



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

Report Nos.: 50-369/85-10 and 50-370/85-11

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

Docket Nos.: 50-369 and 50-370

License Nos.: NPF-9 and NPF-17

Facility Name: McGuire 1 and 2

Inspection Conducted: February 7 - July 3, 1985

Inspector: H C Dance /for 8/1/85
W. Orders Date Signed

Approved by: H C Dance 8/1/85
H. Dance, Section Chief Date Signed
Division of Reactor Projects

SUMMARY

Scope: This special, unannounced inspection entailed 126 inspector-hours on site in the areas of vital battery operability.

Results: Within the one area inspected, three violations and one deviation were identified (Violations: Inadequate surveillance resulting in battery inoperability; failure to implement and have adequate battery surveillance procedures; and inadequate written safety evaluations; Deviation: Battery discharge tests and equalizing charges were not performed per commitment and industry standards).

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REPORT DETAILS

1. Licensee Employees Contacted

- M. McIntosh, General Manager Technical Services
- *T. McConnell, Plant Manager
- **D. Rains, Superintendent Maintenance
- *G. Cage, Superintendent Operations
- **R. White, IAE Engineer
- **N. McCraw, Compliance Engineer

Other licensee employees contacted included technicians, operators, and office personnel.

- *Attended exit interview on March 7, 1985
- **Attended exit interview on June 28, 1985

2. Exit Interview

The inspection scope and findings were summarized on March 7, and June 28, 1985, with those persons indicated in paragraph 1 above. The significance of the findings was understood by the licensee. The apparent violations and deviation were acknowledged. The findings parallels the unresolved items in paragraph 3. The licensee did not identify as proprietary any of the materials provided to or reviewed by the inspector during this inspection. An enforcement conference was subsequently held in the Region II Office in Atlanta on July 3, 1985. A meeting summary is provided in paragraph 11.

3. Licensee Action on Previous Enforcement Matters

- a. (Closed) Unresolved Item 369/85-08-01: Failure to demonstrate the single cell charging of an operable battery does not create an unreviewed safety question. This is a violation. See paragraphs 8.a. and 9.b.
- b. (Closed) Unresolved Item 369/85-08-02: Failure to demonstrate the operability of battery EVCA for the past two years by proper performance of weekly and quarterly surveillance tests. This is a violation. See paragraphs 8.a., 8.b., and 9.c.
- c. (Closed) Unresolved Item 369/85-08-03: Failure to demonstrate the operability of all four batteries by proper conduct of service discharge tests. This is a violation. See paragraph 8.c.
- d. (Closed) Unresolved Item 369/85-08-04: Failure to conduct battery performance discharge tests in accordance with safety analysis report commitments. This is a deviation. See paragraph 8.d. and 9.a.

- e. (Closed) Unresolved Item 369/85-08-06: Failure to implement procedures for the maintenance and operation of the batteries. This is a violation. See paragraphs 7.b. and 9.c(4).

4. Unresolved Items

Unresolved items were not identified during the inspection.

5. Introduction

A special inspection was conducted at the McGuire facility on January 28 - February 6, 1985, by Office of Inspection and Enforcement personnel. Findings are contained in Inspection Report Nos. 369/85-08 and 370/85-08. One of the areas inspected was the operability of the Vital 125 Vdc batteries EVCA, EVCB, EVCC and EVCD. The inspection resulted in the identification of five unresolved items pertaining to this subject. Region II initiated a special inspection on February 7, 1985, to further scrutinize these items. This special inspection culminated in the identification of a number of apparent violations. In as much as this report is quite detailed, a brief review of the batteries' design function precedes the report body.

6. Vital Battery Design Summary

The two McGuire units are provided with four common 125 Vdc vital batteries. Each battery is sized to carry the continuous emergency load of its own vital buses and also assume the loads of another battery in a "backup" capacity, if required, for a period of one hour. The battery is designed to supply power for the operation of anticipated momentary loads during the one hour period. The basis for the selection of the one hour battery capacity is the conservative estimate of the time required to restore power to the battery chargers under adverse credible conditions. During normal operation, the independent and physically separated batteries are floated on the buses and assume load without interruption upon loss of a battery charger or ac power source. Each of the batteries, designated EVCA, EVCB, EVCC and EVCD, consists of 59 cells in clear plastic containers with covers, racks and accessories.

