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

Report No.: 50-416/94-02

Licensee: Entergy Operations, Inc.
Jackson, MS 39205

Docket No.: 50-416 License No.: NPF-29

Facility Name: Grand Gulf

Inspection Conducted: January 10 - 14 and 24 - 28, 1994

Inspector: MB Shymlock for 2-14-94
P. J. Fillion Date Signed

Approved by: MB Shymlock 2-14-94
M. B. Shymlock, Chief Date Signed
Plant Systems Section
Engineering Branch
Division of Reactor Safety

SUMMARY

Scope:

This routine, announced inspection was conducted in the areas of station blackout rule, electrical maintenance and surveillance, and open items from the Electrical Distribution System Functional Inspection.

Results:

In the area of electrical maintenance and surveillance, one violation was identified. It was issued for failure to take adequate corrective action for identified problems. An Inspector Followup Item was identified regarding the classification (i.e. valid verses invalid) of an emergency diesel generator failure which occurred on May 25, 1992. The Violation and the IFI are described in section 3.2. In the area of station blackout rule, no problems were identified. All of the open items from the Electrical Distribution System Functional Inspection were closed out. Overall, the licensee's performance was good.

REPORT DETAILS

1.0 Persons Contacted

Licensee Employees

*T. Barnett, Supervisor, Electrical Systems, Nuclear Plant Engineering
*D. Bost, Director, Nuclear Plant Engineering
*P. Cameron, Assistant Superintendent, Electrical Maintenance
*D. Cupstid, Manager, Project Management
*L. Daughtery, Superintendent, Plant Licensing
*M. Dietrich, Manager, Nuclear Training
*J. Dimmette, Manager, Performance and System Engineering
*C. Dugger, Manager, Operations
*H. Haddon, Electrical Engineer, Nuclear Plant Engineering
*C. Hayes, Director, Quality Programs
*C. Hicks, Superintendent, Operations
*A. Khanifar, Manager, Electrical/Instrumentation and Control Systems, Nuclear Plant Engineering
*R. McNaulty, Superintendent, Electrical Maintenance
*R. Ruffin, Plant Licensing
*T. Thornton, Senior Electrical Engineer, Nuclear Plant Engineering

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

Other NRC Employees

*R. Bernhard, Senior Resident Inspector
C. Hughey, Resident Inspector

*Attended exit meeting

2.0 Station Blackout Rule

10 CFR Part 50.63 requires that plants be able to cope with a loss of alternating current (AC) power sources. Regulatory Guide 1.155 defines which AC sources must be postulated to fail, specifies the required coping duration and provides guidance on how to demonstrate that the station blackout rule has been met. Nuclear Management Resources Council (NUMARC) document 87-00 provides detailed recommendations on all aspects of the station blackout rule.

Pursuant to 10 CFR Part 50.63, the licensee made submittals describing their approach to meeting the station blackout rule. The initial submittal was made on April 14, 1989. Supplementary submittals were made on March 30, 1990, August 26, 1991, and March 19, 1992. The NRCs safety evaluation was issued on December 10, 1991 and a supplemental safety evaluation was issued on May 22, 1992. These documents were reviewed by the inspector during the preparation phase of the inspection.

The essential feature of the licensee's approach to meeting the station blackout rule is that they have demonstrated by analysis that the plant has the capacity and capability to cope with a loss of all AC sources for four hours and recover from this event.

The inspector asked several questions related to battery loading and 125 VDC System voltage analysis. The questions included specifics as to how the inverter load values were developed and details of the calculation of voltage for the emergency diesel generator field flashing circuit. The overall methodology for voltage analysis was reviewed as well as the various margins and safety factors applied. The plan for the restoration of offsite power in the event of a total Transmission System collapse was reviewed. The supplemental safety evaluation recommended that the temperature analysis for the control room, cable spreading room, switchgear/inverter room and the drywell be revised to incorporate more realistic assumptions. The inspector confirmed that these analyses were revised and that results were satisfactory.

The inspector's review in the area of station blackout rule did not identify any significant problems.

