



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

Report Nos.: 50-269/95-14, 50-270/95-14 and 50-287/95-14

Licensee: Duke Power Company  
 422 South Church Street  
 Charlotte, NC 28242

Docket Nos.: 50-269, 50-270, and 50-287

License Nos.: DPR-38, DPR-47,  
 and DPR-55

Facility Name: Oconee Nuclear Station Units 1, 2 and 3

Inspection Conducted: June 26 - 30, 1995

Inspector: *P. Fillion*  
 P. Fillion

7/13/95  
 Date Signed

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

7/28/95  
 Date Signed

SUMMARY

Scope:

This routine, announced inspection was conducted in the areas of licensee's resolution of problems with electrical systems, battery capacity, Direct Current System ground fault, and battery qualification issues.

Results:

In the areas inspected, violations or deviations were not identified.

The inspector concluded that the licensee's short term actions to resolve the battery capacity and ground fault issues were good. The proposed long term corrective actions were also good, but were not in place. Therefore, the NRC continues to monitor the situation. An Inspector Follow-up Item was identified with regard to the battery qualification issue, because sufficient information was not provided to clearly establish extending qualification beyond the ten year life (paragraph 4).

Enclosure

## REPORT DETAILS

### 1. Persons Contacted

#### Licensee Employees

- R. Brock, Electrical Engineer
- \*W. Foster, Safety Assurance Manager
- \*J. Hampton, Site Vice President
- \*C. Little, Manager, Electrical Systems and Equipment
- \*W. McAlister, Supervisor, Electrical Systems and Equipment
- \*B. Peele, Station Manager

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

#### NRC Employees

P. Harmon, Senior Resident Inspector

\*Indicates attended exit meeting.

### 2. Battery Capacity Issue (62705)

The inspector reviewed the licensee's engineering studies aimed at resolving problems with performance of the safety-related control power batteries. Requirements applying to the area of inspection were General Design Criterion 17, Electric Power Systems, and Appendix B, Criterion XVI, Corrective Action.

Oconee had six safety-related banks of batteries comprised of Exide FTC-23 cells. The DC distribution systems for the three units were all interconnected through diodes. They also had six non-safety-related battery banks consisting of FTC-23 cells.

The FTC-23 cells had been used at Oconee since 1970. While some problems had been experienced with individual cells maintaining voltage during float charge mode, overall performance had been considered acceptable. Between 1970 and 1990, the batteries had been subjected to annual service tests (one-hour duty cycle).

In early 1990, the licensee started to perform capacity tests at the eight-hour discharge rate. It was planned to conduct these test at five year intervals with the initial test beginning on a staggered basis. In January 1995, capacity tests were performed on the Unit 2 banks which were installed in 1992 and 1993. Test results indicated that the capacities were 80.2 percent and 77 percent of rated capacity. These results were a problem because the capacity had dropped since installation rather than increased as expected. Also, the values were lower than assumed by the licensee's design basis analysis as it existed at that time. One of the Unit 3 batteries was tested in March 1995, and the test indicated a capacity of 78 percent of rated. Not all the installed FTC-23 banks exhibited the low capacity problem. Since early

1990, several safety-related and non-safety-related FTC-23 banks tested at 90 percent of rated, which was considered acceptable.

The manufacturer performed chemical and physical analysis on a few FTC-23 cells that tested at about 80 percent capacity (rather than the expected 90 percent) in a pre-shipment test. The batteries analyzed had been pulled from the assembly line, and had never left the factory. This analysis did not establish a root cause for the low capacity. The manufacturer did, however, state that the FTC series of cells should be derated. Preliminary derated performance curves were provided to the licensee. Original ratings and proposed new ratings for four discharge rates are summarized below. The values are based on a final individual cell voltage of 1.75 V.

	<u>Original Rating</u>	<u>Proposed Rating</u>	<u>Percent Change</u>
8-hour	231 A	190 A	17
4-hour	374 A	330 A	11
1-hour	825 A	759 A	8
1-minute	1325 A	1287 A	3

The licensee's capacity test used a discharge rate of 230 A. Using the new proposed curve, 230 A would be the 380-minute rate. Since the worst case battery delivered this current for 370 minutes, the test results indicate a capacity of at least 97.2 percent in terms of the revised rates. The factory tests on the Unit 2 batteries indicated a capacity of at least 90 percent for each of the groups tested, which translated to 114 percent of the revised rate, which tended to indicate the new proposed ratings were conservative.

The licensee described their overall approach to resolving this issue as follows:

- \* New performance curves for the FTC-23 cell will be established based on factory testing conducted on a sufficient sample size as approved by the licensee.
- \* The worst performing cells in the last capacity tests conducted on the two Unit 2 batteries and the one Unit 3 battery will be replaced with new cells. The capacity test will be repeated to verify the new rating and to establish a new baseline for capacity of the installed batteries.
- \* The battery sizing calculation will be revised to demonstrate that the derated capacity values would be sufficient to meet the design basis. Review of the original calculation indicates that the proposed new values would meet the design basis. The calculation included the assumption that two cells were jumpered out. This

was not a design basis assumption, but was included to allow extra operational flexibility. Removing this assumption would offset the lost capacity due to derating.

- \* The manufacturer was requested to provide a root cause or logical explanation for the derating and licensee's abnormal test results.

The inspector reviewed the factory test data for the Unit 2 batteries. Serial numbers for the worst performing cells in the licensee's capacity test were obtained so that performance of these cells could be compared to the factory test data. This comparison indicated that the worst performing cells in the licensee's capacity test were not the worst performing cells in the factory test. In fact, these cells performed at 90 percent in the factory test.

