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2CAN040403

April 6, 2004

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Request for Additional Information Regarding Maintenance and Surveillance of Class 1E Station Batteries
Arkansas Nuclear One – Unit 2
Docket No. 50-368
License No. NPF-6

Dear Sir or Madam:

On March 3, 2004, Entergy received a request for additional information regarding the maintenance and surveillance of Class 1E station batteries at Arkansas Nuclear One, Unit-2, from Mr. Thomas Alexion of your staff via e-mail. The attachment to this letter and the enclosed compact disc contain the requested information. Should you have questions or comments, please contact Mr. Richard Scheide at (479) 858-4618.

There are no commitments contained in this submittal.

Sincerely,

Dale E. James
Manager, Licensing
DEJ/rhs

Attachments/enclosure

Enclosure not included in IDEAS verion due to ☐ duplication. See Green Folder in Licensing ☐ Research

cc: Dr. Bruce S. Mallett
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U. S. Nuclear Regulatory Commission
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Attachment
to
2CAN040403

Request for Additional Information Regarding Maintenance and Surveillance of Class 1E Station Batteries

Request for Additional Information

NRC Question 1

What is the make, model, and vintage of Battery 2D11?

ANO Response

Battery 2D11 is a 58 cell lead-calcium battery made by C&D Technology.

The cells in 2D11 are model LC-31. (C&D later changed the designation for this model cell to LCR-31 and no longer uses the LC-31 designator.)

2D11 was installed in July, 1986. Typical date codes on the original cells are 5/86.

Three cells have been replaced since the original installation. These cells are tagged as model LCR-31 and are:

- Cell 14 replaced in 02/2000 with date code 08/99
- Cell 43 replaced in 01/2001 with date code 09/00
- Cell 41 replaced in 09/2003 with date code 08/87

NRC Question 2

Provide the results for each performance test performed on Batteries 2D11 and 2D12.

ANO Response

The overall results of the battery performance tests are summarized in the table below. The actual test data for Battery 2D11 is included as Enclosure 1 on the enclosed compact disc. The actual test data for Battery 2D12 is included as Enclosure 2 on the enclosed compact disc. Enclosure 3 on the compact disc contains the below referenced Condition Report (CR) and Engineering Request (ER).

Bank	Date	Capacity	Comments
2D11	2/28/88	116%	
2D11	9/17/92	116%	
2D11	5/17/97	106%	CR-2-97-0444, discharge rate set incorrectly. As a result, the full capacity of the battery was not determined. (1)
2D11	4/23/02	98%	ER-ANO-2002-0534-000 evaluated test equipment failure that resulted in low current for ~ one hour. Approximately 260 amp-hours (12.5% capacity) in this period were not credited in the capacity calculation, resulting in the conservative final figure.
2D11	10/02/03	108%	

Bank	Date	Capacity	Comments
2D12	9/28/89	112.5%	
2D12	3/14/94	112.5%	
2D12	1/21/99	102.7%	Test equipment failed at 8.2 hours so full capacity was not measured. Voltage at 8 hours was 108.5, compared with 108.1 volts at 8 hours in the previous test, indicating capacity would have been seen as greater than or equal to the 1994 capacity.

1. As stated above, the discharge rate for the 2D11 discharge test performed on 5/17/97 was incorrectly set at 251 amperes instead of the required 265 amperes. The test was terminated after 9 hours with an ending bank voltage of 106.8 V. Subsequently, the battery bank capacity was determined as indicated below. It should be noted that the calculated capacity is conservative since the test was terminated before the battery bank voltage decreased to the normal test termination voltage 105 V.

   Actual Discharge Rate (251 A) × Test Duration (9 Hours) = Ampere Hours expended (2259)

   Ampere Hours expended (2259) ÷ Correct Discharge Rate (265) = Equivalent Duration (8.5 hours)

   Equivalent Duration (8.5 hours) ÷ Duty Cycle (8 hours) = Capacity (106%)

NRC Question 3

Provide the current individual cell voltages for Battery 2D11 based on the latest surveillance data.

ANO Response

Enclosure 4 on the enclosed compact disc contains the last quarterly surveillance test data for Battery 2D11.

NRC Question 4

Provide details on the acceptance criteria used when replacing individual cells within a battery including the technical basis supporting operability of the modified battery.

ANO Response

ANO maintains a "spare" battery bank of fully charged cells that is on continuous float charge from which replacement battery cells are drawn. This spare bank consists of cells for each of the wetted lead acid battery models used on site (C&D Technology types LCR-31, LCR-21, LCY-39 and Exide type FTC-11.) This bank is configured in a series arrangement of cells. Since this bank consist of different size cells, each with different float charging current requirements, "snubbers" are installed across the smaller cells (LCR-21

and FTC-11) to maintain the desired float voltage for all cells. These "snubbers" are designed for this application to maintain a float voltage of 2.23 across the cells.

