NEVADA COUNTY CONSOLIDATED FIRE DISTRICT

Jason Davison
Battalion Chief

PROTECTION/RISK MANAGEMENT

E-BUSES

Fires

Rescues

Exposures

Extinguishing (Water vs Dry Chem Extinguisher)

Fires occur on all vehicles regardless of EV

Electric buses are rightly gaining popularity on our city streets, supporting better air quality in the places our children live, work & play. Like all vehicle fuel types, they do catch fire; research has found at least 18 verifiable e-bus high voltage battery fires globally since 2010, in a stock of over 110,000 vehicles. This incident data may provide some insight into how we can reduce fire risk in depots & at charging hubs.

As with passenger EVs, electric buses have experienced a number of fire events, some of them catastrophic enough to destroy multiple vehicles. –

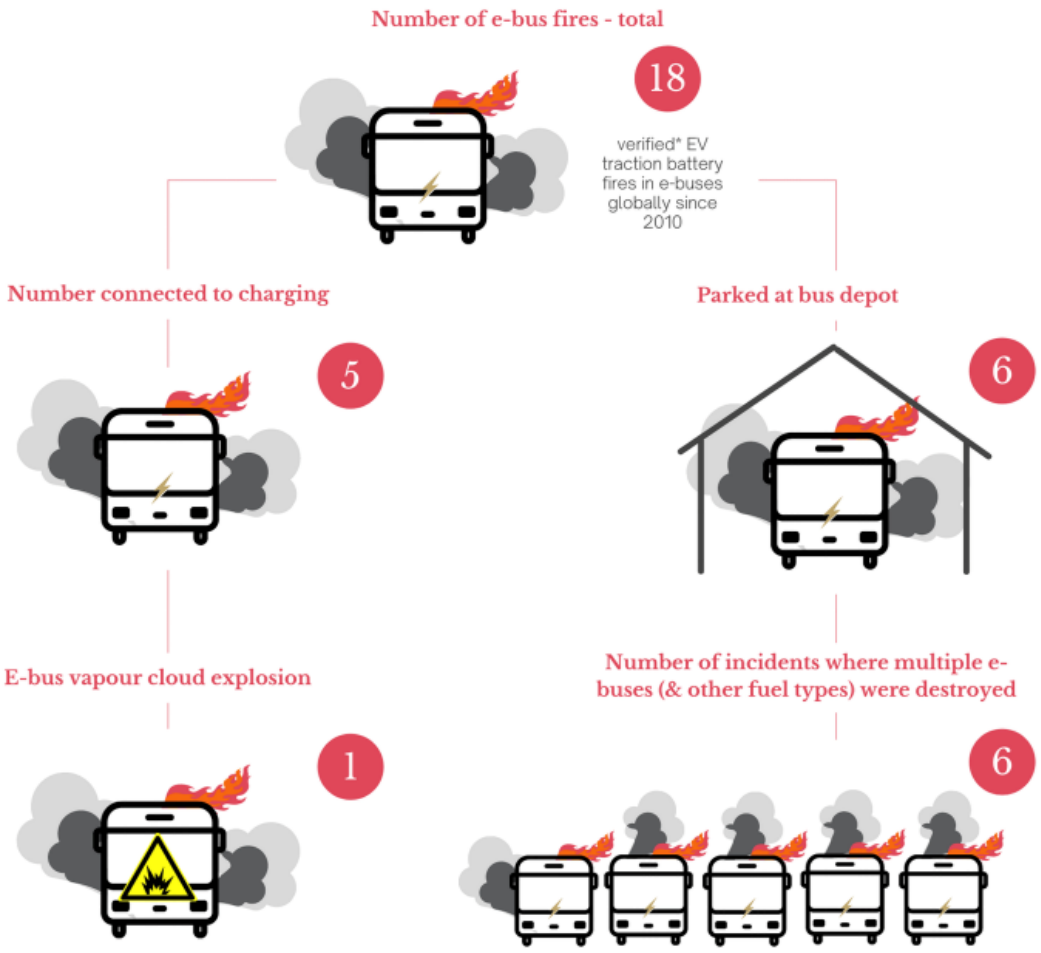
One of the early observations of these incidents is the rate of fire spread when thermal runaway occurs at depot charging hubs, potentially due to the fact that electric bus batteries are typically roof-mounted…

Thankfully, at the time of writing, only minor injuries & no fatalities have been recorded.


