



# IAFC

International Association of Fire Chiefs



## Response to EV/Battery Incidents As a Result of Hurricane Ian

October 19, 2022

# Before we begin



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If the presenters have provided resource materials or links, you will find them in the Handouts section.





# Host

Chief JoAnne Rice,  
Acting Director  
Florida Division of State Fire  
Marshal

850-755-7320

[JoAnne.Rice@myfloridacfo.com](mailto:JoAnne.Rice@myfloridacfo.com)



# Welcome

Donna Black, Fire Chief

International Association of  
Fire Chiefs

President and Chairwoman of  
the Board

[dblack@townofduck.com](mailto:dblack@townofduck.com)



# Presenters

Michael O'Brian

Fire Chief, Brighton Area Fire  
Authority, (MI)

810-459-0116

[mobrian@brightonareafire.com](mailto:mobrian@brightonareafire.com)



# Today's Program

- Partnership/ Collaboration with Florida Division of State Fire Marshal
- Overview of the Response and Paradigm shift
- Best Practices as we know it





## Lithium Ion Response Resources - Google Drive

[drive.google.com](https://drive.google.com)





# Battery Responses Fall Into

- Mobility/Consumer grade (ebikes, scooters, hover boards etx)
- Electrical /Hybrid Vehicle (Car/Bus/Vehicle)
- Recycling (hauling, storing, moving, in waste stream)
- ESS (Energy Storage Systems)
- Storage/Manufacture



# Not All Batteries Create Fire

- **What is the fire department use of batteries**
  - **New apparatus**
  - **Vehicles**
  - **Extrication Equipment**
  - **Lighting**
  - **Portable Equipment**
  - **Backup power at our Fire Stations**

# What is Thermal Runaway



Thermal runaway is one of the primary risks related to lithium-ion batteries in which the lithium-ion cell enters an uncontrollable, self-heating state.

Thermal runaway can result in:

- Ejection of gas, shrapnel and/or particulates (violent cell venting)
- Extremely high temperatures
- Smoke
- Fire



# Non-EV (Mobility Device Response)



- E-Bikes/Scooters/ Etx
- Golf Carts/larger mobility
- Remove from structures, soak batteries if possible or allow to burn away from exposures



# Non EV After the Fire



- Submerged/damage is not just a landfill option
- Limit our fires in trash/recycling/transfer facility
- Pre-response coordination



# EV Response

- Developed by Firefighters and tech experts
- Discussion on training/SOP
- When to let it burn
- Post incident



## Fire Department Response to Electrical Vehicle Fires

Adapting our response plans through training, research, and experience is critical in the Fire Service. As sales of Electric and Hybrid vehicles increase, the fire service must continue to modify our tactics to properly respond and protect our firefighters. Fighting vehicle fires is inherently dangerous. When responding to a Electric or Hybrid vehicle fire there are additional challenges responding crews must consider.

Additional response-specific information can be found on most automobile manufacturer web-pages. [NFPA Quick Vehicle Response Guide](#)

### Pre-Incident

Modify or establish your department policy or standard response guideline to vehicle fires and ensure it includes practices for electrical vehicle fires. include guidelines for limited interaction and when crews should allow the vehicle to burn.

When working on roadways protect the work area per department policy. Staff should consider that this may include a vehicle fire or extrication. Staff operating on roadways should anticipate possibly longer timeliness to manage/control EV vehicle fires and maintain heightened situational awareness.

NFPA has a full series of documents on various EV safety response (including emergency response guides by manufacturer).

Review response and post incident procedures with law enforcement and towing companies.

Batteries that have been or are suspected of damage or otherwise compromised, but have not caught fire, need to be monitored for thermal runaway.

Train on department policy and perform practical scenarios which support the response plan



### INCIDENT ACTIONS

When arriving on scene, the first arriving company should perform a proper size up. This includes the extent of the fire and if it is a compartment fire or includes the electric components of the car. Similar to other vehicle fires, is the "engine" compartment or the passenger compartment on fire? The best method for managing or controlling a battery fire is with water. Battery fires will initially show from under the vehicle.

