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ComEd

April 5, 1996

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Subject: Braidwood Nuclear Station, Unit 1
Facility Operating License NPF-72
DC Battery Operability Assessment and Action Plan
NRC Docket Number 50-456

Reference: Karl Kaup letter to USNRC dated November 16, 1995

The Reference letter provided the NRC with Braidwood Station's assessment of the operability of the Unit 1 Safety Related Battery 112 in light of the results of a modified performance test conducted on October 30, 1995. Also contained in the Reference letter was a commitment to perform single cell discharge tests to further demonstrate the capacity of the 112 battery.

The single cell tests were performed during the week of March 4, 1996 with unacceptable results. As a result, Unit 1 was taken off-line and placed in cold shutdown. Following additional troubleshooting and testing activity, the degraded battery was replaced. Acceptance tests were performed on the newly installed battery and Unit 1 was returned to service on March 26, 1996.

During conference calls conducted with the NRC on March 20 and 22, 1996, Commonwealth Edison (ComEd) discussed the troubleshooting efforts and our basis for considering the remaining batteries operable. As a result of these calls, ComEd agreed to several actions. One of these actions was to provide a description of the testing to date, the status of the root cause determination, and the near term actions contemplated. This information is provided in the attachment to this letter, along with an outline of the longer term actions to be undertaken.

It is ComEd's understanding that a status meeting with NRC representatives will be scheduled for early May of this year.

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The following specific commitments are contained in this letter:

1. Execute the short term action plan documented in the attachment to this letter by May 17, 1996.

2. Further define the long term action plan outlined in the attachment to this letter by May 17, 1996 and execute that plan in accordance with the plan schedule developed.

3. Provide additional information to the Commission during a meeting to be conducted within approximately 30 days of the date of this letter.

4. Promptly inform the NRC Resident of significant safety related battery activities, discharges, or other anomalies of potential regulatory interest.

To the best of my knowledge and belief, the statements contained in this document and its attachment are true and correct. In some respects these statements are not based on my personal knowledge, but on information furnished by other ComEd employees, contractor employees, and/or consultants. Such information has been reviewed in accordance with company practice, and I believe it to be reliable.

Please address any comments or questions regarding this matter to this office or to T. W. Simpkin, Regulatory Assurance Supervisor, Braidwood Station at (815) 458-2801, extension 2980.

Karl L. Kaup
Site Vice President
Braidwood Generating Station

KLK/tts

Attachment

cc: H. J. Miller, Regional Administrator - RIII
R. R. Assa, Braidwood Project Manager - NRR
C. J. Phillips, Senior Resident Inspector - Braidwood
Office of Nuclear Facility Safety - IDNS

ATTACHMENT

1. Overview of the testing of individual cells from the 112 battery and the testing of the whole 112 battery in March 1996:

   In compliance with ComEd's commitment to perform individual cell modified performance testing of three battery 112 cells by April 1, 1996, an individual cell test was performed on cell 32 on March 6, 1996 with a resulting capacity of 62%. A re-test of cell 32 on March 7, 1996 resulted in a 46% capacity. On March 8, 1996, cell 7 was tested with a resulting capacity of 63%. As a result of these individual cell modified performance test results, the 112 battery was declared inoperable at 0820 on March 8, 1996 and Unit One shutdown was started at 0920. At 0938, a one hour ENS phone call was made in accordance with 10CFR50.72(b)(1)(i)(A). Between March 8 and 14, 1996, two additional individual cell tests of cell 32, two additional individual cell tests of cell 7, and one individual cell test of cell 27 were conducted, confirming the degraded capacity of the 112 battery. On March 15, 1996, Battery 112 passed a service test but failed a modified performance test with a capacity of 59%. The decision was made to replace Battery 112. Replacement was completed on March 19, 1996. An acceptance test consisting of the same load profile/requirements as a service test was successfully completed on March 20, 1996. Battery 112 was subsequently recharged in accordance with the manufacture's recommendation, declared operable, and preparations were made for Unit One startup.

2. Status of root cause determination effort for the degradation of the original 112 battery capacity:

   Following the failure of individual cell modified performance tests on battery 112 cells 32 and 7 on March 6 and 8, 1996 respectively, a list of potential root causes was identified. This list was developed based on discussions with Commonwealth Edison engineering resources, AT&T-Lucent Technologies representatives, Arizona Public Service representatives, and a private contractor (a former AT&T battery design engineer). In addition, an extensive review of records and testing results was conducted, and that information was considered in the development of the potential root causes.

