Fire Hazard Assessment of Lead Acid Batteries

Several NFPA standards, such as NFPA 1, 75, 76, 111 and 855 address the fire resistance of large-scale battery deployments. Some, such as NFPA 855 request large-scale fire testing when installations exceed the maximum allowable quantities in the codes and standards.

Lead-acid batteries have had a long history of use in the telecommunications industry, data centers, nuclear industries, power industries, among others. Although the requirements vary, many of these battery chemistries, such as lead-acid, lithium-ion, nickel-cadmium, sodium and flow batteries, are now being regulated by the same standards.

While substantial research has been conducted on many of the newer, emerging battery chemistries, like lithium-ion, a better understanding of the fire risks associated with lead-acid batteries was needed for use as a comparison to other battery chemistries.

Project Goal & Approach

The goal of this project was to conudct a fire hazard assessment of lead acid batteries, through a literature review, that could be used to inform future editions of applicable standards, such as NFPA 1, 855, 76, 75, and 111.

The final report is available here.

Summary Observations

Based on the limited literature, fire test data, and incident reports available, lead acid batteries have low risks as energy sources. This is based on the small number of incidents reported, indicating that the probability of incidents occurring is low, as well as the fact that that most incidents investigated had minor consequences. In addition, the results of the fire testing support this statement, as no fires were observed in the tests. The limited data available shows that the aqueous electrolyte present within the flooded lead acid batteries inhibits fire spread.

This conclusion stems from the fact that the flooded lead acid batteries are involved in fewer documented incidents than VRLA batteries, indicating that flooded lead acid batteries are not prone to thermal runaway. For VRLA batteries, there is no way to replenish the water lost due to exposure to high temperatures and/or overcharging, making them susceptible to thermal runaway. Furthermore, the stored energy in the battery contributes to the fire severity, particularly when the batteries are connected in series. Based on the results of the short-circuit fire testing of batteries enclosed in telecom-grade casing, the casing inhibits the spread of these fires to additional batteries connected in series. This illustrates the usefulness of the telecom-grade casing in fire prevention and mitigation. Thus, these findings illustrate that the lead acid batteries are significantly less prone to fires than lithium ion batteries and generally pose a low fire risk.

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