Battery Energy Storage

Latest technology and standards prioritize safety in Arizona

Utility-scale battery energy storage systems (BESS) are the bridge between a reliable power grid and our clean energy future. Energy storage provides backup for short-term power outages and interruptions; delivers dispatchable energy to meet periods of peak demand; provides ancillary services to maintain the stability of the grid; and supports steadily increasing renewable energy resources on the grid.

For all these reasons, investment and deployment of utility-scale battery storage is accelerating across Arizona and the U.S. In addition to being a leader in renewable energy generation, Arizona is also a leader in battery energy storage. Arizona is home to some of the largest and most innovative BESS installations in the world. Arizona had nearly 1 GW of operating BESS capacity deployed in mid-2024, ranking the state third in the country behind California and Texas in BESS deployments. But that capacity number is expected nearly quadruple by the end of 2025.

Fire and safety incidents are rare

While fire incidents at BESS facilities in Arizona in 2019 and 2022 raised questions about BESS safety, it's important to remember that these events at battery storage facilities are rare occurrences. BESS technology, system design, safety features, and operational practices have advanced significantly in just the past few years.

According to research from the Electric Power Research Institute (EPRI), which collects and analyzes data about BESS fires, "the technology's overall safety record is strong and improving." There were about the same number of fires in 2023 as there were in 2019, even as global battery storage deployments have increased 20-fold. According to EPRI, there were fewer than 10 BESS failure events in the U.S. in 2023.

New safety standards and technologies

The energy storage technology being deployed today looks and operates very differently from the technology installed just three to five years ago. The industry has also developed a much deeper understanding of the technical and safety management of thermal hazards.

More importantly, a new generation of BESS installations now incorporate the latest design standards and safety features that greatly reduce the possibility of fire and thermal runaway.

Lessons learned from previous incidents have resulted in the adoption of new, rigorous standards and codes like UL 9540 Standard for Safety of Energy Storage Systems and Equipment and National Fire Protection Association (NFPA) 855 Standard for the Installation of Stationary Energy Storage Systems, in addition to continual design safety improvements that AES integrates into its energy storage facilities.

All battery cells and modules that AES deploys now undergo testing compliant with the UL 9540A Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems, both to characterize the hazards associated with battery energy storage fires and to demonstrate the effectiveness of new fire mitigation mechanisms.

AES' Westwing BESS project under construction in Peoria

Advanced fire prevention and protection

In addition, new layered protections are designed to address specific battery failure modes to greatly diminish the likelihood of any singular battery cell failure from cascading into a larger thermal runaway event or fire. Containment, at the cell level, enclosure level, and system level, is key to managing and mitigating thermal hazards in the unlikely event of occurrence.

AES is working closely with local fire departments and emergency responders to develop Hazard Mitigation Analysis and Emergency Response Plans in the unlikely event of an incident at a site.

Safety is our top priority. New and rigorous safety standards and technologies are incorporated into the design of the BESS facilities making them safer than current installations in operation.

Today's BESS safety features and practices provide:

- → Hazard Mitigation Analysis
- → Battery Management Systems
- → Emergency Shutdown
- → Flammable Gas Detection
- → Fire Detection and Alarm
- → Direct Injection Fire Suppressant
- → Exhaust Ventilation
- → Deflagration Venting
- → First Responder Training
- → Emergency Response Plans

Earlier vs. current BESS safety standards/features

	Earlier BESS Design	Current, Advanced BESS Design
Enclosure Type	Walk-in design	Non-walk-in (electrical equipment)
Battery Management System Protection	Yes	Yes
Gas Detection & Explosion Prevention	No	Gas detection, ventilation, deflagration panels
Smoke & Heat Detection	Yes	Yes
Fire Suppression	Non-targeted clean agent or sprinkler system	Targeted suppression at module level (clean agent, aerosol, water, etc.)
NFPA 855 Compliant	No	Yes
UL9540A Tested	No	Yes

Energy storage meets rigorous new safety standards

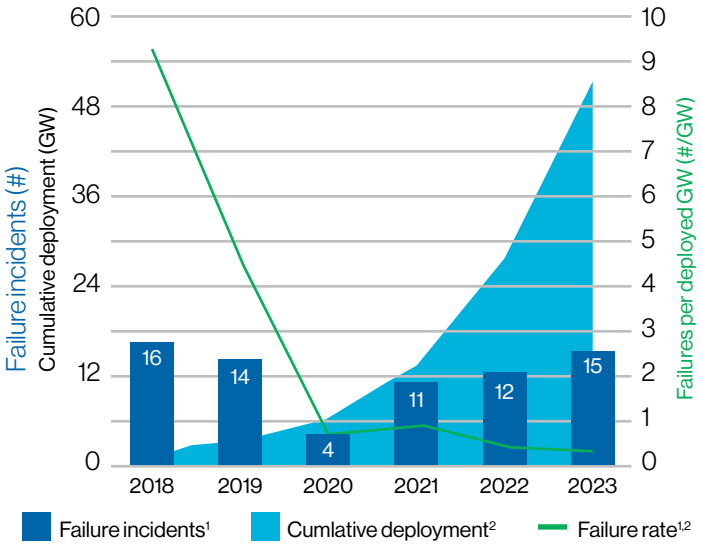
Fire professionals, fire protection experts, and safety leaders have developed a suite of standards that keep energy storage projects safe. These standards play an important role in guiding consistent safety strategies and practices across the United States.

NFPA 855 provides mandatory requirements for the design, installation, commissioning, operation, maintenance and decommissioning of energy storage facilities. The standard includes requirements for metrics such as maximum energy and spacing between units and includes several submittals that must be made to the regulating governmental entity, including 1) Hazard Mitigation Analysis (HMA), 2) Emergency Response Plan, 3) details of all safety systems, and more.

UL 9540 is the safety standard for energy storage equipment, including batteries, that is required under NFPA 855. NFPA 855 requires that batteries included in energy storage projects are listed to the safety specifications included in UL 9540 and undergo rigorous fire testing. This standard ensures that equipment incorporated into battery energy storage facilities are tested, certified and safe for operation on the electric grid.

By locating battery cells in specially designed enclosures equipped with advanced safety and fire suppression systems, today's BESS systems greatly diminish the likelihood that any singular battery cell failure will cascade into a larger thermal runaway event or fire.

Global grid-scale BESS deployment and failure statistics



Sources: (1) ERPI failure incident database, (2) Wood Mackenzie, Data as of 12/31/23

According to EPRI statistics, BESS fire incidents are decreasing while deployments are increasing substantially. The rate of BESS failure incidents fell 97% between 2018 and 2023. During this time, codes and standards regulating BESS have rapidly evolved to better address safety concerns.

New BESS systems feature layered active and passive safety, monitoring and fire suppression systems, including flammable gas detection, fire detection and alarm, direct injection fire suppressant and exhaust/deflagration ventilation.

For more detailed information about today's BESS safety, visit here:

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