GUIDE BATTERY STORAGE · 8 MIN.

Retrofitting Existing Assets: Thermal Compartmentation of In-Service Storage Containers

Many first-generation battery energy storage systems no longer meet today's safety expectations. How existing containers can be sensibly upgraded with thermal compartmentation, penetration sealing systems and explosion venting.

Why Existing Storage Systems Are Under Scrutiny Today

Safety requirements for stationary battery storage have evolved considerably within just a few years. Codes such as NFPA 855 in North America have been tightened several times — among other things with requirements for explosion protection to NFPA 68 and NFPA 69 — and in the German-speaking region, publications by insurers and industry associations have made expectations regarding separation distances, partitions and hazard alarm systems more concrete. Plants built before this development generally enjoy grandfathered status as long as they are not substantially modified. But formal grandfathering does not answer the questions that actually concern operators.

These questions come from three directions: from the insurer, who — after documented fires at storage sites worldwide — ties premiums and conditions to the state of the art; from approval authorities and fire brigades, who reassess the entire site in the event of expansion or repowering; and from the operator's own risk management, when the storage system stands closer to buildings, transformer stations or neighbouring installations than one would plan today. In all these cases, thermal upgrading of the existing asset is often the most economical lever — considerably cheaper than replacement or relocation.

Note: Beware of Substantial Modification — Anyone who alters an existing storage system — for instance by swapping modules, increasing capacity or changing the layout — can lose grandfathered status and may have to have the plant reassessed under approval law as a whole. Retrofit measures should therefore be coordinated early with the authority, the fire protection designer and the insurer.

Step One: Condition Survey and Definition of Protection Objectives

Every retrofit begins with an honest condition survey. This covers the documentation situation (cell type and chemistry, existing test evidence, approval notices, fire protection concept), the structural condition of the container shell, the actual distances to buildings, installations and property lines, and the condition of existing systems: fire detection, gas warning sensors, ventilation, suppression equipment, explosion venting. Common findings in first-generation plants: no or inadequate explosion venting, unsealed or improvised cable penetrations, missing thermal separation between battery room and equipment room, and siting distances that do not correspond to today's recommendations.

Protection objectives are derived from the survey — realistically: a retrofit does not turn an existing container into a newly certified system. What is achievable and sensible are concrete, verifiable goals — such as preventing fire spread to the neighbouring container for a defined period, protecting the equipment room, controlled discharge of electrolyte gases, or reducing thermal radiation onto adjacent assets. Each objective dictates different measures; without this prioritisation the retrofit becomes expensive and arbitrary.

Thermal Compartmentation: Measures with Little Space and Weight

The central constraint in existing assets is: there is hardly any space. Racks, cable runs and HVAC equipment are already installed, every centimetre of wall build-up is lost from the maintenance aisle, and the container's structure limits the additional weight. This is exactly where thin high-performance insulation materials play to their strengths: microporous panels and aerogel composites achieve the insulating performance of conventional materials at a fraction of the thickness, enabling an internal upgrade where classic assemblies simply do not fit. Alternatively or additionally, work can be carried out externally — with facing fire protection boards or free-standing fire walls between containers that compensate for distance deficits.

- Internal lining of critical wall areas with thin high-performance insulation, mechanically fixed and executed with tested detailing
- Thermal separation between battery and equipment rooms as an internal partition wall
- Retrofitting tested cable and pipe penetration seals at all penetrations, including closure of unused openings
- Facing fire protection elements or free-standing fire walls between closely spaced containers
- Protection of supporting structures and external cable runs against thermal radiation from a neighbouring event

In parallel with passive compartmentation, the explosion venting should be reviewed. During thermal runaway, lithium-ion cells release substantial quantities of combustible gases, including hydrogen; without properly sized relief areas, an incident threatens a deflagration that would overwhelm any lining. Sizing follows the relevant explosion protection rules — such as NFPA 68 for deflagration venting — and retrofitting relief flaps or panels into the container shell is technically quite feasible for many existing plants. Passive compartmentation and explosion venting must be planned together: the lining must not obstruct the relief paths.

Implementation During Ongoing Operation

Execution in an existing plant differs fundamentally from new construction: work takes place in the immediate vicinity of batteries with high stored energy and DC voltages that may still be present even when switched off. This demands thorough work preparation — an isolation and safeguarding concept agreed with the plant operator, a definition of which racks or container sections are taken out of service for which work steps, and a strict ban on spark-generating work in the battery room as long as cells are installed. Drilling, cutting and welding on the shell are carried out from outside or in cell-free sections wherever possible.

For storage systems that cannot go completely offline, section-by-section implementation has proven itself: the container is divided into work sections that are isolated, upgraded and returned to service one after another. Low-dust installation methods, prefabricated components with as little on-site cutting as possible, and end-of-day site cleaning are not optional extras but preconditions — conductive dust and insulation fibres have no place in a battery room full of power electronics.

Verification, Acceptance and Working with the Insurer

A retrofit is only complete once it is documented. This includes the fitness-for-use evidence of the systems installed (construction type approvals, test certificates, ETAs, classification reports), the installation documentation with photos of details later concealed, labelled penetration seals, an updated fire protection concept and revised fire brigade plans and operating instructions. Where the retrofit was part of a condition imposed by the insurer or the authority, their acceptance should be actively obtained and confirmed in writing.

Let us stay realistic: thermal upgrading is one building block, not a cure-all. Its value unfolds in combination with functioning gas warning and fire detection systems, well-maintained battery management and clear rules of engagement for the fire brigade. But those who consistently align the passive compartmentation of an existing asset with defined protection objectives gain exactly what counts in an incident — time: time during which propagation to the neighbouring container is prevented, time for the alarm, and time for a controlled response.

Frequently asked questions

Does an existing storage system lose its grandfathered status through a retrofit?

Pure improvements to fire protection do not normally jeopardise grandfathered status — quite the opposite. It becomes critical when substantial modifications to the plant are made at the same time, such as capacity expansions or a cell change. Such projects should be coordinated in advance with the approval authority and the insurer.

Can the retrofit be carried out without shutting down the storage system?

Partly. External measures such as facing fire walls are usually possible during ongoing operation. Work in the battery room, on the other hand, requires an isolation concept; section-by-section implementation, in which only part of the plant is out of service at any time, has proven effective.

Why is explosion venting part of the thermal upgrade?

Thermal runaway produces large quantities of combustible gases, including hydrogen. Without properly sized explosion venting, an ignitable mixture can form in the container, and its deflagration would destroy the shell and any lining. Passive compartmentation and explosion protection must therefore be considered together.