



LITHIUM-ION BATTERY EMERGENCIES:

PROs and CONs

MARKETED EQUIPMENT FOR MITIGATION

FIRE BLANKETS



FIRE BLANKETS



FIRE BLANKETS

PRO

- Protect from some heat transfer
 - Vehicle of origin
 - Neighboring vehicles
 - Structures
- Possible smothering/reduction of non-battery fires
 - Plastics, fabrics, tires, etc.

CON

- Battery fires cannot be smothered
- Close engagement/proximity of fire personnel
- Reduction in cooling capability
- Am I capturing flammable/explosive gases?
- Can I see and measure if the incident is stabilized?
- Limited to size of vehicle it will cover
- It cannot be decontaminated
- Could cause a false sense of security
 - “We put a blanket on it, so we’re good”

ENCAPSULATING AGENT



- Forms “chemical cocoons” that encapsulates fuels, rendering them non-flammable and non-ignitable. Additionally, it interrupts the free radical chain reaction of the fire tetrahedron



- E-FireX uses an advanced encapsulator agent technology that quickly suppresses fires by extinguishing high-heat flames, encapsulating the fuel, and eliminating toxic vapors

ENCAPSULATING AGENT

PRO

- Can work on traditional fuels
- Could coat an exposed area and reduce radiant heat exposure
- Could assist with smothering a fire beyond water capability

CON

- Battery fires cannot be smothered
- Requires access to the battery cells
- May reduce access of water to tight spaces by increasing surface area/volume of material being applied
- Some early research indicates it may not be better than water
 - Fire department has practically endless access to water
- Could cause a false sense of security
 - "We foamed it, so we're good"

BATTERY ELECTRIC VEHICLE (BEV) TOOLS



EMERGENCY PLUG

- The Emergency Plug[®] (Plug) has been developed to prevent unpredictable vehicle movement by any Full or Hybrid Electric Vehicles (EVs) in an emergency situation as well as during regular maintenance.
- As of February 16th, 2024, it has come to our attention that the Emergency Plug[®] doesn't disable two specific US car models, the Hummer EV SUV and the Chevrolet Blazer EV. This likely due to a different interpretation of the regulations.

SUBMERSION

GARRISON FLOOD CONTROL



PRO

- Contains runoff... mostly
- Cools battery pack and reduce radiant heat threat
- Buy time for removal plan
- Relatively quick to deploy anywhere

CON

- Water needs to be managed
- Vehicle will likely reignite at a later time
- Water exposure to batteries may cause further battery damage to uninvolved batteries
- Does not remove vehicle from area

SUBMERSION + CONTAINERS



SUBMERSION + CONTAINERS

PRO

- Remove vehicle on fire from unwanted location
- Cool battery pack and reduce risk of battery projectiles
- Provide a storage tool for tow yards to reduce required footprint for storage/staging
- Some are high tech with monitors, sensors, sprinklers, etc.

CON

- Water needs to be managed
- Vehicle will likely reignite at a later time
- Water exposure to batteries may cause further battery damage to uninvolved batteries
- Requires tow company to transport a container with DDR batteries under water
 - Is there a permitting or hazmat waiver required? Is there going to be?

VEHICLE MOVING



PRO

- Moves vehicle without spinning wheels
- Can help move vehicles out of tight spaces
- Can help move vehicles away from exposures

CON

- Not rated for all EV weights
- Turns vehicle into a very heavy free moving object
- Dolly wheel operation may be impacted by rolling surface characteristics

VEHICLE MOVING



PIERCING NOZZLES



COLD CUT COBRA

- The Cobra Method, including cooling fire gases from a safer place outside the fire compartment, is one of the safest and most efficient firefighting options available to Fire & Rescue Services.
- High pressure mist has been shown to more quickly reduce the temperature of an interior space when compared to standard water application.

PIERCING NOZZLES: COLD CUT COBRA

PRO

- Provides access to battery cells from any angle (above, side, or below)
- Provides cooling to neighboring cells and could prevent propagation
- Uses minimum amount of water
- Mobile, can be placed on multiple platforms for access to a variety of locations
- Has been utilized by European fire services for over 20 years.
- Certified for high voltage battery use
- Can be used for many different applications. Not just batteries.

CON

- Expensive
- Places firefighters close to vehicle
- Can cause thermal runaway upon intrusion
- Vehicles will likely reignite at a later time
 - Towing considerations required
- Requires training and maintenance



PIERCING NOZZLES - BEST



ROSENBAUER BATTERY EXTINGUISHING SYSTEM TECHNOLOGY (BEST)

- The Rosenbauer BEST is an extinguishing system for high-voltage lithium-ion batteries in electric vehicles.

