Mitigating energy storage's unique natural catastrophe risk with insurance

Battery Risk | Battery storage plays an important role in adding resilience to energy networks. But it should also be remembered that natural catastrophes can affect BESS resources too, writes Ross Kiddie of bespoke battery insurance company Altelium.

Natural catastrophe (nat cat) planning and risk assessment is different for battery energy storage compared to renewables such as wind and PV solar because it involves a chemical reaction.

Every battery cell contains a cathode, anode and an electrolyte through which the ions flow when the battery is charged and discharged. Because we're dealing with chemistry, not physics, there is always the potential risk (albeit a small one) of a thermal runaway in a lithium-ion battery if design conditions aren't maintained. Thermal runaway will produce an uncontrolled release of heat and energy, and this will produce fire and toxic fumes.

Writing for Energy-Storage.news earlier this year, my colleague Charley Grimston highlighted the increased risk when wind turbines are located at less-than-ideal sites. In the article 'Comparing the path to maturity and insurance's role in the battery storage and wind turbine markets' he describes how in the early days of wind turbines, fire was quite a common occurrence caused by the blades rotating the wrong way, or rotating too fast and causing a nacelle fire. Natural catastrophes also caused turbines to fall over, but the resulting damage is not on the same scale as is possible with a battery energy storage fire caused by a chemical reaction.

The most damaging potential element in a nat cat situation for batteries is water, and especially saltwater which has been described as a 'death sentence' for batteries. Saltwater corrodes and subsequently can cause short circuits which can lead to thermal runaway.

However, no one should think that because a nat cat event is taking place, energy storage isn't taking place there too. In Texas for example, because of load constraints, reliability issues and the way the independent electricity system ERCOT is structured, there is a very high need for battery storage. But there is also a very high probability of a nat cat event such as hurricanes and flooding.

Credit: Harmony Energy

Harmony Energy's 196MWh Pillswood BESS in East Yorkshire, UK, was built on a raised platform to mitigate the risk of water damage in the flood-prone region.

Texas' ERCOT market had around 2GW of batteries online in Q1 this year, but is set to soar to 8GW by the end of 2023. The nat cat risk hasn't stopped development. Where there is a need for storage, nat cat can typically be addressed with the right planning and design.

Standards a work in progress in many regions

As my colleague, Paul Markham, Power & Energy Risk Engineer, confirms: "It is a question of ensuring developments are structurally developed to withstand wind or hurricane risk, and where there is a flood risk, that the batteries' enclosures are adequately IP rated and are built on a raised platform or raised concrete structure."

Standards established by the National Fire Protection Agency (NFPA) in the US are considered the gold standard for design in this respect. While work is underway in the UK to develop an equivalent, at present in the UK and Europe there is no standard to compare with it.

At Altelium we were recently asked to review the development of a new battery energy storage development, to assess standards of design and planning with reference to NFPA 855. The scope of the standard is defined by the NFPA below:

The standard applies to the design, construction, installation, commissioning, operation, maintenance, and decommissioning of stationary energy storage systems (ESS), including mobile and portable ESS installed in a stationary situation and the storage of lithium metal or lithium-ion batteries.

Energy generation equipment – even if it is tied to the ESS – is not covered under the scope. An example of this is a solar energy farm that feeds ESS on the same property. The solar generation and collection equipment are not governed by this

standard. NFPA 850 and 855 or other relevant standards should be applied for the design, construction, installation, commissioning, operation, and maintenance of generation facilities.

Together with UL 9540 Energy Storage System (ESS), these two standards guide insurers in assessing preparedness and mitigation of nat cat risk.

There are many battery energy storage projects today undergoing approval and construction to address these standards in the US and UK. For example, one is being built in Scotland on a raised plinth to address tidal water, the 'worst' risk because it is saltwater.

All energy resources carry risks

The US Electric Power Research Institute (EPRI) keeps a database of stationary energy storage failure events, with publicly available data. Beginning from 2019, it has tracked over 50 utility-scale battery failures that have occurred over the last four years. The incidents represent a 1% to 2% failure rate across 12.5GW hours of lithium-ion energy storage worldwide. Two events in Korea are believed to have been preceded by heavy rain and thunderstorms, where water may have gotten into the building or container. However, it is not always possible in every case to identify Root Cause Analysis (RCA) and the majority are not believed to have been the result of nat cat.

