Fires in industrial premises have been caused by failures related to the battery charging of vehicles. When this happens, significant property damage and business interruption can occur, particularly in premises where the combustible load and fire challenge is high. This Risktopic presents guidance to avoid fires from battery charging operations. It can apply to a wide variety of mobile equipment such as sweepers, platform hoists, as well as lift trucks. The document focuses on fire and explosion hazards and their controls.

Introduction

Improper charging of batteries in vehicles such as lift trucks can increase the potential for fire or explosion. Improper charging practices include the presence of combustible materials close to battery chargers, poor condition and management of electrical cables, and the location of battery chargers within warehouse storage racking. The resulting fire can be large and challenging, particularly in locations with a high combustible load such as warehouses. Some simple, but effective guidance is available to reduce the risk of fire and explosion. This guidance is presented within this document.

This Risktopic focuses on the general fire and explosion hazards and controls for battery charging. This Risktopic does not cover battery charging in facilities with hazardous atmospheres (flammable vapors or combustible dusts) where more specific guidance is needed. In addition, this Risktopic does not cover health and safety considerations or driver management and training. In all situations, a thorough risk assessment is recommended to methodically recognize risks associated with battery charging operations and identify appropriate control measures for implementation.

Discussion

Fires or explosions involving battery powered trucks and associated charging facilities can occur for a number of reasons such as electrical short circuits, hot resistors, arcing, fused contacts, or lint accumulation.

Charging batteries, including those described as maintenance free, give off hydrogen gas. If this hydrogen gas accumulates and combines with a source of ignition, an explosion can result.
Battery charging can take place across range of industries, exposing buildings, equipment and stock and the business enterprise. Battery charging operations are particularly common in warehouses where the combustible load can be high. The presence of battery charging operations (a potential ignition source) in close proximity to cardboard, plastics and other packaging can result in a rapidly growing fire which can challenge even the best fire brigades. Robust fire prevention is recommended.

**Guidance**

**General**

- The vehicles, associated battery chargers, and equipment should be regularly serviced and maintained in accordance with the manufacturers schedules.

- The use and maintenance of the vehicles, associated battery chargers, and equipment should be restricted to designated personnel trained in their operation.

**Battery Charging Area**

- Locate battery charging operations in one of the following locations (options listed in order of preference):
  - Locate battery charging in a separate building of noncombustible construction dedicated for this purpose.
  - Locate battery charging in a specially designed charging area of fire resisting construction (including openings) of at least 60 minutes fire resistance.
  - Locate battery charging in a designated area of a building kept clear of combustible material. Provide a clearance of at least 2m (6.6 ft) between the charging operation (unit and vehicle) and any adjacent combustible materials including combustible building construction.

- An additional alternative to the above options where the charging operation does not expose highly combustible, highly sensitive, or high-valued goods and the charging operation is limited (e.g. a single charging installation provided serving one or two trucks and the charging is conducted without battery removal) a partition offering at least 30 minutes fire resistance may be used to separate the charging area from the combustible materials.

- Do not locate battery chargers within storage racks.

- Within facilities equipped with automatic sprinklers, provide automatic sprinklers to protect battery charging areas.

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**UK experience with industrial vehicle fire and explosion – April 1997 and March 2001**

Eight incidents involving battery explosions were investigated by regulators:

- Four explosions occurred during battery charging
- Two explosions occurred during vehicle jump starting
- Two fires occurred as vehicles were being driven soon after battery charging
Battery Charging Arrangement

- Battery chargers should be installed on a concrete floor, or securely wall mounted against a noncombustible structure.
- Provide barriers to protect battery chargers from vehicle impact.
- Over current and over charge protection should be provided.
- The battery charger should be provided with a ground fault circuit interrupter.
- All electrical connecting leads should be kept as short as possible. Leads and connectors should be maintained in sound condition via frequent inspection. Suitable precautions should be taken to prevent mechanical damage of the cables when not in use.
- Maintain battery electrolyte level in accordance with battery manufacturer guidelines.
- Note: Manufacturer guidance typically stipulates all battery plates are to be covered by electrolyte before charging. Exposed battery plates may become a potential source of internal arcing leading to the explosive ignition of hydrogen gas generated within the battery during charging.
- The charging area should be kept clean, tidy and free from rubbish.
- Smoking, use of open flames and other ignition sources should be prohibited in battery charging areas.
- Where charging is carried out in enclosed areas, provide adequate natural or mechanical ventilation to avoid the accumulation of hydrogen gas. As hydrogen is lighter than air, ventilation will be needed at high points of the wall or roof. Ventilation rates should be provided to maintain the atmosphere at or below 25% of the Lower Explosive Limit. Consider the installation of hydrogen gas detection interlocked to isolate the charging devices automatically in the event of gas accumulation beyond the 25% of the Lower Explosive Limit. Advice should be obtained from a specialist contractor for the design and installation of combustible gas analyzers for hydrogen monitoring.
- All tools used in the installation and maintenance of batteries should be suitable for battery work. For example, electrically insulated and acid resistant.
- Metallic items worn by operators (such as bracelets and neck chains) should be removed before working on a battery to prevent short circuiting.
- Uncovered batteries should be covered with a suitable non-conducting material during movement to prevent the hoist chain from shorting on terminals or connections.
- Suitable fire extinguishers (e.g. carbon dioxide for electrical fires) should be strategically placed and accessible near the battery charger units. The extinguishers should be maintained and personnel trained in their safe use.
Figure 1: Battery chargers observed during a site assessment (Source: Zurich)

CONCLUSION

Major fires have been caused by problems with battery charger facilities. By following the simple guidance within this Risk Topic, the risk of fire or explosion is reduced, improving risk management and business resilience.

REFERENCES


http://www.hse.gov.uk/pubns/sir60.pdf
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