FULLY ELECTRIC
781
TRANSIT
TRANSIT

ELECTRIC BUS FIRES

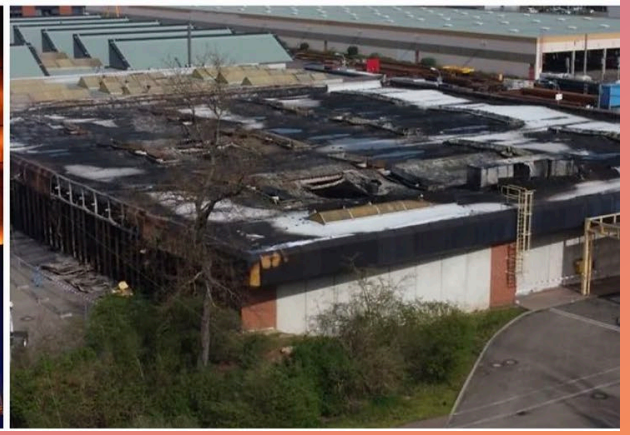
A brief look at electric bus battery fires from EV FireSafe's database of global EV lithium ion battery fires since 2010 (as at April 2022)



FIRE SPREAD

2015, Shenzhen, China - E-bus went into thermal runaway while at a charging hub, but was reportedly not charging at the time. Incident occurred inside an enclosed depot parking area (closed on three sides). Images: D1EV.com

2021, Dusseldorf, Germany - 40 buses - both electric & ICE - were destroyed in depot; e-buses were connected to charging, which cut off as fire overheated the units. Point of origin still unknown, however believed to have started in diesel bus carpark.



39 + Different Manufactures

AC or DC Charging

ISO 17840: First Worldwide Firefighters' Standard

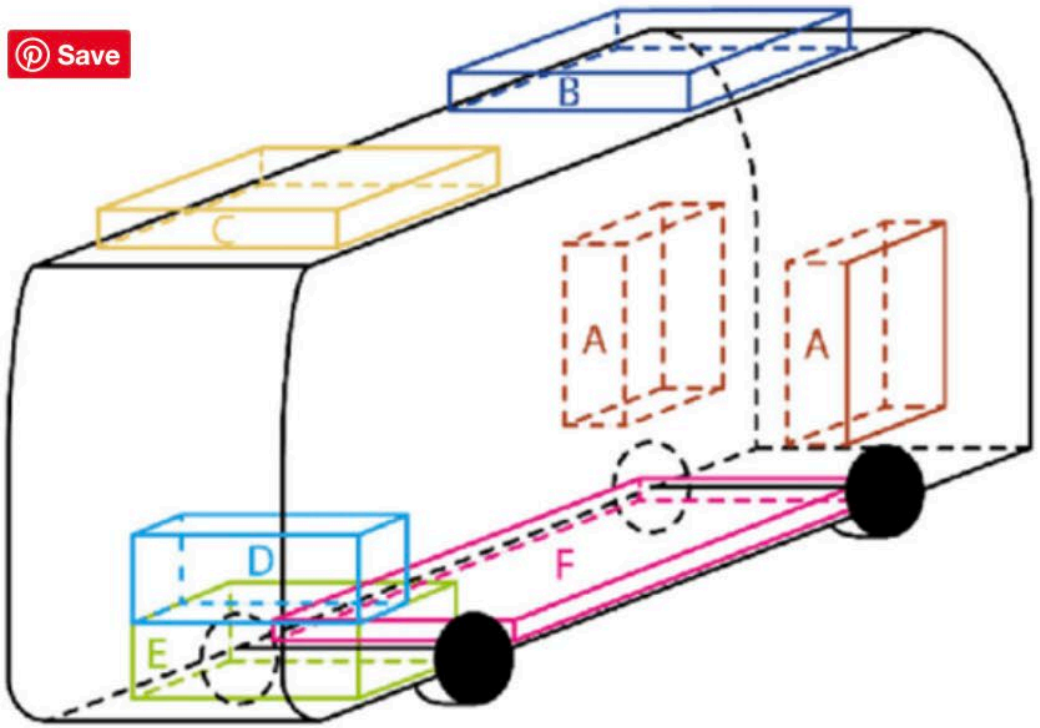
WHAT ARE THE CHALLENGES TO EMERGENCY RESPONDERS WITH E-BUSES?

THE MAIN CHALLENGE FROM AN EMERGENCY RESPONSE PERSPECTIVE IS THE LOCATION OF BATTERIES ON AN ELECTRIC BUS.

