UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W., SUITE 2900
ATLANTA, GEORGIA 30323-0199

Report Nos.: 50-390/95-22 and 50-391/95-22

Licensee: Tennessee Valley Authority
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1101 Market Street
Chattanooga, TN 37402-2801

Docket Nos.: 50-390 and 50-391 License Nos.: CPPR-91 and CPPR-92

Facility Name: Watts Bar Nuclear Plant Units 1 and 2

Inspection Conducted: August 7 - 11, 1995

Inspector: MB Shymlock for 9-8-95
P. Fillion Date Signed

Accompanying Personnel: G. MacDonald, Inspector; M. Shymlock, Section Chief

Approved by: Caudle Julian 9/6/95
C.A. Julian, Chief Date Signed
TVA Startup Branch
Division of Reactor Projects

SUMMARY

Scope:

This routine, announced inspection was conducted in the area of engineering.

Various electrical design topics were reviewed for compliance with regulations and industry standards. The topics reviewed fall into the following system functional areas:

* Coordination and protection in the AC Distribution System

* Calculation of voltage in the AC Distribution System and AC control circuits

* Breaker control and protective relay logic

Results:

Overall, the applicants performance was good. However, one violation and some weaknesses were identified. Findings arranged by system functional area are summarized as follows:

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Coordination and protection in the AC Distribution system

* One violation was identified for failure to provide selective coordination among ground fault relays at the 6.9 kV safety-related buses when the system is aligned to the alternate feeder. The inspectors identified the coordination problem. The applicant had not been aware of the problem, which apparently resulted from discrepancies in the calculations. The safety significance of the coordination problem was that, should a ground fault occur on any 6.9 kV feeder, the entire bus would be deenergized rather than only the faulted feeder. This violation was very similar to Violation 95-08-01 in that both violations involved a discrepancy between design documents. Paragraph 2.1.1.

* The transformer differential scheme could have been better analyzed. The documented analysis did not address all standard design considerations, although they were resolved during the inspection. The consideration of saturation of current transformers due to excitation by the direct current component of transient current (DC saturation) is a special consideration that should have been addressed because it was the subject of a previous NRC Information Notice. The issue was not resolved, and, therefore, an Inspector Follow-up Item was identified. Paragraph 2.1.2.

* The analysis of motor protection was a weakness. Paragraph 2.1.3.

* Based on relay and transformer test data reviewed, as well as inspection of the installed relays, equipment testing was considered a strength. Paragraphs 2.1 and 2.1.4.

Calculation of voltage in the AC Distribution System and AC control circuits

* An inspector follow-up item was identified to ensure Staff review of the applicant's evaluation of a special test aimed at validating the computer model used for voltage analysis. The test is specified in Branch Technical Position PSB-1. The applicant has collected the necessary data but has not evaluated the data, which involves running a load flow case with the computer program. Paragraph 2.2.1.

* The inspectors made a calculation of voltage in a motor control center (MCC) type control circuit. Results closely matched those in the applicant's calculation. Based on this review, the fact that Violation 95-08-01 was closed, and the review documented in NRC Inspection Report No. 95-08, the inspectors had confidence that voltage would be adequate for running the safety-related equipment during all design basis scenarios. This conclusion is contingent on obtaining good results from the PSB-1 test results mentioned above. Paragraphs 2.2.2 and 2.2.3.

Breaker control and protective relay logic

* The breaker control and protective relay circuits reviewed correctly implemented the design basis requirements. Paragraph 2.3.

REPORT DETAILS

1.0 Persons Contacted

1.1 Applicant Employees

*W. Elliott, Engineering Manager
E. Freeman, Startup Engineer
C. Mills, Supervisor, Transmission and Customer Systems
*G. Nicely, Senior Electrical Engineer
*P. Pace, Compliance Licensing Manager
J. Reynolds, Engineer, Transmission and Customer Group
*J. Scalice, Vice President, Watts Bar Nuclear
*R. Stockton, Licensing Engineer
R. Sullivan, Engineer, Transmission and Customer Systems

Other applicant employees contacted during this inspection included engineers and technicians.

