



**ALTERNATIVE
FUEL VEHICLES**
SAFETY TRAINING PROGRAM

ELECTRIC VEHICLE SAFETY FOR FIRST RESPONDERS

INITIAL RESPONSE PROCEDURES

FIRE SERVICE EDITION

Program Goal

Prepare first responders to operate safely at incidents involving:

- Hybrid Electric Vehicles (HEVs)
- Plug-In Hybrid Electric Vehicles (PHEVs)
- Electric Vehicles (EVs)



Hybrid and Electric Vehicle Safety Training - Program Modules



Introduction



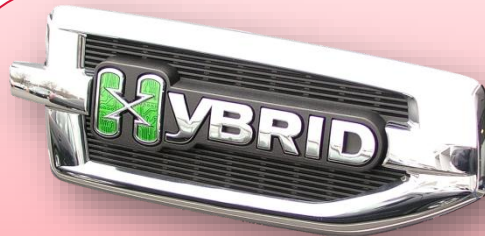
**Basic Electrical
Concepts &
Hazards**



**P/HEV & EV
Systems &
Safety Features**



**Charging
Stations**



**Initial Response:
Identify, Immobilize
& Disable**



**Emergency
Operations**

Initial Response Procedures

OBJECTIVES

Following instruction, the student shall be able to:

- ✓ Describe size-up procedures and scene hazards of an incident involving a P/HEV or EV
- ✓ Positively identify P/HEVs and EVs using visual clues and the NFPA Emergency Field Guide (EFG)
- ✓ Identify and describe proper immobilization techniques
- ✓ Identify vehicle disabling methods and techniques



Scene Safety

Initial Response Procedures

Conduct a Scene Size-Up



Hazards



Types of Vehicles



Determine Course of Action

Scene Safety

Initial Response Procedures

Common Hazards to Consider



- Downed Power Lines
- Unstable Vehicles
- Traffic
- Fuel or Hazmat Spills
- Environmental Ice, Flooding, etc.

Don't become so fixated on the EV that you forget basic scene safety!

Scene Safety

Initial Response Procedures

Potential Hazards at P/HEV and EV Incidents

- Electric Shock
- Silent Powered Movement
- Improper Towing Risks
- Toxic/Flammable Gases
- Battery Fires & Re-ignition



Photo courtesy of the Westport CT Fire Department

Procedures

Initial Response Procedures



Procedures

Initial Response Procedures



Identification Considerations

Initial Response: *Identify*

Key Points

- Many used existing vehicle chassis early on (HEV and EV)
- Move to EV specific chassis designs
- Expansion of EV only OEMs
- Badging designs constantly evolving



Identification Considerations

Initial Response: *Identify*



Identification Considerations

Initial Response: *Identify*

Charging Ports

- Front or rear fenders
- Front of vehicle
- Multiple "fuel" doors (PHEVs and EREVs)



Identification Considerations

Initial Response: *Identify*

Charging Ports



VIDEO

ADVANCE SLIDE TO PLAY



Vehicle Identification

Badging/Labeling

Initial Response: Identify



Some labels may show the location of the 12V and HV batteries

Telematics

Initial Response: *Identify*

Electronic vehicle safety and security systems which monitor vehicle status



Examples

- Onstar (GM)
- Blue Link (Hyundai)
- BMW Assist



Photos courtesy of OnStar

Telematics

Initial Response: *Identify*

Via sat and cellular systems advisor is notified of crash



Info relayed to dispatch center who is notified of P/HEV or EV



The use of telematics is increasing



Photos courtesy of OnStar

Procedures

Initial Response



Approaching the Scene

Initial Response: *Immobilize*

Assume all P/HEVs and EVs are operational and can move until positively shut down