PRO

- Provides access to the battery cells, typically from underneath vehicle
- Could prevent propagation
- Less time near vehicle and greater distance during application than other units
- In use since 2018 in Europe

CON

- Expensive
- Requires precise placement under battery
- Difficult to apply when vehicle is on its belly and when vehicle is not upright (may require lifting vehicle)
- Vehicles will likely reignite at a later time
- Complicated application with multiple moving parts and procedures. Requires training.

PIERCING NOZZLES - HydroPen



HydroPen

- The HydroPen system uses water pressure from the fire main to drill through a standard steel container door, then automatically changes mode to water application of approximately 100 GPM into the container.

PRO

- Provides access/application of a fire stream into a container to container; aloft up to 4 stacks high.
- Could assist with fire/heat control within a container during a fire or thermal event.
- FFs can operate remotely without being directly in front of container or physically opening container.
- Maritime and shoreside use applications.

CON

- Expensive.
- Does not exhaust gases.
- Requires precise placement on the container
- Only mounts to door locking bars of container rear.
- Hose kinking due to appliance design.
- Water weight container stability concerns without adequate drainage.



HydroPen



WETTING NOZZLES



SUDZ-IT

PRO

- Applies water to the battery compartment
- Minimizes exposures to firefighters
- Relatively easy to use



TURTLE FIRE SYSTEMS

CON

- Expensive
- Does not access battery cells
- Uses a significant amount of water
- Requires vehicle to be elevated off the ground

PACKAGING OPTIONS

CELLBLOCK EX



PRO

- DOT Special Permit
 - Packaging of multiple cells up to a standard gross weight
 - All labels provided
- Readily available and widely used in USA
- Easy packing instructions
- Overpressure protection drums available

CON

- DOT Special Permit specification may not be achievable
- Expensive
- First-hand experience of drum over pressurization and/or failure to contain fire
- Overpressure protection drum was required to be made available
 - Allows for off-gassing

PACKAGING OPTIONS



CellBlock Cell Safe



CellBlock Cell Safe



Small DDR Li-Ion Kit



Call2Recycle Large



Ameripak Crates Large

PRO

- 49 CFR 173.185 (f) compliant without DOT-SP
- Readily available
- Easy to use
 - All labels provided

CON

- No vent for off-gassing
 - Deflagration possible
- First-hand experience of fire occurring in container/packaging

PACKAGING OPTIONS

KULR SAFEX

PRO

- DOT Special Permit
 - Packaging of multiple cells up to 2.6 kWh
- Affordable
- Portable
- Available in USA
- Passes propagation testing standards



A Sample KULR-Tech Safe Case

CON

- DOT Special Permit specification may not be achievable
- Allows off-gassing
- Fire could be seen during heavy testing



PACKAGING OPTIONS

DOLAV AKKUGRAIN “OBEXION AG”



PRO

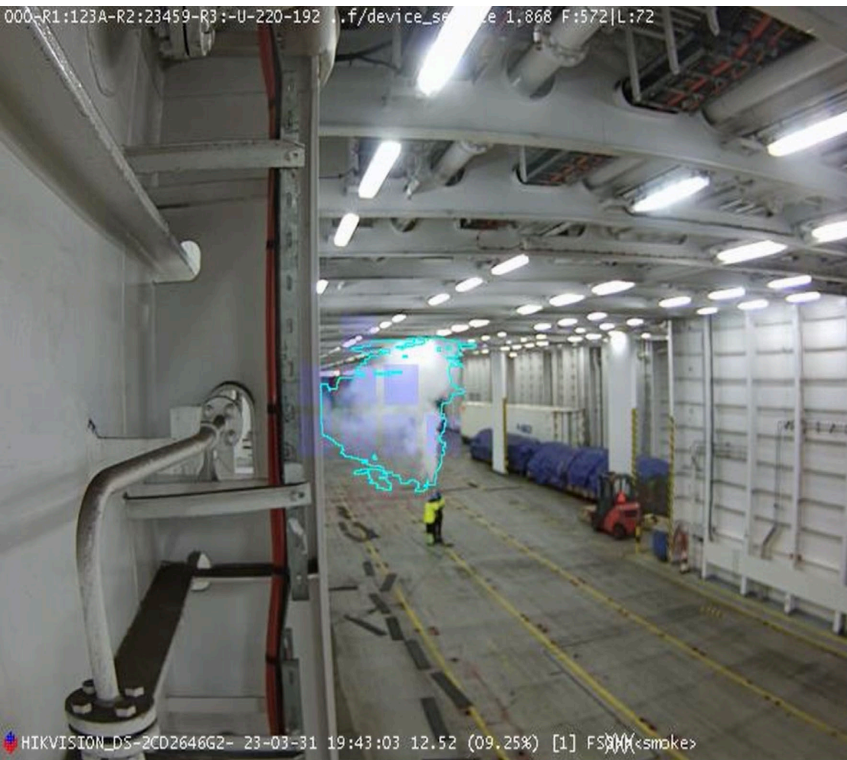
- DOT Special Permit
 - Packaging of multiple cells up to 11 kWh
- Withstood rigorous testing with no radiant heat, no fire outside unit, and no acid gases present
- Available in USA
- Easy packing instructions
- Easy to load and unload