Some events have included loss of life and life-changing injuries to first responders and the risk cannot be underestimated. But it can and should be seen in context: risks are not unique to storing electricity.

The US National Research Council (NRC) found in a study around a decade ago that some storage systems, albeit not energy storage systems, such as carbon capture and storage, are more likely than fracking to trigger nat cat in the form of earthquakes.

Other energy storage systems being explored such as compressed air energy storage in depleted natural gas reservoirs can potentially cause detonations initiated via a shock making an earthquake nat cat a risk.

Writing in the Scientific American, Paul Denholm, a senior energy analyst at the National Renewable Energy Laboratory says: "Fossil fuels are technically forms of stored energy, pose plenty of problems in their extraction, refining, distribution, and delivery.

"We basically have grandfathered these risk factors. Gasoline catches on fire all the time. Electrical energy storage systems aren't inherently riskier than petroleum or natural gas, but their risks are different."

Battery fires are a particular concern because they can occur several days after an initial thermal runaway event and consequent 'original' fire. Battery cells contain energy within themselves, called 'stranded energy' and this means they can reignite days after the fire has been put out. But again, awareness of this means it should be prepared for, and where it is not, insurance will be not offered and the project is highly unlikely to proceed.

In this respect insurance and especially nat cat modelling plays a key part in providing both environmental and financial protection.

According to the NOAA (National Oceanic and Atmospheric Administration), the US alone has sustained 355 weather and climate disasters since 1980 where overall damages/costs reached or exceeded US$1 billion (including CPI adjustment to 2023). The total cost of these 355 events exceeds US$2.540 trillion.

Modelling risks with software

In the battery storage and renewable energy industry we see this trend having a worldwide affect that insurers and reinsurers need to understand and model to assist with making informed decisions.

Nat cat software modelling programmes offer several benefits and can function as a valuable tool when looking at battery energy storage sites. They provide insights into the potential impact of catastrophes such as hurricanes, earthquakes, floods, wildfires, and other events.

When it comes to battery storage, natural catastrophe modelling tools can be valuable in several ways:

1. **Improved risk assessment:** these tools help battery storage facility engineers, owners, operators, banks, and insurers understand the vulnerability of their assets to different types of natural catastrophes. By analysing historical data, climate patterns, and geographical vulnerability to natural disasters. This might include implementing structural reinforcements, relocating facilities away from high-risk areas, or investing in early warning systems and emergency response plans.
3. **Insurance and risk transfer:** catastrophe modelling tools assist insurance companies in assessing the potential losses associated with insuring BESS facilities against natural disasters. These models provide insurers with a statistical and scientific input for help determining premiums, coverage limits, and deductibles, ensuring that the costs align with the risks involved. We see best results when CAT models are combined with deterministic assessments, site reviews, BESS owner and operating conversations and loss histories.
4. **Transparency and data accuracy:** all models that depend on large data sets are sensitive to uncertainty driven by poor quality or missing data. The major providers of CAT modelling tools used for energy and battery storage systems all have recognised the issue of quality of data and have created their own proprietary algorithms to reduce poor quality and to represent that they are providing the most accurate level of results.

As climate change intensifies, the frequency of natural catastrophes will increase and the insurance industry will need to adapt quickly to these exposures for renewable energy and battery storage. The use of modelling software to help them adapt is not the only tool needed by risk engineers, however, it is recognised as a critical tool in their toolbox.

Where battery energy storage developments have the correct facilities to address the risk of flooding or other nat cat, insurance costs would not be exorbitantly high and a good insurance rate can be secured with the correct mitigations in place. In this respect, insurance plays a key role in supporting the transition to clean energy and addressing climate change issues. ■

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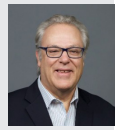

Ross Kiddie is North America general manager at Altelium, an insurtech business that offers insurance for batteries driven by real-time, AI-powered data analytics. Ross specialises in the integration of battery storage technologies to support grid resource for resiliency and reliability. An electrical engineer by training, he has nearly 30 years experience working with utility companies, clean energy technology companies, renewable energy/storage entities and energy consumers. His experience ranges from risk assessment and due diligence, insurance, grid modernisation, energy efficiency programmes, distributed energy resources, electrification, energy engineering to software solutions and national policy objectives.