



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

Report Nos.: 50-259/93-14, 50-260/93-14, and 50-296/93-14

Licensee: Tennessee Valley Authority
3B Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Docket Nos.: 50-259, 50-260
and 50-296

License Nos.: DPR-33, DPR-52,
and DPR-68

Facility Name: Browns Ferry 1, 2, and 3

Inspection Conducted: April 5-9, 1993

Inspector: S. Rudisail
S. Rudisail

5/3/93
Date Signed

Approved by: M. Shymlock
M. Shymlock, Chief
Plant Systems Section
Engineering Branch
Division of Reactor Safety

5-4-93
Date Signed

SUMMARY

Scope:

This special announced inspection was conducted to assess the adequacy of the licensee's corrective actions for safety significant NRC findings identified during the Electrical Distribution System Functional Inspection (EDSFI).

Results:

In the areas inspected, violations or deviations were not identified. The licensee's response to the findings was acceptable. All corrective actions identified in the response to the violation were complete. Violation 92-15-01 is closed. All findings except one are closed. Finding 92-15-05 will remain open. This finding's corrective action involves a hardware modification. This hardware modification had not been completed due to a Part 21 notification on the equipment. This will be identified as Inspector Follow-up Item (IFI) 93-14-01.

REPORT DETAILS

1. Persons Contacted

Licensee Employee

- *T. Ballew, Engineering Supervisor Customer Group
- *R. Baron, Manager, Licensing
- *D. Burrell, Lead Electrical Engineer
- N. Glasser, Electrical Engineer
- *M. Herrell, Operations Manager
- *C. Hsieh, Licensing Engineer
- D. Johnston, Electrical Engineer
- *J. Maddox, Engineering Manager
- D. Matherly, Operations
- *G. Pierce, Site Licensing
- *E. Ridgell, Acting Compliance Manager
- *J. Scalice, Plant Manager
- *J. Schessel, Maintenance
- *J. Smithson, Modifications
- *R. Wright, Electrical Engineer
- *O. Zeringue, Site Vice President

Other licensee employees contacted during this inspection included engineers, operators, technicians, and administrative personnel.

Other NRC employees:

- *J. Mathis, Project Engineer
- *C. Patterson, Senior Resident Inspector
- *G. Schnebli, Resident Inspector

2. Electrical Distribution System Functional Inspection Follow-up (2515/111)

This inspection assessed the adequacy of the licensee's corrective actions for the violation and the safety significant findings identified during the EDSFI and documented in the EDSFI report. Overall, the licensee's response to the EDSFI findings was good. The violation and all findings, with the exception of Finding 5 were closed. All commitments established in the licensee's response to the EDSFI report were met.

The following paragraphs discuss the EDSFI items reviewed by the inspector and indicates the status.

a. Violation 92-15-01: Failure to Adequately Implement Design Requirements

The EDSFI team reviewed calculation ED-Q2000-870026, 4.16 kV and Busload Voltage Drop Calculations with Offsite Power and identified an operating constraint for the Unit Station Service Transformer (USST) Load Tap Change Selector Switch. Instructions in Station Operating Procedure (SOP) 6055 and General Operating Instruction

(GOI) 0-GOI-300-1 did not require the tap changer selector switch to be set to monitor the USST winding supplying the Shutdown Bus (SDB) as required by the calculation. A walkdown of the control room revealed that the selector switch was not set to monitor the USST SDB winding. In this situation, if a LOCA had occurred the resulting voltage drop from LOCA load sequencing could have resulted in loss of the preferred (offsite) power source.

The licensee has revised GOI 0-GOI-300-1, Operations Routine Sheets to require monitoring the position of the tap changer selector switch once per shift. SOP 6055 has been withdrawn. In addition, a label plate has been added to the mimic board in the control room which provided instructions for the correct position of the tap changer selector switch. Violation 92-15-01 is closed.

b. Finding 1: Existing Calculations Did Not Contain Sufficient Data to Determine LOCA Load Sequencing Voltage Profile

The team determined that ED-Q2000-870026, Revision 9, 4.16 kV and Busload and Voltage Drop Calculation did not contain sufficient data to demonstrate what minimum voltage levels would drop to during worst case LOCA load sequencing. During the EDSFI the licensee provided additional computer runs establishing the actual profile to demonstrate adequate system performance. The licensee agreed to incorporate these additional runs in the next revision of the calculation.

