Allianz Commercial

Lithium-ion batteries

Emerging Risk Trend **Talk 1**

Emerging risks have unique characteristics that require specialist technical, management and organizational skills. Our Risk Consulting expertise across different industries and lines of insurance business around the world is key to helping companies understand and mitigate these. In our Emerging Risk Trend Talk series, we address such topics, highlight loss events and look at targeted loss prevention measures.

The risk

A lithium-ion (Li-ion) battery is a type of rechargeable battery used to power a wide range of consumer and electronic goods, as well as electronic vehicles (EVs). They are also widely used in grid-scale energy storage and aerospace applications.

Compared to other rechargeable battery technologies, Li-ion batteries have high energy densities, low self-discharge, and no memory effect. They have a Battery Management System (BMS) which can monitor not only the State of Charge (SoC) of the battery but also the conditions of the cells and modules. The BMS acts as a safety back-up if conditions are outside the normal parameters and will shut down the device. For larger applications, such as a Battery Energy Storage System (BESS), an Energy Management System (EMS) with integrated thermal management and monitoring processes is utilized to track the entire system.

Li-ion batteries can be a safety hazard if not properly engineered, manufactured, transported, installed, charged, and stored because cells have flammable electrolytes. If damaged or incorrectly charged, Li-ion batteries' high temperatures can lead to explosions and fires, as has been seen with a number of recent incidents on land and at sea.

Unlike lithium batteries, Li-ion batteries do not contain lithium metal, which is highly combustible and reactive with water. Water is currently the best medium to fight a Li-ion battery fire due to its effective cooling capabilities. However, these fires can be very difficult to extinguish and can reignite hours, days or weeks later unless their stored energy has been completely discharged.

Hazards to watch

The main hazards associated with Li-ion batteries are:

- **Fire**: electrolyte is an ignitable liquid.
- **Explosion**: release of ignitable vapor in a confined space.
- **Thermal runaway:** rapid self-heating that may cause fire or explosion.
- **Poisonous/Toxic gases:** released during these events.

Photo: Willie Cade

Property

Event Summary

A fire broke out at an old 70,000 ft^2 paper production facility in Illinois, USA. The facility reportedly contained approximately 100,000 new and used Li-ion batteries; 50,000 damaged, defective or recalled Li-ion batteries; 30,000 nickel cadmium batteries and 10,000 nickel metal hydride batteries at the time of the blaze. It was poorly maintained and sprinkler protection was not in service.

Firefighters responded to the fire shortly after it broke out and initially attempted to suppress it with water but were unsuccessful. They then attempted to extinguish it using a dry chemical extinguishing agent, which also failed. Once the fire had diminished to a controllable level after several days, firefighters applied high-flow water and tons of dry Portland cement to smother the burning batteries. The fire was finally extinguished two weeks after it broke out but resulted in a total loss to the building and its contents. The cause was attributed to a short circuit in the Li-ion batteries.

Natural Resources and Construction *(page 3)* and MidCorp *(page 5)* topics are applicable for Property too

Allianz Risk Consulting Risk Mitigation and Loss Prevention Measures

1. Store and handle Li-ion batteries in an appropriate location and conditions in accordance with manufacturer's recommendations. Inadequate storage conditions can often contribute to the cause of such fires.
2. Remove all damaged or defective Li-ion batteries from buildings and store outside, away from other buildings, in properly-designed containers.
3. Provide adequately designed automatic sprinkler protection in accordance with recognized standards, including a strong water supply (flow, pressure and duration) and manual hose streams. This can help to control a Li-ion battery fire inside a building.
4. Ensure the public / private fire brigade is adequately trained and equipped to fight a Li-ion battery fire. Applying large amounts of water can cool a fire and help gain control.
5. Develop and maintain adequate pre-emergency planning with the public / private fire brigade, including removal of involved Li-ion batteries to a safe location (preferably outdoors). In this incident no pre-emergency planning was in place for a Li-ion battery fire and the fire brigade had not been notified that Li-ion batteries were being stored.

