-A page 147 / EDCR Number 53287-A page 188

Miscellaneous

Electrical Design Guide DG-E7.1.2 Rev. 0 Titled: Protective Relay System Design for AC Auxiliary Power System, Section 2.1.3.1 Induction Motors
 Surveillance Procedure 0-SI-82-3, Rev. 0048 WBN Unit 0, 18 Month Loss of Offsite Power With Safety Injection – DG 1A-A, Section 6.2 ESF Actuation – Offsite Power Available
 DNE Calculation E31850221300, Rev. 4 – 6.9 kV Shutdown Board Normal and Alternate Feeders with EBASCO recommendation letter of February 6, 1992 EB-ALS-92-021; Subject: Watts Bar Nuclear Plant 6.9 kV Board Feeder Relay Settings (DCN M-12051)
 EDCR 53287 associated with the replacement of obsolete and replacement circuit breakers type ITE model EF3 and FJ3.

EDCR 54172 for the resolution of a number of motor protection settings and cable sizes
 EDCR 55229 for the replacement of a number of motor feeders that had been undersized
 EDCR 53287, Rev. A Section 6.1.7 Obsolete and Replacement Circuit Breakers
 PEG Package No. 2008-94001, Inverter Specification
 0-MI-235.002, 120 V AC Vital Inverter Automatic Transfer Test
 DS-E12.6.3, Auxiliary and Control Power Cable Sizing, Up to 15,000 Volts, Rev.10
 Integrated Cable and Raceway Design System (ICRDS) Software Requirements Specification,
 Rev. 5
 WB-DC-30-28 titled: Low and Medium Voltage Power Systems, Section 2.10 Protection
 WBN-EEB-ED-Q000-999-2007-0002, Power System Analysis, Rev. 0
 NEDP-2, Design Calculation Process Control, Rev. 15
 WBRD-50-391/86-13, Lack of Adequate Calculations to Document Electrical System Design
 Basis

List of Acronyms

| | |
|-------|--|
| CCRIS | Calculation Cross-Reference Information System |
| CDBI | Component Design Basis Inspection |
| CDR | Construction Deficiency Report |
| CFR | Code of Federal Regulations |
| DC | Direct Current |
| DCN | Design Change Notice |
| EDCR | Engineering Document Construction Release |
| EDG | Emergency Diesel Generator |
| EDS | Electrical Distribution System |
| EDSFI | Electrical Distribution System Functional Inspection |
| ETAP | Electrical Transient Analyzer Program |
| FSAR | Final Safety Analysis Report |
| GL | Generic Letter |
| IMC | Inspection Manual Chapter |
| IP | Inspection Procedure |
| KV | Kilovolts |
| MCC | Motor Control Center |
| NRC | Nuclear Regulatory Commission |
| PER | Problem Evaluation Report |
| SSER | Supplement Safety Evaluation Report |
| SR | Service Request |
| TI | Temporary Instruction (NRC) |
| TVA | Tennessee Valley Authority |
| URI | Unresolved Item |
| VAC | Volts Alternating Current |
| VDC | Volts Direct Current |
| WBN | Watts Bar Nuclear Plant |