Fire safety information for planners on Battery Energy Storage Systems

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Purpose of this briefing note

This note has been prepared by Regen for the Department for Energy Security & Net Zero (DESNZ) following feedback from Local Planning Authorities (LPAs) across England during regional webinars on renewable energy and storage. It is a supplementary resource to support the wider guidance package on Battery Energy Storage Systems (BESS).

Its purpose is to help LPAs in England better understand how fire safety considerations relate to planning decisions for BESS, particularly in informing land use, siting and spatial design. Importantly, this note does not cover technical fire engineering design. These matters sit outside the planning system and are addressed through other regulatory regimes, including building regulations, fire safety legislation and health and safety requirements

This document focuses on the policies and regulations governing BESS in England, with elements applicable to Wales. Planning guidance for BESS in Scotland can be found here.

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1. The evolving context for BESS and fire safety

The deployment of BESS is increasing rapidly across the UK as part of wider energy system flexibility and net zero objectives. The UK government has outlined an ambition to deploy 23 to 27 GW of grid-scale batteries by 2030. The National Energy System Operator estimates that 32 GW will be needed by 2050 under one pathway. As a result, LPAs are increasingly encountering proposals that include complex fire safety considerations.

Fire risk in BESS is taken very seriously by the industry. Recent data shared in the Clean Flexibility Roadmap shows that the fire incidence rate for GB batteries is 0.7% (2020/21-2024/25), lower than that for wider non-domestic building fires in England at 0.8% (2020/21-2024/25).[1, 2] Incidents of fire at grid-scale BESS sites in the UK are extremely rare, with only a handful documented.[3] Where incidents have occurred in the UK, they have demonstrated that safety mitigation has been successful with no propagation (spread of fire) across the site and no significant third-party injury.

Additionally, international data collected by the Electric Power Research Institute shows the rate of failure incidents has fallen sharply (around 97% globally between 2018 and 2023), as lessons from early failures have been incorporated into safer designs, detection systems and operational best practices.[4]

The sector is evolving quickly. Industry practice is becoming more standardised, monitoring technologies are improving and engagement between developers, fire and rescue services and regulators is increasing.

This means LPAs are assessing proposals in a context where:

- Technologies are rapidly evolving
- Risk management approaches are becoming more sophisticated
- Expectations around spatial design are becoming more consistent.

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[1] Calculated by DESNZ from Modo Energy BESS Index (ME BESS GB | Modo Energy) & internal BESS fire incidence tracking.
[2] UK Gov statistics on England non-domestic fires (non-dwelling-fires-attended Fire statistics data tables - GOV.UK), England and Wales non-domestic building stock (Non-domestic National Energy Efficiency Data Framework (ND-NEED), 2025 - GOV.UK), and UK business population estimates (Business population estimates 2025 – GOV.UK).
[3] House of Commons Library, 2025. Battery energy storage systems (BESS)
[4] EPRI, 2024. Insights from EPRI's Battery Energy Storage Systems (BESS) failure incident database: analysis of failure root cause

2. Understanding fire risk

The risk of fire in BESS arises from 'thermal runaway', a process that occurs at the level of individual battery cells. This is when a faulty or damaged battery cell overheats, causing heat to build faster than it can be dissipated. As large battery storage systems contain many individual cells, there is a small risk that one failing cell could affect neighbouring cells within the same container. Importantly, if thermal runaway occurs within a single container, this does not normally constitute a site-wide event, as modern BESS design incorporates measures to prevent inter-container fire propagation.

Changes to battery chemistry

There has been a rapid shift in battery chemistry from nickel-manganese-cobalt (NMC) to lithium-iron-phosphate (LFP) over the past 3-5 years, with LFP becoming the dominant technology in most new BESS developments.

This transition is particularly relevant in the context of fire risk. LFP batteries are inherently more thermally stable and less prone to thermal runaway than NMC systems, making them less likely to overheat or to propagate fire between cells. As a result, while robust fire safety design and mitigation measures remain essential, the widespread adoption of LFP technology has contributed to an improved safety profile for modern BESS installations.