Natural Resources and Construction

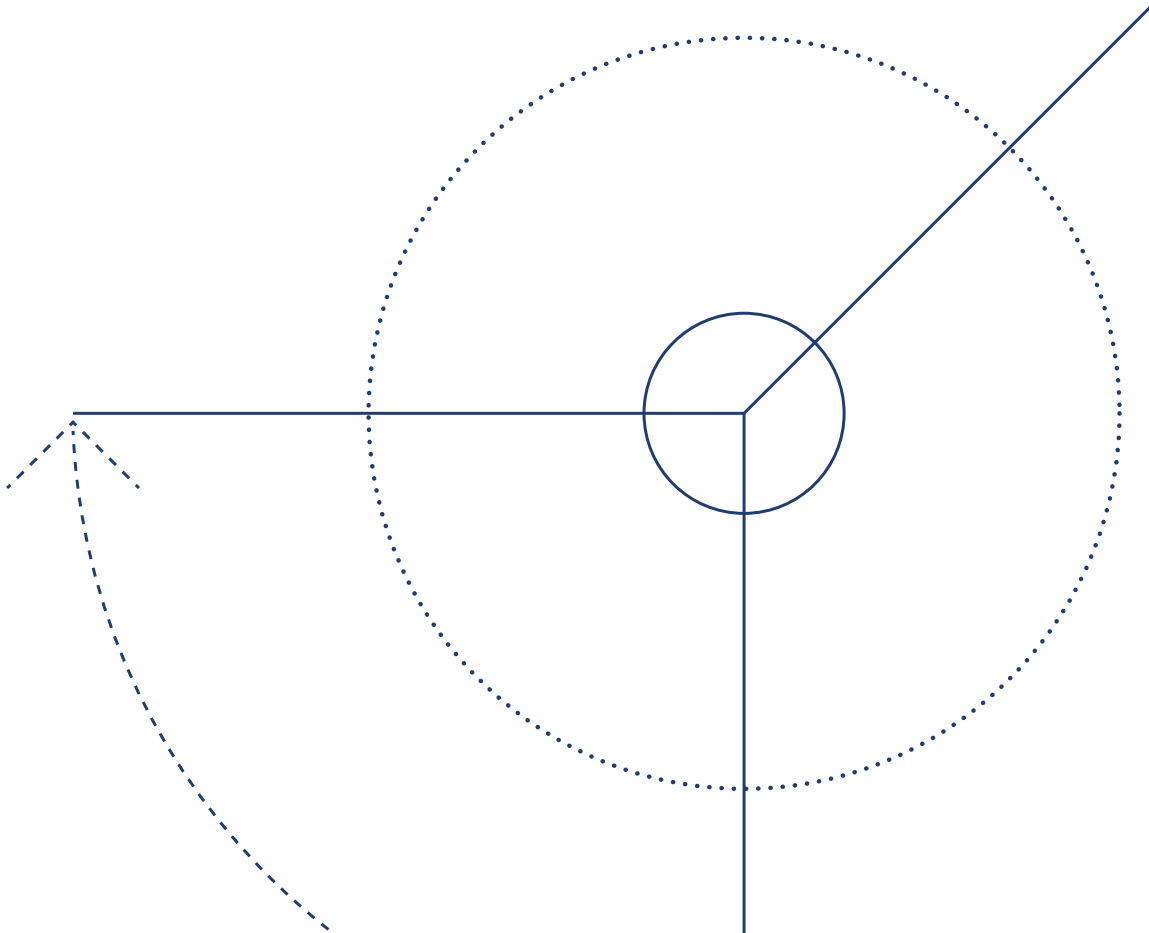
Event Summary

A fire broke out at a large-scale battery storage site in Australia. A single container-based Battery Energy Storage System (BESS) unit caught fire and spread to a neighboring container. The fire did not spread beyond these two units and eventually burned itself out over six hours.

