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FACIL: 50-265 Quad-Cities Station, Unit 2, Commonwealth Edison Co. 05000265
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RECIP. NAME RECIPIENT AFFILIATION

SUBJECT: LER 88-009-00: on 880507, 125 volt battery failed performance discharge test. Caused by five high resistance connections. Cable replaced, procedure revised & reviewed & weekly, monthly & quarterly trending & monitoring increased. W/880526 ltr.

DISTRIBUTION CODE: IE22D COPIES RECEIVED: LTR 1 ENCL 1 SIZE: 8
TITLE: 50.73 Licensee Event Report (LER), Incident Rpt, etc.

NOTES:

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	AEOD/DOA	1	1	AEOD/DSP/NAS	1	1
	AEOD/DSP/ROAB	2	2	AEOD/DSP/TPAB	1	1
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	NRR/DEST/ADS 7E	1	0	NRR/DEST/CEB 8H	1	1
	NRR/DEST/ESB 8D	1	1	NRR/DEST/ICSB 7	1	1
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	NRR/DLPQ/QAB 10	1	1	NRR/DOEA/EAB 11	1	1
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	REG FILE 02	1	1	RES TELFORD, J	1	1
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EXTERNAL:	EG&G WILLIAMS, S	4	4	FORD BLDG HOY, A	1	1
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LICENSEE EVENT REPORT (LER)

Facility Name (1)	Docket Number (2)	Page (3)
QUAD-CITIES NUCLEAR POWER STATION, UNIT TWO	0 5 0 0 0 2 6 5	1 of 0 7

Title (4) UNIT TWO 125 VOLT BATTERY DISCHARGE TEST FAILURE DUE TO APPARENT HIGH RESISTANCE CABLE CONNECTIONS

Event Date (5)			LER Number (6)				Report Date (7)			Other Facilities Involved (8)	
Month	Day	Year	Year	///	Sequential Number	Revision Number	Month	Day	Year	Facility Names	Docket Number(s)
0 5	0 7	8 8	8 8	---	0 0 9	0 0	0 5	2 6	8 8		0 5 0 0 0
											0 5 0 0 0

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10CFR (Check one or more of the following) (11)			
POWER LEVEL (10)	0 0 0	___ 20.402(b)	___ 20.405(c)	___ 50.73(a)(2)(iv)	___ 73.71(b)
		___ 20.405(a)(1)(i)	___ 50.36(c)(1)	___ 50.73(a)(2)(v)	___ 73.71(c)
		___ 20.405(a)(1)(ii)	___ 50.36(c)(2)	___ 50.73(a)(2)(vii)	___ Other (Specify in Abstract below and in Text)
		___ 20.405(a)(1)(iii)	___ 50.73(a)(2)(i)	___ 50.73(a)(2)(viii)(A)	
		___ 20.405(a)(1)(iv)	X 50.73(a)(2)(ii)	___ 50.73(a)(2)(viii)(B)	
		___ 20.405(a)(1)(v)	___ 50.73(a)(2)(iii)	___ 50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

Name	TELEPHONE NUMBER AREA CODE
Dennis Dolecheck, Technical Staff Engineer Extension 2190	3 0 9 6 5 4 - 2 2 4 1

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
X	E J	B T R Y	G 1 8 5	Y					

SUPPLEMENTAL REPORT EXPECTED (14)

		Expected Submission Date (15)	Month	Day	Year
___ Yes (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

ABSTRACT (Limit to 1400 spaces, i.e. approximately fifteen single-space typewritten lines) (16)

On May 7, 1988, Quad-Cities Units One and Two were in the SHUTDOWN modes at 0 percent power. At 1358 hours, the Unit Two 125 volt battery was subjected to a performance discharge test. The test was stopped when the terminal voltage went below 105 volts (minimum acceptable terminal voltage) after an elapsed time of 34 minutes, 37 seconds. The battery capacity was determined to be approximately 58 percent. NRC notification of this event was completed at 1710 hours to comply with 10 CFR 50.72.

The apparent cause for this event was attributed to five "high resistance" connections that resulted in poor battery performance.

