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# LLNL Lessons Learned LLNL

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## Sulfur Dioxide Inhalation Following UPS Battery Failure

During the first week of December 2002, intermittent sulfur odors had been noted in a storage room at a Hanford radiological facility, but the source was not immediately identified. On December 9, 2002, a Nuclear Chemical Operator (NCO) detected a strong sulfur-like odor while entering the room. The employee and two other NCOs standing outside the room immediately left the area and notified management.

Within approximately 10 minutes the exposed employee became nauseated, and was taken to the Hanford Fire Station for examination. Following that examination, the employee was taken to a Hospital for further evaluation. The two other employees reported only minor effects.

An Incident Command Post was established and air monitoring was initiated to detect the presence of chemicals.

### What Was Learned

- During a thorough inspection of the room, the batteries on an out-of-service uninterruptible power supply (UPS) system were noted to be on constant charge.
- Further investigation determined that the 12-volt, 100 amp-hour UPS system battery had boiled partially dry. Preventive maintenance necessary to maintain the UPS had not been performed because the system had been taken partially out of service for modification.
- The UPS system manufacturer indicated that battery failure is more likely to occur when a battery is used beyond its life cycle and left to operate without any preventive maintenance.
- It was determined that the batteries for the UPS system failed during the charging cycle, releasing sulfur dioxide into the work environment.
- Power to the charging system was isolated and the batteries removed.

### Recommended Action

1. Review preventive maintenance procedures before taking a system out of service for long-term maintenance or modification. Determine if any maintenance procedures should be continued during the out-of-service period. This is particularly important for partial deactivation of a system.
2. Ensure that installation design requirements (e.g., overcurrent protection and ventilation requirements for UPS systems) remain in effect when systems are partially deactivated.
3. Evaluate deactivated systems and equipment to determine if conditions similar to this incident exist. Other equipment taken partially out of service as well as UPS batteries may cause unidentified hazards.
4. Give prompt medical evaluation to workers exposed to unknown concentrations of gases that may be toxic, even if no symptoms are evident. Some chemicals may have a delayed effect on worker health.

5. Immediately contact your ES&H Team and Facility Management to identify the source of any foul odor detected in your area when no source is readily apparent.
6. Ensure that routine maintenance is performed on UPS systems (e.g., battery voltage test for overcharging, temperature check of the terminals, visual inspection of the battery for cracks or leaks, an acid level check on flooded systems, and a systems test on load). Check battery expiration dates and replace batteries when 3 to 5 years old, depending on the criticalness of the safety system that the UPS supports.
7. Avoid leaving a critical safety system without backup power when disconnecting a UPS system for routine maintenance. A portable battery bank is available from Plant Engineering to back-up critical systems for seamless turnover during maintenance.

### **Where to Get Help or More Information**

- Your ES&H Team Industrial Hygienist and Industrial Safety Engineer.

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