

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

February 22, 1989

NRC INFORMATION NOTICE NO. 89-17: CONTAMINATION AND DEGRADATION OF
SAFETY-RELATED BATTERY CELLS

Addressees:

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose:

This information notice is being provided to alert addressees to reports of contamination and degradation of safety-related battery cells. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

Several licensees for nuclear power plants have identified contamination and degradation of safety-related battery cells that resulted in decreased station battery voltages. This information notice details such discoveries at the Peach Bottom Atomic Power Station, Unit 2; St. Lucie Plant, Units 1 and 2; and the Duane Arnold Energy Center.

Copper Contamination

On July 29, 1988, the Philadelphia Electric Company (PECo) reported to the NRC pursuant to 10 CFR Part 21 that it had discovered copper contamination on the negative plates of the station batteries at its Peach Bottom Atomic Power Station, Unit 2. The station batteries at the Peach Bottom station are 125-volt direct current (dc) Exide Corporation GN-23 batteries. Similarly in 1987, Florida Power & Light Co. (FP&L) personnel noted that approximately 97 out of 240 safety-related battery cells at the St. Lucie Plant, Units 1 and 2, showed signs of discoloration and copper contamination. The batteries at the St. Lucie Plant are 125-volt C&D Power Systems, Inc., type LC-33.

The copper contamination at the Peach Bottom and St. Lucie plants was caused by the battery electrolyte attacking the copper inserts in the cells' positive terminal posts. The copper inserts improve the current-carrying capability of the posts and are normally isolated from attack by the electrolyte by a lead coating. According to Exide and C&D, the copper does not remain isolated from

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electrolyte attack throughout the design life of the cell if improper alignment or casting occurred at the time of manufacture. For example, gases caught in the lead coating during the casting and freezing involved in the manufacturing process may later develop into perforations that become a path between the battery electrolyte and the copper inserts.

The battery electrolyte attacks all copper and cupric alloys, causing copper to deposit on the negative plates of the affected cell. The first typical indication of copper contamination is the discoloration, a pinkish-red color, of the negative plates and straps, and as the contamination progresses, the discoloration works its way down the negative plates. This condition can quickly lead to loss of battery capacity and serious deterioration.

At Peach Bottom, Unit 2, a total of 19 cells in four station batteries exhibited copper contamination. PECO revised the Peach Bottom station battery surveillance tests to include checks for signs of discoloration on the negative plates during testing of cell voltages and specific gravity.

FP&L, based on C&D recommendations, augmented its Technical Specification surveillances for safety-related battery cells until replacement of all cells showing signs of contamination was completed. The additional surveillances included (1) weekly visual inspections of each cell to monitor the extent of copper buildup on the negative plates; (2) weekly voltage monitoring and trending of all cells exhibiting signs of copper contamination, including recording the temperature, specific gravity, and electrolyte level of each of these monitored cells; and (3) weekly monitoring and trending of battery terminal voltages.

Degradation

In late 1986, personnel at the Duane Arnold Energy Center (DAEC) observed crumbling or eating away of the positive plates on 12 out of 120 cells in the station battery. The degradation is believed to have been caused by a galvanic reaction from impurities in the plate weld materials. The battery cells are 250-volt dc GNB Batteries, Inc. (formerly Gould, Inc.), Model FPS-17.

The degradation consisted of crumbling or eating away of positive plates approximately 1 to 2 inches below the welded connection of the positive plate to the cell's internal positive bus bar. According to DAEC personnel, the crumbling appears to have originated at the edge of the plate and to have worked inward, thus reducing the plate-to-bus bar junction area. The GNB representative noted that the severely degraded areas took on a brown appearance as opposed to the normal flat black color. Sparkling was also noted when a light was shone on the degraded areas, indicating sulfation. After the initial inspection, GNB determined that 14 cells were significantly degraded.

The degradation at DAEC progressed rapidly after its discovery. In one instance, a cell noted to be 50 percent to 75 percent degraded was reexamined less than 72 hours later and was found disconnected from the bus bar. Although the exact root cause of the degradation was not determined, it is believed that impurities introduced into the plates during the welding process, combined with aging, resulted in the galvanic reaction. GNB noted that high temperatures may

accelerate the degradation. DAEC indicated that the degraded cells were located in the upper tier of the two tier-rack, approximately 2 feet higher than the cells in the lower rack. In addition, the ventilation in the battery cell room may not have been sufficient and may have contributed to the degradation rate.


DAEC augmented its battery cell inspections after the initial degradation was identified to include daily visual inspections of degraded cells and biweekly inspections of non-degraded cells. Periodic cleaning of all the battery terminals also was incorporated into the preventive maintenance program.

Discussion:

Station batteries provide a reliable source of dc current for many safety-related functions. Degradation and contamination, as described above, can render the station batteries incapable of delivering sufficient capacity to perform these functions. In most instances, normal battery surveillance programs including total battery voltage, individual cell voltage, electrolyte specific gravity, level and temperature, and visual inspections, are the best indicators of the overall physical condition of a battery and are capable of identifying cell degradation or contamination. In cases in which degradation or contamination occur, the battery vendor plays an important role in providing the appropriate recommendations and in determining the root cause of a problem. Once degradation or contamination is identified, an augmented surveillance program may be necessary to monitor the battery condition and to estimate when replacement of cells may be needed.

Additional guidance on battery surveillance requirements is provided in the Institute of Electrical and Electronics Engineers (IEEE) Standards 540-1975 and 1980, "IEEE Recommended Practice for Maintenance, Testing and Replacement of Large Lead Storage Batteries for Generating Stations and Substations."

No specific actions or written response is required by this information notice. If you have any questions about this matter, please contact the technical contact listed below or the Regional Administrator of the appropriate regional office.


Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contact: Jaime Guillen, NRR
(301) 492-1170

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*with notes
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