

INTELLIGENCE UPDATE

Mitigating lithium-ion fire risks: a review



Daniel Bizo 14 Jul 2026

In its most recent analysis of outage trends, Uptime Intelligence observed that the frequency of major fires at data centers has gradually increased in recent years, with growing adoption of lithium-ion (Li-ion) batteries contributing to the issue (see [Annual outage analysis 2026](#)). Ensuring that best practices are followed can minimize fire incidents and prevent catastrophic loss of equipment and facility — yet fires still happen (see [South Korean data center fire sparks a stark reminder](#)).

The most recent publicly-reported example occurred in June 2026, when a fire started in a Li-ion battery room at an STT Global Data Centres colocation facility in New Delhi, India. The fire resulted in extensive damage, disruption to some online services, and possibly loss of data. This Uptime Intelligence report reviews the key deployment considerations to ensure that risks associated with Li-ion battery energy storage in UPS systems are understood and mitigated appropriately.

The main concern with Li-ion batteries is thermal runaway: an uncontrollable heat-releasing chemical chain reaction that propagates from cell to cell throughout the battery pack (see [Anatomy of a thermal runaway](#)). Typical triggers for a Li-ion cell failure in stationary energy storage applications are electrical in origin, but mechanical abuse during transport and installation might be a latent contributing factor.

It is critical to note that the risk of cell failures is inherent in multiple Li-ion chemistries currently in broad use, even though there are major differences that affect choices around their installation and fire protection measures. Thermal runaway has the potential to lead to powerful fires and even explosions if not contained. It can also damage and potentially trigger further thermal runaways in adjacent battery packs. In the worst-case scenario, the high-temperature heat can cause structural damage to the facility.

Operators that are deploying Li-ion batteries should consider the following fire safety measures.

Cell chemistry trade-offs

Not all Li-ion cell chemistries carry the same risk profile. Cells based on lithium-nickel-manganese-cobalt oxide (typically referred to as NMC) cathodes in particular are more vulnerable to thermal runaway because they are more energy-dense and chemically more volatile. Thermal runaway is not only more likely, but also more violent: developing faster, and producing more heat and higher temperatures. Any cell type that uses metal-oxides has the potential to create a chain reaction on its own. This is because it produces its own oxygen and flammable gases that can sustain the thermal runaway even in the absence of ambient oxygen.

Table 1 Lithium-ion battery chemistries for stationary UPS applications

Chemistry	Energy density (Wh/kg)	Cycle life	Thermal runaway onset	Relative fire risk
NCM/NMC (LiNiCoMnO ₂)	180-250	1000-2000	≈150°C	High
LFP (LiFePO ₄)	140-180	3000-6000	≈ 260°C	Low
LTO (Li ₄ Ti ₅ O ₁₂)	80-100	10,000 +	≈ 400°C	Very low

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Lithium iron-phosphate (LFP) batteries are chemically more stable and do not produce their own oxygen in the event of a fire. This makes them less likely to fail, and slower to release thermal energy should a failure occur. The major trade-off here is lower energy density per battery cabinet, which translates to shorter ride-through times (around 5 minutes at end of life) or requires additional cabinets to match NMC for longer ride-through (7-10 minutes or longer).

Battery management systems and detection

The first line of defense against Li-ion thermal events is the battery management system (BMS), which is responsible for the monitoring and control of cells for the correct state of charge, and rate of charge and discharge. The BMS is also responsible for the detection and electrical isolation of erratically performing cells and modules.

A properly configured BMS can prevent and mitigate most electrical failures, and can also identify the initial stages of thermal runaway by detecting abnormal temperatures and electrolyte vapors to alert operating staff. Any off-gassing with Li-ion batteries is a sign of failure, unlike with valve-regulated lead-acid (VRLA) batteries where limited release of hydrogen is part of its standard operation, especially after a long recharge.

However, even if the BMS functions perfectly, Li-ion cell manufacturing variance and defects can still trigger thermal events. Battery cells also remain vulnerable to external factors, such as overheating, during deep, high-power discharge cycles, for example, when holding the full IT load during a grid disturbance.