It is important to emphasise that modern BESS technologies incorporate multiple layers of safety design and serious incidents remain uncommon. At the cell level, this includes battery management systems that monitor performance, temperature controls, smoke and gas detection, and integrated fire suppression systems. The site layout and engineering design, such as the physical separation between BESS containers, fire-related enclosures and emergency response access, further reduce risk. Emergency response procedures are typically developed in coordination with local fire and rescue services, and international best-practice standards also guide safe design and operation.

Once a battery site is operational, regular maintenance and continuous monitoring ensure the equipment continues to operate as expected. With strong safety controls in place, battery fires are very rare.[5] Many sites incorporate passive designs that mitigate the propagation of a fire even without active intervention.

[5] Department for Energy Security and Net Zero, 2025. Clean Flexibility Roadmap

3. How fire safety is governed: the wider regulatory system

Fire safety for BESS in England is governed by a strong, multi-layered regulatory system, with responsibilities distributed across several regimes. The planning system is one part of this framework, but is not the primary mechanism for controlling technical fire safety.

BESS projects are governed by a framework from the Health and Safety Executive that provides overarching regulatory oversight of workplace and operational safety.[6] DESNZ supports this framework through its involvement in the Electricity Storage Health and Safety Governance Group, helping to coordinate policy and stakeholder engagement.[7] Operators are required to comply with a wider suite of health and safety legislation, under which the ultimate responsibility for safe operation rests with the site owner and operator.

Alongside this, Building Regulations and fire safety legislation govern aspects of construction safety, building design and fire risk management during occupation and operation. Environmental safeguards are also incorporated to protect soil and waterways. The Department for Environment, Food & Rural Affairs has committed to proceeding with further detailed policy work on including BESS as an activity within the Environmental Permitting Regulations (EPR).[8] If introduced, permitting could require developers to demonstrate to the Environment Agency how specific risks have been managed and would provide ongoing regulatory inspections of BESS sites.

Within this wider framework, the planning system focuses on whether fire risk has been appropriately considered in land-use terms, particularly in relation to siting, layout, separation, access and environmental impacts. It does not determine or assess the specific technical fire safety measures used on a site.

The insurance sector also plays a significant role. With substantial financial exposure, insurers are driving a strong focus on demonstrably low-risk system design and operation of BESS sites. This provides an additional layer of scrutiny and reinforces the importance of robust safety measures across the industry.

In practice, planning authorities are therefore concerned with whether proposals demonstrate that fire-related risks have been appropriately addressed at a spatial level and whether relevant guidance and consultation processes have been followed. Recent appeal decisions reinforce that inspectors tend to focus on location, layout, access and environmental risk pathways, rather than the technical specification of fire safety systems.

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[6] Health and Safety Executive, 2025. Grid-scale battery energy storage systems
[7] DESNZ, 2024. Health and safety in grid scale electrical energy storage systems
[8] DEFRA, 2026. Consultation outcome. Summary of responses and government response

The planning system has a role to play in fire safety for BESS in England, but it should not interfere with or override other regulatory systems on matters not relevant to land use. Where applications indicate that other regulatory systems will address aspects such as fire safety, LPAs are recommended to take this into account.

Photo credit: Eku Energy

Photo Credit: Zenobe

4. NFCC guidance and fire and rescue services: the operational interface

The guidance issued by the National Fire Chiefs Council (NFCC) and fire and rescue services plays an important role in shaping how fire risk is managed in BESS developments. Their role sits outside the planning system's decision making powers and instead operates within the wider operational fire safety and emergency response framework.

Understanding this role is important for LPAs, as it helps clarify how fire safety considerations are addressed in practice, and how different parts of the system interact.