- Protect your work area through established department policy and establish tactical priorities (fire, extrication, victim care) and ensure the vehicle is in park and off if possible.
- Wear full PPE with SCBA with face-piece and establish an appropriate command structure.
- Consideration and tactics may be categorized in offensive or defensive mode. This may be based on exposures and the extent of fire which may include actions to let the vehicle burn. Use a thermal imaging camera to help with the size-up.
- Secure a large, continuous and sustainable water supply from one or more fire hydrants or multiple water tenders (3,000-8,000 gallons)
- Where safe, consider chocking the wheels. EVs move silently, so never assume it is powered off. Never assume that an EV will not move.
- Extinguish small fires that do not involve the high voltage battery using typical vehicle firefighting procedures
- When attacking the vehicle fire, understanding that once the contents of the fire are extinguished, sustained suppression on the battery pack may be necessary. Use a large volume of water such as multiple 1 1/2-inch hand-lines to suppress and cool the fire and the battery. Put water on the burning surfaces
- Have sufficient fire personnel and apparatus on scene for an extended operation to monitor the battery's heat or possible secondary ignition. The heat from the fire may have damaged additional cells, which may require additional suppression activities.
- Batteries should always be treated as energized. During overhaul do not make contact with any high voltage components.

### Post Incident

Brief the towing company and their personnel on the hazards, including providing 50' clear space around the vehicle once stored and never inside a building. An engine company may need to escort the vehicle to the recovery location.

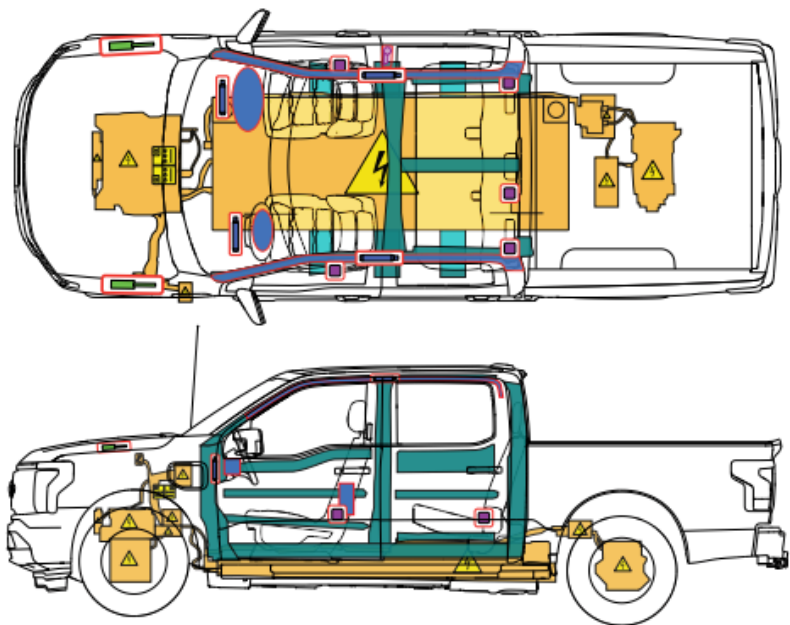
Batteries should always be treated as energized and pose an ongoing risk to the investigator. Follow NFPA 921 protocol for vehicle safety during post-response investigation, arson investigation, and vehicle investigation.

Thermal events with the battery system could continue for some time after the initial incident. Establish response protocol for secondary fires.