1.2 NRC Employees

*P. Fredrickson, Branch Chief, TVA Construction
*J. Jaudon, Deputy Director for TVA Construction Project, Division of Reactor Projects
*J. Lara, Resident Inspector
*G. Walton, Senior Resident Inspector, Construction

*Indicates attended exit meeting.

Unusual acronyms and initialisms used throughout this report are listed in paragraph 3.0.

2.0 Electrical Distribution System Design Review

Watts Bar Nuclear Performance Plan, Volume 4, Revision 1, describes a Design Baseline and Verification Program. The purpose of this program was to ensure that essential or safety-related calculations exist, are technically adequate, and are consistent with the plant design configuration. Essential electrical system calculations were part of this program.

This inspection reviewed various electrical design topics for compliance with regulations and industry standards. The topics were chosen after consideration of the following:

* The Design Baseline and Verification Program

* Experience with electrical design inspections at other plants

* Previous inspection efforts at Watts Bar.

The electrical system design topics reviewed during this inspection are described in the following paragraphs.

2.1 Coordination and Protection in the AC Distribution System

FSAR Section 8.1.5.3, Compliance to Regulatory Guides and IEEE Standards, states that the plant is designed in full compliance with Regulatory Guide 1.32, (Safety Guide 32), Revision 0, Use of IEEE Std 308-1971, Criteria for Class 1E Electric Systems for Nuclear Power Generating Stations. IEEE Std 308-1971 states, in Section 5.2.6, that: "Protective devices shall be provided to isolate failed equipment automatically." Industry has interpreted this statement to mean protective devices shall isolate failed equipment and be applied such that a minimum amount of properly functioning equipment will be affected by operation of a protective device. This criterion is referred to as selective coordination. Demonstrating that equipment protection and selective coordination exist in the system is normally accomplished through coordination studies. Regulatory Guide 1.32 clarifies that the guidelines also extend to the offsite power supply equipment, which may be classified as non-safety-related. The FSAR Section mentioned above also states that the plant is designed in full compliance with Regulatory Guide 1.63, Revision 2, Electric Penetration Assemblies in Containment Structures for Water-Cooled Nuclear Power Plants. This regulatory guide states that electric penetrations shall be protected by redundant protective devices.

The inspectors selected a sample of overcurrent protective devices, and reviewed the application of the devices in relation to the above stated requirements. The overcurrent protective devices reviewed are summarized in Table A below.

Table A

Device ID	Type	Relay Function/Primary Zone
D50C	PJC	Phase and ground fault/High voltage winding of CSST D
D87C	BDD	Phase and ground fault/CSST D differential zone
D51CN	IAC66	Ground fault downstream of CSST D/backup
51-1812	IAC51	Phase fault/Cable feeder (alt) to 6.9 kV SDBD 1A-A
51N-1812	IAC51	Ground fault/Cable feeder (alt) to 6.9 kV SDBD 1A-A
51-2824	IAC51	Phase fault/Cable feeder (normal) to 6.9 kV SDBD 1B-B
51N-2824	IAC51	Ground fault/Cable feeder (normal) to 6.9 kV SDBD 1B-B
51-1932	IAC51	Phase fault/6.9 kV SDBD 1A-A
51G-1932	IFC53	Ground fault/6.9 kV SDBD 1A-A
51-1728	IAC51	Phase fault/6.9 kV SDBD 1B-B
51G-1728	IAC53	Ground fault/6.9 kV SDBD 1B-B
50/51-A8&9	IFC66	Phase fault/Feeders to ERCW pumps
50G-A8&9	PJC	Ground fault/Feeders to ERCW pumps
50/51-A3	IFC53	Phase fault/Feeder to 480 V SDBD 1A1-A

Table A (continued)