The inspector reviewed revision 10 to ED-Q2000-870026, 4.16 kV and Busload and Voltage Drop Calculation. This revision incorporated the computer runs generated to resolve the EDSFI team's concerns and demonstrated adequate voltage during LOCA load sequencing. This item is closed.

c. Finding 2: Incorrect Acceptance Criteria for Degraded Voltage Relay in Surveillance Instruction

The acceptance criteria in Surveillance Instruction 3-SI-4.4.A.4C(I), Revision 1, 4160 V SDB 3EA and 3EB Under/Degraded Voltage Time Delay Relay Calibration, did not properly reflect the 26 V tolerance applicable to the degraded voltage relay dropout and reset values. These values were determined in Calculation ED-Q2211-890144, Revision 4, Setpoint and Scaling Calculations 4 kV Bus Degraded Voltage Relays. The SI did not properly account for the 26 V tolerance because it allowed the reset value to remain in an "as left" condition to where the 26 V drift could exceed the TS allowable limit. The acceptance criteria stated in the SI did not provide a lower limit for the reset voltage allowing it to be set close to the dropout value. This could have resulted in a divergence of the reset and dropout value. The Surveillance Instruction (SI) also allowed the dropout voltage to be at a value that when combined with the possible tolerance of 26 V would have exceeded the TS allowable limit. The licensee corrected the acceptance criteria



of the SI's prior to the conclusion of the EDSFI. The licensee agreed that additional corrective action would be performed to change administrative procedures to require applicable design inputs into all SI's.

The inspector reviewed the corrective action to ensure that the administrative controls had been revised to ensure design input data was incorporated into SI's. The licensee has developed setpoint and scaling documents for electrical surveillance calibrations to document the design requirements for the "as found" and "as left" bands. This item is closed.

d. Finding 3: 460V Motors did not have critical voltages stated in FSAR

Calculation ED-Q2000-870027, 460V Class 1E Motors and Equipment Volt Drop demonstrated that certain motors did not have the minimum required terminal voltage as stated in Section 8.4.8.1.4 of the FSAR. The licensee demonstrated adequate equipment operation based on available design margin. This item represented a deviation from a FSAR commitment. The licensee committed to revise the FSAR to recognize motors that do not meet established voltage criteria.

The inspector reviewed the FSAR revision. The FSAR has been revised to require justification for these motors by engineering analysis or vendor documentation. This item is closed.

e. Finding 4: Calculation Weaknesses

- (1) The EDSFI team noted several weaknesses during a review of various EDS calculations. Calculation ED-Q2000-870027, Revision 3, 460 V Class 1E Motors and Equipment Volt Drop, relied on equipment design margins to justify voltage below the vendor recommended minimums rather than removing known conservatism or correcting circuit deficiencies. For NEMA B motors, this calculation justified voltages below the stated criteria based on adequate torque available at 70% voltage. However, this justification did not consider the effects of increased current at lower voltage and possible tripping of protective devices. Calculation ED-Q2000-870027 referred to Calculation ED-Q0999-890090 to provide the lowest actual operating voltages at various busses. However, these values did not agree. The weaknesses identified above were resolved prior to the completion of the EDSFI either through additional justification or determination that the use of non-conservative values did not affect the final results. The licensee agreed to revise the calculation to correct the weaknesses identified.

- (2) The team reviewed Calculation ED-Q2211-890144, Revision 4, Setpoint and Scaling Calculations 4 kV Bus Degraded Voltage Relays. The team noted several discrepancies in the calculation. The calculation stated that the 26 V tolerance applicable to the relay dropout setting was random and therefore, it was unlikely that two relays would be subject to maximum inaccuracy. The licensee used this to determine minimum bus voltage as the setpoint of the relay without any allowance for tolerance of the relay. The team concluded that the tolerance should be included in the minimum voltage determination. Calculation ED-Q2000-870026 was referenced by Calculation ED-Q2211-890144 to determine a minimum steady state voltage on the 4 kV SDB. However, this minimum value was not found in Calculation ED-Q2211-890144. The calculation also stated that the dropout and reset setpoints for the relay would drift in the same direction and this justified the small difference between the setpoints. The team disagreed with this conclusion. Prior to the completion of the EDSFI the licensee revised the calculation and established settings which would prevent convergence of the two setpoints due to drift.

