EMPOWERING UTILITIES WITH TECHNICAL RISK INSIGHTS FOR BATTERY ENERGY STORAGE

Energy

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Battery Energy Storage Systems (BESS) are rapidly becoming linchpins of modern power grids, enabling renewable integration and grid stability. However, high-profile battery fires and explosions have made safety a paramount concern for utility risk managers. **Our energy-focused risk engineering and insurance brokerage firm** stands out by providing deep technical expertise to help companies navigate these challenges.

Recent **large-scale fire tests** of a 4 MWhr BESS by Wärtsilä offer game-changing data on real-world fire behavior, informing safer designs and smarter risk management. In this brochure, we distill those insights and demonstrate how Gallagher's Energy practice helps you **reduce uncertainty, enhance safety posture and make informed insurance decisions.**

> This rigorous real-world simulation underscored Wärtsilä's commitment to **understanding BESS fire dynamics and yielded invaluable data for the industry.**

Real–World BESS Fire Testing: Wärtsilä's Worst–Case Scenario Trial

To understand BESS fire risks under worst-case conditions, Wärtsilä conducted a full-scale fire test on its GridSolv Quantum 2 energy storage system. The setup comprised three 4 MWhr battery containers placed end-to-end, with a premixed fuel-air burner deliberately igniting the middle container. This aggressive ignition simulated a severe failure scenario and allowed observers to see how a fire might propagate — or fail to — beyond the ignition point. The test was highly instrumented and realistic. Crucial safety features were built in, including sprinkler heads (for temperature monitoring) in the neighboring units and deflagration panels in the container doors to vent any pressure build-up. This rigorous real-world simulation underscored Wärtsilä's commitment to understanding BESS fire dynamics and yielded invaluable data for the industry.

Key Lessons From the 4 MWhr Fire Test

The Wärtsilä fire demonstration provided tangible proof of concept for several safety assumptions. Our team was on site to analyze the results firsthand. The findings validate that well-designed BESS installations can experience a fully-involved fire without catastrophic spread. Key takeaways included:

1. **Fire contained to originating unit:** Despite a ferocious blaze (~10–12 MW peak heat release from a 4 MWhr battery), the flames did not propagate to adjacent containers. This containment success exceeded expectations and demonstrates that robust enclosure design can prevent chain-reaction failures.

2. **Resilience of adjacent systems:** The Battery Management Systems (BMS) and auxiliary controls in the nearby containers remained fully operational throughout the fire. Temperature sensors in those units confirmed that internal conditions stayed within safe limits. This gives operators and underwriters confidence that adjacent BESS units can continue functioning or be safely shut down during an incident, rather than all going offline.

3. **Design improvements identified:** The test wasn't without challenges. The extreme heat caused the burning container's door hinges and latches to fail. However, safety mechanisms worked as intended: the deflagration vent panels in the doors successfully relieved pressure, preventing a violent explosion. Post-test, Wärtsilä immediately redesigned door latches and hinges to be more heat-resistant and secure. This proactive engineering fix, prompted by real test data, highlights how continuous improvement in hardware can enhance containment.

4. **Fire intensity vs impact:** A single 4 MWhr BESS container can produce a 10–12 MW blaze, rivaling a small power plant in thermal output. The lack of damage to neighboring units demonstrates that modern BESS designs can handle worst-case events without cascading failures. This is a critical proof point for both safety codes and insurance models, showing that a total loss can potentially be isolated to one unit even with minimal firefighter intervention.

5. **Spacing and layout matter — but not in the way you'd think:** Prior to this test, conservative code guidelines often called for substantial separation between containers. Wärtsilä's standard recommendation is about ten feet of lateral separation between BESS units, mainly to allow maintenance access. However, the trial indicated no significant fire spread even at extremely tight spacing — as little as a few inches end-to-end. The facing containers only eight feet apart across an aisle also saw no heat damage. This suggests that, from a fire propagation standpoint, current designs can tolerate relatively compact layouts. For facility planners, this offers flexibility: you can prioritize operational practicality without necessarily compromising safety, as long as the system's internal protections are robust. (Of course, a ten foot separation is still advisable for maintenance and emergency crew access).

These insights are immediately relevant to asset owners, engineers and insurers alike. The ability of a BESS to contain a severe fire within a single unit has implications for safety standards and insurance requirements. It validates that large-scale fire tests (beyond the usual UL 9540A propagation test) are invaluable for demonstrating real-world resilience. Armed with this data, our firm helps translate the lessons into concrete guidelines for risk mitigation.

Sources:

Recent insights and data are drawn from Wärtsilä's large-scale BESS fire testing program and expert analysis by our energy practice: e.g., containment of fire to the originating 4 MWhr unit with no spread to adjacent modules, the role of robust BMS and design features in preventing thermal runaway propagation, and industry implications for safety standards and insurance requirements. Additional technical context on battery hazards and mitigation is based on widely-recognized research in lithium-ion safety and our firm's internal expertise in risk engineering for energy systems. Our approach aligns with emerging codes (NFPA 855:2026) and safety benchmarks that require demonstrable prevention of fire spread in BESS installations, underscoring our commitment to fact-based, forward-looking risk management.

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