Device ID	Type	Relay Function/Primary Zone
50G-A3	PJC	Ground fault/Feeder to 480 V SDBD 1A1-A
87S1A	IAC51	Bus differential/6.9 kV SDBD 1A-A
50/51-B20	IAC51	Phase fault/Feeder to pressurizer heater backup group 1B-B
50G-B20	PJC	Ground fault/Feeder to pressurizer heater backup group 1B-B
52N-1A1-A	CO8	Phase fault/480 V SDBD 1A1-A
50/51	Amptector	Phase fault/Feeder to component cooling pump 1A-A
50/51	Amptector	Phase fault/Feeder to C&A vent board 1A1-A
50/51	Amptector	Phase fault/Feeder to reactor vent board 1A1-A
50/51	Amptector	Phase fault/Feeder to MOV board 1A1-A

As part of the review of the application of the overcurrent protective devices listed in Table A the following calculations were reviewed:

* Transmission and Customer Service (T&CS) Relay Setting Calculation, 161 - 6.9 kV Common Station Service Transformers C&D Overcurrent, Ground and Transformer Relay, dated April 10, 1992

* Relay Setting Calculation Tab 1A.27, 6.9 kV Shutdown Board Normal Feeder, dated July 19, 1995

* Relay Setting Calculation Tab 1A.27, 6.9 kV Shutdown Board Essential Raw Cooling Water Pumps, dated June 23, 1995

* Transmission and Customer Service Relay Setting Calculation, 6.9 kV Shutdown Board 1A-A Maintenance Feeder Overcurrent, Ground and Bus Differential, dated April 15, 1992

* WBN EEB-MS-TI08-0008, 480 V 1E Coordination/Protection, dated February 25, 1995

As part of the review of the application of the overcurrent protective devices listed in Table A the following Relay Setting Sheets were reviewed:

CSST D		SDBD A&B		RCP	
Sheet No.	Date	Sheet No.	Date	Sheet No.	Date
0458-92	4/9/92	0464-92	4/9/92	5694-85	8/23/85
3492-84	1/24/84	3880-84	6/13/84	5595-85	8/23/85
0461-92	4/9/92	3881-84	6/13/84		
		5296-78	5/23/78		
		0072-92	6/8/92		
		0465-92	4/9/92		
		7786-88	11/28/88		

As part of the review of the application of the overcurrent protective devices listed in Table A the following test and calibration records were reviewed:

* Relay Test Record (Calibration) for relay 51-1932, conducted June 1, 1992

* Relay Test Record (Calibration) for relay 51-1812, conducted June 2, 1992

* Current transformer circuit phasing test for relay D87C, conducted April 9, 1992

* Current transformer circuit phasing test for relay D50C, conducted January 24, 1984. This test gave inconclusive results because the primary load current was too low. The test was scheduled to be repeated, under Work Request No. C249600, when higher loads are present.

* A complete series of tests conducted on common station service transformer and associated relays conducted June 1992 under Work Order No. 92-05362-00.

* Calibration of the Amptector trip device at 480 V SDBD 1A1-A, compt 8B, breaker serial No. 0011, per MI-57.002 under Work Order No. 94-14905-00

The inspectors verified that any point in the system defined by the relays in Table A had overlapping zones of protection and backup means of clearing faults. Selective coordination was checked. Overcurrent protection of motors, buses, cables, containment penetrations and transformers was checked. Manufacturer's source documents for relay characteristics, motor data and penetration ratings were reviewed as necessary to verify applicant generated studies. The inspectors reviewed all design considerations related to the transformer differential scheme for CSST D. The inspectors verified by reference to Design Change Notices that Amptector discriminator features were disabled where appropriate. The treatment of cable shields and drain wires at window type current transformers was checked by reference to Specification G38, Installation, Modification, and Maintenance of Insulated Cables Rated Up to 15,000 Volts. The potential for saturation of low-ratio window type current transformers was checked. The inspectors checked the proper operation of the relays for various transients such as transformer inrush, motor starting and bus transfers. Each of the devices in Table A was inspected in the field to verify the style number and set points. The inspectors verified that redundant protection for the containment penetrations for the reactor coolant pump RCP-1 and pressurizer heater backup group 1B-B circuits was provided. The inspectors reviewed motor control center design information to verify that feeder breakers would coordinate with the upstream switchgear breaker.