7. Facility Tour - Observations

The inspector toured the battery rooms on a number of occasions during the inspection. The following observations were made:

- a. The rooms were clean and free from dust and dirt which could degrade battery performance.
- b. The batteries did not appear to be installed in accordance with station installation drawing MCM 1356.01-1, revision A, dated March 12, 1974, which specified a minimum clearance of one-eight inch between the end cells and the battery rack. Further, the battery vendor manual,

McGuire document MCM 1356.01-3, specifically states that battery cells should be installed such that the cells are not in contact with the rack supports. The batteries were installed and/or maintained in such a manner that end cells were pressing against the end plate of the battery rack. This is an example of a violation of Appendix B, Criterion V: Failure to install and/or maintain vital batteries pursuant to installation drawing. This example, coupled with the examples detailed in paragraphs 7.d., 9.c(3), and 9.c(4) are examples of violation 369/85-10-01, 370/85-11-01.

- c. Battery EVCA had one cell, cell No. 9, jumpered out of the bank and receiving a single cell charge. Cell Nos. 29 and 45 were receiving single cell charges while still connected to the bank. Each of the three cells was charging at 2.45-2.50 Vdc with electrolytic gassing evident around the cell plates and sediment formation visible on the cell bottoms.
- d. Further investigation revealed that there was no established program for monitoring single cell chargers. This is a procedural violation coupled with examples in paragraphs 7.b., 9.c(3), and 9.c(4). This condition had prevailed on battery EVCA for over two years. Cell Nos. 45 and 29 were placed on a single cell charge on May 29, 1982 and December 29, 1982, respectively, after their specific gravities were determined to be low, but within Technical Specification (TS) limits. Cell No. 9 was placed on a single cell charge on January 23, 1983 after it was jumpered out of the battery, to correct a specific gravity reading which was below the allowable TS limits.

8. Surveillance Requirements

The surveillance requirements for the batteries are delineated in TS 4.8.2, Electrical Power Systems. The inspectors reviewed records of periodic surveillance tests conducted during the past two years to determine if the licensee had properly demonstrated the operability of the batteries. Apparent deficiencies were found in virtually all areas of battery surveillances reviewed. These apparent inadequacies are detailed below:

- a. Weekly pilot cell surveillance conducted to meet the requirements of TS 4.8.2.1.2a were not always measured under battery float voltage conditions as defined in the licensee approved vendor manual. Gould Station Battery Installation and Operating Instructions, MCM 1356.01-3, recommends float voltage for lead-calcium batteries of between 2.17-2.25 volts per cell which corresponds to a maximum battery float voltage of 133 Vdc for a 59 cell battery. The TS limits of Table 4.8.3 were based on the float charge values recommended by the vendor in manual MCM 1356.01-3. When cell 9 was jumpered out of battery EVCA in January 1983, the float voltage was maintained at 133 Vdc. Therefore, subsequent surveillance were performed at an elevated average voltage of 2.29 volts per cell for the 58 cell battery. This is an example of a violation of 10 CFR 50.59: Failure to evaluate and/or follow vendor

recommendation of float voltage of 2.17-2.25 volts per cell. This example coupled with the example detailed in paragraph 9.b(1) collectively constitutes a violation (369/85-10-02, 370/85-11-02).