Approach vehicle from a 45° angle

Approaching the Scene

Initial Response: *Immobilize*

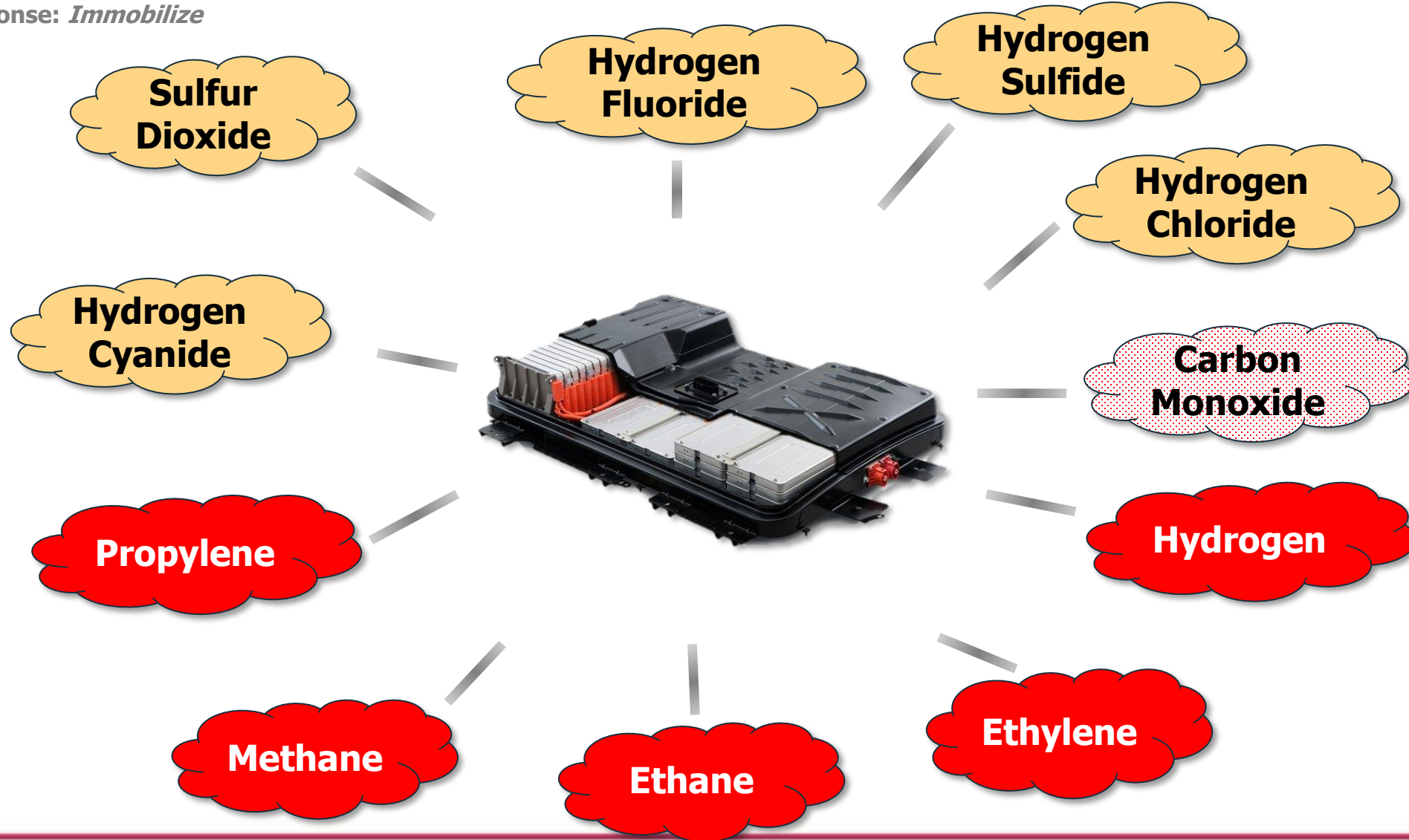
Physical or fire damage to HV battery may result in immediate or delayed release of flammable and toxic gases

IMPORTANT!



Approaching the Scene

Initial Response: *Immobilize*



Approaching the Scene

Initial Response: *Immobilize*

IMPORTANT!

**If HV Battery
is damaged or
produces:**

- Venting gases
- Popping noises
- Venting flames from battery pack



Then:

- Anticipate a thermal runaway event is, or will be occurring

Preventing Vehicle Movement

Initial Response: *Immobilize*

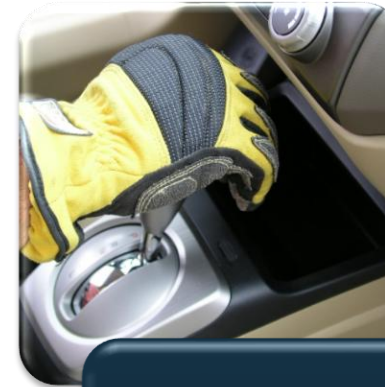
These steps are going to be vehicle dependent, consult vehicle specific ERG for immobilization instructions