2.1.1 Coordination between Ground Fault Relays at the 6.9 kV Shutdown Boards

Each 6.9 kV SDBD had three offsite power breakers: normal, alternate and maintenance. Ground fault detection at the offsite power breakers was provided by either IFC53 or IAC53 inverse time relays which received their current input from a 50-5 A window type current transformer. The pickup was set at 15 A primary current which was about 1 percent of the maximum ground fault current of 1593 A. The time dial was set at 1 for the alternate breakers and at 2 for the normal and maintenance breakers. Ground fault detection at the individual SDBD feeder breakers was provided by PJC instantaneous relays which received their current input from a 50-5 A window type current transformer. The pickup was set at 5 A primary current.

The IFC53 and IAC53 relays have identical response characteristics and would operate in 0.18 seconds for ground fault currents having a magnitude of 600 A (40X pickup) or greater when set on time dial 2. When set on time dial 1, the operation time for a 600 A fault would be 0.1 seconds. Operation time of the PJC relay is about 0.008 seconds.

The ground fault relays at the normal and maintenance offsite power breakers, which were set on time dial 2, coordinated with the ground fault relays at the individual feeder breakers, because the 0.18 second operation time allows sufficient time for feeder faults to be cleared by the feeder breakers. The ground fault relays at the alternate offsite power breakers, which were set on time dial 1, did not coordinate with the ground fault relays at the individual feeder breakers, because the 0.1 second, or 6 cycle, operation time does not allow sufficient time for faults to be cleared by the feeder breakers. Breaker operating time and relay overtravel phenomenon dictate that at least 9.5 cycles margin be provided to ensure coordination.

The significance of the miscoordination was that an entire 6.9 kV SDBD would be deenergized for a ground fault on an individual feeder cable, motor or transformer. Ground faults are the most likely of any of the types of faults that can occur. Miscoordination existed only for the case of power being supplied via the alternate source. There was no procedural prohibition to aligning a SDBD to the alternate source, although the inspectors believed such an alignment would be used a relatively small percentage of the time. Use of the alternate source would likely be concomitant with a degraded system, a situation which would increase the consequences of miscoordination. The miscoordination did not represent a violation of Appendix R requirements, because the power source for Appendix R events is assumed to be the diesel generator. The miscoordination problem described above did not exist for cases where power was being supplied by the diesel generator.

There were discrepancies among the related design documents. The T&CS Relay Setting Calculation, 161 - 6.9 kV Common Station Service Transformers C&D Overcurrent, Ground and Transformer Relay, dated April 10, 1992, called for a time dial setting of 2 for the ground fault relays (51Gs) at the SDBD offsite power breakers. The T&CS Relay

Setting Sheets, last revised in April 1992, indicated that the normal and maintenance breaker relays be set at time dial 2 and the alternate breaker relay be set at 1. The Relay Setting Sheet settings were implemented, as verified by the inspectors. Another calculation by T&CS titled 6.9 kV Shutdown Board normal Feeder and originally issued in February 1985 determined set points for the same ground fault relays. The calculation actually applied to both the normal and alternate feeders to the SDBDs. This calculation was revised in April 1992 in support of the modification to replace the CSST C&D transformers. In July 1995, the calculation was "rewritten to clear up legibility concerns." The July 1995 revision, on page 6, indicated the normal breaker relay set on time dial 2 and the alternate breaker relay set on time dial 1. However, on page 9, both the normal and alternate breaker relays were depicted with a time dial setting of 2. The relay setting calculation for the ERCW pump showed the normal and maintenance feeders ground fault relay set at time dial 2.

