

RESPONSE TO BATTERY FIRES A Proactive Approach



Battery Electric Vehicles and power sources are becoming more commonplace in the undergound workplace...







Mine Rescue Procedures and Operations

- 1. Briefing Information Gathering after initial Report of Fire
- 2. Consult SDS and Emergency vehicle information
- 3. Hazard Risk analysis RISK vs REWARD
- 4. Maps and Ventilation
- 5. Equipment needed
- 6. Scene Size up (Hazard Identification)
- 7. Heat Energy, Gasses and Toxicity monitoring
- 8. Agent Application (if required)
- 9. Post incident operations



New Technology requires a new approach!







New Technology requires a new approach...







Emergency Response Cards



New Technology requires a new approach!







Incident Review #1 Handheld Tool Battery







#2 Used Storage Battery Fire





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#3 Thermal Runaway Lead Acid Battery Incident





Incident #3 Thermal Runaway Lead Acid Battery Incident





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Thermal Runaway Lead Acid Battery Incident







Causes of Battery Fires...

- External damage, misuse or inadequate maintenance
- Over-discharging, overcharging or charging cycles outside of OEM's recommendations
- Defects or internal short circuit leading to thermal runaway and potential exothermic reaction from inside the battery
- External heating from vehicle, fire and other heat sources
- Malfunctioning charging systems, smart cards, ground fault redundancies or cooling systems
- Environmental, Humidity or possible water ingress



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Causes of Battery Fires

WHAT IS THERMAL RUNAWAY?

Thermal runaway is a phenomenon in which a lithium-ion cell enters a state of uncontrollable self-heating.

If Thermal Runaway is left uncontrolled...

An undergound fire emergency...

Reactive Response Tactics...

- Initiation of Mine Rescue Response and Emergency procedures on the mine site
- Mine Rescue teams briefed enter the mine to assess and mitigate the fire emergency
- Assessment of Fire to determine Offensive or Defensive suppression tactics
- This may include letting the fire burn itself out or sealing off the area
- Teams retreating to surface for Decontamination of personnel and equipment
- Ongoing Remediation of fire scene and exhaust routes to eliminate toxic contaminants from the workplace

HAZARDS to Mine Rescue Teams

- Stranded Energy Electrical hazards from battery modules, high voltage output and live charging circuits
- Attempted cooling efforts can expose teams to high voltage (water is a primary conductor)
- In some instances, water and/or foam will increase intensity of fire with possible explosive hazards
- Contact with hazardous combustible electrolyte
- Mine Rescue teams are not equipped with full structural PPE (Bunker Gear) and may be exposed to intense heat and projectiles

HAZARDS to Mine Rescue Teams

- Ventilation limitations within the confined underground environment heat, smoke and hazardous gasses present in the downstream flows or trapped in poorly vented levels and drifts.
- Battery in close proximity to other BEV's, conveyors, mining equipment, electrical and other mine Infrastructure or combustible material
- BEV's located in remote or expansive mining locations increasing response times.
- Other respiratory and contact (skin) hazards. (hydrogen flouride, sodium chloride, other airborne metallics, oxides of carbon, nickel, lithium, copper and cobalt, battery steam, sulphuric acid, etc . . .)
- Vehicle Battery locations and "bomb proof" encasement which could be difficult to access with suppression agents
- Damaged cooling systems can leak, burn or hinder access to cool, monitor or extinguish battery

We are still learning...

- Surprise, Arizona incident
 - April 19th 2019 Resulting in critical injuries of Four Fire Fighters from the Surprise Arizona Fire Dept
 - Explosion due to the build up of Flammable Gasses in a **confined area**
 - Early detection protocols and controls showed a decreased risk prior to entry into the area
 - Investigation showed traditional practices such as temp monitoring, smoke alarms, automatic suppression and space containment (fire doors) contributed to the elevated levels of flammable gasses.

Four Firefighters Injured In Lithium-Ion Battery Energy Storage System Explosion - Arizona

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"...Due to the few incidents that have occurred as of now, practical experience in handling BEV fires in underground infrastructures has not yet had the chance to broadly mature" ...

Risk Minimization of electric vehicle fires in underground traffic structures, DETEC Research Project, Tunnel Research Working Group, August 2020.

Risk minimisation of electric

vehicle fires in underground traffic infrastructures

Being proactive in the workplace...

- Recognize the signs of Thermal Runaway
- Due diligence on reporting maintenance issues
- Avoid infrastructure design that would enable increased exposures to other batteries, fuel loads or blockage of evacuation routes to safe areas. <u>Risk</u> <u>Assessment</u>
- Sharing "Near Misses" can save lives!
- Timely removal of damaged and decommissioned batteries to designated safe areas on surface. <u>Risk Assessment</u>

Thank You!