Corrective actions include: cable replacements; procedure revisions and reviews; and increased weekly, monthly, and quarterly trending and monitoring to ensure adequate battery capacity. The manufacturer is reviewing the test data to make recommendations for further corrective actions. This report is supplied in accordance with 10 CFR 50.73(a)(2)(ii).

IE22
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PLANT AND SYSTEM IDENTIFICATION:

General Electric - Boiling Water Reactor - 2511 MWt rated core thermal power. Energy Industry Identification System (EIIS) codes are identified in the text as [XX].

EVENT IDENTIFICATION: Unit Two 125 volt battery discharge test failure due to high resistance cable connections.

A. CONDITIONS PRIOR TO EVENT:

Unit: 2 Event Date: May 7, 1988 Event Time: 1358
Reactor Mode: 1 Mode Name: Shutdown Power Level: 00%

This report was initiated by Deviation Report D-4-2-88-023

Shutdown Mode(1)

In this position, a reactor scram is initiated, power to the control rod drives is removed, and the reactor protection trip systems have been deenergized for 10 seconds prior to permissive for mannual reset.

B. DESCRIPTION OF EVENT:

On May 7, 1988, Quad-Cities Unit One and Two were both in the SHUTDOWN mode at 0 percent power. At 1358 hours, the Unit Two 125 volt battery [EJ,BTRY] was subjected to a performance discharge test per QTS 120-9 (125 VDC Battery Performance Test).

The battery was tested in the "as found" condition, as recommended in Section 5.2 of IEEE 450-1987 (IEEE Recommended Practice for Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Generating Stations and Substations), to reflect all factors, including maintenance, that determine battery capacity. The discharge rate was held constant at the manufacturer's one hour rated current (527 amperes), corrected for temperature. The test was stopped when the terminal voltage dropped below 105 VDC (minimum acceptable terminal voltage) after an elapsed time of 34 minutes, 37 seconds. The "as found" battery capacity was determined to be approximately 58 percent (34.62 min./60 min.).

Since the battery did not deliver expected capacity, the corrective actions (apply an equalizing charge and check inter-cell connections) as recommended in IEEE 450-1987, Section 5.2 were completed. Sargent and Lundy Engineering Company and Edison's BWR Engineering Department were consulted to provide recommendations to the Station on resolution of the problem and to provide corrective actions.

NRC notification of this event (via the Emergency Notification System) was complete at 1710 hours to comply with the requirements of 10 CFR 50.72.

A Performance Test is a constant current capacity test, the purpose of which is to compare the battery's capacity (as determined by the test) to the manufacturer's rated capacity. Therefore, the test length selected could theoretically be any total discharge time (e.g., 2 minutes, 4 hours, 24 hours, etc.) for which the manufacturer's rated discharge current is known. IEEE Std. 450-1987, Section 5.2(1) notes (a) that for comparison purposes it is desirable that the "performance tests be similar in duration to the battery acceptance test," but also recommends (b) that capacity tests be made "for approximately the same length of time as the critical period for which the battery is sized" (Section 6.2). Since it is often difficult (if not impossible) to comply with both these IEEE recommendations, engineering judgement must be applied to the selection of the test length most appropriate for a given application. Although it makes the comparison of battery capacity test results easier when the Performance and Acceptance Tests (8 hours) are conducted under the same conditions (e.g., test length and discharge rate), it is by no means essential. It is more informative, and therefore more important, (a) that the performance test length (and the corresponding rated current) be selected so as to be reasonably close to the "critical period for which the battery is sized" for the specific application; and (b) that each successive performance test be conducted under approximately the same conditions (i.e., test length and discharge current) as the previous performance test. This similarity between successive performance test conditions makes trending of changes in battery capacity (e.g., degradation over time) much less complex.

The phrase "critical period for which the battery is sized" has over time, had two different interpretations.

To some (battery manufacturers and users), "critical period" meant the length of the section in the battery duty cycle which determines the size of the cell when the required size was calculated. For the subject battery, this "critical period" is 1 minute. The selection of a 1-hour test length (a reduction from the previous 8 hour test length) for the 5/7/88 performance test was an attempt to comply with this interpretation of the IEEE standard; i.e., (a) to be reasonably close to the 1-minute "critical period", (b) to produce currents within the capacity of the test equipment, an (c) to be long enough to permit the measurement of all 58 cell voltages several times throughout the test period.