- b. Monthly Surveillance conducted to meet the quarterly requirements of TS 4.8.2.1.2b were not always measured under battery float conditions as required by TS and defined in the vendor manual, MCM 1356.01-3. In addition to the elevated float voltage problems discussed above in paragraph (a), cells 29 and 45 in the battery had been receiving single cell charges since December 29, 1982 and May 29, 1982, respectively. These cells were receiving what is equivalent to a continuous equalizing charge. The individual cell voltages measured during the monthly surveillance inspections were the output of the single cell chargers and not the cell voltage as is required. In that the battery float voltage was not obtained as specified by TS, this constitutes a failure to perform required surveillance. This example coupled with the example detailed in paragraph 8.c constitutes violation 369/85-10-03, 370/85-11-03. This fact was demonstrated when the single cell chargers were removed from the two cells on February 5, 1985 and their voltages dropped from 2.45-2.5 to 2.10 volts for cell No. 29 and 2.14 volts for cell No. 45.
- c. Battery service discharge tests conducted to meet the requirements of TS 4.8.2.1.2d were not always performed in accordance with TS requirements. TS 4.8.2.1.2d.2 requires that a service test be performed by either supplying actual emergency loads for one hour or supplying a dummy load of at least 440 amps for one hour while maintaining a battery terminal voltage of at least 105 volts. Contrary to this requirement, service discharge tests performed in March and April, 1984 on all four Vital and Instrumentation Control Batteries were conducted by discharging into a dummy load at 1217 amperes (amps) for one minute and 370 amps for 59 minutes. This is a violation. Failure to perform battery capacity test as specified. This example coupled with the example detailed in paragraph 8.b constitutes a violation. The technique employed corresponds to a superseded TS requirement and indicates a failure by the licensee to revise TS surveillance procedure. The procedure, PT/O/A/4350/08A, 125 Vdc Vital I&C Battery Service Discharge Test, was changed on January 11, 1985 (22 months after the requirement was changed) to reflect the new requirements. Subsequent review of a DPC analysis of February 18, 1985, by the Region II staff concluded that the test performed was a close approximation of the specified test and unit shutdown to perform the specific test was not required. The specified test is planned to be conducted during April/May 1985.
- d. Battery performance discharge tests conducted to meet the requirements of TS 4.8.2.1.2e and f were not always conducted in accordance with licensee commitments to IEEE 450-1972 as described in the Final Safety Analysis Report. IEEE 450-1972 requires that performance tests be conducted at a predetermined discharge rate until the battery reaches a minimum voltage determined by the number of connected cells and the

minimum voltage per cell identified in the vendor manual. The battery performance discharge tests conducted in January 1980 on all four Vital and Instrumentation Control Batteries discharged the batteries at only the one hour rate for one hour. The test was then secured, and the battery was determined to operate at 100% rated capacity. This is a deviation from licensee commitment to test batteries in accordance with IEEE-450. This example of a deviation coupled with the example detailed in paragraph 9.a collectively constitutes a Deviation (369/85-10-04, 370/85-11-04). Additionally, TS 4.8.2.1.2e and f require that a performance discharge test be conducted at least once per 60 months to verify battery capacity above 80% rated capacity and to determine when a degraded battery exists. One of two methods for determining degradation is the detection of when battery capacity drops more than 10% from the average of the two previous tests. A second determination of a degraded battery exists when battery capacity drops below 80% of manufacturer rating. The licensee's method of conducting the battery performance test may prevent trending of battery capacity to determine when a degraded condition exists.

9. Equipment Operability

a. Battery Charging

The inspector reviewed the technical content and implementation of licensee procedures for conducting battery charges. The charges are apparently not being conducted when required or in a manner that is consistent with reference documents as is explained below:

- (1) IEEE 450-1972 and the battery vendor manual, MCM 1356.01-3, require that an equalizing charge be conducted when:
 - (a) the specific gravity of any individual cell drops .010 or more below the average of all cells, or
 - (b) the average specific gravity of all cells drops .010 or more from the average specific gravity of the battery after its initial acceptance charge or
 - (c) the individual cell voltage (ICV) of any cell varies by .04 volts or more from the average ICV within the battery or any cell ICV is below 2.13 volts.

McGuire procedures that specify when an equalizing charge should be performed, only identify charging as being required when:

- (a) the ICV of any cell varies by .05 volts or more from the average ICV within the battery or
- (b) the average specific gravity of the battery is less than .010 from its acceptance charge average value.

