

ENERGY STORAGE FIRE HAZARDS



Do fire departments need better training to deal with energy storage system hazards? Fire departments need data, research, and better training to deal with energy storage system (ESS) hazards. These are the key findings shared by UL's Fire Safety Research Institute (FSRI) and presented by Sean DeCrane, International Association of Fire Fighters Director of Health and Safety Operational Services at SEAC's May 2023 General Meeting.



What is a fire and explosion hazard? The fire and explosion hazard present in a BESS is therefore defined as the release of flammable battery gas from a failing battery module or multiple modules. The origin of this failure is an initiating cell within a module which is somehow driven to vent battery gas and transition to thermal runaway.



What happened at an Arizona energy storage facility? In April 2019, an unexpected explosion of batteries on fire in an Arizona energy storage facility injured eight firefighters.



What are battery storage fire safety initiatives? These initiatives have included creating a battery storage fire safety roadmap, developing recommendations and leading practices for designing systems, and training and working with first responders responsible for putting out fires.



Do battery storage systems prevent fires? As battery storage systems today overwhelmingly utilize lithium-ion technology, the industry must take steps to prevent and mitigate potential fires and preparing effective responses for the rare instances when they occur.

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Are battery energy storage systems safe? Owners of energy storage need to be sure that they can deploy systems safely. Over a recent 18-month period ending in early 2020, over two dozen large-scale battery energy storage sites around the world had experienced failures that resulted in destructive fires. In total, more than 180 MWh were involved in the fires.



An energy storage system, often abbreviated as ESS, is a device or group of devices assembled together, capable of storing energy in order to supply electrical energy at a later time. Battery ESS are the most common type of new installation and are the focus of this fact sheet. According to the US Department of Energy, in 2019, about



China is targeting for almost 100 GWh of lithium battery energy storage by 2027. Asia.Nikkei wrote recently about China's energy storage boom: By 2027, China is expected to have a total new energy storage capacity of 97 GW. New energy storage systems in China are largely based on lithium-ion battery technology, according to the



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safety review of these sites included analysis of data (design documents and equipment certifications), site walkthroughs, and assessment based on fire hazard mitigation guidance from the Energy Storage Integration Council. Based on those assessments, EPRI developed lessons learned and guidance about steps that could be taken to improve safety.



The event was a catalyst for the need for updated fire safety standards, including increasing fire department awareness of the hazards of an ESS, as the ESS was reportedly installed in compliance with applicable codes and standards at the time of its commissioning. energy storage capacity,

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energy storage management systems, and safety

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Ms Nicholson, from Harmony Energy, said: "If it didn't meet the safety thresholds we wouldn't be able to get finance or insurance for it, they are remotely monitored 24/7 and routinely maintained



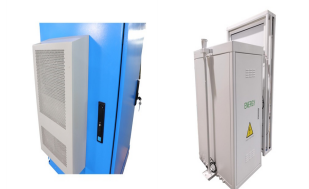
Given these concerns, professionals and authorities need to develop and implement strategies to prevent and mitigate BESS fire and explosion hazards. The guidelines provided in NFPA 855 (Standard for the Installation of Energy Storage Systems) and Chapter 1207 (Electrical Energy Storage Systems) of the International Fire Code are the first steps.



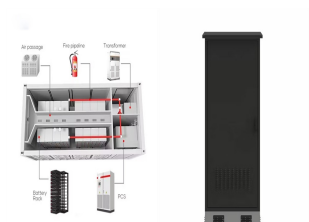
Firefighters are being urged to take extra precautions when approaching structure fires involving residential energy storage systems (ESS), an increasingly popular home energy source that ???



