Hydrogen Gas Monitoring for Standby Battery Systems

Introduction:

Since batteries are such effective energy storage medium for almost any backup power system, many industries use backup battery banks for emergency power. The need for gas monitoring occurs while these backup batteries are being charged. Typically, batteries are continuously trickle charged. After an incident that requires battery use, a higher charge is used to quickly restore the batteries to full capacity. This charging process generates hydrogen gas which is emitted into the battery storage room. The faster the charge rate is, the higher the hydrogen generation rate.

Backup batteries are typically of the lead acid type, either liquid based (flooded), gel cells or sealed type batteries (VRLA). No matter which of these battery types, hazardous hydrogen is generated while being charged.

Hazard:

Hydrogen is a highly flammable gas. The National Fire Protection Association lists the lower explosive level (LEL) for Hydrogen as 4% by volume. If sufficient hydrogen collects in a room, it can potentially explode if ignited. This type of explosive hazard can destroy equipment as well as causing injury or death to personnel. The likelihood of this happening depends on the number of batteries, their charge rate, the size of the room, and the ventilation available for the room. Although this may not be a common occurrence, the potential hazard exists with any type of enclosed backup battery station. This danger can be eliminated by monitoring for a hydrogen buildup and taking appropriate action if a build up occurs.

Code Requirements:

Federal, state and local codes require sufficient ventilation in battery rooms and VRLA battery cabinets to limit hydrogen gas accumulation below 1% by volume (25% of LEL). This is a safe level with a sufficient safety factor. The 2006 IFC 608 requires the same 1% LEL limit as the NFPA code shown in the inset.

Solution:

How do you know that the actual hydrogen level remains below 1% by volume? Hydrogen gas monitors will enable either direct measurement of the gas level or alarm indications at pre-set LEL. Continuous monitoring in battery rooms provide early warning and the ability to react in event of excessive hydrogen gas levels.

NFPA 1 (2006) Section 52.3.6 — Ventilation. Ventilation shall be provided for rooms and cabinets in accordance with the mechanical code adopted by the jurisdiction and one of the following:

- The ventilation system shall be designed to limit the maximum concentration of hydrogen to 1.0 percent of the total volume of the room during the worst-case event of simultaneous boost charging of all the batteries, in accordance with nationally recognized standards.
- Continuous ventilation shall be provided at a rate of no less than 1 ft3/min/ft2 (5.1 L/sec/m2) of floor area of the room or cabinet.

Most monitors have two alarm levels, typically set to 10% LEL (0.4% volume hydrogen) and 30% LEL (1.2% volume hydrogen). If these alarm levels are exceeded, the monitor activates a relay and its own audible and visual alarm. If action is taken at the first alarm level (for example, turning on a ventilation fan in a room to clear out the hydrogen), then the second alarm level should never be exceeded. The second alarm level typically would be used for more drastic action, such as turning on secondary or redundant ventilation, turning off the battery charger, or sounding a louder or remote alarm to bring attention to the problem.

Analysis:

Continuous monitoring provides safety assurance and is the only 100% means of early warning. Many inspectors and local code enforcers demand hydrogen gas monitoring along with proper ventilation. Overall costs of hydrogen gas monitor systems are relatively low, at 1% to 2% of the Total Cost of Ownership of the stand-by power system.

EnviroGuard gas monitors provide solutions for single channel to multiple channel monitoring. The industry recommended spacing of the sensors is 40 to 50 feet apart. See Application Brief AB100X "Steps for Selecting Hydrogen Gas Monitor Systems."

EnviroGuard recommends that a yearly check of sensor response is performed for confidence in operation and accuracy. A low cost calibration kit delivers a small amount of hydrogen to the sensor to confirm that the sensor will go into alarm.

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