The inspectors concluded from review of the calculations that persons performing the calculations correctly determined that a time dial setting of 2 for the 51G relays at the SDBD offsite power breakers was required. However, this design requirement was not correctly translated onto the Relay Setting Sheets, which were the design output documents, with regard to the 51G relays at the SDBD alternate offsite power breakers (relays 51G-1932 and 51G-1728). The fact that there were redundant and conflicting calculations indicates that corrective actions beyond correcting the particular relay setting in question may be in order. Also, the inspectors noted that the July 1995 revision to the calculations represented a lost opportunity to identify the problem

The incorrect setting of the ground fault relay at the alternate power offsite source breakers to the SDBDs was not consistent with the design criterion to provide coordination, and had potential safety significant consequences. The discrepancies between design documents concerning the relay settings indicates a design control problem, and represents a violation of 10 CFR 50, Appendix B, Criterion III, Design Control. The violation is identified as Violation 95-22-01, Failure to Provide Coordination of Overcurrent Protective Relays due to Lack of Design Control.

2.1.2 <u>Consideration of the Potential for DC Saturation of the Current Transformers in the Transformer Differential Scheme</u>

IE Information Notice No. 86-87, Loss of Offsite Power Upon an Automatic Bus Transfer, describe an event involving saturation of current transformers as a result of the DC component of transient current. The inspectors found that the applicant had not analyzed the current transformers in the CSST A, B, C and D differential schemes to determine whether they were susceptible to the same problem. Preliminary calculations performed by the applicant during the inspection indicated that the current transformers could be susceptible to DC saturation and that further analysis was needed to resolve the issue. The Senior

Electrical Engineer stated that the applicant would address the following scenarios that could lead to a loss of offsite power in light of the DC saturation issue:

* Fast dead bus transfer of safety-related motors between CSST C and CSST D
* Fast dead bus transfer of non-safety-related motors from the unit auxiliary transformer to CSST A or CSST B
* Short-circuits in the 6.9 kV system.

To ensure NRC follow-up on this issue, Inspector Follow-up Item 95-22-02, Potential for DC Saturation of Current Transformers, is identified.

2.1.3 Protection of Component Cooling Pump Motors

Data furnished by the manufacturer for the 350 HP component cooling pump motors (letter No. 42P051) indicated that the locked rotor withstand time was 14 seconds when starting from ambient temperature and 6.4 seconds when starting from rated running temperature. Response time of the Amptector trip device for locked rotor current at 100 percent voltage was from 8 seconds (upper edge of band) to 5 seconds (lower edge of band). Therefore, the circuit breaker did not provide complete protection for hot starts, because the upper edge of the band (8 seconds) was greater than the 6.4-second withstand time. Protection was provided for cold starts. The Amptector was set at the minimum available long time delay setting. The Amptector trip device settings were consistent with the applicants guidelines for protection of pump motorsfed from 480 V switchgear as stated in the TI08-0008 calculation, Attachment 2, page 180. The guideline stated that the lower edge of the long-time delay band be set between 5 and 10 seconds for 100 percent voltage locked rotor current. The calculation indicated that this guideline was based on typical motor data. The inspectors considered the long-time delay setting for the component cooling pump motors acceptable, because it was the minimum available setting and provided nearly complete protection. The inspectors considered the use of typical motor data, rather than specific data, to determine Amptector trip device settings with regard to locked rotor withstand a weakness in the TI08-0008 calculation. Use of this methodology did not provide auditable documentation that all motors were protected for locked rotor. The ratings of certain motors could vary significantly from the typical data, as did the example chosen at random by the inspectors.

2.1.4 Conclusions with regard to Coordination and Protection in the AC Distribution System

Weaknesses in the documented analysis were identified:

* Discrepancies in the calculation for the ground fault relays probably lead to an incorrect setting and miscoordination (Violation 95-22-01).

* The transformer differential scheme could have been better analyzed. The documented analysis did not address all standard design considerations, although they were resolved during the inspection. The consideration of DC saturation is a special consideration that should have been addressed because it was the subject of an information notice. The issue was not resolved, and will be tracked by IFI 95-22-02.