The role of NFCC guidance

In April 2023, the NFCC published initial planning guidance for grid-scale battery energy storage systems. The most recent update to this guidance, published in February 2026, reflects the rapid evolution of both BESS technologies and industry practice.[9] It incorporates an updated understanding of fire behaviour, operational response considerations and site design approaches. It places particular emphasis on engagement and proportionality, recognising that BESS projects vary significantly in scale, context and risk profile. It also reflects the sector's increasing maturity and the move towards more standardised design approaches.

Importantly, the NFCC guidance is not a statutory or mandatory standard. It does not establish a set of prescriptive requirements that must be demonstrated for planning approval, nor does it function as a compliance standard within the planning system. Instead, it is intended to support:

- Informed discussion between developers, fire services and planners
- Consistent understanding of risk factors across different projects
- Proportionate, context-specific application of fire safety principles.

The guidance is referenced in the Planning Practice Guidance for renewable and low-carbon energy, which encourages planning authorities and applicants to have regard to relevant fire safety guidance, including that produced by the NFCC, where appropriate to the development being considered.[10] NFCC guidance should not be treated as a checklist for planning approval, but as a framework for engagement and understanding.

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[9] NFCC, 2026. Grid scale energy storage system planning - Guidance for fire and rescue services
[10] MHCLG, 2023. Renewable and low carbon energy

The role of fire and rescue services

Fire and rescue services are responsible for preparing for and responding to fire incidents, rather than regulating infrastructure design. In the context of BESS, fire and rescue services are not a statutory consultee for planning. However, as stated in the NFCC guidance, they have a "*statutory responsibility under the Fire and Rescue Services Act. This includes obtaining information to assist with the extinguishing of fires, and the protection of life and property in their area*".[11]

Their involvement is primarily focused on ensuring that, should an incident occur, it can be managed safely and effectively. In planning terms, fire and rescue services' input is typically most relevant to inform:

- Site access and internal circulation routes
- Emergency response strategies and operational feasibility
- Understanding of layout constraints and containment logic
- Engagement during pre-application design discussions.

This operational perspective means that fire and rescue services' input is particularly relevant at the site design stage, where layout and access decisions are being made. Developers frequently engage with them voluntarily, particularly for larger or more complex schemes. Early engagement allows operational considerations to be incorporated into the design before submitting a planning application, while local authorities may liaise with fire and rescue services for advice and comments during assessment.

Post-planning, during the detailed design and construction phase, there is greater engagement with the relevant fire and rescue service to develop site-specific emergency response plans, once technology selection is confirmed and the designs are finalised. LPAs should expect that the relevant fire and rescue service will be invited to attend the site to review emergency response procedures during both the construction and operational phases of the project.

How NFCC guidance and fire and rescue services' input influence BESS design and development

In practice, NFCC guidance and fire and rescue services can influence BESS development primarily through design iteration and early-stage engagement, rather than through formal regulatory approval processes. They also inform operational procedures and emergency planning throughout the lifecycle of a site.

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[11] Fire and Rescue Services Act 2004

While fire and rescue services are not statutory consultees for planning applications, their input helps ensure that operational considerations are embedded in site design, construction and operation, providing context and reassurance to planners.

1. Conceptual/pre-planning stage

Developers are increasingly using NFCC guidance and other international standards as a reference point when designing site layouts, particularly in relation to:

- Separation distances between infrastructure elements
- Access routes and site circulation
- Spatial organisations and containment strategies
- Consideration of emergency response requirements.

Fire and rescue service engagement at this stage is generally limited and informal, but where it occurs, it helps validate adherence to NFCC guidance and allows these design assumptions to be tested against operational realities.

2. Detailed design/pre-construction stage

Once the technology and site design are confirmed post-planning, developers engage more closely with the fire and rescue services. This phase focuses more on developing site-specific emergency response plans and testing design assumptions against operational realities. Feedback from the fire and rescue services may lead to refinements in layouts, adjustments to access arrangements, or changes to the configuration of infrastructure within a site.

3. Construction/early operations stage

During construction and early operations, fire and safety services' engagement becomes practical and hands-on, including site visits, familiarisation exercises and joint training. This ensures that the emergency response plan is fully operational and that emergency services are confident in their response procedures.