# FORD F-150 Lightning 2022 ->



## Legend



Airbag



Structural  
Reinforce-  
ments



Control unit



High-voltage  
battery



High-voltage  
disconnection  
point



Gas generator



Gas filled  
spring device



Battery



High-voltage  
wire /  
components



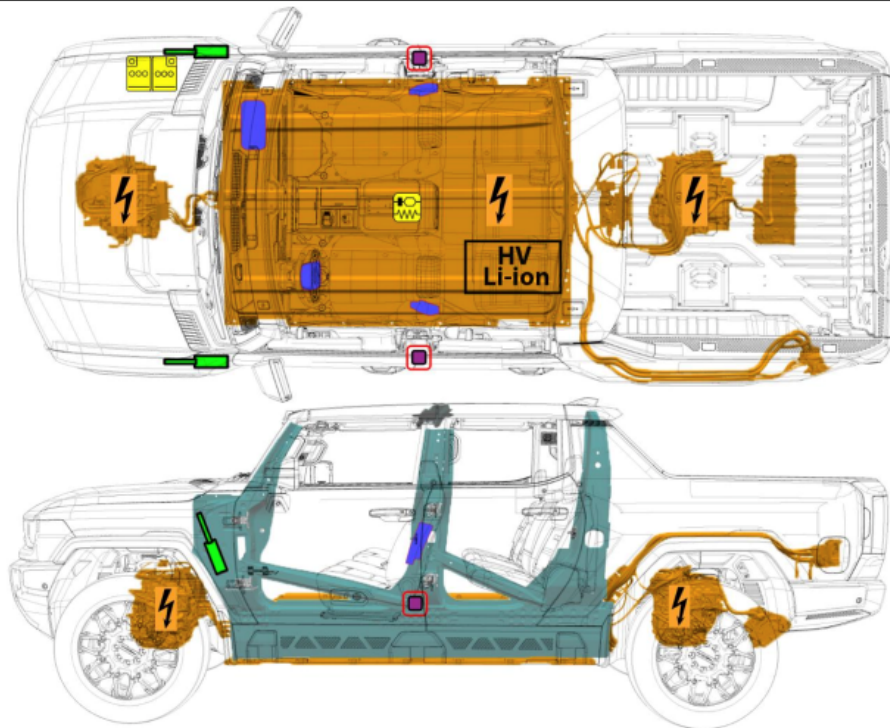
Fuel tank  
Gasoline



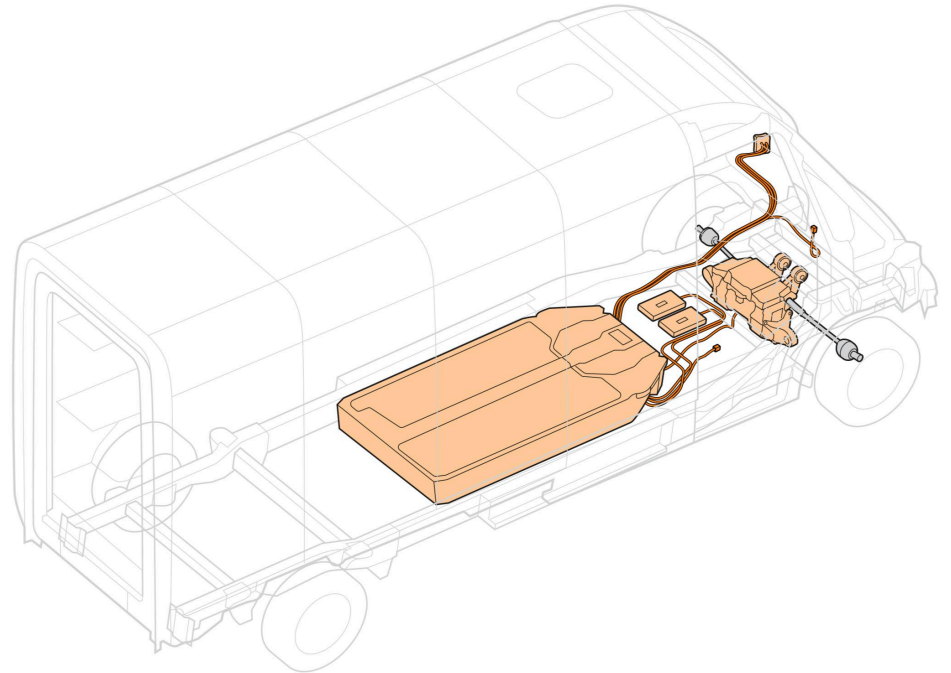
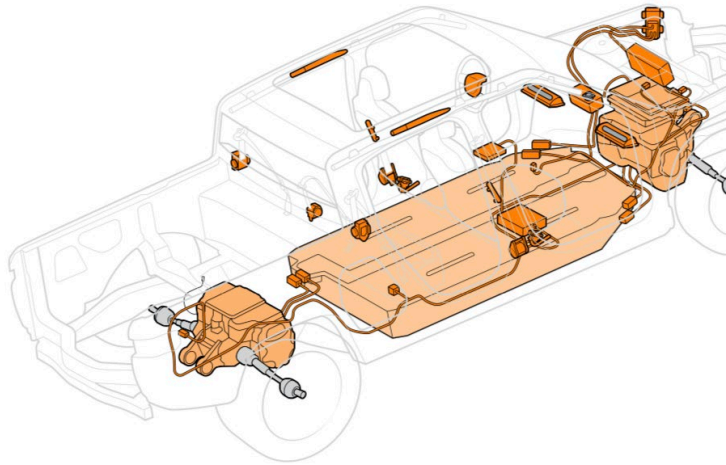
Seat belt  
tensioner