To others (battery manufacturers and users) "critical period" meant the overall duration of the battery duty cycle for which the battery is sized. For the subject battery, this "critical period" is 4 hours.

At the March 1988 meeting of the IEEE Battery Working Group (WG), the intended meaning of "critical period" was discussed at length. The WG conclusion/consensus was (a) that "critical period" meant the overall duration of the battery duty cycle for which the battery was sized, and (b) that IEEE Std. 485 should be revised to so define "critical period."

In view of this pending clarification of the meaning of "critical period" it was decided that Quad-Cities conduct Performance Tests at a constant current corresponding to the overall duration of the battery duty cycle (i.e., 4 hours for the subject battery). Since all of the Class 1E batteries at Quad Cities are sized for a 4 hour duty cycle, this would make the test length uniform between batteries.

The battery was retested on May 13, 1988, at the manufacturer's four hour rated current (260 amperes), corrected for temperature. The test was stopped when the voltage dropped below 105 VDC after an elapsed time of 3 hours, 12 minutes, and 46 seconds. The battery capacity was calculated to be 80.3 percent.

C. APPARENT CAUSE OF EVENT:

This report is provided to comply with the requirements of 10 CFR 50.73(a)(2)(ii): The licensee shall report any event or condition that resulted in the nuclear power plant being in a condition that was outside the design basis of the plant.

The May 7, 1988 battery performance discharge test results were reviewed. The final cell voltages indicate that five (5) of the cells reached voltages less than the allowable minimum average (1.81 v/c). The abnormal cells and their measured final voltages were:

#12 (1.73v)
#17 (1.59v)
#22 (1.71v)
#34 (1.74v)
#46 (1.54v)

Further review shows that these cell voltages were consistently low throughout the test; in fact, they all fell below 1.81 volts immediately upon application of the load. This anomaly typically indicates a weak cell, an under-charged cell, a cell with high internal resistance, or a cell with high external resistance (e.g., inter-cell connector).

A review of the specific gravity readings before the Performance Test indicates that, although the cells average well above the 1.215 nominal expected for a fully charged cell, these specific cells (except #46) were below average. These abnormalities are not as apparent in the post-test specific gravity readings.

As recommended in IEEE Std. 450-1987, resistance readings were taken of the inter-cell, inter-tier and inter-rack connections. A comparison of these readings to the installed (baseline) values revealed that five connections were unacceptable; i.e., they exceeded the "+20 percent change" acceptance criteria. Each of these five "high resistance" connections involved one of the "low voltage cells" identified during the Performance Test. It was determined that these five "high resistance" connections were inter-tier and inter-rack jumper cables [CBL]. When the joints were disassembled, cleaned and rechecked, it was determined that the majority of the resistance was in the cable/lug interface rather that in the lug/post interface. Because the lug/cable connections cannot be remade, it was necessary that they be replaced with new cables and lugs.

The apparent cause of the poor performance of the battery can be attributed primarily to the five "high resistance" connections. Although the good pre-test specific gravity readings would seem to indicate that the battery, as a whole, was near full charge, the below average readings of the five "low voltage" cells may have been a secondary contributor.

D. SAFETY ANALYSIS OF EVENT:

The Unit Two 125 VDC battery is an 8 positive plate per cell, 58 cell battery. The plate number, plate size, and number of cells combine to determine the capacity of the battery. The battery plate number and size was determined by a "critical period" of applied load during the first minute of an accident. The overall capacity of the battery was determined by the "critical period" of the expected length of the accident duty cycle - 4 hours, assuming load shedding of unnecessary emergency lighting. The Unit Two battery fully charged at an average cell temperature of 70 degrees only requires 62 percent of the battery capacity. Therefore, the one hour performance test that demonstrated a 58 percent capacity was nearly acceptable from strictly a duty cycle standpoint.

As stated earlier, a performance test is a constant current capacity test, the purpose of which is to compare the battery's capacity to the manufacturer's rated capacity. The Quad Cities Technical Specifications requires a "rated load discharge test". The station has satisfied this requirement by performing a performance test per IEEE 450. The criteria for passing a performance test, however, is not related to the required duty cycle capacity of the battery. The criteria for passing a performance test is some acceptable measure of the battery against its designed capacity (in this case 80 percent of design).