This iterative process means that NFCC guidance and fire and rescue services' input are embedded throughout the BESS development lifecycle. By the time an application reaches the planning stage, many fire-related considerations have already been addressed through design development, internal risk assessment and engagement with operational stakeholders. For LPAs, this is an important point of context, demonstrating that fire safety is not being considered for the first time at the planning stage but is already embedded in the design process.

Photo Credit: Pulse Clean Energy

Relationship to planning decision making

Within the planning system, the role of NFCC guidance and fire and rescue services is best understood as informing the evidence base, rather than introducing additional decision-making requirements.

Planning authorities are not responsible for determining compliance with NFCC guidance, nor for assessing the adequacy of detailed fire engineering solutions. However, they may have regard to whether:

- Relevant guidance has been considered
- Engagement with fire and rescue services has taken place where appropriate
- Site layout and access arrangements reflect operational considerations.

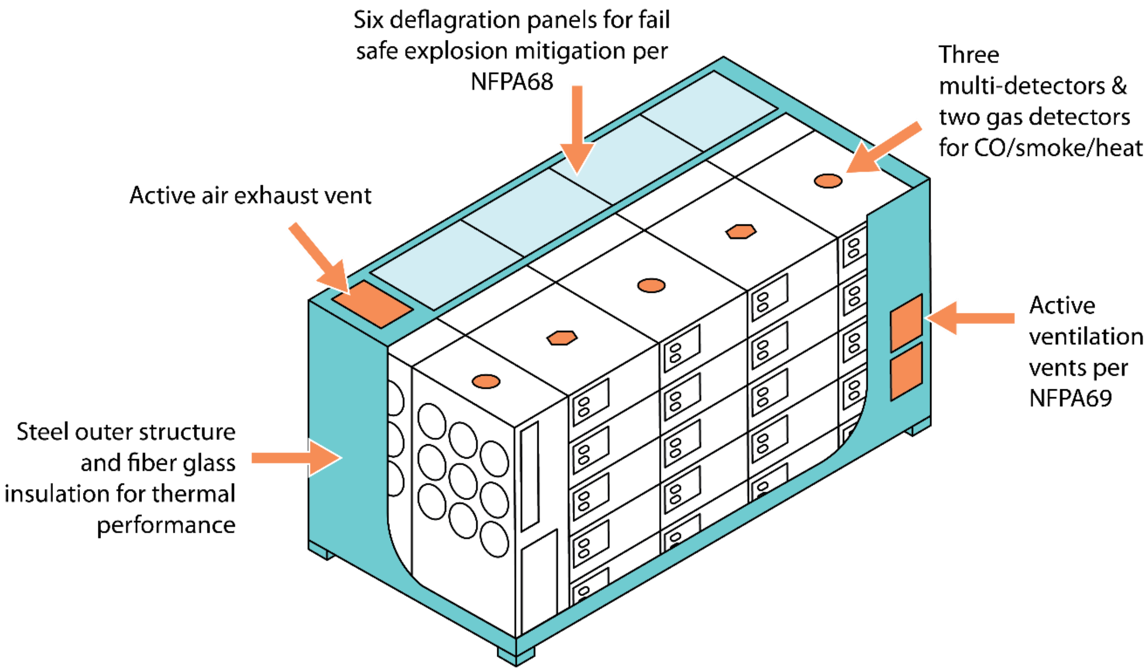
In this way, NFCC guidance and fire and rescue services' input can help provide confidence that fire risk has been considered in a structured and informed way, without requiring planning authorities to assess technical detail.

5. How fire risk is managed in practice

Fire risk in BESS developments is actively managed through evolving industry practice, particularly at the design stage. Industry practice and guidance, including that from the NFCC, emphasise the need to design sites to limit both the likelihood of escalation and the potential for spread.

In practice, this means that BESS sites are designed with layered systems of fire prevention, detection and containment (Figure 1). The aim is not only to reduce the likelihood of an incident, but also to ensure that, if one does occur, it can be effectively managed with minimal off-site impact and a safe, coordinated emergency response.