## 0. Rescue Sheet



	Airbag		Stored gas inflator		Seat belt pretensioner		SRS control unit		Pedestrian protection active system
	Automatic rollover protection system		Gas strut/ Preloaded spring		High strength zone		Zone requiring special attention		
	Battery low voltage		Ultra capacitor, low voltage		Fuel tank		Gas tank		Safety valve



**DANGER**

- You could be injured, electrocuted, or die if you cut, pierce, or damage the highlighted areas.
- These areas contain lithium-ion battery packs, high-voltage cables (up to 450 V), traditional car batteries (12 V), compressed gas, and triggering devices.



# Pre Response

- Training for First Responders
- General understanding
- Burn or not burn
- Extinguishing methods
- Vehicle Extrication resources

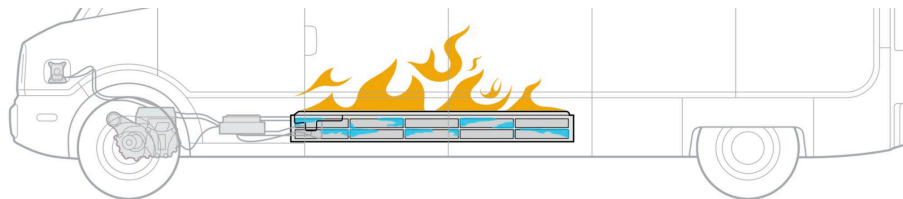


# Response Guides



- Visit the manufacture response guides for
  - Vehicle Extrication
  - Vehicle Fire
  - Towing
  - Submerged Vehicle





### IMPORTANT

Rivian believes that electric vehicle fires are best addressed with defensive firefighting and management of the environment to minimize risk. Only attempt to extinguish a fire if you have a specific need to do so.

Perform these steps to extinguish a vehicle battery fire.

1. Wear proper personal protective equipment (PPE) with full SCBA when approaching any vehicle fire.
2. Use a sustained, high-volume water application. A minimum of 2,000-3,000 gallons (7,500-11,500 liters) will be needed. Consider an established water supply, a tender, or additional units to shuttle water to the pumping engine.
3. If water is not readily available, use defensive firefighting tactics to prevent the fire from spreading until a clear need to extinguish the fire is identified and water is available. If necessary, use CO<sub>2</sub>, dry chemicals, or other fire-extinguishing agents to suppress the fire, for example, to extricate passengers, until water is available.
4. Use a thermal imaging camera (TIC) or infrared (IR) to monitor the battery temperature during the cooling process. Look for ambient temperatures at or below 212°F (100°C). The battery still needs to cool down if it is at or above 302°F (150°C).
5. Continue evaluating the battery structure and apply water directly to any exposed areas. Submerge loose battery cells or modules in water for at least 24 hours.