The safety significance of this event therefore is minimal because, although the battery only demonstrated a 58 percent capacity compared to a test criteria of 80 percent, that test was a test of the battery capacity compared to its design capacity. The criteria of operability from a plant duty cycle approach could be said to be 62 percent (assuming load shedding and 70 degrees temperature). The battery was therefore nearly meeting its plant design requirement.

E. CORRECTIVE ACTIONS:

1. The five "high resistance" cables have been replaced with new jumper cables of acceptable resistance. The battery was retested at the manufacturer's four hour rate and demonstrated 80 percent capacity.

2. The Shift Engineer and Technical Staff Engineer will be notified if the Unit Two 125 volt battery charger trips or the battery displays low voltage, so that the status can be evaluated by performance of the weekly surveillance (QOS 6900-1). The Unit Two control room annunciator procedures (QOA 900-8-A,C blocks) have been revised to reflect this.

3. The inter-cell connection inspection (procedure QEMP 100-1) is being revised to meet the criteria established in IEEE 450-1987 (Nuclear Tracking System (NTS) 2652008802301).

4. Although not considered a contributing factor, procedures that address equalizing batteries (QOP 6900-1,2,3 and QOS 6900-1,2,4,5 and associated checklists) will be reviewed by Sargent and Lundy to ensure compliance with applicable sections of IEEE 450-1987, Commonwealth Edison Production Instruction 1-3-N-8, and GNB vendor manuals (NTS 2652008802302).

5. GNB is reviewing the test data to make recommendations for further corrective action (NTS 2652008802303).

6. The Technical Staff will assist the Operating Department to weekly trend the cell and terminal voltage, specific gravity, level, and temperature of selected cells which are identified as being weak.

7. The inter-tier jumper resistances of station batteries will be measured and recorded monthly to verify that they do not increase by more than 20 percent from the installed value. This will be done with the Work Request System. Corrective action will be implemented if a 20 percent increase is reached. This data will be trended for an operating cycle to increase the station's knowledge of how these jumper resistances vary over time.

8. An equalizing charge will be given every year, or when conditions per IEEE 450-1987 and vendor (GNB) instructions warrant it. These conditions are:

   a. If the specific gravity, corrected for temperature, of the pilot cell (or any cell for a quarterly reading) is more then ten points below its full charged value. For the Unit 1/Unit 2 125 and 250 volt batteries, this corresponds to less than 1.205 (1.215 nominal);

   b. If the float voltage of the pilot cell, (or any cell for a quarterly reading) is more than 0.04 volts below the average of all the cells;

   c. If any cell voltage drops below 2.13 volts.

The Station Technical Staff will make the determination for an equalizing charge during review of the data (NTS 2652008802304).

9. An experimental battery testing device from the Edison Technical Center is to be used to evaluate the Unit Two 125 volt battery (NTS 2652008802305).

F. PREVIOUS EVENTS:

No previous events have occurred at Quad-Cities Station.

G. COMPONENT FAILURE DATA:

The battery is a product of GNB Incorporated type NCX-4344. The cables are a product of the Essex Corporation type 4/0 AWG 600V welding cable. The lugs are ILSCO type BE 4/0 5320134.

Commonwealth Edison
Quad Cities Nuclear Power Station
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Cordova, Illinois 61242
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RLB-88-180

May 26, 1988

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Reference: Quad-Cities Nuclear Power Station
Docket Number 50-265, DPR-30, Unit Two

Enclosed is Licensee Event Report (LER) 88-009, Revision 00, for Quad-Cities Nuclear Power Station.

This report is submitted in accordance with the requirements of the Code of Federal Regulations, Title 10, Part 50.73(a)(2)(ii): the licensee shall report any event or condition that resulted in the nuclear power plant being in a condition that was outside the design basis of the plant.

Respectfully,

COMMONWEALTH EDISON COMPANY
QUAD-CITIES NUCLEAR POWER STATION

R. L. Bax
Station Manager

RLB/MSK/djb

Enclosure

cc: I. Johnson
R. Higgins
INPO Records Center
NRC Region III

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