Figure 1. Safety measures are built into individual battery containers.



Note: This is a schematic diagram and specific technologies may differ.

Battery storage design has evolved significantly in recent years, and developers continue to refine and enhance safety approaches as technology develops and operational experience grows. Each new project typically incorporates the latest available technology, updated design practices and lessons learned from previous deployments. This iterative process is reinforced by engagement with insurers, regulators and fire and rescue services, helping to embed safety improvements across the sector.

Where incidents do occur, lessons are shared across the industry and with fire and rescue services to inform future design approaches and operational response planning.

Taken together, these developments demonstrate that fire risk in BESS is being managed through a combination of technology, site design, operational practice and wider commercial and regulatory drivers, with a clear direction of travel towards reducing both the likelihood and potential consequences of incidents. This reflects a sector that is becoming increasingly standardised and mature, particularly in the delivery of grid-scale projects across the UK.

Modular nature

Modern systems are typically modular, using enclosed battery containers with integrated monitoring, detection and control systems. These technologies enable early identification of abnormal conditions and support intervention before faults escalate.

At the container level, some systems incorporate engineered gas management and explosion mitigation features, including active ventilation designed in accordance with NFPA 69 principles and deflagration relief panels designed in accordance with NFPA 68, to reduce the risk of pressure build-up and provide controlled venting in the unlikely event of internal deflagration.[12]

Site layout

Site layout (see Figure 2) is a central mechanism for managing fire risk in BESS developments. Increasingly, developers are adopting more consistent and structured approaches to site design, reflecting both evolving industry practice and the principles set out in guidance such as that produced by the NFCC, alongside other relevant standards.

Clearance distances are typically provided between operational infrastructure and occupied or welfare buildings, such as substation control buildings. This ensures appropriate separation between higher-risk energy storage components and areas of regular personnel activity.

While early grid-scale BESS projects were more conservative in spacing between battery enclosures and adjacent infrastructure, current best practice uses large-scale fire-testing methods to demonstrate that fire will not propagate between adjacent containers, sometimes supporting distances of less than a metre.

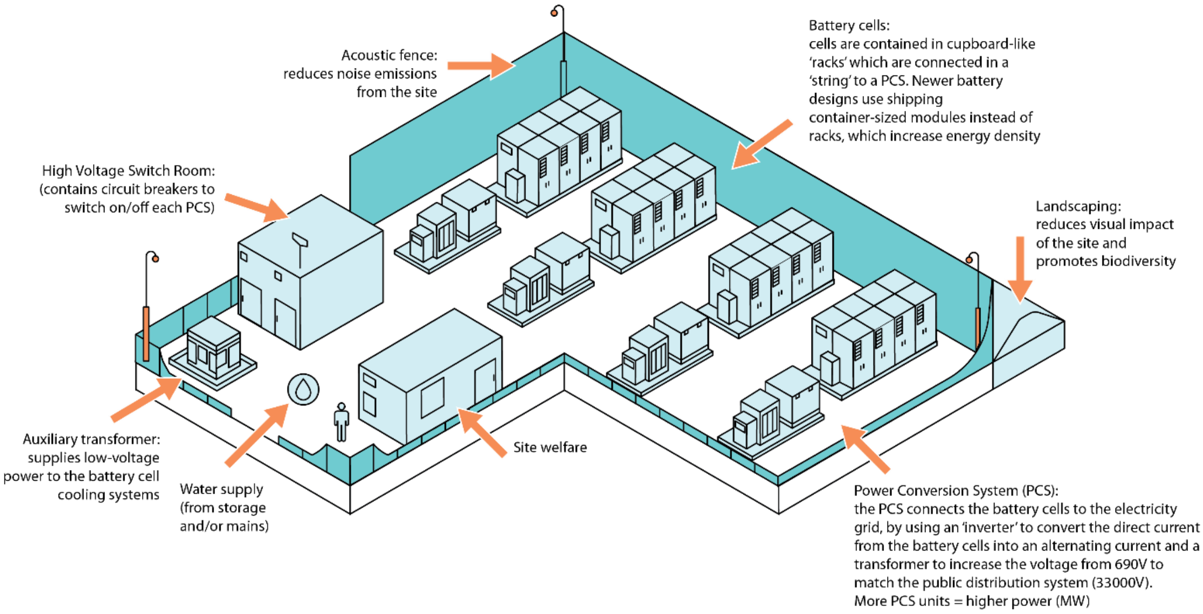
Alongside these measures, developers are increasingly using structured zoning and repeatable layout configurations across projects. This includes grouping infrastructure into defined zones, maintaining consistent internal spacing and designing layouts that are readily understandable and navigable by emergency responders.