## 6. In case of fire

### Firefighting



USE WATER TO FIGHT A HIGH VOLTAGE BATTERY FIRE. If the battery catches fire, is exposed to high heat, or is generating heat or gases, use large amounts of water to cool the battery. It can take between approximately 3,000- 8,000 gallons (11,356- 30,283 liters) of water, applied directly to the battery, to fully extinguish and cool down a battery fire; always establish or request additional water supply early. If water is not immediately available, use CO<sub>2</sub>, dry chemicals, or another typical fire-extinguishing agent to fight the fire until water is available.

**NOTE:** Tesla does not recommend the use of foam on electric vehicles.

Apply water directly to the battery. If safety permits, lift or tilt the vehicle for more direct access to the battery (see chapter 2). Water may be applied from a safe distance **ONLY** if a natural opening (such as a vent or opening from a collision) already exists. Do not open the battery for the purpose of cooling it.

Tesla does not recommend placing the vehicle in a large container full of water. The use of a Thermal Imagery Camera or Infrared (TIC or IR) is recommended to monitor battery



## 6. In case of fire



High Voltage Warning, potential for electric shock



A battery on fire will not explode



A battery on fire will not explode. If battery cells reach high enough temperature, they vent and release electrolyte. Battery electrolyte is flammable.



Gases emitted from the battery pack are toxic



Skin contact may cause irritation. Prolonged contact with electrolyte mixture may result in more severe irritation.

Flush contaminated skin with plenty of water.



Potential for eye, nose, and throat irritation with prolonged exposure.



Use copious amounts of water to cool the battery and to extinguish a fire. Do NOT use an ABC dry chemical extinguisher because it will not extinguish a battery fire.



Potential for Battery Re-Ignition.

# Key items

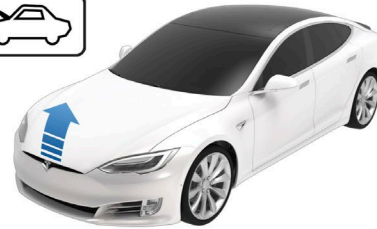
- Follow the high voltage disconnect procedures.
- When using the high voltage shut down methods high voltage power is typically isolated to the battery.
- The high voltage battery is always energized.



## 3. Disable direct hazards / safety regulations

### ACCESS

1. Open the hood (see chapter 4: Access to the Occupants).
2. Remove the access panel by pulling it upward to release the clips that hold it in place.



### MAIN DISABLE METHOD

1. Double cut the first responder loop and then remove the cut section.
2. Disable the 12V battery.





# Defensive Firefighting or Lots of Water

- Entrapment
- Compartment vs battery pack
- Exposures
- Limited involvement
- Charger shutdown
- Vehicle from roll away





# Vehicle with Exposures

- Tow out of garage or where stored if possible
- Extinguish and use large amounts of water



# Cooling vs Extinguishment



- We are working to cool the fire environment not suppress the cells/batteries in thermal runaway



# Considerations



- During overhaul, do not make contact with any high voltage components. Always use insulated tools for overhaul.
- Do not attempt to cut open the battery pack to gain access
- Extinguish small fires that do not involve the high voltage battery using typical vehicle firefighting procedures.





# Our Response Methodology

- Roadway Safety, Protect the work zone
- Full PPE and SCBA
- Inner and Outer Circles (Think 360 hot lap)
  - What is on Fire (Battery pack vs cabin)
  - What is vehicle energy
  - Is vehicle still in a charge state



# Response Methodology Continued



- Request additional Resources
- Secure Vehicle (Crib) from movement
- If Exposures, humans trapped, secure large water and resources
  - Cool the battery pack, extinguish contents on fire





# When is the Incident Over

- Use thermal imaging camera at battery pack
- Allow to cool for 45-60 minutes
- Post event towing protocol
- Post event storage



# Common Questions



- What's are the thoughts with products that pierce the battery pack to put water directly on the cells?