Chock the wheels



Engage parking or emergency brake



Place the vehicle in park

Truck/Bus Considerations

Initial Response: *Immobilize*

Apparatus

wheel chocks should be used with trucks and buses due to size



Truck/Bus Considerations

Initial Response: *Immobilize*

Parking Brake

Air brakes are common



Park

Park feature on gear shift



Transmission

May only have neutral position

Procedures

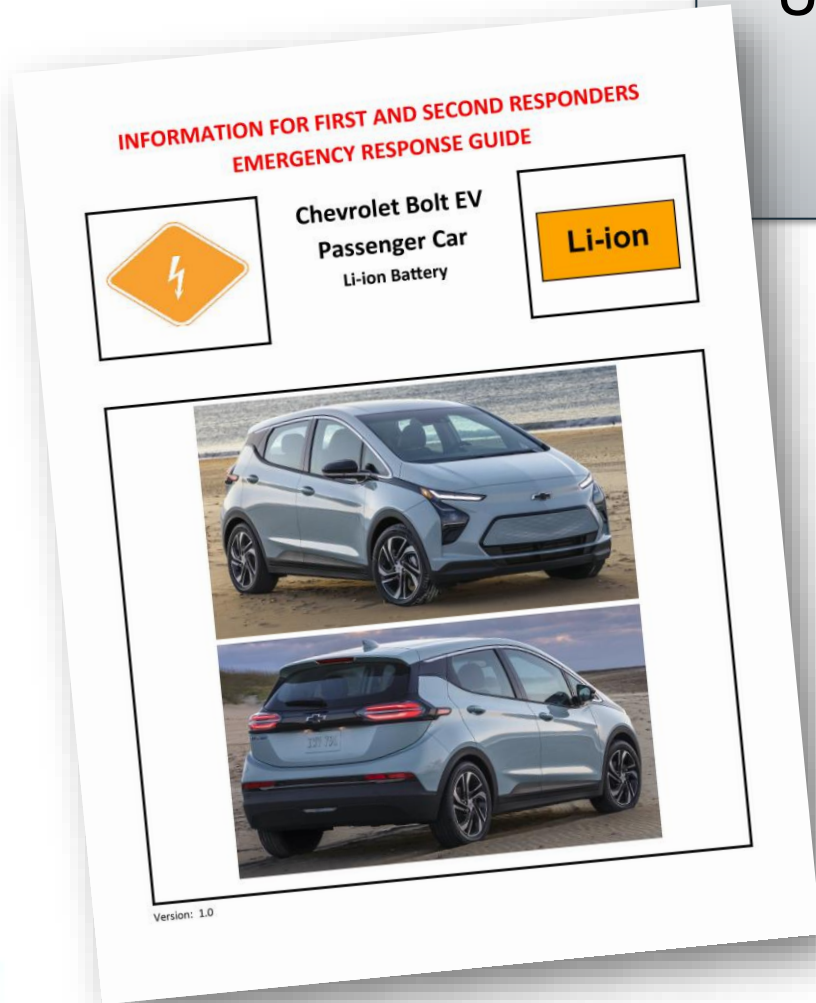
Initial Response



Reference Sources – Emergency Response Guides (ERGs)

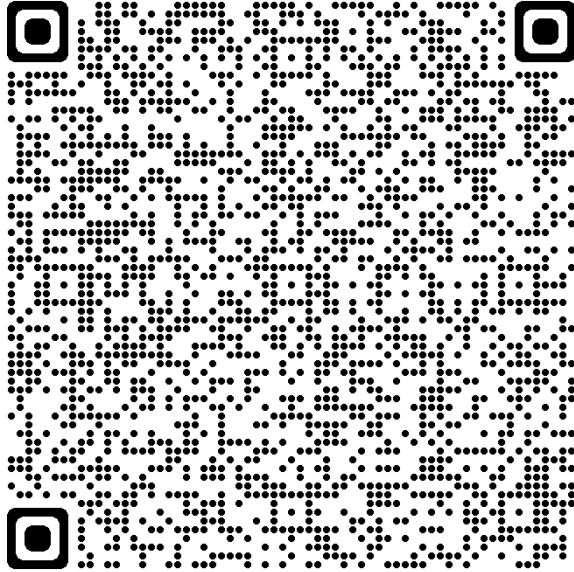
Initial Response: *Disable*

Used to determine model specific shutdown procedures



ISO Standard 17840

Initial Response: *Disable*



[NFPA ERG Library](#)

Volkswagen ID.4
5-door model, as of 2020

Note: The illustration shows the maximum possible range of equipment.

