LONGVIEW FIRE DEPARTMENT

Standard Operating Procedures/Guidelines

Revision Number
NEW

Response to Electric Vehicle Emergencies

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Purpose: This policy establishes procedures when responding to incidents involving electric vehicles

Scope: This policy applies to all personnel of the Longview Fire Department. This policy shall serve as a guideline to conduct safe and recommended practices for personnel responding to motor vehicle accidents or vehicle fires involving Hybrid or electric vehicles

I. Definitions:

- **A.** **EV/BEV:** Electric vehicle/battery electric vehicle – Any vehicle that uses electric motors, either in full or in part, as propulsion
- **B.** **HEV:** Hybrid electric vehicle – A car that integrates a small battery and an electric motor to enhance the efficiency of the engine. The engine maintains the batteries charge. They are not charged by plugging into an electrical supply
- **C.** **PHEV:** Plug-In hybrid vehicle – A vehicle configured like a traditional hybrid, but with a larger battery pack that can be charged by plugging into an electrical supply.
- **D.** **1st Responder Cut Loop:** A low voltage harness loop that, when cut, will shut down the high voltage system outside of the high voltage battery
- **E.** **Battery Cell:** The smallest unit of the battery pack. These individual components resemble AA batteries in most cases and hold the charge. IF the battery pack housing is damaged these cells can become dislodged or even ejected in a severe collision.
- **F.** **Battery Module:** A module can contain several hundred battery cells. The module design allows for electronic battery management thermal control and allows for greater capacity by using space more efficiently
- **G.** **Battery Pack:** All the components of energy storage for a vehicle. The pack contains all the modules used to store energy. The battery pack is used as a structural member of the vehicles body. On most EV's the battery pack is located on the bottom of the vehicle and will run the length of the car between the axles. On HEV's and PHEV's, the battery pack location varies but mostly could be found towards the vehicles rear (under or behind the back seat or in the trunk)
- **H.** **Charging Station:** A fixed electrical station specifically designed to provide fast charging to PHEV's and BEV's. These charging stations convert AC voltage to DC voltage and consist of switchgear and converters some of these stations may also have a lithium-ion battery pack.
- **I.** **High-Voltage System:** System and wiring (almost always orange in color) which sends high voltage current (60volts DC or Greater) to vehicle components; typically, the battery pack and battery management system, electric motor(s) and motor control unit, on-board charger, power distribution unit, DC to DC convertor and the air conditioning and heating system.
- **J.** **Lithium-Ion Battery:** The current standard in electric vehicle batteries and offers the energy density, power, and fast charging capabilities needed for HEV and PHEV.
- **K.** **Low-Voltage system wiring:** System and wiring which provides low-voltage power to components including vehicle electronics, latches, locks, window control and safety components.
- **L.** **Power Distribution Unit (PDU):** A distribution box that contains relays and fuses and is used to distribute high voltage throughout the vehicle

M. **Thermal Runaway:** A process that is accelerated by increased temperature, in turn releasing energy that further increases temperature. It occurs in situations where an increase in temperature changes the conditions in a way that often leads to a destructive result

II. **Incidents involving an Electric vehicle (No fire):** All responders should be aware of and fully understand the unique risk that personnel can potentially be exposed to when operating at an EV incident. Actions taken by responders should be in compliance with applicable manufacturers Emergency Response guide for that specific electric vehicle.

A. Always assume the high-voltage (HV) battery and associated components are energized and fully charged
B. Exposed electrical components, wires, and high-voltage batteries present potential HV shock hazards
C. Venting/Off-gassing HV battery vapors are potentially toxic and flammable
D. Physical damage to the vehicle or HV battery may result in immediate or delayed releases of toxic and/or flammable gases and fire
E. A HV battery in a flooded vehicle may have high voltage and short circuits that can cause shock and fire

1. **Ensure proper scene management (Reference LFD SOP/SOG -Traffic Incident Management)**
   a) Apparatus positioning
   b) Personnel PPE that is appropriate for known and potential hazards

2. **Identify the presence of an EV**
   a) Charging ports
   b) Emblems/Badges
   c) Labels
   d) Instruments
   e) Components (Bright orange wiring and disconnects)

3. **Immobilize the vehicle (REMEMBER, THESE VEHICLES RUN SILENT)**
   a) Approach the vehicle at an angle or from the side
   b) Place the vehicle in park
   c) Applying parking brake if equipped
   d) Use of wheel chocks

