Preventing UPS/Battery Room Explosions

By Connie Muncy

Utilities, like many industries, house a variety of uninterruptible power supply (UPS) and battery rooms. The electric utility industry alone employs countless battery charging rooms—you will find them in substations, generation stations, peaker stations, (peaking power plants) and administrative facilities. They are housed in telecom UPS rooms, back-up generator rooms, forklift storage areas, dedicated battery sheds, vehicle maintenance shops and other areas, sometimes even in trailers.

The threat of a battery-room explosion is a real hazard, particularly for those who do not periodically assess the ventilation of those rooms. The aftermath of such an explosion can be devastating; employees can be injured or killed, mission critical operations can be interrupted, expensive equipment can be destroyed, and a public relations nightmare can be created.

Based on interviews throughout my career, the primary reason that organizations fail to periodically conduct ventilation surveys of UPS and battery rooms seems to be a lack of knowledge on the part of the facility manager, the safety department and employees. This is easily corrected as explained in the following summary. Consider educating personnel at your facility, creating a list and risk assessment of all UPS/battery rooms at your facilities, and create a periodic battery/UPS room ventilation survey schedule to protect your facilities, operations and personnel.

Examples of Battery Room Explosions
Sometimes a case history with a photograph is worth a thousand words. Case in point: The following excerpt comes from a Sacramento Fire Department press release about an explosion in Rancho Cordova, on March 20, 2001.

When firefighters entered the building, they found several walls blown over and visible smoke from a room that housed several large batteries. Firefighters also reported that a 40-ft section of the roof was missing just above the area of the explosion. Rescuers searched the building for trapped victims, but none were found. The property management
company indicated that a computer firm that handled data collection had occupied the building a month before the incident. It was also indicated that a battery backup system that was suspected of exploding was partially in operation.

Cholamandalam MS Risk Services Ltd. investigated the explosion and stated the following admonition in its final report, “This accident is a very good example of what can happen when you lose ventilation in a battery charging room. The explosion blew a 400+ sq ft hole in the roof, collapsed numerous walls and ceilings throughout the building, and significantly damaged a large portion of throughout the building, and significantly damaged a large portion of the 50,000+ sq ft building.”

Many similar reports may be accessed online. H2 Tools is a particularly good resource. It contains reports such as:

- **Hydrogen Alarm Sounds in Battery Room due to Ventilation Fan Failure**
- **Combustible Hydrogen Gas Vapors Ignited in a Battery Plant**
- **Nickel Cadmium Battery Explosion**
- **Emergency Battery Container Incident**
- **Battery Room Explosion**
- **Hydrogen Gas Present in Forklift Battery Charging Facility**

### The Hazard: Hydrogen Gas Build-Ups

Charging batteries, even supposedly sealed batteries (simply check the battery safety data sheet or owner’s manual), particularly batteries in a fault or overcharge condition, can generate hydrogen, a highly flammable gas that accumulates and becomes highly explosive particularly when confined in a room such as a battery or UPS room. A mixture of hydrogen in air of as little as 4% poses a significant risk of fire and explosion. It is recommended that hydrogen concentrations be maintained below 1% with a properly designed and periodically surveyed ventilation system. While battery rooms may be interlocked with hydrogen detectors, these detectors may be cost-prohibitive for many organizations and are a reactive versus a proactive measure. So many organizations opt to take no action, a very hazardous prospect.

Instead, organizations should be proactive and have a qualified industrial hygienist periodically perform ventilation surveys of all their UPS and battery rooms. This is supported by battery manufacturer’s recommendations. For example, **C&D Battery’s RS-1476 Standby Battery Vented Cell Installation and Operations Manual** (lead calcium multi-cell flooded battery) states:

- Gas produced by this battery can be explosive. Maintain adequate ventilation.
- Monthly battery inspection should include condition of ventilation equipment.

### Ventilation Surveys

Cholamandalam’s report on the incident cited earlier provides a nice summary of common battery room ventilation standards that may be applicable. Be sure to also check local building and fire codes for additional standard which may be more stringent than those listed in the report.

Extreme caution must be exercised when performing the ventilation survey. The surveyor must not inadvertently contact the terminals and cause a short that could have disastrous results. This individual also should not
carry any device that could cause a spark into a battery room that could be filled with hydrogen, or to create a spark once in there.

The evaluator should also:

• Confirm that the room contains a acid spill kit (to neutralize any spilled acid), fire extinguisher and an ANSI-approved eye wash and safety shower.
• Inspect air supply and exhaust for any malfunction or blockage, such as equipment pushed up against a vent or animal nesting material inside a vent.
• Verify proper signage on the entrance containing message such as “Battery Room: Authorized Personnel Only,” “No Smoking-Flammable Gas”, “Caution: Acid” (check local codes and applicable regulations for a complete list).
• Ensure that appropriate rubber gloves, rubber apron, chemical resistant face shield, a SDS sheet and other protective measures are available when servicing batteries.
• Make sure the battery room exhaust and supply vents are not located together where exhaust is re-entrained into the battery room or into other areas of the building.

To complete this survey, the inspector must not only measure air flow through all air supply and exhaust vents, but must also measure vent dimensions as well as the dimensions of the battery room, battery trailer or battery shed.

Also never assume that battery rooms, particularly older ones, have been properly (safely) designed. For example, check to see that air supply and exhaust vents are located in a manner that ensures adequate mixing of air to prevent “dead spots.” Case in point: Having the air supply and exhaust located directly adjacent on a wall near the ceiling will likely result in air flowing directly from one vent to the other with no mixing and, therefore, no adequate exhaust in the remainder of the room. Also ensure that vents are not clogged, and listen to detect possible mechanical malfunctions that require service.

Several resources provide additional information on this topic:

• C&D Batteries’ RS-1476 Standby Battery Vented Cell Installation and Operations Manual (lead calcium multi-cell flooded battery)
• OSHA 29 CFR Subpart S, 1910.305(j)(7)
• NFPA 111, Standard on Stored Electrical Energy, Emergency and Standby Power Systems
• NFPA 76—Fire Protection for Telecommunication Facilities
• American Society of Heating, Refrigeration and Engineering 62—Ventilation for Acceptable Indoor Air Quality
• Battery Room Guidelines by EXIDE Technologies
• NFPA 70E Electrical Safety Requirements for Employee Workplaces
• OSHA Electric Power Generation, Transmission and Distribution; Electrical Protective Equipment; Section 3—III. Summary and Explanation of the Final Rule
• Uniform Fire Code 64.104(e)

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