Airbag	Stored gas inflator	Seat belt pretensioner	SRS control unit	Pedestrian protection active system
Automatic rollover protection system	Gas strut / preloaded spring	High-strength zones	Special attention	
Battery pack, low-voltage	Ultracapacitor, low-voltage	Fuel tank	Gas tank	Safety valve
Battery pack, high-voltage	High-voltage power cable	High-voltage disconnect	Fuse box, disabling high-voltage system	Ultracapacitor, high-voltage
Low voltage device that disconnects high voltage	Fuse box disabling high voltage	High voltage component		

Additional information: High-voltage disconnection point option 3 changed

Document number: rds_vvw_316_001_en

Version: 08/2020

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Volkswagen ID.4
5-door model, as of 2020

1. Identification / recognition

The electric motor is silent. The indicator on the left of the instrument cluster (power meter) indicates whether the electric drive is switched "OFF" or "READY" for operation.

Lettering: Charging connection: Engine compartment:

2. Immobilization / stabilization / lifting

Immobilize the vehicle

Apply the parking brake. Lifting points:

3. Disable direct hazards / safety regulations

Turn off the ignition (Powermeter "OFF")

Press the START-STOP button without depressing the brake pedal.

Deactivate the high-voltage system

Option 1: From the engine compartment

Disconnect the 12-volt battery. Disconnect the negative pole from the body contact point.

Additional information: High-voltage disconnection point option 3 changed

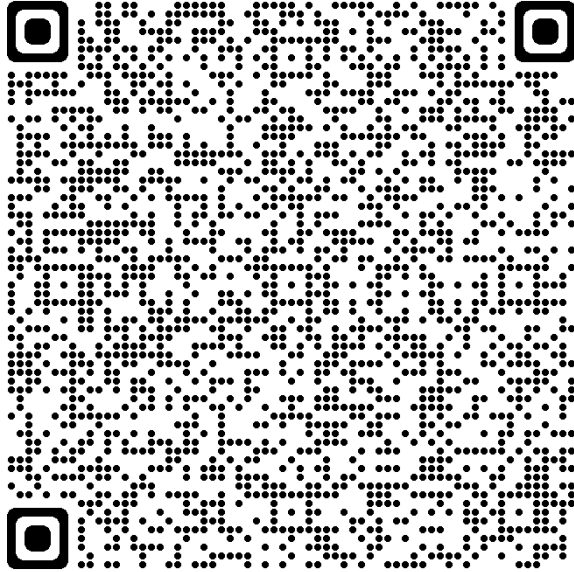
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ISO Standard 17840

Initial Response: *Disable*



[NFPA ERG Library](#)

Volkswagen ID.4
5-door model, as of 2020

Option 2: from the passenger compartment

Option 3: From the luggage compartment

Do not touch, cut or open high-voltage components and high-voltage batteries!
Wear appropriate protective equipment!

In the event of an accident in which the airbags are deployed, the high-voltage system will be automatically deactivated. The high-voltage system is de-energized approx. 20 seconds after deactivation.

Disconnect from the charging station (emergency release)

1. Remove the right side panel.
2. Locate the loop of the emergency release (without the yellow flag).
3. Pull the loop.

4. Access to the occupants

Glass types:
① Laminated safety glass
② Toughened safety glass

5. Stored energy / liquids / gases / solids

LI ION		400 V
		12 V

Additional information: High-voltage disconnection point option 3 changed

Document number: rds_vvw_316_001_en

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Volkswagen ID.4
5-door model, as of 2020

If coolant escapes from the battery cooling system, there is a risk of a thermal reaction in the high-voltage battery.
Monitor the temperature of the high-voltage battery!

6. In case of fire

A damaged or corrupt lithium-ion battery may self-ignite and or re-ignite!
Wear appropriate protective equipment!

7. In case of submersion

After rescuing the vehicle from the water, deactivate the high-voltage system (see Chapter 3) and allow the water to drain. Wear appropriate protective equipment!

8. Towing / transportation / storage

Do not tow a vehicle that has been involved in an accident on its drive axles.
Deactivate the high-voltage system (see Chapter 3).
Park the vehicle at a safe distance, at least 5 m, from buildings and other vehicles (quarantine area).

Lithium-ion batteries can self-ignite, and or re-ignite after a fire has been extinguished.

9. Important additional information

10. Explanation of pictograms used

	LI ION						

Additional information: High-voltage disconnection point option 3 changed

Document number: rds_vvw_316_001_en

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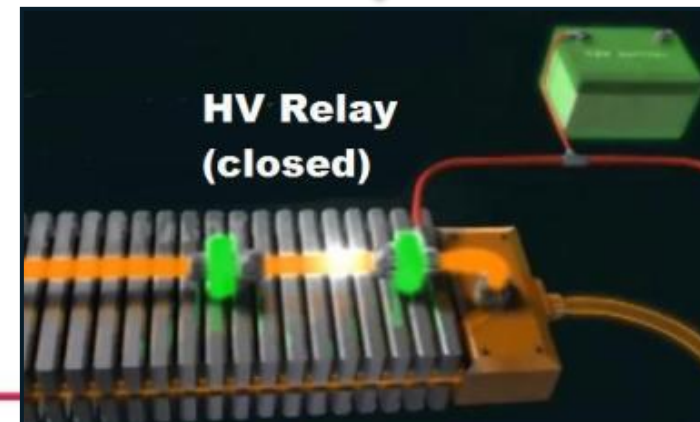