In 2017, UL released Standard 9540A entitled Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems. Following UL's lead, the NFPA (R)[2] -The design of the cell necessarily results in a deep-seated, hard-to-reach fire. Given the special hazard nature of lithium-ion BESSs, special fire



NFPA is undertaking initiatives including training, standards development, and research so that various stakeholders can safely embrace renewable energy sources and respond if potential new hazards arise.



on battery and ESS fires. Work characterizing the fire and explosion hazards of batteries and energy storage systems led to the development of UL 9540, a standard for energy storage systems and equipment, and later the UL 9540A test method for characterizing the fire safety hazards

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associated with a propagating thermal runaway

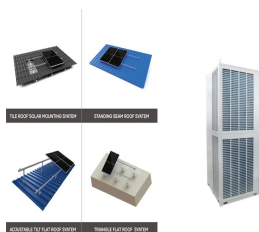
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Battery Energy Storage Systems must be carefully managed to prevent significant risk from fire???lithium-ion batteries at energy storage systems have distinct safety concerns that may present a serious fire hazard unless proactively addressed with holistic fire detection, prevention and suppression solutions.



This paper identifies fire and explosion hazards that exist in commercial/industrial BESS applications and presents mitigation measures. Common threats, barriers, and consequences are conceptually shown and how they would be identified in a hazard mitigation analysis (HMA). International standard for electrical energy storage systems



7 Hazards ???Thermal Runaway "The process where self heating occurs faster than can be dissipated resulting in vaporized electrolyte, fire, and or explosions" Initial exothermic reactions leading to thermal runaway can begin at 80? - 120?C.



ESIC Energy Storage Reference Fire Hazard Mitigation Analysis . 3002023089 . 15143739. 15143739. EPRI Project Manager M. Rosen EPRI 3420 Hillview Avenue, Palo Alto, California 94304-1338 PO Box 10412, Palo Alto, California 94303-0813 USA 800.313.3774 650.855.2121 askepri@epri