   These six possible causes were:

   a. Improper charger function adversely affecting state of charge.
   b. A combination of cell temperature and float voltage causing continuous gassing which might impede plate energy transfer.
   c. Long boost charges following the October/November 1995 testing causing long term gassing which blocked battery plate energy transfer.
   d. Electrolyte contaminants.
   e. Successive significant discharges in the October/November 1995.
   f. Recharge methodology.

Each of these six possible causes were investigated to determine its effect on battery 112 capacity. The details of those investigations and conclusions reached to date are provided herein:

a. Improper charger function adversely affecting state of charge.

The battery 112 charger was checked by station personnel and the charger vendor and found to have all parameters within the limits specified by the battery manufacturer and the charger manufacturer. The parameters were also in close agreement with those of the 111, 211, and 212 chargers. Although within limits, a small AC voltage and current ripple was referred to AT&T-Lucent Technologies for evaluation. AT&T-Lucent Technologies evaluated this small ripple as having no impact on battery capacity or life.

Unlikely to be a significant contributor.

b. A combination of cell temperature and float voltage causing continuous gassing which might impede plate energy transfer.

A curve depicting the temperature / voltage correlation necessary to induce gassing showed that continuous gassing was very unlikely to be occurring at the float voltages and with the room temperatures existing in the 112 battery room. Further, a single cell evacuation test (resulting in the mechanical degassing of the cell) showed that elimination of most gas in the battery cell resulted in a minimal effect on that cell's capacity.

Unlikely to be a significant contributor.

c. Long boost charges following the October/November 1995 testing causing long term gassing which blocked battery plate energy transfer.

Although extensive gassing was likely to have occurred during the long boost charges following the October and November 1995 discharge tests, AT&T-Lucent Technologies has stated that little gas generated during such charges is expected to remain in the cells beyond one week. Further, a single cell evacuation test (resulting in the mechanical degassing of the cell) showed that elimination of most gas in the battery cell resulted in a minimal effect on that cell's capacity.

Unlikely to be a significant contributor.

d. Electrolyte contaminants.

Electrolyte samples from ten battery 112 cells, two spare cells, and a battery 111 cell (control sample) analyzed for nine possible electrolyte contaminants showed all values within the limits specified by the battery vendor, AT&T-Lucent Technologies.

Unlikely to be a significant contributor.

e. Successive significant discharges in October/November 1995.

A series of successive discharge tests of six strings of L1SH round cells was performed by AT&T-Lucent Technologies at Conshohocken, Pennsylvania between October 1995 and February 1996 in support of Arizona Public Service. This testing clearly identified that successive full capacity discharges resulted in capacity reductions of 10 to 15 % per discharge cycle. Battery 112 was the only one of Braidwood's four L1SH round cell batteries to have experienced significant successive discharge cycles. Both battery 111 and 212 have passed modified performance tests with 112% capacity and have nearly the identical history as battery 112 with the exception of 112's three closely spaced discharges occurring in October/November 95. Further, modified performance testing of inservice batteries at another utility have shown reductions in capacity for individual cells with significant discharge histories.

Likely to be a significant contributor.

f. Recharge methodology.

Both battery 111 and 212 have used the same float-boost-float (constant voltage) recharge methodology used by battery 112 prior to the unsuccessful tests. This methodology was consistent with the vendor recommendations in effect at that time. Those batteries have both passed modified performance tests with 112% capacities. However, a series of successive discharge tests of six strings of L1SH round cells was performed at Conshohocken, Pennsylvania between October 1995 and February 1996 by AT&T-Lucent Technologies. These tests demonstrated that recharging successively discharged battery strings using a constant current charge to recharge 130% of the ampere hours removed during a discharge mitigated the resulting capacity reduction from the aforementioned 10 - 15% to 1 - 2 % for the first three discharge cycles. This testing showed limited beneficial effect on capacity after three successive discharge/recharge cycles.

Likely to be a mitigating factor, not likely to be a contributing factor.