High Voltage System Operation

P/HEV and EV Systems & Safety Features: *Vehicle Operation*

High Voltage Battery Relay

- Located in HV battery
- Functions like a switch
- Activated by 12V/24V power from the low voltage system
- Removal of all 12V/24V current to relay causes it to open, stopping the flow of HV current



Shutdown Methods – Typical Earlier Models

Initial Response: Disable

Primary

Step 1

Turn Vehicle Off



Step 2

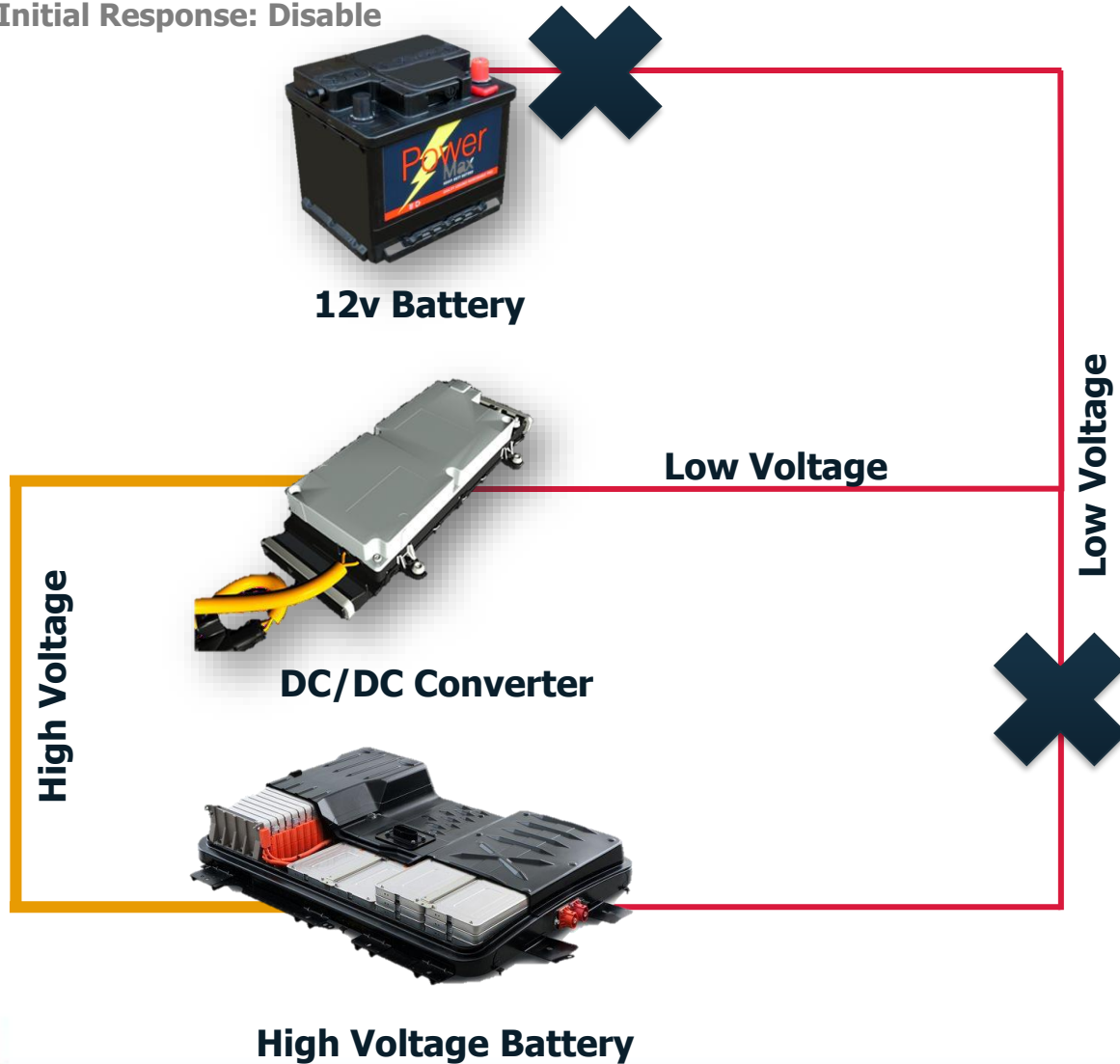
Disconnect 12V Battery



These steps are going to be vehicle dependent, consult vehicle specific ERG for disabling instructions