CON

- DOT Special Permit specification may not be achievable
- Expensive
- Allows off gassing of flammable gases (H₂, CO, etc.) and products of combustion (HCN, smoke, etc.)

EARLY DETECTION EARLY DECISION

FIKE VIDEO ANALYTICS



PRO

- Earliest detection for smoke and by-products of visible Li-ion battery off-gassing.
- Vetted through LASH FIRE international research project to reduce fire risk on ro-ro ships.
- Used widely in shoreside and maritime applications.
- Widely used for engine room atmospheric oil mist detection, recommended by DNVGL.
- Simple operation using closed-circuit cameras.
- Integrated into fire alarm panel system.
- When armed, replaces human factor as sentinel.

CON

- Restricted to interior installation applications only.
- Ambient exterior light conditions must be controlled.
- Relatively new technology, reliability will need to be proven over time.

EARLY DETECTION EARLY DECISION

FLAME DETECTORS



IR3-HD TRIPLE IR FLAME
DETECTOR



PRO

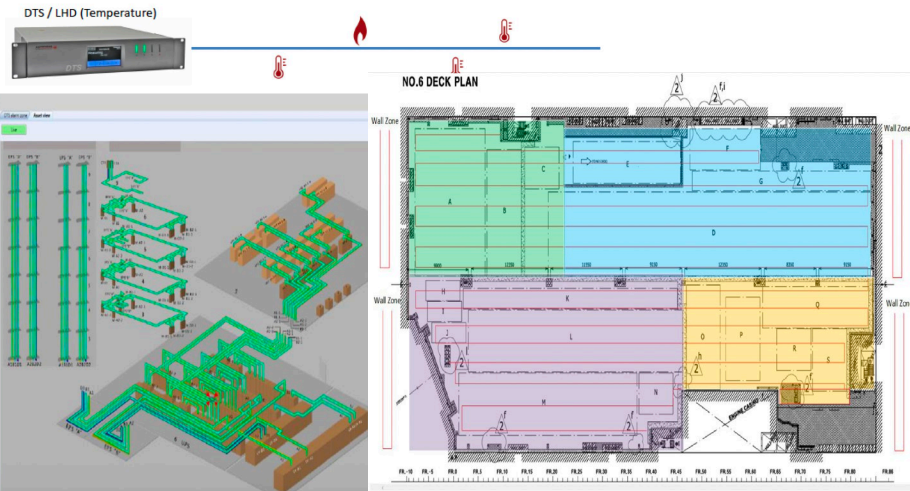
- Fast reliable detection of flame from reading hot CO₂ gas signature.
- Effective for slow and fast developing fires.
- Operates in all weather and light conditions.
- Low false alarms.
- Detects explosions/fire ball in 40 milliseconds, standard fire from 50' in 1.2 seconds and 230' in 4.1 seconds.
- Can be integrated in combination with video analytics.
- Can be integrated into fire alarm panel system.
- When armed, replaces human factor as sentinel.

CON

- An open flame is required for detection
- Coverage of space requires enough detectors.
- Hidden or deep-seated flames not in view will not activate the detector.

EARLY DETECTION EARLY DECISION

LINEAR HEAT DETECTION



PRO

- Reliable ongoing temp monitoring of event, mitigation, and temp deltas.
- Read temp rate of rise in up to 256 zones and changes/movement of temperature across or down zones.
- Unique alarm set points.
- Identify “Go” and “No Go” conditions for safety, size-up, evaluation and throughout event.
- When armed, replaces human factor as sentinel.

CON

- If not looped to server downrange zones readings will be cut-off from fire damage to cable.
- Not as fast acting as other systems