RESEARCH FOUNDATION
RESEARCH FOR THE NFPA MISSION

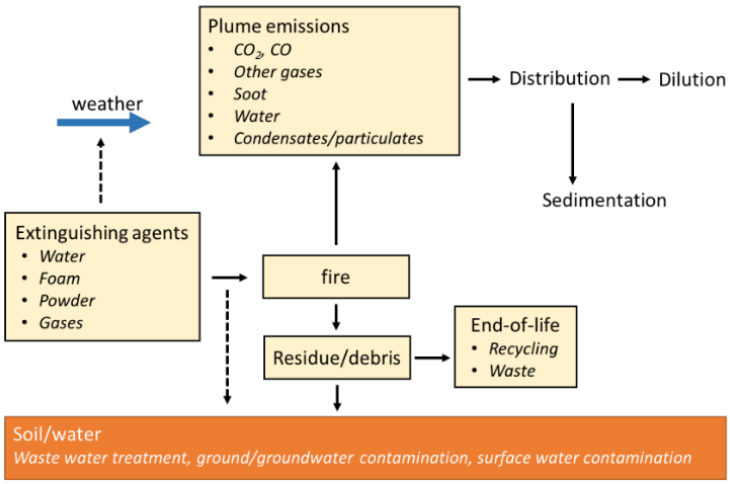
Project Summary

Environmental Impact of Li-ion BESS Incidents compared to other types of fires

Background

Most fires occurring in the built environment contribute to air contamination from the fire plume (whose deposition is likely to subsequently include land and water contamination), contamination from suppression water runoff containing toxic products, and other environmental discharges or releases from burned materials.

Incidents involving lithium-ion batteries are mostly focused on fires and the release of potentially toxic gases, which may pose toxicity concerns for first responders or the public. In addition to the exposure risk to first responders and spectators at, for example, a road traffic accident, there is also the broader spectrum of the environmental impact of such fires. In addition to heat, with fire or a toxic and potentially explosive vapor cloud, there is also a possibility of air transportation of substances and with time, their deposition in other, distant places.



The close surroundings are also affected by the fire debris, transportation of pollutants by fire extinguishing agents and release of remaining contamination from fire debris of burnt batteries. Following fire suppression activities, the run off into the water or soil may present concerns in terms of environmental impact. As the use and application of lithium-ion batteries continues to grow, questions remain as to how the environmental impact to air, soil and water from lithium ion battery fires compares to other common fires.

Research Goal

The overarching goal of this research program is to evaluate the environmental impact (to air, water, and soil) of a lithium-ion ESS fire (including runoff from suppression activities) compared to other common types of fires.

Research sponsored by

This project is generously sponsored by the members of the FPRF Energy Storage Research Consortium (ESRC), including: Energy Safety Response Group (ESRG), Fire & Risk Alliance, LLC, FM Global, General Motors (GM), Pacific Northwest National Laboratory (PNNL), Southern Company, Tesla, UL Research Institutes, and Wartsila Energy.

Updated: November 6, 2023

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Project Tasks

This research project, with technical oversight from the project technical panel, will involve the following tasks:

Task 1: Literature review

Task 1.1: Collect and analyze the relevant literature on the topic. The analysis should consider types of environmental impact, facility/fuel types, fire impacts, etc.

a) Generally characterize ESS systems. Where information is available, identify and characterize the material composition of the components of a BESS, including the batteries, coolants, insulation, electrical components, encasement materials, etc. that may contribute to the airborne emissions or ground contamination following fire suppression activities during a fire event.
b) Scenario identification: Identify a representative number of lithium-ion battery fire scenarios to characterize and evaluate the toxic gas emissions, pathways and environmental impact.
    i. Identify a representative number of lithium-ion battery fire scenarios to characterize and evaluate the toxic gas emissions, exposure pathways and environmental impact. Also identify relevant datasets or other data sources that consider emissions and particulates from li-ion battery cells with different chemistries, state of charge, different failure modes, etc.
    ii. Identify a representative number of other common fire scenarios (e.g., other products/fuels) to characterize and evaluate the toxic gas emissions, exposure pathways and environmental impact. Also identify relevant datasets or other data sources of emissions and particulates from other common fire scenarios fires
c) Identify, review and summarize available international literature and compile available test data on toxic gas products, concentrations, emissions and particulates to the *Air* (airborne contamination) and exposure pathways resulting from:
    i. Li-ion battery ESS fire scenarios selected in Task 1.1.C.(i)
    ii. Other types of fire scenarios selected in Task 1.1.C(ii)
d) Identify, review and summarize available international literature and compile available test data on toxic gas products, concentrations, emissions and particulates to **Soil and Water** (e.g., contamination from water-runoff) and exposure pathways resulting from:
    i. Suppressed Li-ion battery ESS fire scenarios selected in Task 1.1.C(i)
    ii. Other types of suppressed fire scenarios selected in Task 1.1.C(ii)
e) Summarize a list of toxic products and exposure pathways resulting from fire scenarios defined in Task 1.1(c) and clarify the similarities and differences between Li-ion ESS fires and other standard fire scenarios.

Task 1.2: Summarize all information gathered in Tasks 1.1 in an interim draft report. This summary report should address all the findings from Tasks 1.1, including the impact of different li-ion battery chemistries, battery capacities, and varying states of charge and states of health.

Task 2: Update Emissions Factors Database.

Using the data found in Task 1 and building on the database of emissions factors of building materials from the past FPRF "Environmental Impact of Fire in the Built Environment: Emissions Factors" project, add data on emissions from li-ion battery ESS fires to this existing database.

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Task 3: Gap Analysis and Research Plan

- Conduct an assessment of key gaps in information reviewed in Task 1, in consideration of an overall environmental impact assessment of li-ion battery ESS fires compared to other common fires. Specifically, identify key gaps in literature, data, and emission factors, at a minimum.
- Based on the identified gaps, develop a research plan to fill the knowledge gaps, including preliminary details for needed experimental testing.

Task 4: Develop a Final Report

Develop a draft final report, summarizing the findings from Tasks 1 – 3, and review with the technical panel. After incorporating panel feedback, submit a final report for publication.

Schedule and Implementation

This project is expected to be completed within 6-months of project initiation. This research project is led by the Fire Protection Research Foundation and will be conducted in accordance with the "Research Foundation Policies for the Conduct of Research Projects". The project will be guided by a Project Technical Panel who will provide input to the project, recommend contractor selection, review periodic reports of progress and research results.