In practice, McGuire does not appear to analyze monthly surveillance results to determine whether the battery needs an equalizing charge. Furthermore, station personnel could not produce a copy of the initial acceptance charge values that are to be used for a comparison standard. No equalizing charges have been conducted on any Vital and Instrumentation Control Battery in the past two years except as restoration from a service discharge test. The inspectors reviewed completed monthly surveillance data sheets for the past two years and found that battery EVCA met the reference document criteria for requiring an equalizing charge in nearly all months. This is a deviation from industry standard for failure to conduct equalizing charges recommended by IEEE-450 and the vendor manual. This example coupled with the example detailed in paragraph 8.d constitutes a Deviation.

- (2) The licensee employs three techniques of conducting equalizing charges, none of which embrace the vendor manual recommendations. The vendor manual MCM 1356.01-3, recommends two charging procedures:
 - (a) A constant current method where the battery is charged at 83 amps until the lowest cell specific gravity is constant for a 5 hour period.
 - (b) A constant voltage method where voltage is raised to the maximum allowed by the system and maintained for a minimum of 95 hours after charging current has stabilized. The duration of the charge is determined by the voltage that can be achieved from a table in the vendor manual.

McGuire procedure, IP/O/A/3061/08, Vital Battery Equalizing Charge, describes a constant voltage method of charging but at a higher rate (2.45 volts per cell average) than the vendor manual recommends (2.39 volts per cell maximum). IP/O/A/3061/11, Charging by Constant Current Method for Vital I&C Batteries, specifies charging at 50 amps maximum until the specific gravities of six pilot cells stabilizes over a three hour period. Procedure IP/O/A/3016/12, Charging Vital Batteries After Discharges, provides for an accelerated charge rate initially to replenish the battery and then offers a choice of continuing by either the constant voltage or constant current methods. Pursuant to the vendor manual, a charging battery should be monitored at least every two hours. Historically, equalizing charges have been conducted only after discharge tests. A review of the applicable charging records revealed that periodic monitoring was not always accomplished at the prescribed interval. Additionally, there are provisions in IP/O/A/3061/12 for reducing the charging rate to 10 amps on the back shifts and terminating the periodic monitoring of the battery. This practice has resulted in a battery under

charge not being monitored for up to 17 hours. During the inspection, the licensee could not produce any documentation that would justify their deviations from the recommendations by the vendor manual MCM 1356-01-03. The practice of periodic monitoring and charging rates that differ from those recommended by the vendor manual are included in the overall deviation from industry standard addressing equalizing charges referenced in paragraph 9.a(1).

b. Single Cell Charging

McGuire procedure IP/O/A/3601/13, Operation of Single Cell Battery Charger, describes a method of connecting an unqualified, nonclass IE battery charger to a cell installed and functioning in a class IE battery. This violates the required independence of the class IE electrical system. No regulatory or vendor reference material justifying this method could be found during the inspection. The following deficiencies were noted with procedure IP/O/A/3061/13:

- (1) The safety evaluation conducted on this procedure to meet the requirements of 10 CFR 50.59 does not address the violation of class IE system independence. The written justification for determination that an unreviewed safety question does not exist states that the use of a single cell charger will not affect the battery capability to perform as required in that the single cell charger and leads will be restrained and thus will not constitute a safety hazard. This justification does not provide a basis that an unreviewed safety question did not exist as the result of the attachment of the single cell charger to the Class I seismic battery pack or to establish charging criteria of voltage, duration, etc. This and the example of paragraph 8.a constitutes a violation of 50.59 in that an incomplete review was performed prior to jumpering a cell and installing individual cell chargers.
- (2) There were no limits specified for cell charging voltage or current nor a clear definition of when to secure the charge and replace the cell if the cell did not improve its capacity. This contributed to an excessive voltage being applied to the single cell charging of cells 29, 45 and 9 (jumpered out) for over two years. See paragraph 9.c(3).
- (3) There was no delineation between when to use a single cell charging procedure and when to conduct an entire battery equalizing charge. See paragraph 9.c(4).

c. Operations and Maintenance

The inspector reviewed the technical content and implementation of licensee procedures for battery maintenance and operations. The following deficiencies were noted:

- (1) TS 4.8.2.1.2b requires that quarterly, the temperature of the battery, as determined by six connected cells, be verified greater than 60°F. Additionally, IEEE 450-1972 requires that corrective action be taken when temperature variance is greater than 5°F. Procedure IP/O/A/3061/01, 125 Volt Vital Batteries Weekly Monthly Inspection and Preventive Maintenance, implements these requirements on a monthly basis by selecting the pilot cell and every tenth cell thereafter for measurement. The procedure assumes but does not specify that the cells are connected to the battery. On February 23, 1984 and May 19, 1984, jumpered cell (No. 9) was included in battery EVCA temperature determination. The TS requirement, (i.e., the quarterly surveillance), was satisfied by measurements taken on the following monthly inspection.
- (2) TS 4.8.2.1.2c requires that cell-to-cell resistance be verified less than or equal to 150 microohms at least every 18 months. IP/O/A/3061/07, Vital Battery and Terminal Post Inspection, implements this requirement. Additionally, IEEE 450-1972 requires that intercell connectors shall be taken apart, cleaned and refastened if measured resistance is more than 20% above the average at the time of installation. Procedure IP/O/A 3061/07 does not require this comparison and apparently the licensee does not accomplish this requirement when intercell resistances are measured.
- (3) Procedure IP/O/A/3061/18, Installation and Removal of Jumpers on Battery Cells, is implemented when one cell is below TS limits. This procedure states in part "up to one cell in a vital battery bank may be jumpered out if it is determined that particular cell is inoperable per Technical Specification... The installation of a jumper is not considered a modification as denoted on drawing MC 1705.01." Drawing MC 1705.01 originally had a similar statement included at the bottom of the drawing in a note, but revision 39, issued July 10, 1984, deleted the note. Change 2 to procedure IP/O/A/3061/18 was issued December 14, 1984, to improve the technical content of the procedure but did not revise this part of the procedure. During the inspection the licensee could not provide a documented technical basis for allowing one cell to be jumpered from a vital battery. Additionally, the only post installation testing required by procedure IP/O/A/3061/18 was to measure the resistance of the installed jumper and verify that the battery meets operability requirements. There was no requirement to measure the redistribution of the float voltage across the reduced number of cells or verify the capacity of the newly

configured battery. On January 23, 1983, a monthly surveillance was performed on battery EVCA. Cell 9 specific gravity was below TS limits, the battery was declared inoperable, cell 9 was jumpered out, and the battery was declared operable without any additional operability demonstration by surveillance testing. This is an inadequate procedure for failure to have adequate acceptance criteria for the modification. This example coupled with the examples detailed in paragraphs 7.b, 7.d, and 9.c(4) collectively constitutes a violation.

- (4) The battery vendor manual MCM 1356.01-3, recommends that water be added and recorded to cells prior to conducting an equalizing battery charge. Instrument Procedure IP/O/A/3061/01 125 volt vital batteries weekly/monthly inspection and preventive maintenance, step 10.2.13, requires that an equalizing charge be conducted after the addition of water to the battery and does not require that the quantity of water be recorded. On January 17, 1985, water was added to the battery and an equalizing charge was not conducted. This is an example of a violation for failure to follow procedure requirements. This example coupled with the examples detailed in paragraphs 7.b, 7.d, and 9.c(3) and the following two paragraphs collectively constitutes a violation.

IP-O-A-3061-01 also facilitates the surveillance requirements of TS 4.8.2.1.2b which requires in part that quarterly, the temperature of the battery, as determined by six cells, be verified greater than 60°F. There is no requirement in the procedure for the cells to be connected to the battery. On February 23, 1984 and May 19, 1984, jumpered cell (No. 9) was included in battery EVCA temperature determination. The procedure is inadequate in that it did not allow for or recognize a jumpered cell. This inadequacy is included in the above violation.

IP-O-A-3061-01, step 10.2.3, requires the technician to determine the maximum temperature of the six measured cells (see A above), and if the maximum differentiated temperature exceeds 5°F, to investigate the cause, and document the corrective action. On January 17, 1985, the temperature of the six cells varied by 9°F and no corrective action was taken. The cause of the high temperature variance was the inclusion of cell No. 29 in the measurement which was receiving a single cell charge and operating at an elevated temperature. This constitutes a failure to follow procedure and is incorporated in the above procedural violation.