The inspector reviewed Calculation ED-Q2000-870027 and Calculation ED-Q2211-890144. All of the weaknesses and inconsistencies identified during the EDSFI as discussed above had been corrected. This item is closed.

f. Finding 5: Control Bay Water Chiller A and B Circuit Breaker Settings

During a review of calculation ED-Q2000-870548, the team noted that the circuit breaker settings for the Control Bay Water Chiller A and B were not adequate. The tripping region of the coordination curves was within the operating range of the equipment. The licensee had previously identified this circuit breaker setting as inappropriate and had initiated actions to modify the breaker with a GE Type RMS-9 trip unit. The work order had been written to perform this modification.

The inspector reviewed the status of this corrective action. Subsequent to the EDSFI inspection a 10 CFR 21 notification was made concerning the GE RMS-9 type trip unit. The notification was made because extremely short duration, high amplitude current transients like those experienced on the Browns Ferry ungrounded 480 V system will cause The RMS-9 to trip. The licensee has recently resolved this issue with the vendor, and expected to have the necessary equipment to complete the modification of the Control Bay Water Chiller Breaker in the Fall of 1993. This item will remain open and will be identified as IFI 93-14-01.

g. Finding 6: Procedure Weaknesses

The team identified several weaknesses in procedures for operation of the EDS. Alarm Response Procedure 1/2 ARP 9-23, Revision 12 did not provide adequate guidance regarding Diesel Generator Ground Fault Annunciation. Procedure 0-OI-82, Revision 35, Standby Diesel Generator System Operating Instructions, did not provide guidance on restarting large loads, in particular the 2000 hp RHR pump, should it become disconnected while being powered from a diesel generator. The licensee agreed to revise these procedures.

The inspector reviewed the procedures identified above to ensure that they had been revised appropriately. Alarm Response Procedure 1/2 ARP 9-23, Revision 14 had been issued to provide guidance regarding diesel generator ground fault annunciation. Abnormal Operating Instruction 0-AOI-57-1A, Revision 15, Loss of Offsite Power has been issued to provide specific instructions for reducing load on the diesel generators prior to manually initiating a RHR pump start. This prevents potentially overloading the diesel generator. The procedure also requires a check for any 480 V loads which may have tripped during the initial voltage dip during restart of the RHR pump. This item is closed.

h. Finding 7: DC Battery Systems Ground Detectors

The EDSFI team reviewed the DC system ground fault protection system. The team expressed concern that a reading of zero on the ground fault meter could result from a faulty meter or an open circuited connection. A zero reading is normally indicative of "no ground fault" on an inverse logic system. This faulty condition would not be recognized on a daily check by the operator. The team noted that the meters were calibrated at three year intervals and that the incidence of failure of the meters was 28%.

The licensee has revised the calibration frequency of the ground fault meters from 36 months to 24 months. The licensee considers the ground fault detection adequate but, stated in their response to the EDSFI that if future calibrations do not provide sufficient confidence in the system, additional monitoring or design changes would be evaluated. The inspector verified that a program existed to trend the failure of ground detection system meters. This item is closed.

i. Finding 8: Improper Breaker Replacement

The team identified that the circuit breaker changeouts in the 480 V SDB had resulted in two non-Class 1E breakers being placed in Class 1E boards. The licensee issued a problem evaluation report BFPER9-20039 to investigate this occurrence.