A liquid coolant leak caused thermal runaway in battery cells. It is important to note that some of the circumstances which caused the fire are unlikely to be repeated when these systems are operational. As the unit in question was undergoing testing it had been manually disconnected from some of the monitoring, control and data collection systems that it would usually be connected to. High wind conditions also contributed to the fire's propagation, despite the units being properly spaced apart as per requirements. After this event the Original Equipment Manufacturer (OEM) implemented a number of improvements, including improved inspection procedures for coolant systems, as well as the addition of more alarms.

Allianz Risk Consulting Risk Mitigation and Loss Prevention Measures

1. Ensure all related systems and equipment are installed to manufacturers' guidelines / recommendations. Maintain all records of installation. Ensure operation of equipment remains within parameters provided to and by equipment manufacturers is complied with as this is essential to ensure that equipment warrantees are not voided.
2. Provide and maintain records of fire protection, security, and operations and maintenance (O&M) concepts, Supervisory Control and Data Acquisition (SCADA) systems and site layout plans. Provide training, and documentation of these to all applicable personnel.
3. Ensure the public / private fire brigade is adequately trained and equipped to fight a BESS fire.



Marine

Event Summary

An intermodal freight container reportedly loaded with computer parts was being transported by highway from Raleigh, North Carolina to the Port of Virginia in the US for loading to a container vessel for transport to a port in China. The cargo caught fire on the highway while in transit resulting in the loss of the cargo and significant damage to the intermodal freight container.

The responding fire department determined that the heat produced from the fire burned hot enough to burn a hole through the metal container's structure. A subsequent investigation determined the actual cargo was illegally-loaded discarded lithium batteries, not computer parts. This mis-declared/undeclared shipment put first responders at risk, and could have been potentially catastrophic if the freight container had been loaded to the vessel prior to catching fire. A probable cause was residual charge remaining in improperly-prepared undeclared lithium batteries.