# Common Question 2



- We were considering F500 or Cell Block for use in our response, any thoughts?



# Common Question 3



- What about the covers we have seen for use by Fire Service when the vehicle is on fire?



# Common Question 4



- We have seen thoughts on the submersion of a vehicle into a large body of water or a large dumpster, thoughts?



# Post Incident



Use a thermal imaging camera to ensure that the high voltage battery is completely cooled before leaving the incident. The battery must be **monitored** for at least one hour after it is found to be completely cooled.

**Smoke or steam indicates that the battery is still heating.** Do not release the vehicle to second responders, such as law enforcement and towing personnel, until there has been no heating detected for one hour.





# Post Incident



- Storage for Police
- Inside or outside
- Fire or just an accident
- Discussion with towing yards
- Recycle?

# Charging



Caption



**WARNING:**

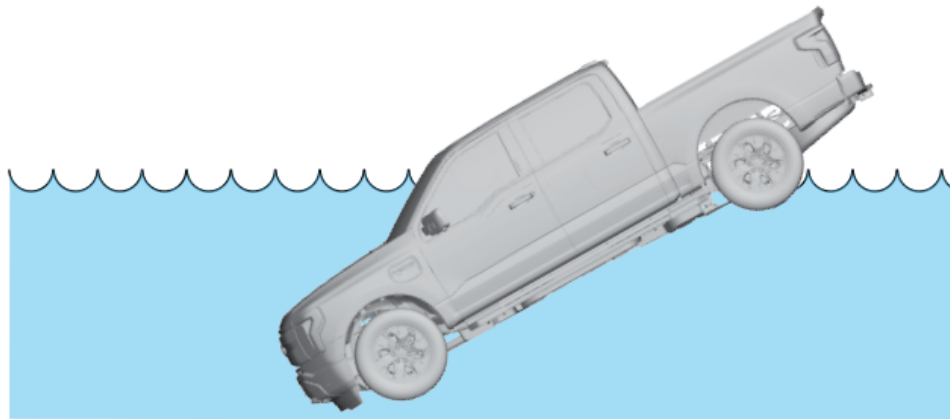
**DAMAGED ELECTRIC VEHICLES SUBMERGED IN WATER PRESENT A POTENTIAL HIGH VOLTAGE ELECTRICAL SHOCK HAZARD. EXERCISE CAUTION AND WEAR APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT (PPE) INCLUDING HIGH VOLTAGE SAFETY GLOVES AND BOOTS. REMOVE ALL METALLIC JEWELRY, INCLUDING WATCHES AND RINGS. DO NOT ATTEMPT TO EXTRACT THE VEHICLE UNTIL THE HIGH VOLTAGE BATTERY HAS DISCHARGED INDICATED BY THE ABSENCE OF BUBBLING OR FIZZING. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN SERIOUS PERSONAL INJURY OR DEATH.**

If the vehicle is submerged in water, varying degrees of arcing/shorting within the battery will take place. Do not touch any High Voltage components or orange cables while removing the occupant(s). Do not remove the vehicle until you are sure the High Voltage battery is completely discharged. A submerged High Voltage battery may produce a fizzing or bubbling reaction to the water. If fizzing or bubbling is observed, the High Voltage battery will be discharged when the fizzing or bubbling has completely stopped. The battery should still be treated as if it is not discharged.

Battery Electric and Hybrid vehicles when submerged should only be handled while wearing the appropriate Personal Protective Equipment (PPE) for water rescue and vehicle extraction.

Vehicles that have been submerged in water may have potential risk of a high voltage electrical battery fire therefore should be handled with increased caution.

Once the vehicle has been removed from the water proceed to the high voltage depower procedure, as outlined in section 3 of this document.