10. On February 1, 1985, the inspector met with licensee management to discuss their concerns about the operability of battery EVCA. A short summary of the findings discussed above was presented and the question of battery operability was posed to station management. The station manager and Instrumentation and Electrical engineer were unaware that the single cell charging was still in progress on cells Nos. 9, 29 and 45.

The licensee chose to leave the single cell chargers in place until replacement cells could be prepared for change out. It was subsequently decided not to change the cells out. This deliberation required four days during which the Unit I was operating at 100% power. On February 5, 1985, the single cell chargers were removed from cells No. 29 and No. 45. Individual cell voltages measured 2.10 volts on cell 29 and 2.14 volts on cell No. 45 at an elevated flat voltage of 133 volts (2.29 volts per cell average). This placed battery EVCA in a seven day action statement to return cell 29 voltage to at least 2.13 volts in accordance with TS Table 4.8-3. The licensee disconnected the battery from the dc bus, voluntarily entering a 72 hour action statement, jumpered out cell No. 29 and placed cell No. 9 back into service. Subsequently, battery EVCA successfully passed an eighteen-month service test and was declared operable. The licensee's position was that battery EVCA was operable until the out of specification cell voltage on cell No. 29 was identified on February 5, 1985. It was returned to an operable status within the allowable TS action statement limits. The licensee is being asked to address the delay from February 1, to February 5, 1985, evaluating and removing the battery chargers from battery EVCA.

11. Enforcement Conference

An Enforcement Conference was held at Region II's request in the Nuclear Regulatory Commission (NRC) Region II office on July 3, 1985 to discuss the concerns associated with the Vital and Instrument Control Batteries. Personnel in attendance is shown in Attachment 1.

Following introductions, the NRC identified the concerns associated with the Vital and Instrument Control Batteries. Initial inspection Findings were contained in Report Nos. 50-369/85-08 and 50-370/85-08 as five unresolved items and further reviewed in this report with specific violations. The concerns involved the failure to properly conduct service discharge and surveillance tests and the lack of procedural control and adherence. Duke Power Company (DPC) representative stated that the issues identified for the control of battery activities was not the way DPC conducts their business and corrective actions have been taken to prevent recurrence. The DPC presentation, see attachment 2, detailed the battery system design, the sequence of events and responded to each of the inspection findings. Questions and discussion occurred throughout the meeting. The licensee concluded that although the batteries may have been technically inoperable, subsequent testing has confirmed they would have performed had they been called upon.

The NRC stated the presentation and exchange of views was most helpful in clarifying the issues and that their comments would be considered in further evaluation.

Attachments:

1. Attendance List
2. Enforcement Conference on Vital Batteries

ATTACHMENT 1

ATTENDANCE LIST

July 3, 1985

Duke Power Company

H. B. Tucker, Vice President Nuclear Production
K. S. Canady, Manager, Nuclear Engineering
T. L. McConnell, Station Manager, McGuire
N. A. Rutherford, System Engineer, Licensing
T. A. Ledford, Supervising Design Engineer
K. R. Caraway, Supervising Design Engineer
D. J. Rains, Superintendent of Maintenance, McGuire
E. O. McCraw, Compliance Engineer, McGuire
R. B. White, Jr., IAE Engineer, McGuire
R. F. Turner, Engineering Specialist, McGuire

Nuclear Regulatory Commission

J. N. Grace, Regional Administrator
R. D. Walker, Director, Division of Reactor Projects (DRP)
A. F. Gibson, Acting Director, Division of Reactor Safety (DRS)
G. R. Jenkins, Director of Enforcement and Investigations
B. W. Jones, Regional Counsel
H. C. Dance, Chief, Project Branch 2A, DRP
C. W. Burger, Project Engineer, DRP
W. T. Orders, Senior Resident Inspector, McGuire
J. E. Dyer, Inspection Specialist, Operating Reactor Programs Branch,
Office of Inspection and Enforcement (IE)
A. B. Beach, Enforcement Specialist, IE
T. C. Poindexter, Enforcement Specialist, IE