LOW FLOOR REQUIREMENTS TO ENABLE EASY ACCESS FOR PASSENGERS, PARTICULARLY THOSE LIVING WITH DISABILITY, MEANS E-BUS BATTERIES ARE TYPICALLY ROOF-MOUNTED, NOT WITHIN THE CHASSIS LIKE PASSENGER EVS. ADDITIONALLY, ROOF-MOUNTED BATTERIES ARE EASIER TO RETROFIT TO EXISTING DIESEL BUSES & MAY REQUIRE LESS COOLING DUE TO AIRFLOW DURING TRAVEL.

WHILE DIRECTING WATER UNDERNEATH A PASSENGER EV IN THERMAL RUNAWAY CAN BE DIFFICULT, GETTING ENOUGH WATER ONTO A ROOF MOUNTED E-BUS HV BATTERY TO COOL IT EFFECTIVELY CAN BE SIMILARLY TRICKY.

LARGE AMOUNTS OF WATER



BYD K9	A+C+E [14]
Volvo 7900	C[15]
VDL Citea	B [16]
Solaris Urbino	B [17]
Optare Versa	D+E [18]
Proterra Catalyst	F [19, 20]

Electric bus HV battery locations from the Handling Lithium-Ion Batteries in Electric Vehicles: Preventing and Recovering from Hazardous Events report*

Charging Station

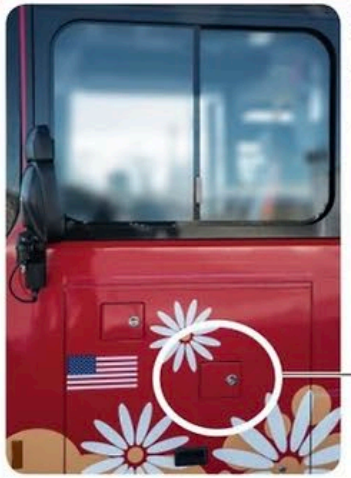
ower Down

2

The BYD K Series Electric Bus is also equipped with an emergency spring brake release. This green knob is used in the event that the primary and secondary air is depleted. This valve is held down to release the spring brake to allow the bus to roll for short distances.

After the parking brake is set, **press and hold down the power button** for more than 3 seconds. This will shutdown all low voltage, open all the high voltage contactors and isolate all the high voltage battery packs.

Battery Disconnect



The battery disconnect switch is located outside and **below the drivers side window** (street side).

The battery disconnect switch controls both high and low voltage. When the battery disconnect is turned to the OFF position, High Voltage is isolated to each battery pack.

To disconnect the battery, turn the battery disconnect switch **counterclockwise**.

High Voltage Battery Disconnect

4

Removing the high voltage maintenance plug disrupts current flow.

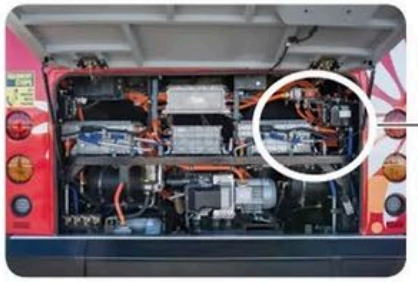
De-energize and isolate the high voltage system anytime the high voltage batteries or orange cabling are suspected of damage.

To disconnect the high voltage battery, first pull out the high voltage maintenance plug handle. Then, after waiting 5 seconds, remove the high voltage maintenance plug.

⚠ WARNING

EXCEPT for EMERGENCIES

Never disconnect the high voltage maintenance plug without first disabling low voltage.



