

FAILURE ANALYSIS

CRACKED CONTAINERS LEAD-ACID STORAGE BATTERIES

BYRON AND BRAIDWOOD NUCLEAR POWER STATIONS

COMMONWEALTH EDISON COMPANY

Prepared By:

R. W. Hopewell
R.W. Hopewell

Reviewed By:

R. L. Kreutzfeldt
R.L. Kreutzfeldt

Approved By:

S. L. Deshpande
S.L. Deshpande

On October 19, 1983, M.A. Todd and Mark Stohr of Janes Power Systems performed a visual inspection of six (6) sets of batteries in service at the Commonwealth Edison Nuclear Power Station at Byron Illinois. Those batteries examined and their findings were as follows:

1. Unit #1 - 250 Volt Battery

116-NCX-1500 S/N KHF-1797 New 8/80

There were 20 cells out of 116 that had cracked containers in the area of the jar-cover juncture. No cracks in the middle side walls or bottoms of any containers.

2. Security Battery Room Elevation 426

58 NCX-1350 S/N ? New 4/83

No container cracks found. Battery was on rack, but not yet connected.

3. Unit #2 East End - Class IE Room 211

58-NCX-1200 S/N KJE-971F New 9/79

No cracked containers observed.

4. Unit #2 West End - Class IE Room 212

58-NCX-1200 S/N KJE-9070H New 9/79

No cracked containers observed.

5. Unit #1 Room 111

58-NCX-1200 S/N KJE-973E New 9/79

3 cells out of 58 with cracked containers. Here again cracks were limited to the jar-cover juncture area only.

6. Unit #1 Room 112

58-NCX-1200 S/N KJE-972D New 9/79

No cracked containers observed.

From the foregoing, it can be seen that only two batteries (Item #1 and #2) were observed to have cracked containers, with cracks being concentrated in the jar-cover juncture area.

In February, Sales/Marketing advised that sample jars from each of the batteries exhibiting cracks were being returned to my attention for failure-cause analysis.

The samples were received and examined by myself and others here at Langhorne. In the absence of the elements and cell covers, most of any meaningful evidence was missing.

On Friday, March 2nd, Ramesh Desai and myself visited the Byron Nuclear Station at Byron, Illinois accompanied by Mark Stohr of Janes Power Systems. Mark Stohr had advised the week before, that Byron Station had just reported three cracked containers on NCX-1200 type. Prior to this, the cracked containers had been restricted to the Braidwood station. Site visitation was opted for in order to see first hand all available evidence prior to any container and cover replacement.

We met with Art Deming, Construction Supervisor and Doug Kruger, Technical Staff. We then examined a 58-NCX-1200 New 9/79 S/N KJE 967 in Room 212. Cells #3 and 4 were found removed from the string, setting on a four wheel hand truck in the battery room. It was noted that on all four jar wall faces, there was a varying degree of etching of the jar material with accompanying radial cracking.

Mr. Deming's first comment was "the acid from the cell was attacking the spacer material between cells and was, in turn attacking the containers".

In addition to the etching of the side walls, there were also crescent shaped cracks at the jar-cover juncture almost identical in pattern observed on the samples sent to me from the Braidwood Station.

Closer examination of Cell #3 and #4 disclosed an extensive mottled or etching pattern on the entire cover surfaces.

I asked Art Deming what was used to clean cells and he replied-- "nothing but clear water".

I indicated that there appeared to have been some type of solvent attack and again asked what types of materials may have been used. Finally, it was revealed that Edison Cleaner was used to clean inter-cell connectors of No-ox-id "A" Grease. The contention, however, was that this cleaner was only used in the shop and not on the battery.

I asked to have the cleaning material brought to the battery room. Mr. Deming agreed to have the material brought to us for examination.

While awaiting its arrival, all cell covers on the remaining 55 cells were examined closely and it was observed that almost every cover had varying degrees of etching or mottling.

A gallon can of Edison Cleaner was produced with the label indicating the material to be trichlorethylene. I applied some of this material to the cover of one of the cells out of service. When allowed to dry, an almost identical mottling or etching pattern resulted as observed on most other cell covers.

It is postulated that the trichlorethylene was used to clean cell posts of No-ox-id "A" grease during rework of intercell connections. Varying quantities of the cleaner came in contact with cell covers and in some cases ran over the edges of the covers coming in contact with the containers.

In the case of cells #3, 4 and 5, it appears that a large quantity of this cleaner was spilled between the cells saturating the spacer material. Therefore, prolonged exposure of unevaporated cleaner to the mid jar wall caused severe etching.

A sample of the cleaner was obtained and I brought it to Langhorne for testing. The GNB Accelerated Stress Cracking Test P-130 was conducted exposing an SAN test slab to the Edison Cleaner. Results were rapid and dramatic with the test slab breaking at the fulcrum point in about 10 seconds. Almost instantaneous crazing was observed with slab failure shortly thereafter.

As a result of our findings at Byron as well as in-house testing of the Edison Cleaner, a visit to Braidwood Nuclear Station was made on 3-23-84. GNB was represented by Ramesh Desai, Miles Todd and myself with Mark Stohr representing Janes Power Systems.

The first battery examined was the 116-NCX-1500 S/N KHF-1797 New 8/80. This battery previously had 20 cells with cracked jars (jar-cover juncture area) and which were re-jarred and re-covered by Mark Stohr at GNB's expense. All cell covers of cells not repaired were examined and the majority exhibited the mottling or etching observed at Byron Station.

We also looked at a 58-NCX-1200 S/N KJE-973E New 9/79 in Room 111. This battery previously had 3 cells with cracked jars which also were repaired by Mark Stohr at GNB's expense. Here again, examination of unrepaired cells revealed mottling and etching of covers in the same manner found on other batteries where cracked jars resulted.

In the afternoon a meeting was held to discuss our findings at both Byron and Braidwood as well as the results of the Accelerated Stress Cracking Test. In addition, I repeated the test in the meeting room using Edison Cleaner and SAN test slab. Again, crazing appeared almost instantaneously followed by failure of the test slab in about six seconds following application of the Edison Cleaner.

Conclusion:

The use of Edison Cleaner on the cells resulted in stress release and cracking of a quantity of containers at both Byron and Braidwood and in no way was the result of a design and/or material deficiency.

This was pointed out to the nine Commonwealth Edison people attending the meeting. In addition, we referenced the warning in our Operating Instructions against the use of solvents or mineral spirits as crazing and cracking of plastic materials could result.