Vehicle Disabling – HV System

Initial Response: Disable



1. **Shut car off/12v Battery disconnect**
2. **12v Battery disconnect/Pull HV fuse or relay**
3. **1st Responder cut point/12v Battery disconnect**

Consult Vehicle Specific ERG for Shutdown Instructions

Shutdown Methods – Typical Earlier Models

Initial Response: Disable

Secondary

Step 1

Disconnect 12V Battery



Step 2

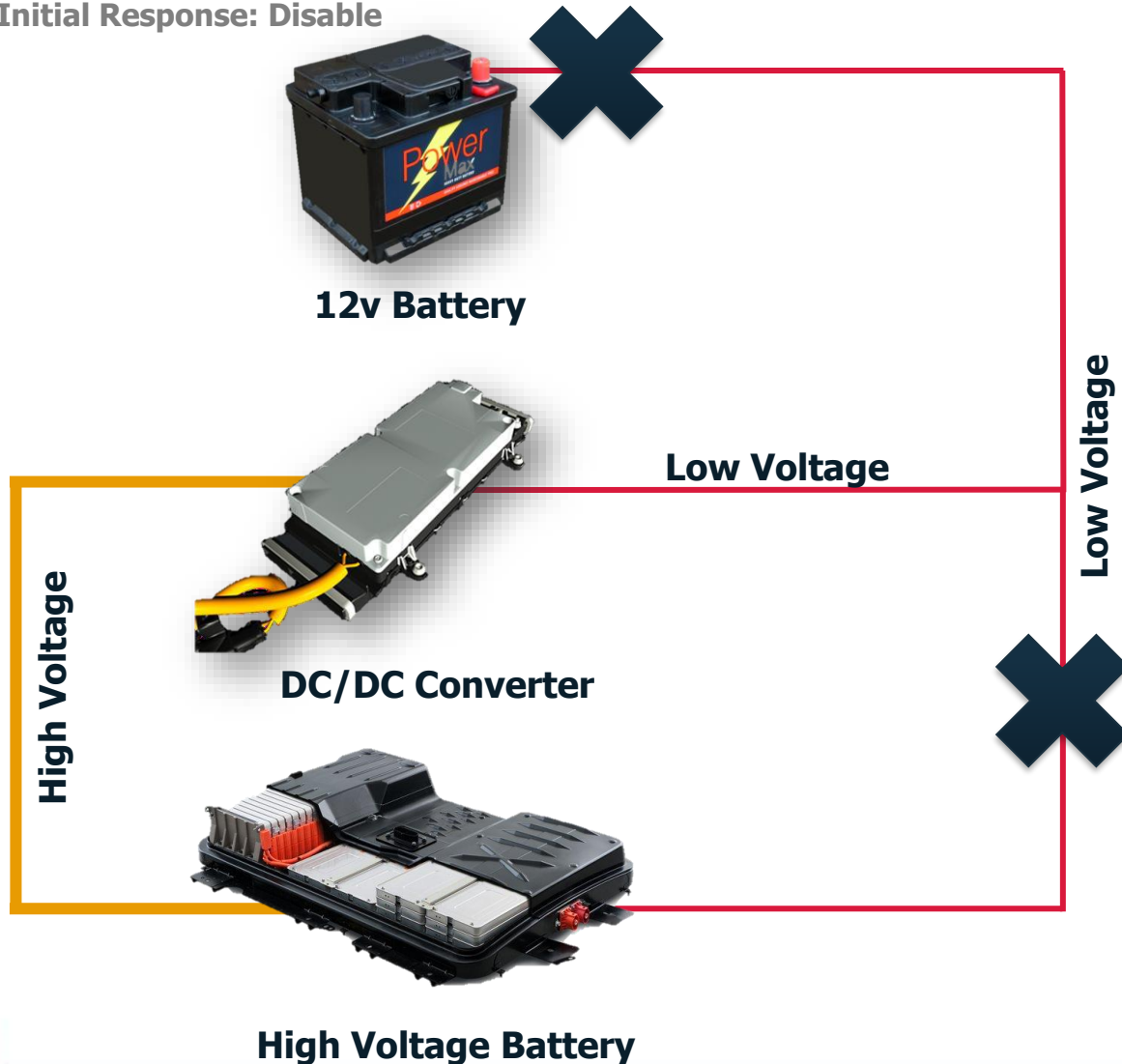
Pull HV Control Fuse/Relay



These steps are going to be vehicle dependent, consult vehicle specific ERG for disabling instructions