Monthly testing and periodic "Performance Discharge Tests" of the individual cells are performed in accordance with procedure OP-1403.079 "Unit 1 & 2 Station Battery Spare Cell Maintenance and Testing". Performance discharge tests on individual cells are performed every 3 years with an acceptance criterion of > 90% capacity.

The monthly testing measures and records the following parameters to ensure each cell remains fully charged:

Parameter	Acceptance Criteria
Cell's Serial No.	N/A
Cell's Float Voltage	2.20V – 2.25V
Cell's Electrolyte Temp	Average temp > 60F
Cell's Electrolyte Level	> Min LVL Line & < ¼" above Hi LVL Line
Cell's Specific Gravity	Within 25 points of Cell's "initial specific gravity"
Equalize Charge	Every 6 months or cell voltage < 2.17V or SG >.025 less than initial recording
Visual Inspection of Cells	Notify Electrical Maintenance Supervisor for Resolution
Visual Inspection for Corrosion	Clean
Room Temp	60F-90F; Desired-77F

Bi-annual equalize charges on the bank are also performed to ensure each cell remains fully charged.

OP-2403.077 "Battery Cell Replacement" procedure provides guidance for replacement of a battery cell that includes:

a. Measuring and recording the following data on the cell to be installed prior to disturbing the battery bank in which the cell will be installed:

Parameter	Acceptance Criteria
Cell's Float Voltage	2.17V – 2.25V
Cell's Electrolyte Temp	> 60F & < 100F
Cell's Electrolyte Level	Hi Level Line to ½" below Hi Level Line
Cell's Specific Gravity	Temperature and Level Corrected SG > 1.200
Cell's Manufactured Date	Verify Cell is Younger than Bank
Visual Inspection of Cell	No Physical Damage

b. Torque Requirements for disturbed rack & cell connections

c. Coating of connection surfaces with No-Ox-ID grease
d. Measure & Record resistance of affected connections with acceptance criteria of < 50μΩ.

Battery cell replacements are controlled under work orders. Work orders provide detailed written guidance for replacement of the cell and required post maintenance test (PMT) acceptance criteria. Work orders may contain additional guidance and acceptance criteria beyond those requirements specified in the battery cell replacement procedure. "Like for like" battery cells are utilized for all cell replacements.

All tools, equipment and the spare cell are staged local to the battery prior to isolating the battery from its bus, thus minimizing the effects of "self-discharge" of the spare cell and battery while they are both in an "open circuit" configuration. C&D Technology's vendor manual (RS-1476) states that a lead-calcium stationary battery cell will self-discharge at a rate of 1 to 2 percent/month. Technical Specification 3.8.2.3 limits the time that a battery may be inoperable to 2 hours or be in Hot Standby within the next 6 hours and Cold Shutdown within the following 30 hours. Typical time required to replace a cell is approximately 2 hours. Consequently, limiting the time a spare cell is open-circuited to 12 hours and the battery to 2 hours results in there being a negligible effect on the state of charge of the replacement spare cell and battery. Therefore, the battery's capability to perform its safety function after being returned to service is not compromised.

Replacement of Cell No.41 in Battery 2D11:

CR-ANO-2-2003-1426 documented a declining trend in cell No. 41's float voltage from 2.252V (7/03) to 2.168V (10/03). This cell's voltage dropped below ANO's established maintenance limit of 2.17V, but remained well above the 7 day Technical Specifications limit of 2.13V. Corrective action No.1 to CR-ANO-2-2003-1426 recommended replacement of the cell if its voltage did not return to within previous performance trend values following the bank's scheduled Performance Discharge Test.

On 10/3/03, during Refueling Outage 2R16, Battery 2D11 was subjected to a Performance Discharge Test in which cell 41 demonstrated a >106% capacity. Battery 2D11 was returned to service on 10/5/03 following the bank's equalize and float charge and verification of acceptable cell parameters (float voltage, electrolyte temperature, electrolyte level, charging current of < 2 amps, and bank terminal float voltage.) However, cell 41's float voltage did not return to its pre-test value of 2.25V. Therefore, it was replaced as a conservative measure.

Cell 41 was replaced on 10/8/03. The replacement cell was one of four cells that were removed from the original 2D12 battery, which was replaced earlier in the outage.