Fire Suppression

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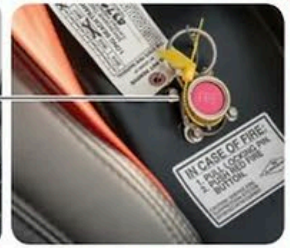
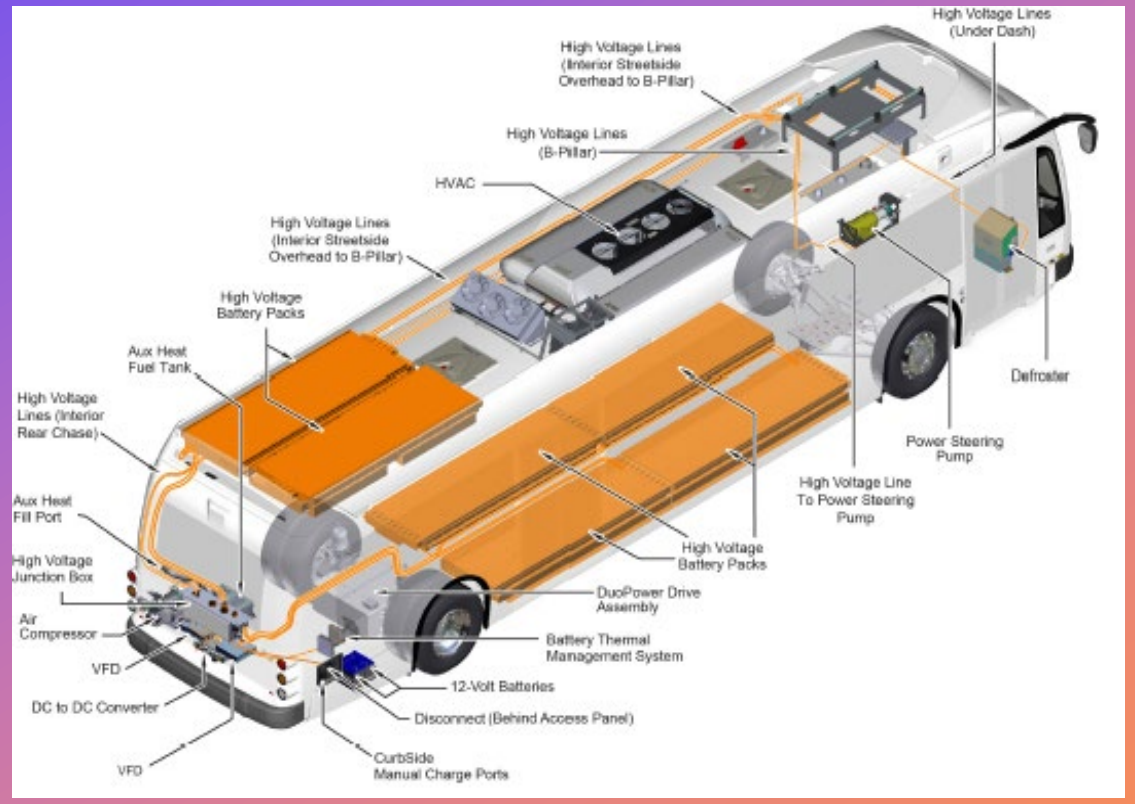
In the unlikely scenario of a thermal event, the fire suppression system is automatically triggered from thermal sensors mounted in the battery areas. The nozzles will spray fire repelling agent only on or in the battery pack areas. The fire suppression system can also be manually discharged from the driver's area by pulling the fire suppression locking pin and pressing down on the **red FIRE button**.



PROTERRA E-BUS

- ProDrive Area:
  - Air Compressor
  - DuoPower e-Axle
  - High-Voltage Junction Box
  - DC-to-DC Converter
  - Variable Frequency Drive Inverters
  - Manual Charge Port(s)
  - Battery Thermal Management
- Rooftop:
  - HVAC System
  - Rooftop Charge Rails (if applicable)



Undercarriage:

Power Steering

High-Voltage Batteries

Interior:

High-Voltage wiring (shown in Orange)

