Sample

Emergency Response Guide

In case of fire

Firefighting Operations

Strict precautions must be taken while conducting firefighting operations due to following Reasons:

- Lithium-ion batteries contain electrolyte that can vent, ignite, and produce sparks when subjected to temperatures above 300°F.
- Vehicle may burn rapidly with a flare-burning effect.
- Even after the high-voltage battery fire appears to have been extinguished, renewed or delayed fire can occur.
  - Use a thermal imaging camera to ensure the high voltage battery is completely cooled before leaving the incident.
  - Always advise second responders that there is a risk of the battery re-igniting.
  - In a fire, submersion or a collision that has compromised the high voltage battery, always store it in an open area with no exposures within 50 feet.
- A burning battery could release hydrogen fluoride, carbon monoxide, and carbon dioxide gasses. Use NIOSH/MSHA approved full-face self-contained breathing apparatus (SCBA) with full protective gear. Even if the high-voltage battery pack is not directly involved in a vehicle fire, approach the vehicle very carefully.

Extinguishers

- Small fires that do not involve the high voltage battery should be extinguished using an ABC fire extinguisher. (ex. Fire caused by wiring harnesses, electrical components, etc.)
- Do not attempt to extinguish fires that involve the high voltage battery with small amounts of water as this can result in electrocution. Fires that involve the high voltage battery should be extinguished using large amounts of water(Max 10,000 liter) to cool the high voltage battery. Fire fighters should not hesitate to pour larger amounts of water on the vehicle in such scenarios. Make sure the battery is fully cooled to avoid fire re-ignition.

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In case of fire

How to deal with the situation

Fire → Extinguish the fire with a large amount of water. Don't use seawater or salt water. It can generate the toxic vapor or cause the reignition.

Damaged battery or Fluid leak* → Disconnecting 12V Battery (-) terminal, Disabling the high voltage system, Neutralize the battery by applying a large volume of water. (It doesn't discharge the battery) → **Battery discharging**

*If electrolyte solution leakage, or any damage to the H.V battery casing is observed

- Vehicle fire

- Use a large volume of water (max. 10,000 liter). The water must cool down the battery.
- If water is put into the high voltage battery casing, it will be better to cool down the battery. (But never attempt to penetrate the HV battery or its casing to apply water.)

If it is possible, Soaking the vehicle in the container filled with water can be a effective way to extinguish the fire.

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In case of fire

- High Voltage Battery Damage and Fluid Leaks

If electrolyte solution leakage, or any damage to the Lithium ion battery casing is observed, the first responders should attempt to neutralize the battery by applying a large volume of water to the battery pack while wearing appropriate Personal Protective Equipment (PPE). The neutralization process helps stabilize the thermal condition of the battery pack but does not discharge the battery.

- Do not put any smoke, spark, flame around the vehicle.
- Do not touch or step on the spilled electrolyte.
- If electrolyte leak occurs, wear appropriate solvent resistant PPE and use soil, sand, or a dry cloth to clean up the spilled electrolyte. Be sure to adequately ventilate the area.

⚠ CAUTION **Electrolyte Irritation**

The high voltage battery contains electrolyte solution. To avoid exposure to electrolyte solution and serious personal injury, always wear appropriate solvent resistant PPE (Personal Protective Equipment) and SCBA (Self-Contained Breathing Apparatus).

- *Electrolyte solution is an eye irritant – In the event of contact with eyes, rinse with plenty of water for 15 minutes.*
- *Electrolyte solution is a skin irritant. Therefore, in the event of contact with skin, wash off with a soap.*
- *Electrolyte liquid or fumes coming into contact with water will create vapors in the air from oxidization. These vapors may irritate skin and eyes. In the event of contact with vapors, rinse with plenty of water and consult a doctor immediately.*
- *Electrolyte fumes (when inhaled) can cause respiratory irritation and acute intoxication. Inhale fresh air and wash mouth with water. Consult a doctor immediately.*

In case of fire

High Voltage Battery re-ignition by stranded energy

Damaged cells in the high voltage battery can experience thermal runaway* and reignition. To prevent reignition, the first responder and second responder need to be aware of the risk of stranded energy* which remains in the damaged cells and lead to reignition.

*Thermal runaway : The originating cause of thermal runaway is generally short-circuiting inside a battery cell and a resulting increase in the cell's internal temperature. Battery produces heat with thermal runaway and it can spread from one battery cell to many cells, in a domino effect.

*Stranded energy : Energy remains inside any undamaged battery cells after the accident. That stranded energy can cause a high voltage battery to reignite multiple times after firefighters a fire.