3. Basis for the operability determination of the replaced 112 battery and other safety related batteries at Braidwood Station:

The replaced Battery 112 was declared operable at 1334 on Friday March 22, 1996 based on successfully completing the same testing sequence as used when initially installing the AT&T L1SH round cell batteries at Braidwood. Specifically this included: Engineering Construction Test Procedure 30 Sections 4, 5, and 7 (March 19, 1996); Acceptance Test 1BwVS 8.2.1.1.d-112 (March 20, 1996); 18 Month Battery Charger and Rack Surveillance 1BwHS 4002-136 (March 19-20, 1996); and Quarterly Battery Surveillance 1BwOS 8.2.1.2.b-2 (March 21, 1996). Following the discharge test (service test profile), the battery was recharged by constant current methodology based on current vendor recommendations. This testing and recharge sequence is considered adequate to declare Battery 112 operable because it is the approved sequence for new battery acceptance and because the cells used to form this battery are new and were prepared in accordance with the manufacturer's recommended actions. The testing is similar to that used for batteries 111 and 212, which have successfully passed modified performance tests within the past six (6) months.

The operability of Safety Related Batteries 111, 211, and 212 was reviewed and confirmed. None of these three batteries have had the discharge history of the replaced 112 battery. All three have passed all periodic surveillances with no anomalous results, and batteries 111 and 212 have recently passed Technical Specification modified performance tests with capacities of 112% (111 - October 1995, 212 - March 28, 1996).

4. Short term actions:

Short term actions to enhance the viability of all safety related batteries at Braidwood Station have been broken down into three key areas:

a. Minimizing discharges on the safety related batteries.
b. Responding to discharges of the safety related batteries (evaluation/recharge).
c. Revising charging methodology following discharges such as those experienced during Technical Specification modified performance tests and service tests.

a. Minimizing discharges on the safety related batteries:

(1) Train station operators on the potentially adverse impact that protracted battery discharges can have on subsequent battery capacity and on actions to minimize such discharges. This will be accomplished during the next Operator requalification cycle.

(2) Investigate the feasibility of a load shedding plan for the non-ESF sections of the instrument busses which would be placed in effect prior to major bus outages during which the temporary charger is required to carry the 125 VDC ESF bus and its two associated instrument inverters. If loads can be shed prior to such bus outages such

that the DC current to be supplied by the temporary charger is less than 100 amps, station operators could effectively utilize the cross-tie capability to minimize battery discharge in the event of the subsequent loss of a temporary charger. This evaluation will be completed by May 17, 1996.

(3) Review temporary charger power supply and output breaker tie-in configurations for possible changes to enhance reliability. This review will be completed by May 17, 1996.

b. Responding to discharges of the safety related batteries (evaluation/recharge):

(1) A threshold discharge level of 300 Ampere hours has been established. Discharges above this level will require an evaluation of the impact of the discharge on the affected battery and a determination of actions required (if any) will be conducted by a minimum of one Site Engineer, one System Engineer, and one Senior Reactor Operator. The specific actions will be dependent on the circumstances of the situation. This threshold value has been established as 300 ampere-hours.

c. Revising charging methodology following discharges such as those experienced during Technical Specification modified performance tests and service tests.

(1) Evaluate the use of the constant current recharge methodology recently recommended by AT&T-Lucent Technologies to mitigate the capacity loss effect associated with successive deep discharges. If the evaluation supports the use of the constant current recharge methodology, the necessary equipment will have to be purchased. This evaluation will be completed by May 17, 1996.

5. Longer term actions:

Longer term actions to evaluate the life expectancy of the L1SH round cell battery in its current safety related application at Braidwood Station have been broken down into five key areas:

a. Destructive testing of degraded 112 battery cells to better understand the mechanism causing reductions in capacity following successive discharges. Schedule and testing facility remain to be determined.

b. Development and execution of an integrated test program, in cooperation with other L1SH users and AT&T-Lucent Technologies, to determine the life expectancy over which the AT&T L1SH battery can be expected to satisfactorily respond to the load demands of a nuclear safety application, including required periodic testing. Review and utilization of available testing data is important to ensure the timeliness of this effort. Verify that current surveillances and replacement criteria are adequate to allow sufficient planning

time for a battery replacement, should one become necessary. The schedule and scope of this program must be developed with other L1SH users and AT&T-Lucent Technologies.

c. Develop a battery trending program to allow for monitoring and benchmarking of battery information. This action is anticipated to be completed by January of 1997.

d. Evaluate existing battery capacity margin to determine if the maximum cross-tie current limit could be increased to 120 amps, the maximum expected current without the rectifiers which are the normal power supplies to the instrument inverters in normal service. This would allow operators to utilize cross tie capability to minimize battery discharge, but, in this case, would not require previous load shedding. This evaluation will be completed by May 17, 1996. Any action as a result of this evaluation would require a license amendment.

e. Review Technical Specification requirements to determine if changes are required. This review will be complete by August 1, 1996.