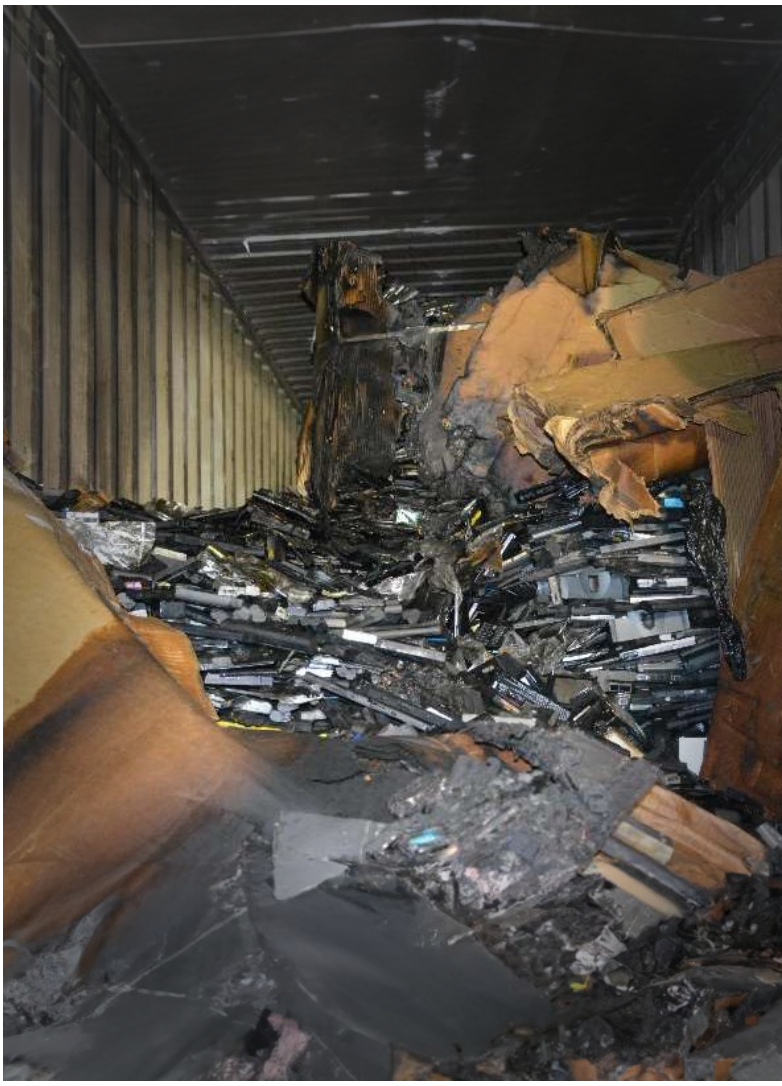


Photo: USCG Marine Safety Alert 01-22

Allianz Risk Consulting Risk Mitigation and Loss Prevention Measures

1. Establish standard operating procedures (SOP) and protocols to ensure all hazardous material (dangerous goods) shipments are in full compliance with all domestic and international applicable hazmat regulations. Including, but not limited to:
   - **a.** Employee hazmat training
   - **b.** Proper packaging of the hazmat (new, used, or recycled lithium (all types) batteries)
   - **c.** Proper markings, labels, and placarding
   - **d.** Proper declarations and certifications.
2. Transport Li-ion batteries at a maximum SOC (state of charge) of 30%, unless otherwise approved.
3. Dropped, or otherwise damaged packaging of Li-ion batteries should not be transported.
4. Properly handle, store, and transport Li-ion batteries in accordance with manufacturer's recommendations and in compliance with dangerous goods regulations.
5. When applicable, ensure pre-emergency contingency plans are developed and shared with local first responders for Li-ion batteries in temporary storage, as part of their transportation.

