
Please contact the Operations Section for further information and resources if you have any questions.

Purpose

To establish operational guidelines for effective response, mitigation, and safe operational procedures for electric vehicle fires and incidents involving Battery Energy Storage Systems (BESS).

Policy

The San Diego County Fire Chiefs Operations Section developed this guideline to provide information on current best practices regarding electric vehicle and battery storage fires. This guideline may be updated as new information or techniques become available.

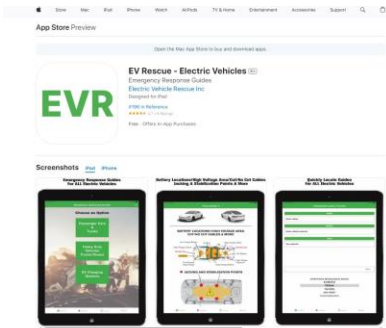
Definitions

- A. Hybrid Vehicle: Hybrid vehicles are vehicles which use both battery power and some other form of flammable or combustible liquid or gas, with the most common being gasoline.
- B. Fully Electric Vehicle/Battery Electric Vehicle (BEV): A fully electric vehicle uses only battery power to operate.
- C. Thermal Runaway: Lithium-ion (Li-ion) battery thermal runaway occurs when a cell, or area within the cell, achieves elevated temperatures due to thermal damage, mechanical damage, internal/external short-circuiting, or electrochemical abuse. This elevated temperature releases energy, which in turn further increases the temperature. It is a phenomenon known as a positive feedback loop in which the lithium-ion cell enters an uncontrollable, self-heating state.
- D. Battery Energy Storage System (BESS): Battery Energy Storage Systems are rechargeable batteries that can store energy from different sources and discharge it when needed. BESS consists of one or more batteries and may be found in commercial or residential applications.

Procedure – Electric Vehicle Fires

- A. Hybrid Vehicle Fires
 - 1. Ensure all personnel wear full PPE including SCBA.
 - 2. If safe, chock the wheels.
 - 3. Never assume the vehicle is powered off and won't move.
 - 4. Immediately check for trapped victims.
 - 5. Avoid the smoke whenever possible.
 - 6. Attack the fire as a normal vehicle fire as the batteries may not be involved.
 - 7. After confirming it is a hybrid vehicle and the batteries are involved, notify dispatch

- for documentation and to notify incoming units of a lithium-ion battery fire.
- a. If safe to do so, allow the batteries to burn, evacuate the area 330' in all directions, and protect exposures.
 - b. If extinguishment is required, secure a water supply.
 - c. Extinguishment may require copious amounts of water.
8. Locate the main lithium-ion batteries.
- a. Refer to the Emergency Response Guide for the specific make and model of the vehicle for guidance. Guides may be found at www.nfpa.org or <https://energysecurityagency.com/erg/>
 - b. Apps such as EV Rescue for iPhone, Android and our apparatus MDC's can be resources on scene for hazard recognition/ mitigation.



EV-Rescue App



Energy Security Agency Emergency Response Guides
Vehicle Identification-Hybrid/EV



NFPA Emergency Response Guides

A thermal imager should be used to check the temperature of the lithium-ion battery and cooling measures should be used if necessary. Temperatures above 200 degrees F are a probable indicator of impending thermal runaway. Camera targets should be the battery pack and high voltage components.

- c. Smoke (GAS) produced from Li ion batteries contains Hydrogen, Hydrogen Fluoride, Carbon Monoxide, Carbon Dioxide, as detectable gases. Gas production is flammable, explosive, and toxic. 4 Gas Meters should be deployed to help identify hazard levels for atmospheric management and isolation zones.
 - d. Apply water as directly to the batteries as possible.
 - e. Once extinguished, if possible, locate the main disconnect to isolate power to the main lithium-ion battery.
 - f. This can be done by removing the negative terminal from the 12-volt battery and cutting the first responder loop.
9. Never cut, crush, puncture, or open a high-voltage battery to extinguish it.
- a. If the cells are visible due to damage a hose stream can be used directly on the cell.
 - b. Observe the battery for smoke, steam, and popping noises from the battery.
 - c. If any of these are observed, the lithium-ion battery is in thermal runaway.
10. Once the lithium-ion battery has been cooled, stand by for at least one hour and continue monitoring the lithium-ion battery using the thermal imager and observe for any other signs of thermal runaway (e.g., steam, hissing, popping, etc.).
- a. If on a freeway, consider using CHP to move the vehicle out of the way, if feasible and safe.
 - b. Once determined the vehicle is safe for transport, release the vehicle to the tow company, making sure it's towed on a flatbed. Wheel Lift towing may send unwanted power to the lithium-ion batteries.
 - c. The tow company is responsible for properly storing the vehicle.