**7. In case of submersion**

The high voltage battery is isolated from the vehicle chassis. If the vehicle is immersed in water, you will not be electrocuted by touching the vehicle.

After the vehicle was removed from the water, do the following:

1. Allow the vehicle to dry out.
2. Perform the high voltage disabling procedure in Section 3.

**8. Towing / transportation / storage****Tow Hooks**

The vehicle is equipped with two front tow hooks used to pull the vehicle onto a flatbed carrier from a flat road surface.

The vehicle may be equipped with two optional rear tow hooks to pull the vehicle onto a flatbed carrier from a flat road surface.

**Vehicle Towing and Transportation**

General Motors recommends a flatbed carrier to transport a disabled vehicle.

# Best Practices



- Never attempt to charge a HV Battery that has been submerged, is gasping or exhibits signs of external damage
- Partner with towing/removal agencies





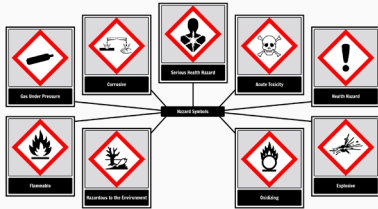
# ENERGY SECURITY AGENCY

Global Leaders in Electric Vehicle and Stationary Storage Safety through testing and research, training, consulting, and real time guidance and high hazard response.

The ESA brings real world experience to the forefront of all of their operations to passionately impact the safety, risk management, and investment protection of our clients and the communities that they serve.

Dalan Zartman – Chief Operations Officer ESA





## Testing

Collaborative World Leaders in Fixed and Mobile Destructive Battery testing for Research and Safety Standards

## Education

Tow and Recovery H/EV Virtual and Hands On Courses with Educational Partners

## Compliance

Stakeholders and contributors in industry standards and interpretation

## Guidance

24/7 Resource Center for real time Risk Assessment, Compliance and Consultation Services



## THE OBJECTIVES

- EV's exposed to saltwater surge are high hazard damage/defective classification and must be managed properly.
- Execution Requirements:
  - Identification
  - Tracking
  - Compliant Transport
  - Compliant Storage
  - Compliant Post Incident Management

# Total Protection

# 855 ESA SAFE



ESA Response Center

24/7 Guidance for  
Tow and Recovery  
Specialists and Emergency  
Responders

***For Responders By  
Responders***

# Total Protection 855 ESA SAFE



## Step 1

- CALL THE ESA
- 855 ESA SAFE

## Step 2

- All Hazards Real Time Support
- **REQUIRE** Towing Compliance

## Step 3

- Complete Data Point Link Form
- Support Tow Operation

# Develop a Plan



- Who should we talk to about a defensive firefighting approach?
- What CRR activities on all batteries can we initiate
- How do we limit the secondary incidents (proper disposal, proper towing, understanding of incident



# Report to Florida



**Electric Vehicle and Lithium-Ion Related Call Sur...**

survey123.arcgis.com

<https://survey123.arcgis.com/share/fe-da4eff50bc4b5581b2c63a5e6d28e0>





# Q&A





# Michael O'Brian

[mobrian@brightonareafire.com](mailto:mobrian@brightonareafire.com)

810-459-0116



# Upcoming Events



- **Symposium in the Sun**
  - Nov 10-13, 2022 - Clearwater, FL
- **Annual Florida Fire Prevention Conference (FFMIA)**
  - Oct 31- Nov 3 - Hyatt Regency Sarasota, FL
- **FFCA Firefighter Safety and Health Conference**
  - Dec 5-9, 2022 - Orlando, FL
- **Wildland-Urban Interface (WUI)**
  - March 28-30, 2023 - Reno, NV
- **Community Risk Reduction Leadership Conference (CRRL)**
  - March 23-25, 2023 - Murfreesboro, TN

More info at [www.iafc.org](http://www.iafc.org)



# Recording and Survey



You will receive a link to today's recorded session by email, along with a brief survey. Please let us know about your experience today.





# Thank you