Vehicle Disabling – HV System

Initial Response: Disable



1. **Shut car off/12v Battery disconnect**
2. **12v Battery disconnect/Pull HV fuse or relay**
3. **1st Responder cut point/12v Battery disconnect**

Consult Vehicle Specific ERG for Shutdown Instructions

Shutdown Methods – Newer Models

Initial Response: Disable

1st Responder

cut locations and other options more common



These steps are going to be vehicle dependent, consult vehicle specific ERG for disabling instructions

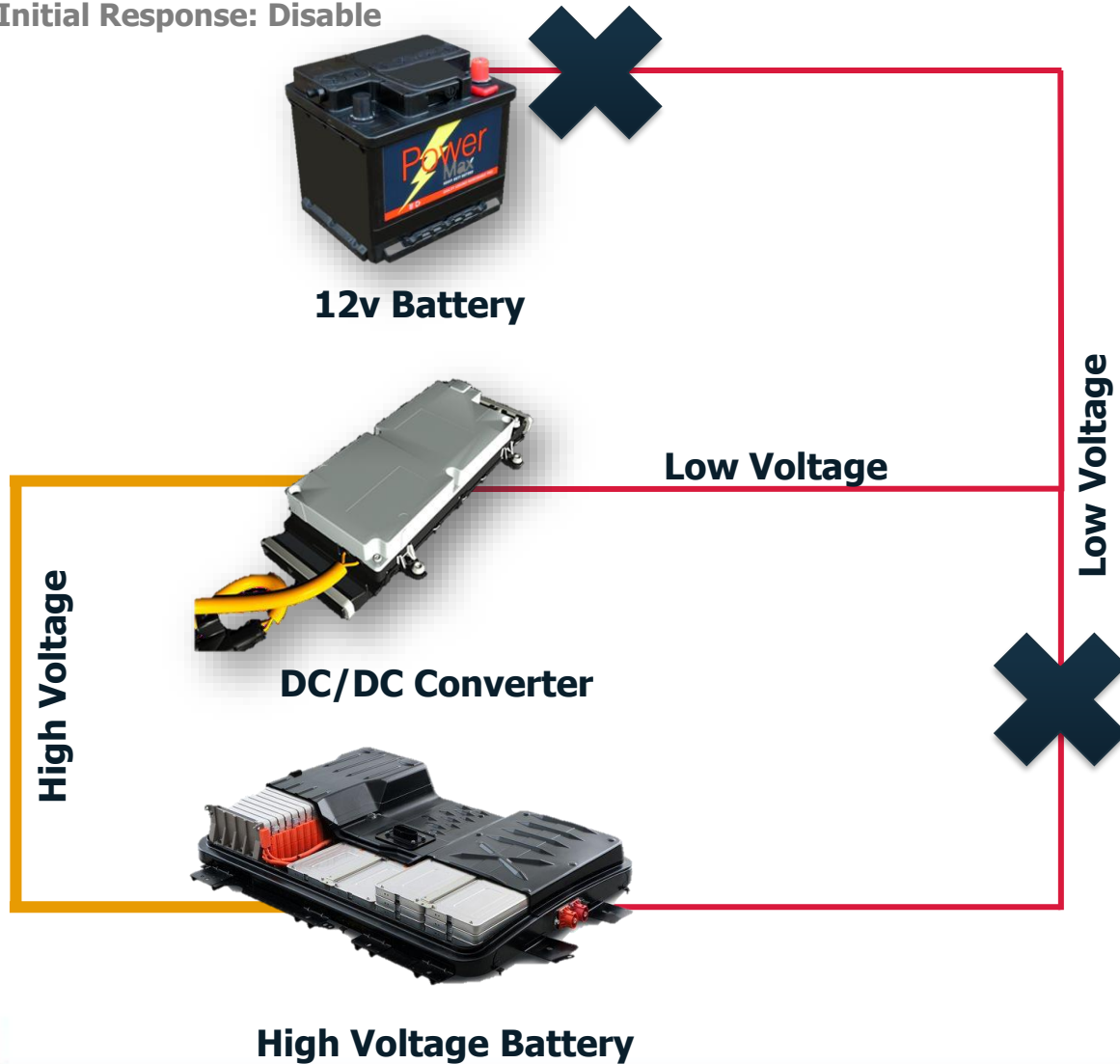


Consider

- Vehicle 12v systems stay active until 12v battery disconnected
- 12V positive – do not ground out when cutting