4. **Disable Vehicle**
   a) Turn off the power by key or push button (move vehicle keys at least 16 feet away from the vehicle if it is safe to do so)
   b) If possible, disconnect the vehicle's 12-volt battery. *Consider opening all doors prior to disabling if pt access will be needed.* If necessary/possible, **disable the vehicles high-voltage system** by cutting the first responder loop, this cut will need to be "double cut." Cut the loop prior to extrication and on significantly damaged vehicles or those with visibly compromised or unstable high-voltage batteries. (It can take up to 5 minutes to completely de-energize)

5. **Determine the location, condition, and size of the HV battery**
   a) Access and utilize information and guides from the vehicles manufacturer's emergency response sheets and guides
   b) Use of vehicle reference cards or NFPA's Emergency Response Guides webpage: https://www.nfpa.org/Training-and-Events/By-topic/Alternative-Fuel-Vehicle-Safety-Training/Emergency-Response-Guides also located on your MDC
   c) Venting, hissing, sounds, bubbling at the battery, and vapors are all signs of an impending run-a-way that are potentially toxic and flammable
   d) Use of a thermal imaging camera will also assist in determining condition by identifying heat signatures within the battery. (This may be difficult accomplish on some vehicle due to location of HV battery)
6. **Extrication**
   a) Use of proper PPE required
   b) Deployment of manned pre-connect prior to extrication (Consider hydrant location for sustained water supply)
   c) Use only tools and techniques on EV's when the location and condition of EV's high-voltage battery and cables are certain

III. **Incidents involving an Electric vehicle (With fire):** When arriving on scene, the first arriving apparatus should perform a proper size-up. This shall include the extent of the fire and if it is a compartment fire or includes the electrical components of the car.

A. Water does not pose a shock hazard and is the best extinguishing agent
B. Do not use foam or dry chemical extinguishers
C. Never attempt to penetrate the HV battery
D. Consider the entire car energized.
E. Thermal Runaway may potentially take hours to extinguish (Allowing the battery to burn and protect exposures is an option)

1. **Size Up Considerations**
   a) Identify the presence of an EV
   b) Request second apparatus
   c) Request Battalion Chief
   d) Traffic Management
   e) Scene perimeter (Smoke contains high concentrations of Hydrofluoric acid)
   f) Stabilize vehicle if able to safely
2. **Fire Suppression**
   a) Use of full PPE including SCBA
   b) Secure a water supply as soon as possible (May require a large amount of water; 2500 – 3000 gallons is the minimum recommended amount for EV Fire with potentially up to 30,000 gallons)
   c) Deployment of second hose line
   d) Monitor Battery temperature throughout fire suppression with TIC to monitor temperature
3. **Overhaul**
   a) Continuous cooling of the battery may be required for up to an hour after extinguishment
   b) Continuous use of TIC to monitor battery temperature
   c) Attempt to lift one side of the vehicle 18" – 24" to allow for additional cooling of the battery with hose lines and access to monitor battery temperature

4. **Recommendations**
   - **a)** Do not release the vehicle to a third party until no heat is detected for an hour after extinguishment
   - **b)** Communicate with recovery service on potential hazards
     - **i.** Battery could potentially reignite for up to 48 Hrs
     - **ii.** Recommend that the vehicle is placed a minimum of 50 ft for any exposures or combustibles
     - **iii.** Consider having an engine company follow recovery service to yard
     - **iv.** Before transport, discuss plans with recovery driver if the vehicle reignites during transport
   - **c)** Use of ph paper to test for contamination on SCBA, turn out gear, and hose

IV. **EV Submersion**: Treat a submerged EV, HEV, BHEV like any other vehicle submerged. The vehicle's body and chassis does not present a greater risk of shock because it is in the water.

- **A.** Appropriate and Proper use of PPE
- **B.** Monitor for signs of thermal runaway (bubbling or smoke or gas coming from the water)
- **C.** Removal of vehicle from the water
- **D.** Follow above procedures to safely vehicle (Section II)
- **E.** Monitor vehicle for at least one hour before transport

V. Resources

- **A.** NFPA's Emergency Response Guides
  https://www.nfpa.org/Training-and-Events/By-topic/Alternative-Fuel-Vehicle-Safety-Training/Emergency-Response-Guides
- **B.** Fire Protection Research Foundation
  https://www.energy.gov/sites/prod/files/2014/02/f8/final_report_nfpa.pdf
- **C.** International Association of Fire Chiefs
  https://drive.google.com/drive/folders/1WTOiHMxkH1gCdoxFTcFHY7vJ94GpDhHL

APPROVED:

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