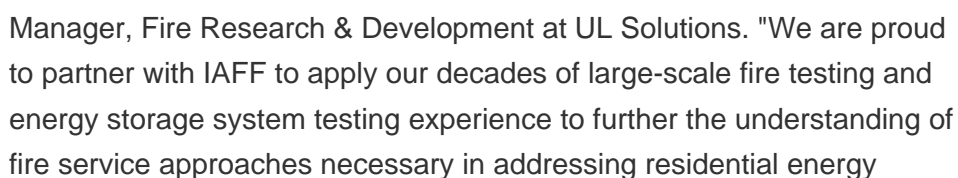
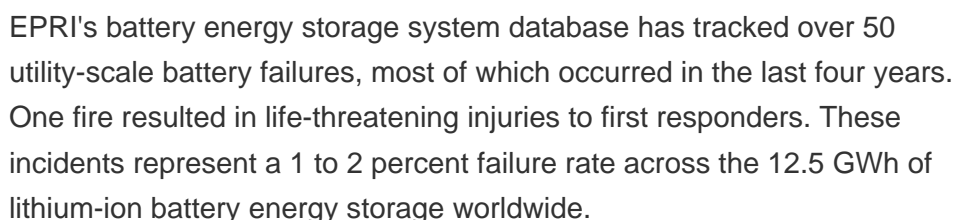
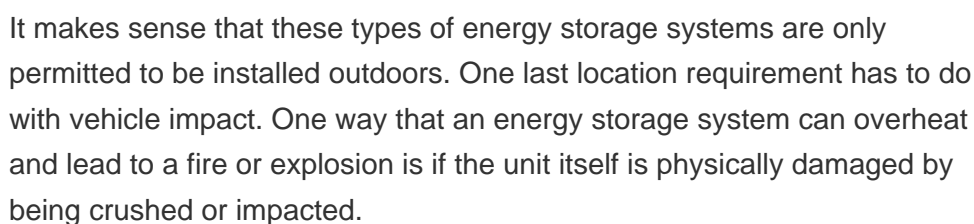
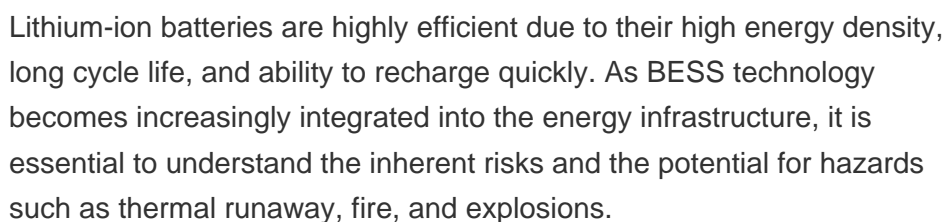
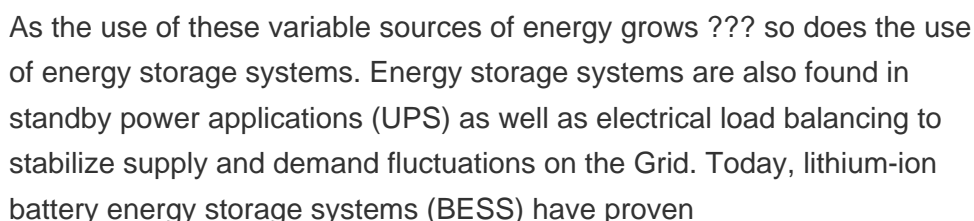
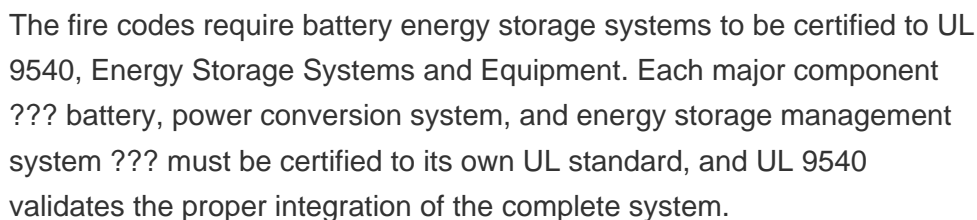
Battery Energy Storage Systems Explosion Hazards research into BESS explosion hazards is needed, particularly better characterization of the quantity and composition of flammable gases released and the factors that cause a failure to lead to fire or explosion. This white paper describes the basics of explosion hazards and the



Safety evaluations rely on a group of multidisciplinary experts asking "what if" questions and comparing observations of project features (for example, requirements, design characteristics, 3. Energy Storage Integration Council (ESIC) Energy Storage Reference Fire Hazard

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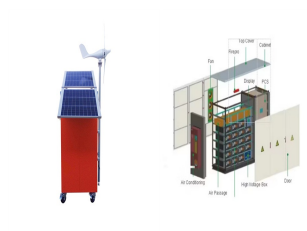
Mitigation Analysis. EPRI, Palo Alto, CA: 2019. 3002017136. 15137937



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storage system hazards."

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The Importance of Fire Safety in BESS. Battery Energy Storage Systems, especially those utilizing lithium-ion batteries, can pose significant fire risks if not properly managed. Lithium-ion batteries are known for their high energy density, but they also have a tendency to overheat, which can lead to thermal runaway???



The objectives of this paper are 1) to describe some generic scenarios of energy storage battery fire incidents involving explosions, 2) discuss explosion pressure calculations for one vented deflagration incident and some hypothesized electrical arc explosions, and 3) to describe some important new equipment and installation standards and



With the rapid growth of alternative energy sources, there has been a push to install large-scale batteries to store surplus electricity at times of low demand and dispatch it during periods of high demand. In observance of Fire Prevention Week, WSP fire experts are drawing attention to the need to address fire hazards associated with these batteries to ensure that the power is stored ???



When a battery energy storage system (BESS) has a multilayered approach to safety, the thermal runaway, fire, and explosion hazards can be mitigated. Successful implementation of this approach requires cooperation, collaboration, and education across all stakeholder groups to break down these preconceived notions.