* The methodology did not allow the inspectors to conclude that all motors fed from 480 V switchgear were protected for locked rotor. This issue was considered of relatively minor safety significance, because the methodology used did assure that Amptector settings would allow motors to start and run under normal conditions. Providing complete protection for locked rotor is not an NRC requirement. Nevertheless, the applicant's design objective was to provide protection where practical, and the calculation was weak in assuring this objective was met.

Except for examples specifically noted in this paragraph, all design criteria were met.

Relay Setting Sheets contained complete information and were maintained up to date.

Based on relay and transformer test data reviewed, equipment testing and related documentation by Transmission and Customer Service were considered a strength by the inspectors.

Device set points, style numbers and labels inspected in the field matched the information in the Relay Setting Sheets.

2.2 Calculation of Voltage in the AC Distribution System and AC Control Circuits

2.2.1 <u>Preoperational Testing</u>

NUREG-0847, Supplement No. 13 to the SER, on pages 8-9 and 8-10, states that the staff will review the results of a preoperational test which would be performed pursuant to Branch Technical Position PSB-1. The test consists of two steps. First, make precise measurements of power flow and voltage at all voltage levels during steady state conditions and a motor starting transient. Second, model the system configuration and loading, as it existed while the measurements were taken, in the computer program used for the system voltage analysis. Then, run the load flow calculation. Measured voltages and calculated voltages must match within the allowed differences specified in PSB-1. The purpose is to validate the values used for major system elements such as transformers and cables in the design bases calculation. The applicant has completed the first step, but not the second step. To ensure that the test results will be reviewed by the NRC as stated in the SSER, Inspector Follow-up Item 95-22-03, Review PSB-1 Test Results, is identified.

2.2.2 Follow-up on Previous Inspection Findings

During an inspection of the voltage relay set points conducted during February and March 1995, Violation 95-08-01, Incorrect Design Input Used in Control Circuit Voltage Calculation, was identified. The violation involved an incorrect design input in the calculation which was analyzing voltage in 120 VAC control circuits which emanate from distribution panels. Specifically, the design input stated that minimum source voltage was 440 V, but the calculated minimum voltage (from another calculation) was as low as 432 V. Basically, there was a discrepancy between calculations.

In their response to the NOV, dated April 27, 1995, the applicant agreed the violation occurred as stated. The root cause was personnel error. The response specified the relevant calculations would be revised.

During this inspection, the inspectors verified the corrective actions were implemented by reviewing the following calculations:

* WBN MS-TI06-0029, Degraded Voltage Analysis, Revision 15, dated April 28, 1995

* WBN MS-TI02-0020, 120 VAC Class 1E Distribution Panel and Transformer Sizing and Voltage Drop Calculation, Revision 11, dated, April 26, 1995.

The 0020 calculation was revised to clarify that circuits shall be analyzed with a source voltage of 432 V. In fact, at the time of Revision 7, circuits had been analyzed using 432 V as the source voltage, and were found acceptable. All MCCs were enveloped by 432 V - many had higher voltages.

The applicant determined that the diesel generator room intake damper control circuits, which had been analyzed after Revision 7, did not have adequate voltage with 432 V source voltage. These circuits were then analyzed further in the Degraded Voltage Calculation (0029). The summary of results indicated that the MCC feeding the intake damper control circuits received a minimum of 436 V. Reanalysis of the control circuits showed that 436 V was adequate source voltage.

The inspectors verified that the corrective actions for the violation were implemented; no hardware changes were required, and the plant was in full compliance with regard to the identified problem. Therefore, Violation 95-08-01 was closed. In addition, the inspectors performed further examination of voltage in control circuits which is described in paragraph 2.2.3.

2.2.3 Examination of Voltages in MCC Control Circuits

The 0020 calculation mentioned in the previous paragraph utilized a voltage analysis computer program called CTRL-VOLT. Calculation WBN EEB-MS-TI02-0019, 120 VAC Control Transformer Sizing, utilized the same computer program. The inspectors selected a sample circuit from the 0019 calculation for independent analysis.