The licensee evaluation identified one of the incorrectly installed breakers as a spare breaker which had been removed prior to the

EDSFI inspection. The second breaker installation was evaluated and it was concluded that the breaker was capable of performing its intended function and did not affect the operability of the circuit. However, this breaker was replaced with a Class 1E breaker. Additional controls were implemented to ensure that proper breaker replacement occurs in the future. Walkdowns were performed by the licensee to ensure that the correct circuit breakers were installed. Additionally, instructions for swapping GE AK type circuit breakers were revised to require the system engineer to perform an acceptability evaluation for the breaker being used as a swapout prior to the breaker change. This item is closed.

j. Finding 9: Configuration Control

During the EDSFI, the team found the configuration of the EDS correctly reflected in drawings with several exceptions. Several instances of incorrect breakers being installed were identified. The inboard and outboard core spray valves had 30 ampere breakers installed in the 480 V RMOV boards, but the drawings depicted a 7 ampere breaker. During the inspection of the DG's, a 50 ampere breaker was observed to be installed in the DG start circuit. The drawings required a 30 ampere breaker. Other configuration control discrepancies noted were unidentified wiring in battery chargers, unterminated cable in 250 VDC RMOV board 2A, and incorrectly positioned disconnect switch for the SD battery chargers B and C.

The licensee has replaced the inboard and outboard core spray valves with the correct size breaker. The licensee determined that the incorrectly installed breakers did not affect the operability of the core spray valves. The DG start circuit breaker has been replaced with a 30 ampere breaker. The spare wiring and unterminated cable have been removed. The shutdown (SD) battery charger disconnect switch position was corrected. The inspector verified these corrective actions were complete through verification of work records and walkdown of equipment. This finding is closed.

k. Finding 10: Cracked Thermal Overload Relays

During walkdowns of the EDS the EDSFI team noted instances of cracked thermal overload relays. The cracked thermal overload relays were found in the 480 V RMOV boards and the 250 VDC RMOV boards. Work requests were issued to replace the defective overload relays.

The licensee has replaced all the cracked thermal overload relays identified during the EDSFI. Additionally, the licensee has performed walkdowns of all the 480 V and 250 V safety related systems. Work requests were written to replace any potentially defective relays which were identified during this walkdown. This item is closed.

1. Finding 11: Battery Capacity

The team noted during a review of the battery capacity test results that several of the batteries were nearing the criteria stipulated for replacement. The diesel generator battery C was noted to be at 80.67% of capacity. The licensee responded that the SD batteries, diesel generator batteries, and Main Bank Batteries 2 and 3 were scheduled for replacement during the next refueling outage.

The inspector reviewed the status of the battery replacements. All diesel generator batteries have been replaced. Main Bank Batteries 2, 3, and 4 have been replaced. Main Bank Battery 1 was replaced previously. The licensee has deferred the replacement of the SD batteries until after the current outage. The SD batteries will either be replaced prior to or during the next outage. The inspector reviewed the last capacity test results for the SD batteries. This capacity testing was accomplished during the current outage. All batteries tested above 98% capacity with the exception of the SD battery C which yielded an 85% capacity. This item is closed.

3. Exit Interview

The inspection scope and results listed below were summarized on April 9, 1993 with those persons indicated in paragraph 1. Proprietary information is not contained in this report. There were no dissenting comments received from the licensee.

(Closed) Violation 92-15-01, Failure to Adequately Implement Design Requirements

(Closed) IFI 92-15-02, EDSFI Report Findings 1 through 11

(Open) IFI 93-14-01, EDSFI Finding 5, Control Bay Water Chiller Circuit Breaker Modification.

4. Acronyms and Abbreviations

CFR	Code of Federal Regulations
DG	Diesel Generator
EDS	Electrical Distribution System
EDSFI	Electrical Distribution System Functional Inspection
FSAR	Final Safety Analysis Report
GE	General Electric
GOI	General Operating Instruction
IFI	Inspector Follow-up Item
kV	Kilovolts
LOCA	Loss of Coolant Accident
NEMA	National Electrical Manufacturer's Association
RHR	Residual Heat Removal



RMOV	Reactor Motor Operated Valve
SDB	Shutdown Board
SOP	Station Operating Procedure
SI	Surveillance Instruction
TS	Technical Specifications
USST	Unit Station Service Transformer
V	Volts
VDC	Volts Direct Current

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