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Battery Firewater Composition and Risk Assessment

Project Highlights:

- Water contamination risk assessment for battery fire suppression
- Entrainment potential for lithium, cobalt, electrolytes, or chemical suppressants
- Evaluation of chemical release and subsequent environmental transport
- Estimated risk level for soil, surface water, and groundwater impacts

Background, Objectives, and New Learning

Use of a substantial volume of water is currently recommended in many situations to extinguish fires resulting from incidents involving lithium ion batteries. The National Fire Protection Association Standard for the Installation of Stationary Energy Storage Systems (NFPA 855)[1] requires minimum water flow densities for sprinkler systems of 0.3 gallons per minute per cubic foot. Fire management investigations have also recommended large water densities on the order of 500 hundred gallons per minute for a 1MWh system[2]. Currently, little is known about the composition of the resulting firewater (i.e., water used in firefighting) or appropriate handling methods. Anecdotal information suggests certain facility types or jurisdictions may use firewater containment processes to trap, collect and remove the large quantities of water remaining after extinguishment for safe disposal. Temporary berms, such as straw bales, are sometimes used. Sometimes the water runoff is tested with acid strips, and sometimes not. Currently there are no clear water management protocols or requirements in widespread use.

Questions exist as to whether firewater could become contaminated with hazardous materials (such as lithium, cobalt, organic electrolytes, or solubilized organics released to the gas phase) that leach or are entrained from the battery systems during suppression and subsequently released to soil, surface water, and groundwaters. If this transfer of material occurs, there is risk of exposure to personnel and environment. Thus, battery storage system developers, owners and operators, as well as first responders, must have robust information with which to propose mitigation practices and assess their value.

Importantly, data (such as the release rate of chemicals from the battery) with which to determine environmental risk, the necessity for firewater management protocols, and potential impacts on risk by implementing these protocols, are very limited or not available. In a recent survey of EPRI members interested in fire prevention and mitigation, 75% of respondents who have permitted and installed a lithium ion battery system have included a water-based fire suppression system. Similarly, 80% of those designing or considering installation of a lithium ion battery are considering using a water-based suppression system. Of those utilities, 64% are considering secondary containment of firefighting water. As a result, EPRI has received increasing inquiries for guidance on the topic of firewater management.

Thus, a need exists for the determination of a general risk level for potential soil, surface water and groundwater impacts of firefighting water from battery fires. This project would evaluate the potential for chemical release into firewater and subsequent environmental transport, and subsequently perform a first calculation to determine the general risk level.

[1] https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=855

[2] https://www.dnvgl.com/cases/considerations-for-battery-storage-safety-in-new-york-89392?_ga=2.88735067.1571302056.1529694727-67757860.1528844973

Benefits

This project will have widespread relevance to electric utilities, first responders and battery storage system manufacturers and developers. Benefits will include:

- Improved understanding of potential for contamination of firewater used to suppress electrochemical battery fires
- Determination of general risk levels for potential soil and groundwater impacts of firefighting water
- The option to include expanded fate and transport screening modeling, depending on early results
- Data to inform battery facility and catchment design
- Ability to inform emergency management protocols and priorities, and public health risk assessments

This project will provide data-based estimates for use by utilities, first responders or jurisdictions to inform firewater runoff management practices and designs for secondary containment.

Project Approach and Summary

This project will gather information on firewater containment requirements and runoff composition testing from prior research activities and real-world incidents. New laboratory-scale burn testing will also be performed, and the composition and amount of materials leached or entrained into suppression water will be measured directly. Different chemistries and capacities will be tested as funding allows. EPRI will also pursue opportunities to collect water samples from collaborators' burn testing for analysis in this project. This information will be used to estimate the mass fraction of material from a full-scale battery energy storage facility event that could be transferred to surface water and to the soil and pore water through infiltration and equilibrium partitioning. Estimated surface water concentrations will be compared to ecotoxicological data from U.S. EPA ambient water quality criteria and species-specific information (which is often less conservative). The resulting potential concentrations in groundwater as the runoff mixes with porewater and rainfall will be estimated using attenuation factors (e.g. sorption and dilution). Sensitivity to various driving factors, such as fraction of water discharged to soil vs catchment ponds, can also be investigated. The resulting concentrations will be compared to background groundwater geochemistry, and metrics such as stormwater runoff permit limits, soil, and groundwater risk-based screening levels and maximum contaminant levels (MCLs) used to evaluate drinking water quality. Discussion of the fate of fire suppressants can also be included based on funder priorities. Assumptions will be noted, and input data cited, so that future calculations can be updated.

Deliverables

The deliverables from the project will include:

1. Report describing water sampling and testing methodologies, results of chemical testing, assessment of potential impact on soil and groundwater, and comparisons to risk-screening and regulatory threshold concentration levels
2. Implications for runoff water management at battery energy storage facilities
3. Periodic webcast updates to funders
4. Discussions with relevant stakeholders in the battery, firefighting and environmental management communities

The non-proprietary results of this work will be incorporated into EPRI's Environmental Aspects of Fueled Distributed Generation and Energy Storage R&D program, and made available to the public, for purchase, or otherwise.

Price of Project

The price to participate is $40,000. This project is eligible for Tailored Collaboration, Self-Directed Funds, or co-funding.

Project Status and Schedule

The project is expected to take one year and can begin when two funders join. Fully funding the planned effort requires four funders. Additional funders would allow for expanding the range of battery scenarios tested for chemical release.

Who Should Join

This project would be of interest to all utilities who own, operate or procure services from electrochemical battery energy storage facilities. Other stakeholders with interest in understanding the environmental impact from firefighting methods used for electrochemical battery facilities.

Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

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