Vehicle Disabling – HV System

Initial Response: Disable



1. Shut car off/12v Battery disconnect
2. 12v Battery disconnect/Pull HV fuse or relay
3. **1st Responder cut point/12v Battery disconnect**

Consult Vehicle Specific ERG for Shutdown Instructions

Proximity Keys

Initial Response: *Disable*

Keys may not be easily located

If found, move keys to at least 16' from vehicle

Turn power button off and disconnect low voltage battery – Key will no longer function

Once 12V power is disconnected, key is disabled



Shutdown Method – Trucks/Buses

Initial Response: *Disable*

Step 1 Turn Vehicle Off



Step 2 Disconnect 12V/24V Battery



Truck/Bus Considerations

Initial Response: *Disable*



Low Voltage

disconnects may be located in or near battery compartment

Truck/Bus Considerations

Initial Response: *Disable*

Disabling the 24V System

Markings

on each battery may not directly indicate ground to chassis



Cut

the black cable attached to the chassis ground if no disconnect

Shutdown Method – Trucks/Buses

Initial Response: *Disable*

Additional

step may be necessary in some models to fully disable HV system

Emergency

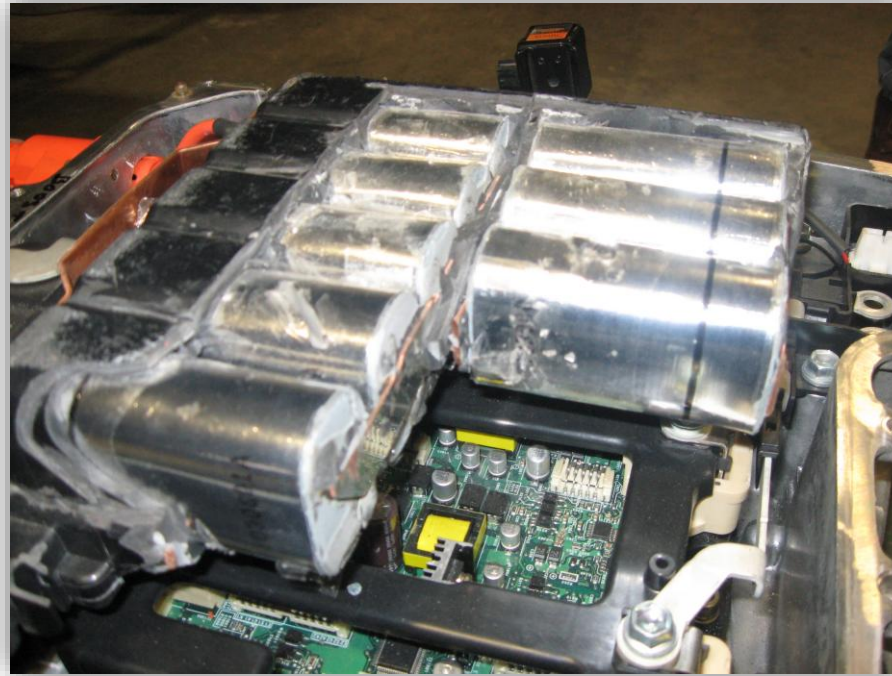
switch opens relay in HV system



HV System Drain-Down

Initial Response: *Disable*

HV capacitors can remain energized up to 10 minutes after vehicle shutdown (model dependent)



**Inverter/Converter HV
Capacitors**

Do not confuse with SRS capacitors

Manufacturer guides
or NFPA EFG list
specific drain down
times

HV Battery – Manual Service Disconnects

Initial Response: *Disable*



- Found on HV battery
- Removal prevents HV current from leaving the battery
- Usage recommendations vary by manufacturer, consult ERG's before removal

Truck & Bus Manual Service Disconnects

Initial Response: *Disable*



Similar

concept to those found
on passenger cars



Disabling Cautions - HV Battery

Initial Response: *Disable*



Stranded Energy

- HV battery always remains energized after disabling HV system
- Always assume HV system components are energized, treat with caution

Photos courtesy of Nissan

Module Review

Initial Response

- Scene Size-up
 - Hazards
 - Types of Vehicles
 - Course of Action
- Use proper PPE and Safety Equipment

Scene Safety



Don't become so fixated on the EV that you forget basic scene safety!

Module Review

Initial Response

Identify



- Badging/Labeling
- Telematics
- Design Features

Immobilize



- Chock Wheels
- Engage Parking or Emergency Brake
- Place Vehicle into Park

Disable



- Utilize methods outline in the vehicle's ERG