

SAFETY BULLETIN

SEPTEMBER 2021

Fire risk of battery units for underground battery electric vehicles

This safety bulletin provides safety advice for the NSW mining industry.

Issue

The use of electricity as an energy source for mains-powered mobile machinery in underground mines is common for equipment associated with mining activities. Support equipment, such as personnel transports and loaders, have been dependent on the use of diesel engines to ensure the vehicles can cover the necessary distances and work in remote locations. Lead acid batteries have been used as an alternative energy source, but the size and weight, along with charge and discharge cycle times, have limited the operational capabilities of these machines.

The development of new types of batteries, using alternative chemistries, has enabled significant increases in the energy that can be stored in a battery. These new types of batteries are smaller in size and lighter in weight. New electronic controls incorporated into the battery management systems have enabled significant improvements in the charging times and discharge/operational times.

Vehicles fitted with these new batteries are now being introduced at mine sites as replacements for diesel powered vehicles.

While battery electric vehicles manage risks to workers from exposure to hazards such as diesel particulates, noise and vibration, they introduce other risks that must be managed.

Areas of concern

One such introduced risk area pertains to fire in the electric vehicle battery itself. Due to the chemicals involved in the construction of some batteries and the enclosures that house the cells, special measures may be required to fight a fire associated with the battery. This is more prevalent with some battery types where the chemistry of the cell may be susceptible to thermal runaway.

Questions that should be asked when determining the level of risk posed by the use of electric vehicle batteries at a mine include:

- Is the battery susceptible to fire? If so, what factors may lead to a battery fire? Factors may include events such as an internal cell fault, overheating during charging or operation, physical damage to cells or to the battery unit, high resistance connections or heat from external sources.
- Have control measures been incorporated into the design of cells that will minimise the likelihood of internal faults occurring during normal operation or charging?
- What controls are in place to limit cell temperature and to warn personnel if a cell does exceed its allowable operating temperature?
Note: Cell over-temperature may happen at any time, not just during operation of the vehicle. The battery management system should be functional during periods where the vehicle is unattended and should report back to a central monitoring system, where possible, in addition to initiating local alarms and warnings on the vehicle.
- What maintenance activities have been identified by the battery designer to minimise the likelihood of cell over-temperature events occurring?
- What training and assessment requirements have been identified by the battery designer for personnel performing maintenance activities to ensure that the battery assembly retains all designed safety measures?
- Is the battery unit contained in a special housing to minimise contamination from dust and water, or to provide explosion protection if used in an underground coal mine?
- If a fire does occur, what type of extinguishing agents are required, where are they located, what quantity would be required to extinguish the fire and what training is required for mine workers?
- If a fire occurs, what atmospheric contaminants are generated and how do these contaminants affect firefighting, persons in by and the egress of persons to a place of safety (refuge chamber or surface)?
- Once the fire has been extinguished, are there residual effects from leaked battery or cell chemicals, products of combustion, fumes, odours, firefighting chemicals or contaminated water from firefighting?

Recommendations

- Designers of battery electric vehicles for underground mines should incorporate control measures, in accordance with the hierarchy of control measures, into the design of electric vehicle batteries that will enable the safe operation of battery electric vehicles, without risk of fire caused through normal operation, including charging.
- Designers should provide sufficient information to end users to enable the users to implement appropriate emergency management strategies and responses in the event of a fire occurring involving an electric vehicle battery.
- When deciding whether or not to introduce battery electric vehicles at the mine, mine operators should ensure that a thorough review of hazards and risks posed by the use of electric vehicle batteries in the underground parts of the mine is undertaken, in accordance with their risk management and change management procedures. The assessment should cover all aspects of the battery lifecycle.
- Mine operators should ensure that risks identified during the risk management and change management processes are effectively managed, or can be managed through the implementation of additional control measures, to prevent harm to workers or others at the mine. Refer to clauses 35 and 36 of the Work Health and Safety Regulation 2017.

Additional information

There are many documents published online that may provide additional information regarding risks and control measures relating to batteries for use with battery electric vehicles. Three of these are listed below:

- [A Review of Battery Fires in Electric Vehicles](#), (Article in Fire Technology · January 2020)
- [Safety Report - Safety Risks to Emergency Responders from Lithium-Ion Battery Fires in Electric Vehicles](#), National Transportation Safety Board
- [Recommended Best Practices for Battery Electric Vehicles in Underground Mining](#) – 2nd Edition, Global Mining Guidelines (GMG) Group

NOTE: Please ensure all relevant people in your organisation receive a copy of this safety bulletin and are informed of its content and recommendations. This safety bulletin should be processed in a systematic manner through the mine's information and communication process. It should also be placed on the mine's common area, such as your notice board, where appropriate.

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