10 CFR 50 Appendix A General Design Criteria 17 requires that an onsite electric power system be provided with sufficient capacity and capability to permit functioning of structures, systems, and components important to safety. From this requirement comes the design criteria that control circuits have adequate voltage to operate and fulfill their safety function under design basis conditions. Calculation EEB-MS-TI02-0019, Revision 49 analyzed the control circuits for voltage adequacy. The calculation consisted of a computer program, CNTL-VOLT, which modeled each control circuit. The program included control power transformers, motor starters or contactors, relays, heaters, indicating lights, and control circuit wiring. The program evaluated the voltage to the circuit devices and compared it to device ratings. The calculation identified modifications for circuit components which failed to meet the adequate voltage criteria.

The voltage for the control circuit of motor operated valve (MOV) 1-FCV-70-87 was reviewed. MOV 1-FCV-70-87 was the inside containment isolation valve for the component cooling from the reactor coolant pump (RCP) thermal barriers. This circuit was selected due to the importance of the RCP thermal barrier cooling function to the plant Probabilistic Risk Assessment (PRA). This MOV was a containment isolation valve which incorporated control at main control room and at the auxiliary shutdown panel and had a complex control circuit with more extensive cable runs.

Calculation EEB-MS-TI02-0019, Revision 49, Attachment 7 evaluated the circuit voltage adequacy for motor starter pickup conditions. The calculation determined that the voltage to the starter at inrush conditions for the circuit was adequate to ensure starter pickup. The starter pickup voltage acceptance criteria used in the calculation was verified to meet the manufacturer's requirements. The inspectors verified that the correct MCC voltage was utilized in the calculation.

The inspectors performed a walkdown of the circuit using the information from the calculation, schematic diagram 1-45W760-70-4, Revision 7, and wiring diagram 45B1769-12D, Revision 10. The circuit breaker, breaker setting, starter size, control power transformer (CPT), thermal overload heater and circuit fuses were inspected. The inspectors verified that the equipment installed in the field matched the wiring diagram and the calculation.

The inspectors calculated the voltage to the starter for 1-FCV-70-87 for inrush conditions. The independent evaluation determined that the voltage to the starter for the existing circuit components and cable lengths exceeded the manufacturer's minimum pickup voltage. The results closely matched those in the applicant's calculation. The independent evaluation supported the conclusion for this control circuit performed by the applicant using CNTL-VOLT.

Calculation EEB-MS-TI02-0019 Appendix A identified several circuits requiring modifications. The inspectors selected the following three circuit modifications for review:

0-FCV-26-141-A	100 VA CPT replaced with 150 VA CPT
1-FCV-67-9B-A	100 VA CPT replaced with 150 VA CPT
1-FCV-67-298-B	100 VA CPT replaced with 150 VA CPT

The inspectors verified through field inspection that the above control circuit modifications were implemented. Based on the independent evaluation of selected control circuit voltage adequacy and on field verification of completed control circuit modifications, the inspectors concluded that voltage would be adequate to safety-related MCC control circuits.

2.2.4 Conclusion with regard to Calculation of Voltage

Based on the results of the review of voltage in AC control circuits performed during this inspection and conclusions documented in NRC Inspection Report No. 95-08, the inspectors had confidence that voltage would be adequate to operate safety-related equipment during all design basis scenarios. This conclusion is contingent on evaluation of the PSB-1 test results.

2.3 Breaker Control and Protective Relay Logic

The inspectors reviewed portions of the protective relay logic and breaker control logic for the safety related distribution system to determine if the plant installation met the design basis. The 6.9 kV shutdown board (SDBD) undervoltage protection and the 6.9 kV SDBD incoming breaker control logic were selected for review.

