GUIDE BATTERY STORAGE · 8 MIN.

Fire incidents in battery storage: what the loss record shows

The failure rate of utility-scale storage has fallen sharply since 2018, yet root cause analysis shifts attention away from the cell. This analysis evaluates publicly documented databases and incidents and draws the consequences for thermal barriers.

The data situation: few sources, clear trends

Anyone discussing fire incidents in battery storage works from a thin data base. In Europe there is neither a reporting obligation nor a public loss database for stationary storage. The most important publicly accessible collection is the BESS Failure Incident Database of the US Electric Power Research Institute (EPRI), begun in 2021 after a cluster of incidents in South Korea and an incident in Arizona. It records failures at utility-scale and commercial-scale storage worldwide.

This data situation has limits that you should bear in mind with every statement. What is recorded is what becomes publicly known. Smaller incidents without fire service attendance, near misses and damage without a resulting fire appear in no statistics at all. For Germany, robust figures so far exist only for the home storage segment.

Note: What the statistics do not capture — The available databases count incidents, not risks. They say nothing about how many installations ran without disruption over the same period. Statements about the probability of occurrence can be derived from them only to a limited extent.

The failure rate over time: a marked decline

The most important finding from the EPRI database is a decline. Between 2018 and 2023 the failure rate at utility-scale storage fell by 97 percent, and the updated evaluation reports a decline of 99 percent for 2018 to 2025. The reason given is that the lessons from the early loss events have fed into new designs and into practice.

For the home storage segment in Germany, a study published by RWTH Aachen at the end of 2024 is available. It puts the fire probability of photovoltaic home storage systems at 0.0049 percent per year. For comparison, the same study cites photovoltaic systems at 0.0014 percent, tumble dryers at 0.0037 percent, electric vehicles at 0.024 percent and vehicles with internal combustion engines at 0.089 percent. The data on home storage fires were collected for the year 2023 by evaluating publicly available reports, because no other data were available.

- Decline in the failure rate at utility-scale storage from 2018 to 2023: 97 percent (EPRI)
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Decline from 2018 to 2025 in the updated evaluation: 99 percent (EPRI)

- Fire probability of PV home storage in Germany: 0.0049 percent per year, reference year 2023 (RWTH Aachen, 2024)
- For comparison in the same study: tumble dryers 0.0037 percent, electric vehicles 0.024 percent per year

These figures are not an argument against fire protection, but an argument for the right sense of proportion. The probability of occurrence is falling, yet the loss per event rises with the energy content installed per site. It is precisely this combination, a rare event with high loss potential, that is the classic case for passive protective measures.

Root cause analysis: it is rarely the cell

More revealing than the number of incidents is their cause. A white paper published in 2024, produced by EPRI together with the Pacific Northwest National Laboratory and an analytics provider, evaluated the database systematically. Of 81 recorded incidents, 26 contained sufficient information to establish a root cause.

The result contradicts the widespread expectation. In 89 percent of the failures evaluated, the cause lay in the controls, that is in the battery or energy management system, or in the balance of plant, that is everything outside the cells and the controls. In 86 percent of cases the root cause was not a manufacturing defect in the battery, but poor installation, faulty design or operator error. Only around 11 percent could be traced to defects in a cell or module.

Note: The practical consequence of the distribution of causes — If the great majority of incidents arise from design, installation and operation, then cell quality alone cannot prevent them. Protection concepts built entirely on the assumption of faultless execution fall short. A protection concept has to hold even when an execution error has gone undetected.

The course of an incident: long deployments, large volumes of water

What an incident means for operators and the fire service shows less in its frequency than in its course. A thermal runaway is characterised by sustained heat generation, the risk of reignition and the rapid release of large quantities of toxic and ignitable gases. Extinguishing in the conventional sense is not possible; deployment tactics come down to continuous cooling and prolonged monitoring afterwards.

For one documented storage fire, the European fire protection association CFPA Europe reports a deployment lasting twelve hours in which close to 1,400,000 litres of water and 400 kilograms of extinguishing powder were used. In Germany, a fire at a storage facility in Saxony was publicly documented in July 2026, consisting of four battery storage containers with around 1.5 megawatts of power, designed to support local grid stability. The operator and manufacturer are deliberately not named here; what matters for the conclusions is the course of events, not the attribution.

These experiences have changed design practice. EPRI describes a shift in plant design since 2018 towards smaller, modularised cabinets with few battery racks that are accessible from outside. Responders then do not have to enter a container, and the design at the same time limits the damage. The price: more separating surfaces are created that have to act as barriers.

What follows from this for thermal barriers

First, it follows from the distribution of causes that a passive barrier is the only element of protection that works independently of the cause of the fault. Whether an incident arises from a software error in the energy management system, a poorly executed bolted connection or an operator error makes no difference to the task of the separating surface between two cell blocks. With 89 percent of causes lying outside the cell, this is the statistically most likely design situation.

Second, the course of an incident imposes a requirement on endurance. A deployment lasting twelve hours that

consists primarily of cooling means that the barrier has to work for hours, not minutes, and to remain effective while soaked and subject to alternating thermal loads. Test values from short-duration tests do not reflect this. Pay attention to the exposure duration that underlies the evidence for your barrier.

Third, the shift towards modularised designs brings an increase in interfaces. More cabinets mean more joints, more penetrations for cables and cooling media and more transitions between components. Experience shows that thermal barriers rarely fail across their surface; they fail at precisely these points.

Fourth, the high share of causes attributable to installation and operation imposes a requirement on traceability. A thermal barrier whose execution is not documented and whose condition cannot be inspected shares exactly the risk that the statistics show. Record the execution in an acceptance report and define access for recurring inspections at the planning stage.

Note: The core message of the loss record — The probability of an incident has fallen markedly, the causes lie overwhelmingly outside the cell, and the course of an incident is protracted. Passive thermal barriers are tailored precisely to this profile: they work independently of the cause of the fault, they need no power supply, and they work for the entire duration of the deployment.

Frequently asked questions

How far has the failure rate of utility-scale battery storage fallen?

According to an evaluation of EPRI's BESS Failure Incident Database, the failure rate at utility-scale storage fell by 97 percent between 2018 and 2023; the updated evaluation reports a decline of 99 percent for 2018 to 2025. The reason given is that lessons from early loss events have fed into new designs.

Are cell defects the main cause of fires in battery storage?

No. In the white paper published in 2024 by EPRI, the Pacific Northwest National Laboratory and an analytics provider, the cause in 89 percent of the assessable failures lay in the controls or in the balance of plant. In 86 percent of cases the root cause was poor installation, faulty design or operator error. Only around 11 percent were attributable to defects in a cell or module.

How long does a fire service deployment at a storage fire last?

For one documented storage fire, the European fire protection association CFPA Europe reports a deployment lasting twelve hours with close to 1,400,000 litres of water and 400 kilograms of extinguishing powder. Sustained heat generation, the risk of reignition and the release of toxic and ignitable gases are characteristic, which is why tactics come down to continuous cooling and prolonged monitoring afterwards.