3.0 Electrical Maintenance and Surveillance (62705)

Electrical maintenance and surveillance activities were reviewed with the objective of determining whether corrective actions for the various maintenance and test problems were adequate.

3.1 Scope of the Inspection

The scope of the inspection included the following elements:

- In the preparation phase of the inspection, the inspector reviewed the summary of electrical corrective maintenance for 1993. The summary had 933 entries. Seventy work request were selected for further review.

- For seventy work requests the inspector reviewed pages one and two of the work request record which gave additional information about the nature of the problem and the work performed. About 15 of these work request were discussed in detail with the cognizant engineers.

- The inspector reviewed the summary of Incident Reports for 1992 and 1993.

- The inspector confirmed that the solenoid operated valves on the main steam isolation valves were replaced at the time intervals required by the Equipment Qualification program.

- The inspector reviewed the licensee's response to a Part 21 Report submitted by Asea Brown Boveri Power Distribution Incorporated on April 30, 1991, concerning the potential for cracks in current transformers used in medium-voltage switchgear.

- The inspector reviewed the licensee's response to NRC Information Notice 93-91: Misadjustment between General Electric 4.16 kV Circuit Breakers and their Associated Cubicles.

- The inspector reviewed data sheets for the following Technical Specification surveillance tests:

TEST	DATE
4.8.1.1.1.a, Verify two offsite power sources	12/20&27/93 and 1/3/94
4.8.1.1.2.d.15, Sequencer test	10/17/93 and 11/7/93
4.8.2.1.d, Battery service test	10/5/93
4.8.4.1.a.2, Penetration protection breaker test	10/28/93
4.8.4.3.b, RPS electric power monitoring assemblies calibration	3/9/93

- The following root cause analyses were discussed with the responsible engineers:

NUMBER	EQUIPMENT/PROBLEM
93-0309	High pressure core spray service water pump motor failure
93-0602	RPS electric power monitoring assemblies spurious operations
93-0706	Riley temperature switch

3.2 Findings

During review of the corrective maintenance work requests, the inspector identified one case where the completeness and thoroughness of corrective actions were less than required given the importance of the components involved. The facts and circumstances surrounding this problem are as follows. In late 1990, engineers identified that four circuit breaker closing spring latch release coils would receive less than rated voltage for certain battery loading conditions. The calculations which indicated this problem were Calculation No. EC-Q1L21-9003, Division I 125 VDC Class 1E Voltage Drop Study, and Calculation No. EC-Q1L21-90046, Division II 125 VDC Class 1E Voltage Drop Study.

The breaker close coils involved were for Divisions I and II emergency diesel generator output breakers, Division I RHR pump motor breaker and Division I drywell purge compressor motor breaker. The rated voltage was 100 V and the calculated voltages ranged from 78 V to 98 V. The licensee decided to establish a new pick-up voltage rating lower than the calculated values by conducting onsite tests on the actual devices in question. An initial test was conducted in December, 1990, and subsequent (periodic) tests were conducted in March, 1992, and July/August, 1993.

The breaker close coils were rated to be energized for one minute. During normal breaker operations, the coils are energized for less than one second. The work instruction for performing the voltage test intended to establish the lowest voltage at which the coils would operate by slowly increasing the voltage at the test equipment. The instruction called for two data readings to be recorded for each test. Since the total coil energize time during the test was not explicitly limited by the instruction, the potential existed to put more heat energy into the coil during performance of the test than allowed by the one-minute rating. On July 15, 1993, the coil associated with Division II emergency diesel generator failed during the special voltage test. The failure mode was distortion of the plunger sleeve and locking of the plunger in the operate position due to excessive heating of the coil. The breaker was removed from its compartment at the time the failure was identified. Sometime after a spare breaker had been installed in place of the failed breaker, maintenance personnel identified that the test instruction was the root cause of the failure. The instruction was revised at that time to prevent recurrence of the problem.