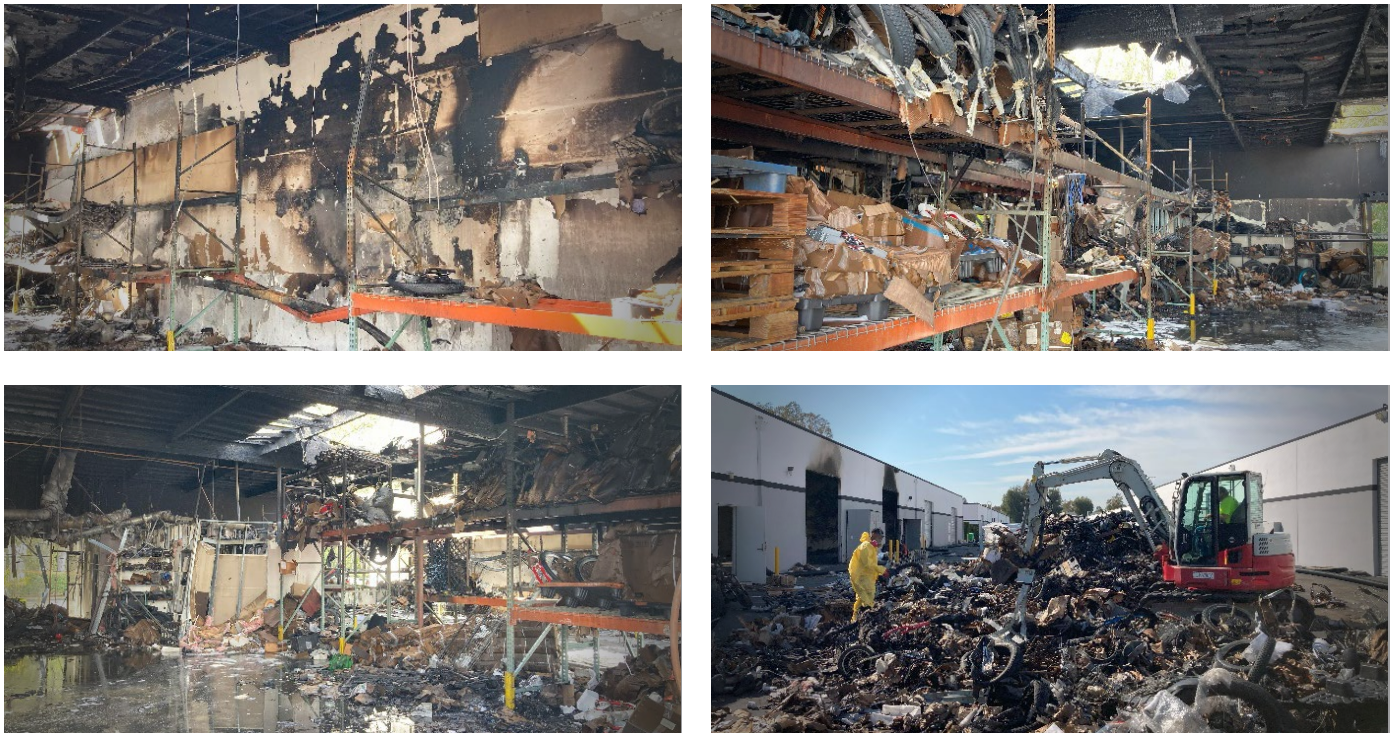


Photo: Jim Biram, Resco Properties

MidCorp

Event Summary

A fire broke out in a tenant-occupied space in a five-unit commercial warehouse building in California, USA. The tenant operated an electric bicycle and scooter import and repair operation. The definite cause of the fire is unknown due to the amount of destruction to the building but is thought to have originated from a work bench that contained numerous Li-ion batteries and chargers.

As the tenant did not have adequate insurance, the hazardous material clean-up of the batteries fell to the warehouse owner, who did. More than 1,000 Li-ion batteries needed to be separated from the debris and properly disposed of as per Environmental Protection Agency (EPA) guidelines. As the batteries continued to explode and catch fire, a 24-hour fire watch with a manned water truck was required. The approximate cost of the fire watch and hazardous material disposal was close to $2mn.

Allianz Risk Consulting Risk Mitigation and Loss Prevention Measures

1. Understanding of insured / management risk transfer should be a high priority. Review the Executed Lease to ensure adequate risk transfer language is in place ('Indemnity', 'Hold Harmless' and 'Additional Insured'). A copy of the current Certificate of Insurance (COI) should be maintained on file, with limits equal to or greater than own.
2. Automatic Sprinkler Protection should also be a high priority. Install throughout the building based on occupancy.
3. Store, handle and use Li-ion batteries and chargers in accordance with manufacturer's recommendations.
4. Provide at least annual training to all employees to promptly recognize and respond to any observed hazards involving the storage, use and handling of Li-ion batteries. Any damaged batteries should be removed from the building immediately.
5. Ensure the public / private fire brigade is adequately trained and equipped to fight a Li-ion battery fire.
6. Develop and maintain adequate pre-emergency planning with the fire brigade, including removal of involved Li-ion batteries to a safe location (preferably outdoors).

Liability

Event Summary

Between 2020 and 2022 five major automotive announcements resulted in requests for a minimum of 360,000 electric vehicles (EVs) in the USA and Germany to be recalled because of safety concerns involving Li-ion batteries.

Automobile manufacturers impacted included GM Motors[1] and Hyundai[2], which recalled cars due to the risk of high-voltage battery packs catching fire and Ford[3], because of the risk that the high voltage battery's main contactors could overheat, resulting in a loss of propulsion power, potentially increasing the risk of a crash.

Meanwhile, VW[4] flagged an issue that battery cells could show an increased self-discharge due to a manufacturing defect and asked owners of certain models around the world to visit workshops.

