RESEARCH FOUNDATION

RESEARCH FOR THE NFPA MISSION

Stranded Energy within Lithium-Ion Batteries

Project Summary

Background

Stranded energy – defined as the energy remaining in a cell after efforts to safely discharge the stored energy in damaged lithium-ion cells – is an important, unresolved issue. Residual, stranded, DC energy within damaged lithium-ion batteries presents a significant fire and shock hazard – particularly to emergency responders.

Stranded energy can impact when emergency responders can declare an event "safe" as well as when and how the batteries can be safely removed from their respective installation, transported, and disposed. Significant responsibility is placed on first and second responders to ensure the hazard of stranded energy is properly mitigated and the batteries are safely and properly handled post event.

The most effective approach to mitigate the hazard of stranded energy and safely neutralize the batteries is still unclear. Procedures, guidelines, and related tools for all first and second emergency responders are needed to address this issue.

Project Implementation and Timeline

This is a six-month project to be led by the Research Foundation. Guidance will be provided by a Project Technical Panel of key stakeholders and subject matter experts who will provide input to the project, review periodic reports of progress, and review the final project report.

Project Goal

The goal of this project is to develop a summary report of the present and anticipated hazards of stranded energy, related incidents, and established mitigation procedures for safely handling stranded energy within damaged lithium-ion batteries across the full-spectrum of industry applications to provide guidance to first and second emergency responders.

Project Implementation

Task 1: Literature Review. Review literature on the hazards associated with stranded energy in lithium-ion batteries, with a focus on how this is being addressed by regulators, emergency responders, industry, facility owners, and other key groups.

Task 2: Trend Analysis. To define the scope of the current and future stranded energy problem, its magnitude will be approximated through a trend analysis of lithium-ion batteries based on their expected lifespan and the implementation rate of lithium-ion batteries across diverse industries and use groups. This trend analysis includes, but is not limited to, the following industries/use groups: the automotive industry, energy storage industry, consumer electronics industry, industrial powered equipment groups, medical use groups, and other military applications.

Task 3: Incident Data Collection. Conduct a case study review of past incidents where stranded energy contributed to an ignition or re-ignition event to assess the methodologies implemented by emergency responders and other responding groups to remove the stranded energy from the damaged lithium-ion batteries. Analyze the effectiveness of the implemented tactics and identify successes, failures, and/or challenges from each incident. Data, where available, will be collected from responding fire departments, battery manufacturers, battery disposal groups, research labs/testing groups, etc.

Task 4: Identify, Review, and Analyze Established Procedures. Identify and summarize strategy profiles of professional communities, emergency responders, and others for removing stranded energy within damaged lithium-ion batteries (e.g. battery manufacturers, battery recycling and disposal facilities, automobile industry, ESS distributors, military applications, etc.).

Review and analyze the established procedures of these parallel groups/industries exposed to the same hazard of stranded energy in lithium-ion batteries. Items to be reviewed and analyzed include the following:

(1) How field evaluations of significantly damaged batteries are conducted to determine if stranded energy remains in the batteries?
(2) If stranded energy is present, how is the hazard properly mitigated and/or controlled to negate future re-ignition events?
    a. Establish a logical evaluation framework to categorize the type and level of damage to lithium-ion batteries.
    b. Identify novel approaches used to mitigate the hazards of stranded energy in lithium-ion batteries.
(3) What procedures must be taken before a disposal and/or recycling facilities will accept the damaged batteries?

Task 5: Packaging and Reporting. Develop a summary document outlining recommended best practices for first and second responders dealing with the stranded energy issue in li-ion batteries.

Deliverable

A final report outlining the scope of the li-ion battery stranded energy issue and effective procedures for mitigating the hazard of stranded energy within damaged lithium-ion batteries in a vast spectrum of industry applications to provide guidance to the emergency response community.