160 kWh lithium-ion battery energy storage safety

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This work describes an improved risk assessment approach for analyzing safety designs in the battery energy storage system incorporated in large-scale solar to improve accident prevention and mitigation, via incorporating probabilistic event tree and systems theoretic analysis. The causal factors and mitigation measures are presented.

Sources of wind and solar electrical power need large energy storage, most often provided by Lithium-Ion batteries of unprecedented capacity. Incidents of serious fire and explosion suggest that ...

lithium-ion batteries per kilowatt-hour (kWh) of energy has dropped nearly 90% since 2010, from more than $1,100/kWh to about $137/kWh, and is likely to approach $100/kWh by 2023.2 These price reductions are attributable to new cathode chemistries used in battery design, lower materials prices,

Decentralised lithium-ion battery energy storage systems (BESS) can address some of the electricity storage challenges of a low-carbon power sector by increasing the share of self-consumption for photovoltaic systems of residential households.

Lithium-ion batteries (LIBs) have raised increasing interest due to their high potential for providing efficient energy storage and environmental sustainability [1]. LIBs are currently used not only in portable electronics, such as computers and cell phones [2], but also for electric or hybrid vehicles [3].

Lithium-ion batteries are here to stay. Use cases are growing every day. Cell pricing continues to decline and manufacturing is ramping up to meet global demand. At the same time, battery energy density continues to improve, and manufacturers are developing more cost-effective packaging to reduce installation costs. And, finally, though current fire safety concerns are serious, they can be addressed with proper equipment selection, planning and engineering.

Any discussion about the future of lithium-ion technology typically starts with cost. In 2010, lithium battery pack pricing was around $1,200 per kilowatt-hour (kWh) for large-scale storage configurations. As of early 2020, pack pricing was less than $160/kWh and continuing to decline.

With 29 confirmed lithium-ion fires in South Korea as of year-end 2019, the South Korean government issued a moratorium on new storage projects and initiated a root cause investigation that lasted five months and covered 23 of the 29 fires. The investigation determined that poor battery integration was a leading contributor to the fires. Examples of poor integration include lack of DC ground fault protection, poor humidity control, water ingress, module damage during installation, and faulty control systems.

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Lithium-ion battery fires are typically the result of thermal runaway, a process caused either by battery cell manufacturing defects or some form of battery abuse. Generally, there are three forms of battery abuse: electrical (over-charging, for example), mechanical (puncturing or dropping the battery module, for example), or thermal (heating a battery beyond its temperature range, for example).

Most typically, battery storage containers have been outfitted with a clean agent or aerosol-type fire prevention system. These have been shown to be very ineffective at controlling the thermal runaway process.

When a lithium-ion battery cell is damaged, it will typically release volatile organic compounds (VOCs) as a result of electrolyte vaporization and a subsequent rupture of the cell packaging. If the abuse continues, smoke and heat follow shortly thereafter. The period between off-gas release and smoke beginning can range from seconds to minutes depending on a variety of factors and typically precedes other early warning signs, including cell voltage and temperature excursions, by minutes.

Off-gas detection systems are commercially available that can sense the VOCs released as a result of cell damage. These systems consist of small sensors placed on the battery racks and wired back to a controller that determines the presence of abnormal levels of VOCs. Upon detection of an off-gas event, the system can initiate an alarm and shutdown of the battery. By detecting the damage before the thermal process begins, off-gas detection systems may be one of the only external protective devices available today that can effectively prevent thermal runaway.

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