Both 2D11 and the original 2D12 batteries were installed within a year of each other (2D11 in 1986 & 2D12 in 1987) and it was decided to use a cell of the same vintage as the bank to preclude encountering problems associated with suppressed cell voltage due to cell de-polarization agents. Replacement cell 41 was equalized, and then floated for 24 hours prior to being subjected to a Performance Discharge Test. The cell demonstrated a capacity of >120%. The cell was again equalized and placed on float charge and, when its float charge current was < 2 amps, it was considered fully charged and ready to be installed. This cell's parameters (float voltage, specific gravity, temperature, level, etc.) were measured and recorded in accordance with procedure before removing it from the spare battery bank. The cell's parameters were within established acceptance limits and the

cell was then moved local to battery 2D11. Battery 2D11 was then isolated from its bus to support the cell replacement. The cell was replaced using established procedural guidance. The cell's connections were coated with NO-OX-ID grease and torqued to vendor recommended values. All disturbed battery rack bolts were also re-torqued to vendor recommended values. The disturbed connections were verified and documented as acceptable by performing DLRO (digital low resistance ohm) measurements on the connections. The battery's disconnect switch was then closed and the battery was returned to service.

Shortly after returning the battery to service (30 minutes), cell 41's float voltage was measured and recorded to be 2.12V (below the Technical Specifications limit of 2.13V). The Technical Specifications allow the battery to be considered operable with an individual cell's float voltage < 2.13V providing that its voltage is returned to ≥ 2.13V within 7 days. The cell's float voltage increased above the 2.13V limit on 10/11/03 (2.211V.) At no time did the cell's voltage reach the operability limit of 2.07V. Cell 41's float voltage was recorded at 2.229V during the following quarterly surveillance that was conducted on 2D11 on 12/12/03, which is within the allowable float voltage range of 2.20–2.25vpc.

NRC Question 5

Describe the definition of battery float voltage that is currently being used at Arkansas Nuclear One and any variation from industry standard practices.

ANO Response

ANO Float Charge:

Float Charge as used at ANO is a range of voltage, measured at the battery bank's terminals, whose purpose is to maintain the battery in a fully charged state to support the battery's function (delivery of its required amp-hour duty cycle.) The range of voltage selected is based on the battery vendor's allowable float voltage Vpc Min/Max of 2.20-2.25Vpc for a nominal specific gravity of 1.215. Therefore the limits established in the surveillance procedures for battery terminal voltage are 127.6V – 130.5V (58 cells X 2.20 – 2.25Vpc) for our 58 cell banks and 132.0V – 135.0V (60 cells X 2.20-2.25Vpc) for our 60 cell banks.

Industry Standard Practices:
IEEE 450-1980:

Section 4.3.1: Regularly scheduled inspections (at least once per month)

Item No.2: Charger output current and voltage
Comply: Performed weekly during the "Pilot Cell Surveillance Test."

Item No. 7: Pilot cell voltage, specific gravity, etc.
Comply: Performed weekly during the "Pilot Cell Surveillance Test."

Section 4.3.2: Quarterly

Item No.2: Voltage of each cell and total battery terminal voltage
Comply: Performed during "Quarterly Surveillance Tests." Battery Terminal Voltage is also measured and recorded in the weekly "Pilot Cell Surveillance Test"

Section 4.4: Corrective Actions

Item No.5 When the float voltage, measured at the battery terminals, is outside of its recommended operating range, it should be adjusted

The original C&D vendor manual 12-800 (ANO-TDC173.0260) provided a recommended "Nominal" Float Voltage of 2.20V–2.25V but did not specify a "recommended operating range."

The current C&D vendor manual RS-1476 (ANO-TDC173.0310) provides "Recommended" and "Allowable" Float Voltage Vpc Min/Max limits as follows:
Recommended: 2.21 – 2.22V
Allowable: 2.20 - 2.25V

ANO's current weekly & quarterly surveillance procedures require the battery float voltage, as measured at the battery terminals, to be maintained within 2.20V – 2.25Vpc in accordance with the original vendor manual. Therefore, ANO's procedures are not consistent with the specific wording of the IEEE standard considering the wording in the current vendor manual. However, based on the historical trends of both Service & Performance Discharge tests, the batteries (2D11 & 2D12) have performed exceptionally well. The batteries have performed at a level "above expected life" on their life cycle curves (performance discharge testing) and their end of discharge terminal voltages have remained ≥ 110.9V, with an acceptance criteria of ≥ 105V, during all service discharge tests. Nonetheless, CR-ANO-2-2004-0504 was written to document and evaluate this deviation (existing procedures use the "allowable" float voltage limits and not the current "recommended" float voltage limits).