Battery pack thermal barriers

Fire barriers, both physical and chemical, built into the battery packs (modules) that make up a battery cabinet can slow down or even stop a thermal runaway from spreading between cells and/or between modules. Examples of cell-to-cell and module-level propagation prevention include plates and pads that efficiently spread heat on the heated side but isolate heat propagation to the other side. Other examples include volumetric fillers, such as polyurethane foams, thermal cottons and aerogels with extremely low thermal conductivity. These integrated thermal barriers play a key role in preventing localized thermal events from developing into major fire incidents. Fire safety performance testing standards, such as UL9540A (Test method for evaluating thermal runaway fire propagation in battery energy storage systems), observe propagation of a forced thermal runaway in a battery module.

Battery cabinet thermal barriers, separation and room design

If mitigation measures in cell selection, BMS and battery module construction all fail, the next line of defense against fire is the layout of the battery room. Battery cabinets are broadly expected to prevent propagation of a thermal runaway to adjacent racks, as demonstrated in UL9540A or similar fire safety performance tests. Nevertheless, depending on the size and layout of the battery room, additional distancing and/or the installation of additional thermal barriers between groups or rows of cabinets to compartmentalize will help contain a moderate fire and prevent it from developing into a catastrophic incident.

If UL9450A or a similar performance test is absent or has failed, authorities having jurisdiction (AHJs) and insurance carriers will likely demand distancing measures, including greater distancing between battery cabinets: as much as 3-5 feet (1-1.5 meters). However, such distancing will likely undermine the business case for the battery energy system of choice. An alternative to greater separation distancing is the addition of fire-rated barriers between racks (minimum 1 hour fire rating) at additional cost.

As standard practice, electrical and battery rooms are expected to have fire containment rated for 2 hours. The location of the battery room is also a factor in determining the risk posed to the rest of the facility. Although relevant electrical installation standards, such as the IEC 62485 series that discusses safety requirements for secondary batteries and battery installations, do not place additional requirements on the location of Li-ion battery rooms relative to VRLA, AHJs and insurance carriers may require easy external accessibility to the room for manual firefighting.

Fire suppression system selection

The final critical component to Li-ion safety is the selection of an effective fire suppression system. Although clean agent systems (typically inert gases) are popular in data center facilities, they are ineffective against thermal runaways because they can only interrupt and delay the chemical reaction by a few minutes. The only effective way to suppress a thermal runaway is to cool down the room and, in turn, provide additional cooling for the batteries to stop propagation. This cooling must be sustained at rated discharge capacity for the duration of a fire event. Today, water-based systems are the standard choice.

Because Li-ion fires, once fully developed, cannot be fully extinguished until all combustible materials in the battery packs undergoing thermal runaway fully burn out, the fire system needs to be able to provide suppression for long periods. This requirement will likely be a minimum of 1 hour with no propagation between battery cabinets assumed (UL9540A rated, fire barriers) and all distancing requirements met. If cabinet-to-cabinet propagation is assumed, best practice is to multiply expected fire duration by the number of cabinets in one fire area. This may require large volumes of water, making adequate drainage essential to prevent water damage to the equipment and building.

Summary

While these measures focus on Li-ion risk mitigation in central battery rooms, Li-ion also poses additional risk to some data halls. Li-ion battery backup units in close proximity to IT equipment — such as those seen in some Open Compute Project designs today, and direct current power

cabinets in the future — introduce further challenges to data center operators in managing Li-ion risks (see [Vendors gearing up for 800V DC adoption](#)). Containment is difficult: there is immediate risk to IT operations and fire suppression systems may cause further damage to hardware. Limiting the total amount and concentration of stored energy per rack is essential to reducing potential fire damage. Fully mitigating these risks will require the adoption of more stable battery chemistries, including nickel-zinc and sodium-ion, together with chemically reactive agents that target fire sources locally.

ABOUT THE AUTHOR



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Over the past 15 years, Daniel has covered the business and technology of enterprise IT and infrastructure in various roles, including industry analyst and advisor. His research includes sustainability, operations, and energy efficiency within the data center, on topics like emerging battery technologies, thermal operation guidelines, and processor chip technology.

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