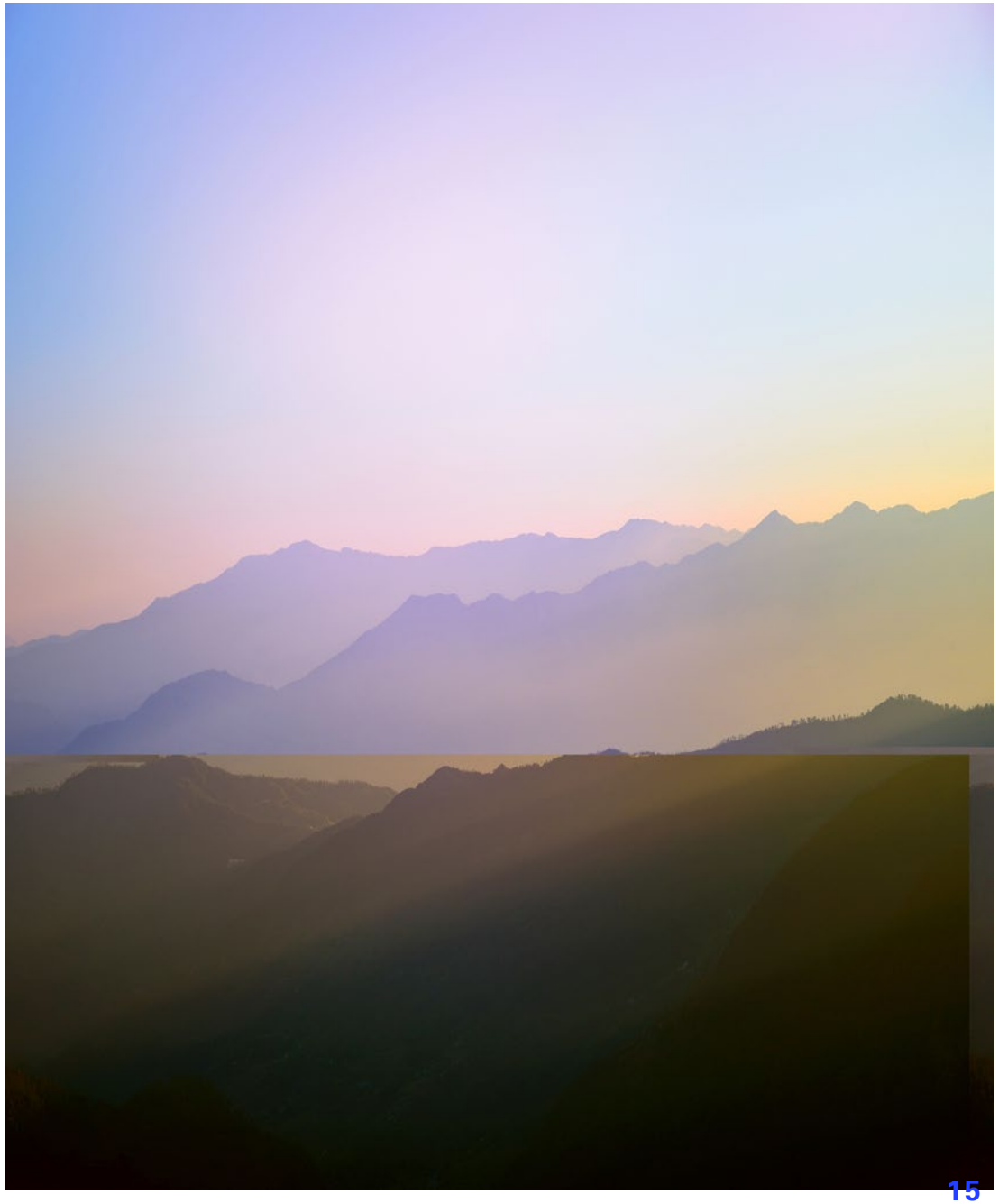
Defroster

By the Numbers:

	Fires during charging	Fires under transit	Parked at Bus Depot	Vapor Cloud Explosion
Percentages	27%	41%	20%	12%

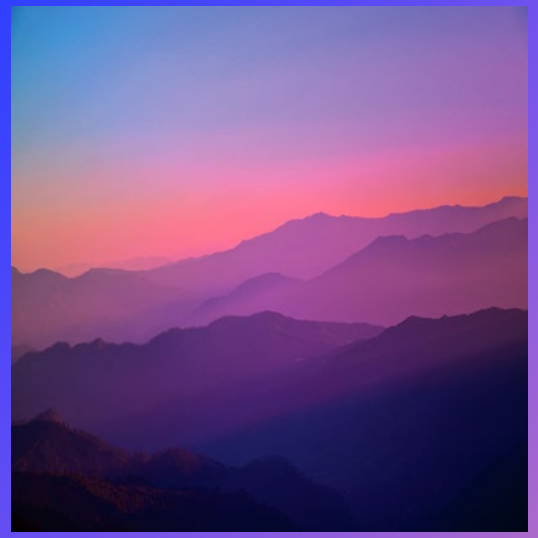
Can e-Buses explode

Vapor Cloud Explosion



Timeline/ sequence of events

Fire/Smoke	Park	Evacuate	911: Fire/EMS	Safe refuge
Driver smells burning	Safely pull over, set park brake	Calmly evacuate the bus	Call 911, provide location and information about bus (e-bus) advise bus has been evacuated	Safely, evacuate surrounding area and await the fire department

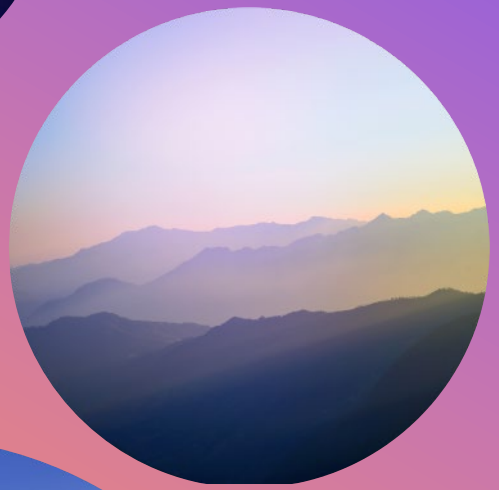


Safety First

Evacuating the bus: Passengers (Adults, Children, and people with disabilities – “wheelchair”.

Evacuate the surrounding area

Exposures



THANK YOU

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