The design basis for the undervoltage and degraded voltage protection logic was documented in Design Criteria WB-DC-30-28, Low and Medium Voltage Power Systems, Section 2.10.3. The degraded voltage and undervoltage protection contained four sets of protective relays and represented a fairly complex protection scheme.

The inspectors examined the following drawings to review the design of the undervoltage protection logic:

1-45W760-211-9, Revision 14	1-45W760-211-8, Revision 11
1-45W760-211-17, Revision 7	1-45W724-1, Revision 19
1-45W760-211-18, Revision 5	1-45W749-1, Revision 33
1-45W760-212-1, Revision 13	1-45W760-82-6, Revision 17
1-45W760-82-2, Revision 13	1-45W760-82-3, Revision 9
1-45W760-82-4, Revision 17	1-45W760-82-5, Revision 17

The inspectors' review determined that the undervoltage and degraded voltage protection logic design met the requirements of Design Criteria WB-DC-30-28 Section 2.10.3.

The breaker control logic for the 6.9 kV SDBD 1A-A incoming breakers was reviewed. The design basis for the 6.9 kV SDBD incoming breaker logic was contained in Design Criteria WB-DC-30-28, Low and Medium Voltage Power Systems, Sections 2.3.4 and 2.6.4.

The specific control circuits reviewed are summarized below:

BREAKER / POWER SOURCE		SCHEMATIC DIAGRAM
1716	Normal Feeder / CSST C	1-45W760-211-3, Revision 8
1932	Alternate Feeder / CSST D	1-45W760-211-18, Revision 5
1718	Maintenance Feeder / Unit Bd 1B	1-45W760-211-2, Revision 6
1912	Emergency Feeder / EDG 1A-A	1-45W760-211-4, Revision 12

Additional drawings reviewed included:

1-45W724-1, Revision 19
1-45W760-211-9, Revision 14
1-45W760-211-1, Revision 11
1-45W760-82-5, Revision 17
1-45W760-211-17, Revision 7

The criteria which were verified included:

* Automatic transfer from offsite power to the EDG within the appropriate time delay on undervoltage or degraded voltage conditions.

* Automatic open circuit fast transfer from the normal to the alternate CSST supply for a transformer or line failure condition on the normal if the alternate was a good source.

* Manual open circuit fast transfer from the normal to the alternate source and from the normal to the maintenance source.

* All reverse transfers are manual.

* Interlock between the normal, alternate, and the maintenance sources.

* The maintenance source is administratively controlled and only allowed to supply the shutdown boards during cold shutdown conditions on both units.

* Trip open under fault conditions detected by the protection system.

* Prevent transfer of a power source to a faulted bus.

* Prevent paralleling two live sources unless they are synchronized.

The inspectors determined that the 6.9 kV SDBD 1A-A incoming breaker control logic met the requirements of Design Criteria WB-DC-30-28, Sections 2.3.4 and 2.6.4.

3.0 List of Acronyms and Initialisms

CSST	Common Station Service Transformer
PSB	Plant Systems Branch of NRC Headquarters
SDBD	Shutdown Board (Switchgear)
T&CS	Transmission and Customer Service - An organizational unit of Tennessee Valley Authority

4.0 Exit Meeting

The inspection scope and results were summarized on August 11, 1995, with those persons indicated in paragraph 1.1. The inspector described the areas inspected and discussed in detail the inspection results including the items listed below. Dissenting comments were not received from the applicant. Proprietary information is not contained in this report.

Item Number	Status	Description and Reference
390,95-08-01	Closed	Violation, Incorrect Design Input in Control Circuit Voltage Calculation, paragraph 2.2.2.
390,95-22-01	Open	Violation, Failure to Provide Coordination of Overcurrent Protective Relays due to Lack of Design Control, paragraph 2.1.1.
390,95-22-02	Open	Inspector Follow-up Item, Potential for DC Saturation of Current Transformers, paragraph 2.1.2.
390,95-22-03	Open	Inspector Follow-up Item, Review of PSB-1 Test Results, paragraph 2.2.1.