The inspector reviewed Calculation OSC-5938, Operability Analysis for PIP 2-095-0013 Battery Performance Test, Rev 14. The inspector agreed with the conclusion of this calculation that the batteries were operable in light of the capacity test results, i.e. 77 percent. The inspector reviewed letters from the manufacturer to the licensee dated March 13 and May 26, 1995, on the subject of root cause analysis and capacity derating for the FTC-23 cell problems. The inspector reviewed calculation OSC-2429, Oconee 125 V Control Battery Duty Cycle and Voltage Profile, Rev 7, dated March 27, 1995. Based on this review, the inspector concluded that there was substantial margin in the analysis, and the licensee's statement that a derated battery could continue to meet the design basis was reasonable. One assumption in this calculation was that all the batteries basically share the total load equally because the batteries were essentially connected in parallel through diodes. To verify this assumption, the inspector requested that current measurements be made at the diode cabinets. The inspector witnessed the measurements being made, and the measurements indicated that the load was being equally shared between the sources.

The overall conclusion with regard to review of the battery capacity problem was the inspector agreed that the licensee's approach to resolving the problem was acceptable and that the batteries were operable.

### 3. Grounds on DC System Issue (62705)

The Resident Inspectors identified issues related to grounds on the DC Distribution System. Refer to Inspection Reports 93-22 (paragraph 2.d), 93-26 (paragraph 4.c) and 94-08 (violation). The purpose of this inspection was to review the licensee's corrective actions to resolve this issue.

The issues were that known significant grounds were allowed to exist on the DC Distribution System for extended periods of time and ground detection and location capabilities were not adequate. A significant ground is a deficient condition because it could cause misoperation of

safety-related equipment. The DC Distribution System at Oconee was a very extensive system due to the fact that six batteries were operating in parallel. This increased the probability of multiple grounds on the system and made the task of locating grounds more difficult. Therefore, the generic problem of grounds is aggravated at Oconee due to the design of the system.

The licensee was addressing the grounds issue within their Problem Investigation Process, and it was identified as Serial No. 0-094-1148, initiated on January 31, 1995.

Specific inspection activities and findings are summarized below:

- \* The inspector established that there were no significant grounds existing on the DC system at the time of the inspection. This was performed during voltage measurements made at the main DC bus and witnessed by the inspector. Measurements were made from the positive bus to ground and from the negative bus to ground. The voltage values measured indicated that no significant grounds existed. At the switchyard relay house, the inspector verified that ground detection relays and indicating lamps did not indicate a ground. At the Keowee station, a high resistance ground was present. However, the licensee was in the process of removing this ground. The Keowee operators log contained voltage measurements being made once per shift which indicated the ground was a high resistance ground of no real consequence.
- \* The inspector reviewed the licensee's report titled, 125 VDC Vital Instrumentation and Control System Ground Detection, Location, and System Operation Design Study, dated February 1, 1995. This report made nine recommendations to resolve the grounds issue. These recommendations included installing ground detection equipment having the required sensitivity, acquiring ground locating equipment having the desired accuracy, and implementing proposed comprehensive alarm response procedures. The report also recommended expanding the study to include Keowee, switchyard and safe shutdown 125 VDC Systems. The inspector concluded that the report was thorough and detailed. The recommendations were under review by licensee management.

In summary, multiple grounds of a certain ohmic value can cause misoperation of safety-related equipment. Single grounds are also a concern because hidden grounds could exist and single passive failures must be postulated. The criterion applied by the inspector in assessing the grounds issue at Oconee was based on the recommendations in the study and the licensee's current practice for detecting, locating and removing grounds from the system in a reasonable time period. The inspector concluded there were no immediate concerns, the system was operable and that implementation of the recommendations in the design study would constitute acceptable corrective action to resolve this issue in the long term.

## 4. Battery Qualification Issue (62705)

The licensee was attempting to upgrade the qualification of the batteries at the Keowee station to IEEE Std 535-1986, IEEE Standard for Qualification of Class 1E Lead Storage Batteries for Nuclear Power Generating Stations for 20 year life. The batteries in question were 10 year old NCX-1950 cells by GNB Co. and had been qualified for 10 years. Probably the most difficult qualification requirement according to the standard is 20 year natural aging, followed by a seismic vibration simulation, followed by a capacity test. The licensee had contracted with Nuclear Logistics, Inc. (NLI) to furnish a qualification report. The inspector reviewed this report. The report summary stated that the NCX-1950 cells were qualified for 20 years per IEEE Std 535-1986. The actual testing had been done by Wyle Laboratories. The inspector's review of Wyle's report indicated that some of the cells failed the post-vibration capacity test. It was also noted, following the return of cells to GNB, that further test failures were identified. The inspector questioned how the NCX-1950 cell could be considered qualified when failures were experienced. In response to this question, the licensee contacted NLI to pose the same question. The inspector was later told that NLI believes the cells are qualified and will furnish additional test results and other information to support the qualification. The inspector was told by the system engineer that the failed cells described in the report had been subjected to much more severe seismic testing than required for the Oconee plant. The inspector could not reach an independent conclusion concerning the qualification extension without reviewing the additional information to be furnished by NLI. Therefore, Inspector Follow-up Item 95-14-01, Qualification Extension of the Keowee Batteries, was identified.

## 5. Exit Meeting

The inspection scope and results were summarized on June 30, 1995, with those persons indicated in paragraph 1. The inspector described the areas inspected and discussed in detail the inspection findings, including the item listed below. No dissenting comments were received from the licensee. Proprietary information is not contained in this report.

<u>Item Number</u>	<u>Description and Reference</u>
50-269,270,287/95-14-01	Inspector Follow-up Item: Qualification Extension of the Keowee Batteries - paragraph 4.