Allianz Risk Consulting Risk Mitigation and Loss Prevention Measures

1. BMS (Battery Management System) must shut off quick charging in harsh environments.
2. Ensure direct monitoring of all cell temperatures via BMS.
3. Operators should closely consult and follow EV and battery instruction manuals.

4.* Conduct full diagnosis on the cell level for batteries in use on a regular basis.

* Due to the potential danger posed by 'thermal runaway', especially after several charging cycles under harsh conditions, Allianz Risk Consulting supports the idea that all owners and operators of EVs should have such diagnoses every two to three years, as well as after events such as an accident or crash, and before events such as the sale of a vehicle, transportation by sea or if an EV is to be regularly parked in garages. Such diagnoses can be carried out by original equipment manufacturers, testing organizations or independent suppliers.

Five major recalls of EVs announced in USA and Germany (2020-2022)

Risk	Year	OEM Model	Tier 1 Supplier	Sources of recall information
Vehicle fires **Recall (minimum)** **161,000 cars worldwide**	2020/2021	GM Bolt / Opel Ampera	LG ES (KOR)	NHTSA 20V701, 21V150, 21V160 (GM) KBA Code: 10384 (Opel)
Vehicle fires **Recall** **108,000 cars worldwide**	2021	Hyundai Kona / Ioniq	Mobis (KOR)	NHTSA none KBA Codes: 10314, 10643
Loss of power **Recall (minimum)** **50,000 cars worldwide**	2022	Ford Mustang Mach e	Ford (USA)	NHTSA 22V412 (mainly sold in the US) KBA Code: none
Short circuit **Recall (minimum)** **34,200 cars worldwide**	2021	Polestar 2 Volvo XC 40 Recharge	Lear Automated Electronics (CHN)	NHTSA 21V109 (Volvo), 21V110 Polestar KBA Code: 10617 (Polestar)
Too deep discharge **Recall / Action** **10,000 cars worldwide**	2022	VW ID.3 and ID.4	LG Chem (POL)	NHTSA 22V162 (US vehicles only) KBA Codes: none (voluntary action)[5]

Source: Recall data bases from the National Highway Traffic Safety Administration (NHTSA), USA, and KBA, Germany

1 NHTSA, Consumer Alert: GM Expands Recall, All Chevrolet Bolt Vehicles Now Recalled, August 20, 2021. NL Times, Opel recalls all Ampera-e models; battery could go up in flames, August 21, 2021

2 FleetNews, Hyundai recalls electric cars due to battery fire risk, February 25, 2021

3 Reuters, Ford recalls 49,000 US Mach-E EVs over potential power loss, June 14, 2022

4 Electrive.com, Possible battery problem with 10,000 VW ID.3 and ID.4, September 26, 2022

5 Auto Motor Und Sport, VW ruft gut 10.000 ID.3 und ID.4 in die Werkstatt, October 4, 2022

Conclusion

Timeframe to emerge	0-3 years / 4-10 years / >10 years All lines of business/industries: 0 to 3 years Liability: 10 years on end of life products
Impact on Insurance	Low / Medium / High Property: Medium Natural Resources and Construction: Medium (BESS becoming more standardized) Marine: High (General Average claims) MidCorp: Medium Liability: Low-High The assessments in this table are based on the level (and severity) of potential claims activity that could emerge from this emerging risk.
Allianz Risk Consulting Assessment	Low / Average / High / Very High **Inherent hazard per line of business / industry** Property: High Natural Resources and Construction: Average Marine: High to Very High MidCorp: High Liability: High to Very High The assessments in this table are based on a combination of the 'time frame to emerge' and 'impact on insurance' criteria with the result being the inherent hazard per line of business / industry sector for this emerging risk.

Further information and contacts

For more detailed information on any type of Li-ion battery please contact your regional Allianz Risk Consulting risk consultant(s).

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Cover image: Willie Cade