However, at the time of this inspection, the four close coils mentioned above may have been subjected to operating conditions beyond their rating, and therefore the life expectancy was indeterminate, but this condition had not been addressed. After the NRC inspector identified the situation, engineers presented arguments as to why the breaker coils in question were not an immediate concern. Since each of the four coils had successfully completed several normal-voltage energize/de-energize cycles after being subjected to the voltage test, it was demonstrated that they did not have the degree of deformation which could block the plunger. The issue of long term useful life of these close coils was still a problem. The significance of this problem was that the close coils could prematurely fail to operate upon demand, such as during accident load sequencing. The potential for common mode failure existed because both emergency diesel generator breakers were involved.

In summary, a test which was developed as part of the corrective action for a calculated voltage problem did not contain sufficiently detailed instructions which resulted in damaging the component in the process of testing. Furthermore, once that instruction was found to be deficient, corrective actions were inadequate in that the long term effects on the four breaker close coils had not been addressed.

As a result of the inspector's review of the Incident Report summary and follow-up questioning, another example of inadequate corrective action was identified. Incident Report 93-1106 was written to address the fact that the Division II drywell purge compressor control circuit did not respond as intended during performance of a simulated LOP/LOCA test (Procedure No. 06-OP-1P75-R-0004-04) on November 12, 1993. The feeder breaker for the compressor closed at the proper time, and immediately opened and remained open. The root cause of this anomaly was a relay race in the control circuitry. According to design requirements, the compressor was blocked from starting during the first 30 seconds following a LOCA. During this 30-second period, a trip signal was placed on the breaker, as intended. At the 30-second point the compressor received a start signal, which should have started the compressor. However, the relay contacts providing the trip signal did not open until after the close signal appeared. Therefore, the breaker closed then immediately tripped. The close signal remained sealed in, but the anti-pump relay was energized which prevented the breaker from re-closing. Schematic Diagrams E-1186, sheets 8 and 11, show the control circuit for the drywell purge compressor. Minor Change Package MCP 93/1080, which was implemented after the event, modified the control circuit of Divisions I and II drywell purge compressors to prevent recurrence of this problem by ensuring that the trip signal is removed before the close signal is given.

The inspector became aware that the relay race problem with the purge compressor circuit had been identified in 1983, which was about one year before the Operating License was issued. The problem had come to light during start-up testing. The licensee stated that a time trace of relay contact status, made in 1983, showed that simultaneous trip and close signals could occur. Design Change Package 83/0452 had been developed to correct the problem, but it was not implemented. The original change package had not been cancelled, however a new package was generated in 1993 because the original had not been prepared according to the current guidelines. The significance of the relay race problem was that the potential existed to defeat or degrade the functioning of the safety related Drywell Purge System (both Divisions) during a design basis event. Since the problem was a relay race, the circuit could sometimes respond properly. At least five LOP/LOCA tests were performed over the years where the problem did not manifest itself. The inspector's concern was that the licensee had identified the need to modify the control circuits for the safety-related drywell purge compressors in 1983, but the modification was not implemented until 1993 after the circuit malfunctioned during performance of a test to verify the proper functioning of the circuit.

The failure to address the potential for degradation of certain circuit breaker close coils and failure to correct a known problem with safety-related control circuits for a period of ten years constitutes inadequate corrective action. Therefore, Violation 94-02-01, Failure to Take Adequate Corrective Action for Problems with Breaker Close Coils and Control Circuits, is being issued.

During review of Incident Report 92-0602, the inspector identified a problem with the classification of emergency diesel generator failures, ie. valid versus invalid. On May 25, 1992, while performing post-maintenance and post-modification testing, Division I emergency diesel generator experienced a failure. The emergency diesel generator had been running at 5.45 MW for 2.28 hours when the failure occurred. The failure mode was tripping of the generator output breaker due to large oscillations in the field voltage. The oscillations were evaluated to have been caused by excessive resistance at the rectifier bridge selector switch. This switch, which does not have any safety-related function, has since been bypassed on emergency diesel generators for both Divisions.