How to prevent reignition (Mitigating stranded energy risk)

Use a thermal imaging camera to ensure the high voltage battery is completely cooled before leaving the incident.

Always advise second responders that there is a risk of the battery re-igniting.

1. 12V battery terminal disconnection (To depower battery management system)
2. High voltage shut off
3. Discharging the high voltage battery

Sample

In case of submersion

Submerged or Partially Submerged Vehicles

Some emergency responses can involve a submerged vehicle. EV that is submerged does not have high-voltage components on the vehicle's body or framework. It is safe to touch the vehicle's body or framework if there is no severe damage to the vehicle, whether it is in water or on land.

In the event of the vehicle is submerged or partially submerged, remove the vehicle from the water before attempting to disable the vehicle. Drain the water from the vehicle. Use one of the methods to disable the vehicle.

Case I Power Off → 12V battery disconnection → High voltage shut off

Case II 12V battery disconnection → Fuse removal (Fuse box) → High voltage shut off

*In case of emergency

Then, discharge the battery by referring to next page.

⚠ CAUTION

- *If severe damage causes high voltage components to become exposed, responders should take appropriate precautions and wear appropriate insulated personal protective equipment.*
- *Do not attempt to remove a safety plug while the vehicle is in water.*

Failure to follow these instructions can lead to death or serious injury by electrocution.

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Towing / Transportation / storage

Storage of damaged vehicle with the damaged battery

- Drain fluids and water, then disconnect the positive(-) terminal of the 12 V battery before storing a damaged vehicle.
- In addition, remove the water inside the battery or vehicle, then remove the service interlock connector before storing a damaged vehicle.
- Place the vehicle in an open space away from any structure, vehicle, or building.
- Then, keep on eye on the vehicle until the discharging procedures are completed.
- If the battery can be removed from the vehicle by moving the vehicle on the lift, remove and discharge the battery.
- If the battery can't be removed, set the water pool and pouring water until the entire battery is submerged.

Water pool condition : tap water or pond water that does not contain salt

- Maintain this water level for at least 90 hours.
- Put salt into the water pool to make under 2wt% salt water.
- Wait for additional 72hours in salt water.
- Then, drain the water and dry it.

※ Discharging Criteria: 1V per serial connected cell. EX) 3P100S -> 100V

CAUTION **Battery discharging**

- *DO NOT USE SALT WATER FOR THE FIRST STEP.*
- *A large volume of flammable gas can be generated in salt water due to electrolysis.*
- *After submerging the vehicle in pure water for at least 90hours, put salt in the water pool.*

Battery discharging

Sample

8. Towing / Transportation / storage

Battery Storage

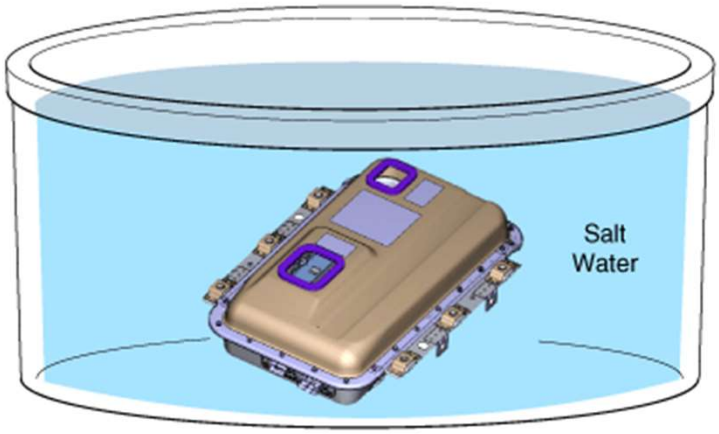
- To store the damaged battery safely, the battery must be discharged.
- If the battery can be removed from the vehicle, discharge the battery to prevent re-ignition.

⚠ CAUTION

- *Extinguish all smoke, spark, flame around the vehicle.*
- *Electrolyte solution is a skin irritant.*
- *Do not touch or step on the spilled electrolyte.*
- *If electrolyte leak occurs, wear appropriate solvent resistant PPE and use soil, sand, or a dry cloth to clean up the spilled electrolyte. Be sure to adequately ventilate the area.*

- Prepare water that does not contain salt such as tap or pond water.
- Leave the battery in water for at least 90 hours.
- Put salt into the water pool to make under 2wt% salt water.
- Wait for additional 72hours in salt water.
- Then, drain the water and dry it.

※ Discharging Criteria: 1V per serial connected cell. EX) 3P100S -> 100V



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