B. Fully Electric Vehicles/Battery Electric Vehicles (BEV)

1. Ensure all personnel wear full PPE including SCBA.
2. If safe, chock the wheels.
3. Never assume the vehicle is powered off and won't move.
4. Immediately check for trapped victims.
5. Avoid the smoke whenever possible.
6. Use 1¾ inch hose line to extinguish the fire.
 - a. Foam is not recommended.
7. Attack the fire as you would a normal vehicle fire at a 45-degree angle.
8. After confirming this is an electric vehicle (EV) and the batteries are involved, notify dispatch for documentation and to notify incoming units of a lithium-ion battery fire.
 - a. If safe to do so, allow the batteries to burn, evacuate the area 330' in all directions, and protect exposures.
 - b. If extinguishment is necessary, secure a water supply.
 - c. Extinguishment may require copious amounts of water, likely in the thousands of gallons.
9. Consider requesting a resource (fire or tow company) to assist with tilting the vehicle to gain access to the underside of the vehicle where the floor pan lithium-ion battery is located, if necessary, to gain access to the battery pan.
10. Refer to the Emergency Response Guide for specific make and model guidance on securing power to the lithium-ion battery. Some battery cooling mechanisms are powered by the 12-volt system. Guides may be found at www.nfpa.org or <https://energysecurityagency.com/erg/>
11. If any lithium-ion cells have come out of the battery and lying on the ground request HazMat.
 - a. Do not touch any battery that has come out of the battery compartment.
12. Use a thermal imager to check the temperature of the lithium-ion battery.
 - a. Cool with a continuous water stream.
13. Never cut, crush, puncture, pressurize, or open a high-voltage battery or Orange high Voltage cables to extinguish it.
 - a. If the cells are visible due to damage, a hose stream can be used directly on the cell.
 - b. Observe the battery for smoke, steam, hissing and popping noises from the battery.
 - c. If any of these are observed, the lithium-ion battery is in thermal runaway.
14. Once the lithium-ion battery has been cooled, stand by for at least one hour and continue monitoring the lithium-ion battery using the thermal imager and observe for any other signs of thermal runaway (e.g., steam, hissing, popping, etc.).
 - a. Once the vehicle is safe for transport, you can release the vehicle to the tow company, making sure it's towed on a flatbed. Wheel Lift towing may send unwanted power to the lithium-ion batteries.
 - b. The tow company is responsible for properly storing the vehicle.
 - c. Vehicles Submerged
15. Treat a submerged BEV like any other submerged vehicle. The body of the vehicle

does not present a greater risk of shock because it is in the water. However, handle any submerged vehicle while wearing proper PPE for water rescue. Remove the vehicle from the water and continue with normal high voltage disabling of batteries if possible.

- a. Once removed, vehicle should be handled with greater caution due to potential risk of high voltage electrical battery fire. Be prepared for potential fire risk once vehicle is out of water.
- b. Raise the front of the vehicle to allow water to drain out of the vehicle and the battery pack.

16. Post Incident

- a. Fire hose and turn-out cleaning should follow current post-fire incident decontamination procedures.

Procedure – Battery Energy Storage System Incidents

- A. Personal Protective Equipment (PPE)
 1. Wear self-contained breathing apparatus (SCBA).
 2. Wear structural firefighting gear.
- B. Signs of possible Battery Energy Storage System (BESS) failure:
 1. Smoke or suspicious odor emanating from an Energy Storage System can be an indication of an abnormal and hazardous condition.
 2. Battery thermal runaway fires are preceded by smoke.
 3. The battery may not generate visible signs of a thermal event although the event can still be active, and the battery can flare up.
- C. If fire, smoke, or a suspicious odor is observed emanating from the product at any time, perform the following:
 1. A defensive strategy should be utilized.
 2. If possible and safe to do so, shut off the emergency switch.
 3. Evacuate the area of all non-emergency personnel.
 4. Do not approach the unit and attempt to open any doors. A BESS has a variety of safety mechanisms. Some are designed to keep the doors shut, and some have automatic doors designed to aid in ventilation.
 5. If not already done, contact the site emergency contact and/or manufacturer.
 6. Maintain a safe distance from the unit and monitor for evidence of continued smoke venting or fire.
 7. Complete an area size-up and establish a water supply.
 8. If a fire has not developed:
 - a. Position attack lines to protect neighboring exposures and neighboring battery enclosures.
 - b. Do not apply water (no cooling measures).
 9. If a fire develops:

- a. Allow the affected unit to consume itself as it is designed to do. Applying water to the burning unit will only slow its inevitable combustion.
 - b. Use a wide-fog stream at the lowest volume possible to achieve the desired cooling of **neighboring** battery enclosures. Coordinate procedures with site emergency contact or product manufacturer.
10. Allow the battery pack to cool down (this process may take 12-48 hours or longer).

CHARGING STATIONS (LEVEL I, II, III Commercial)

Electrical vehicles that are plugged in to a charging station and require first responder interaction should be disconnected from the power source.

In the case of fire, off-gassing, smoke, audible signs of electrical damage or collision while plugged in, charging stations, charging posts or main breakers should be isolated through charging station electric panels or SDGE personnel.

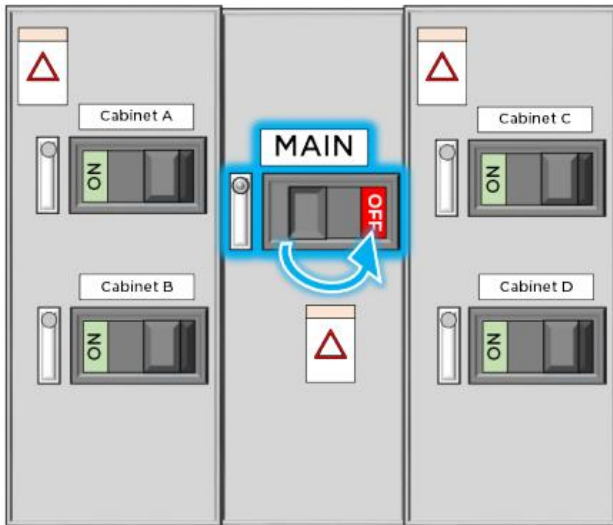


Identify the charging station/post to be deenergized (5C above)





Identify main power supply OR Cabinet with corresponding charging station post (Above).



Secure MAIN disconnect within cabinet. If disconnect or breaker are inoperable or have major damage, contact the utility company (SDGE) to disconnect power from the grid.