

FIREFIGHTING OPERATIONS WITH LITHIUM-ION BATTERIES

Li-ion battery or ESS fires pose a unique hazard to firefighters. They produce toxic gasses, create explosive environments, are difficult to get water to, reach flashover in as little as 24 seconds, and always pose an electrocution hazard.

For all responses, ensure a Risk Management Plan is implemented.

All operating personnel shall work within a standard Risk Management Plan during all emergency operations on every emergency incident. This application will be continuously re-assessed at all levels of the incident until all units leave the scene.

1. We Will risk our lives a lot, in a calculated manner, to save savable lives.
2. We Will risk our lives a little, in a calculated manner, to save savable property.
3. We Will Not risk our lives at all for lives or property that are already lost.

All types of fires involving Li-ion batteries have similar hazards. The size and scope of the problem is directly tied to the size of the battery and the state of charge.

General Hazards associated with all types of incidents

- Off-gassing (white to gray) – indicates hazmat
- Thermal runaway - uncontrollable self-heating state
- Flaring - could be up to 3000 degrees F
- Stranded energy - causes secondary fires and electrocution hazard

Although Li-Ion batteries can be found almost anywhere. We will focus on improving our firefighting efforts in four areas, **Electric Vehicles, Personal or Micro Mobility, Photovoltaic Systems, and Energy Storage Systems** (Residential and Commercial)

Electric Vehicle Fire

- This could be a passenger compartment fire (no battery involvement) or caused by the batteries.
- Attack the fire with water at a 45-degree angle and from 40 feet away.
- Upon recognition of EV, upgrade the assignment based on jurisdictional resources.
- Look for flaring from battery vent points (running boards/rocker panels and wheel wells).
- Recognize off-gassing (white smoke even post extinguishment).
- Establish water supply, protect exposures, and evacuate the area.
- Initial evacuation zone should be 150 ft in all directions, if possible.
- Without a Life Hazard or Exposure, consider letting it burn.
- If the vehicle is extinguished, check temperatures of battery locations with TIC or temp gun. Look for trending temps for indications of thermal runaway. This will indicate secondary fire potential.
- If the batteries have suffered thermal or mechanical insult, the potential for electrocution is present. Limit contact to the vehicle.

Personal or Micro Mobility Fire

- Upon recognition that it is a Li-ion fire, a direct attack with water is preferred in full PPE with facepiece.
- If safe to do so, remove the battery from the occupancy. Use nonconductive tools, buckets, or shovels. Do not use interior stairs or elevators.
- After extinguishment, ensure a thorough search of the area is conducted for any battery cells that may have been dispersed prior to overhaul to limit secondary fires.
- Upon recognition of damaged batteries, upgrade the assignment based on jurisdictional resources.
- After extinguishment, temperature readings should be made with a TIC or a thermal temp gun. Look for trends to better predict a secondary fire from stranded energy.
- Overpack into a vented metal container rated for the watts of the battery and cover with a thermal regulating material.
- A charged hose line should remain in place anytime we are working around damaged batteries including overhaul and investigations.
- Depending on your jurisdiction, only certified/permitted disposal companies can transport damaged Li-ion batteries.

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Battery Energy Storage System (BESS) Fire

- BESS must always be considered energized. Firefighters should exercise extreme caution when dealing with BESS and all energized electrical equipment.
- Request utility company to respond.
- Do not make entry or approach BESS building or compartment. Introducing fresh air may result in a deflagration.
- Isolate the area. Recommended initial evacuation distance is 150 feet. Do not enter the fenced area. The exception to this is a savable life/known rescue.
- Be aware of explosion potential and off-gassing of hazardous materials. White colored smoke is a good indication of hazardous off-gassing.
- Place apparatus in a safe location away from BESS and overhead power lines.
- DEFENSIVE FIREFIGHTING, water streams are the preferred agent for response to lithium-ion battery fires (lithium-ion is not water reactive).
- If a fire has not developed and only smoke is visible, take a defensive stance toward the system and be prepared to apply water spray to exposures.
- If a fire develops, take a defensive stance toward the burning unit and apply water to neighboring battery enclosures and exposures.
- Maintain a safe distance from the unit involved (large commercial systems, at least 150').
- Response crews should allow the battery to burn out. Water should be applied to adjacent battery enclosures and exposures.
- The Incident Commander will make the ultimate determination regarding hazard mitigation. The hazard mitigation plan should be developed in partnership with the utility representative and/or responsible party.
- Firefighters must wear full personal protective equipment, including SCBA with facepiece.

Photovoltaic (PV) and Residential BESS Fire

- If a PV array is burning, use water to extinguish the fire after the electrical disconnects have been operated.
- A fog pattern delivered at a minimum of a 10-degree pattern from a minimum distance of 20 feet away will provide for the safe application of water on a PV array.
- This tactic may only be employed on PV installations up to 1000 volts. Most residential and commercial PV systems generate less than 1000 volts.
- This tactic may not be employed on high voltage utility PV installations greater than 1000 volts.
- In large utility substation events, do not engage in any activities related to fire suppression inside the facility. Simply isolate the area. All fire department personnel will remain outside the fence line and protect exposures as needed.
- As the PV panel burns, the material can liquify and can follow the path of least resistance. This may extend the fire non-typically and cause extension below the panels and in the structure. Overhaul efforts must address this risk.
- When a PV system is identified, it is critical to evaluate the system to determine if there is a BESS as part of the installation.
- It is critical to operate electrical disconnects if it is safe to do so. This will isolate the battery from the PV.
- After operation of the electrical disconnects it is important to recognize that the batteries will still pose an electrical hazard due to the stranded energy that they contain.
- Crews will wear full PPE with SCBA facepiece in place.
- A charged hose line will be in place (1 3/4" or larger shall be used).
- Isolate the area surrounding the residential BESS a minimum of 40 feet. Hazardous Materials crews will set a hot zone.
- Avoid parking apparatus directly in front of the house.
- Evaluate if the battery pack has been impacted by the initial fire or other event. Check temps at intervals looking for trends.

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