Special Report 92-003, which reported the details of this failure, stated that the event was a valid test and an invalid failure pursuant to Position C.2.e.(7) of Regulatory Guide 1.108. However, the Surveillance Procedure Data Package indicates that the failure was classified invalid pursuant to Position C.2.e.(3) of Regulatory Guide 1.108. In either case, the licensee's classification of this failure is not a correct classification. Position c.2.e.(7) states that a post-modification or post-maintenance test is considered a valid test and failures during such a test are valid failures. This would be especially true if the failure was due to a component not involved in the maintenance or modification, as was the case with the bridge selector switch. Position C.2.e.(3) states that successful starts followed by successful loading and continued operation of at least one hour should be considered valid successful tests. In relation to this position, the licensee's procedure 06-OP-1P75-V-0011 which provides guidance in interpreting Regulatory Guide 1.108 states: "If any failure occurs after [one-hour], it will be classified as an invalid failure." The intent of Position C.2.e.(3) is that the diesel must run for a minimum of one hour to constitute a successful test. However, should the licensee choose to continue the test for longer than one hour, failures that would have been valid failures before one hour are still valid if they occur after one hour.

The Surveillance Procedure Data Package indicates that, when the failure described above occurred, four valid failures had already been recorded. Had the failure in question been properly classified, there would have been five valid failures in the last 100 valid test. Therefore, according to Technical Specification Surveillance Requirement 4.8.1.1.2.a and Table 4.8.1.1.2-1 the test frequency should have been once per 7 days rather than once per 31 days.

The cause of the failure has been corrected and the diesel generator has been successfully tested monthly since May 25, 1992. After consultation with Regional and NRR management, it was decided that no safety value would result from causing weekly testing a year and a half after the event. However, the licensee's internal guidance for interpreting Regulatory Guide 1.108 does not appear to be consistent with the intent of the Regulatory Guide. This matter is an Inspector Follow-up Item pending review of the licensee's overall approach to classifying

emergency diesel generator failures, and will be identified as Inspector Follow-up Item 94-02-02, Classification of Emergency Diesel Generator Failures per RG 1.108.

3.3 Walkdowns

The inspector went to the control room to see whether any alarms were present related to electrical systems. None were present. The inspector performed a walkdown inspection of the safety-related batteries (three Divisions) and the emergency diesel generator areas (three Divisions). No problem conditions were identified during these inspections. The inspector looked inside motor control center compartment 52-16401 where a short-circuit had occurred in the past. He observed that the compartment had been restored to good condition.

3.4 Overall Conclusion Regarding Electrical Maintenance and Surveillance

Despite the Violation identified in section 3.2, the inspector concluded that the licensee's performance was good. This assessment was based on consideration of all the maintenance and surveillance activities inspected. Except for the Violation identified in section 3.2, the inspector did not identify any other significant problems. Corrective action was proactive and aggressive in most cases. The various groups worked as a team, and personnel were quite knowledgeable.

4.0 Electrical Distribution System Followup (TI 2515/111)

In December, 1991, inspectors reviewed the open items which had been identified during the Electrical Distribution System Functional Inspection (EDSFI). The results of that follow-up inspection are documented in NRC Report 91-22. NRC Report 91-22 states that the following items remained open:

- Lack of a comprehensive fuse control program.
- Failure to compare voltage calculation results to measured values.
- Completion of updated voltage and short-circuit calculations.
- Review of thermal overload settings.
- Calculations to demonstrate adequate ventilation in the safeguards and ESF switchgear room contained non-conservative assumptions.

The inspector reviewed the licensee's programs and calculations related to the above stated open items, and concluded that the licensee had completed this work. The new calculations did not identify any modifications that needed to be made. Therefore, these items are closed.

5.0 Exit Meeting

The inspection scope and results were summarized on January 28, 1994, with those persons indicated in section 1. The inspector described the areas inspected and discussed in detail the inspection results listed below. Dissenting comments were not received from the licensee.

Item Number	Description and Reference
416/94-02-01	(Opened) Violation - Failure to Take Adequate Corrective Action for Problems with Breaker Close Coils and Control Circuits, section 3.2.
416/94-02-02	(Opened) Inspector Follow-up Item - Classification of Emergency Diesel Generator Failures per RG 1.108. This item was identified as an unresolved item at the exit meeting, however, upon further NRC review, an IFI was determined more appropriate.