Access routes are also a key component of site design. These are typically configured to support safe and effective movement of fire and rescue services within the site, enabling

[12] CSA Group, 2026. Deflagration safety: why NFPA 68 and NFPA 69 matter for energy storage

operational response while maintaining appropriate separation from potential hazard areas. Developers may consider providing two separate vehicular access and egress points to the BESS compound, enabling the local fire response service to approach safely while accounting for prevailing wind directions. A looped internal road can help to accommodate fire vehicles navigating the site and accessing enclosures. Hardstanding surfaces, wider road widths and gentle gradients further support safe and reliable access.

Figure 2. Safety measures built into BESS site layout.



Note: This is a schematic diagram and specific sites may differ.

Water usage

The NFCC provides guidance on battery storage fires. In line with this guidance, if a battery fire occurs, water is applied strategically to protect adjacent containers and contain the incident, employing a controlled-burn approach to the affected container. Using such an approach reduces water use, as water is used for defensive cooling and boundary protection rather than for direct extinguishment. Specialised battery technology and appropriate spacing prevent any fire from spreading.

Water drainage and containment

Battery storage site designs include plans for managing water in an emergency. Firefighting water can mix with battery electrolytes and other chemicals during a fire. To manage this, containment measures such as bunds, interceptors, lined drainage or storage areas are used to prevent runoff from entering soil or waterways.

Following NFCC guidance, operators develop robust outline battery safety management and emergency response plans alongside local fire and rescue services, ensuring that water use, containment and fire response are managed in accordance with regulatory requirements.

A controlled-burn approach

The NFCC guidance acknowledges that battery storage fires are difficult to extinguish and that using large volumes of water can generate large volumes of contaminated firewater runoff. To address this, it describes a managed or 'controlled-burn' approach as the prevailing firefighting tactic in many BESS incidents.

In practice, this means:

- Allowing the affected battery container to safely burn itself out under controlled conditions
- Using water defensively for boundary cooling to protect neighbouring containers and prevent fire spread
- Focusing on containing the fire, rather than aggressive extinguishment using water.

This approach reduces water usage and protects the surrounding environment.

Airborne emissions

The environmental consequences of battery storage fires have been studied through real-world incidents, experiments and monitoring, and show minimal long-term impact compared to other industrial fires.[13] Airborne emissions, which can include carbon monoxide, carbon dioxide, volatile organic compounds and trace gases, disperse rapidly into the atmosphere at outdoor sites. Developers are aware of the potential impact on neighbouring buildings and take this into account in emergency planning and response. Smoke plumes from a fire naturally rise above building heights, helping to minimise effects on nearby properties. Rapid dispersion also keeps concentrations below flammability or toxic limits.

Monitoring and control systems

A key area of development is the use of advanced monitoring and control systems, which track parameters such as voltage, temperature and cell performance in real time. These systems are designed to detect early signs of abnormal behaviour, allowing operators to intervene at an early stage and significantly reduce the likelihood of escalation into thermal runaway events.

[13] Fire & Risk Alliance, LLC, 2025. Assessment of Potential Impacts of Fires at BESS Facilities

Relationship to planning decision making

At the planning stage, fire safety in BESS developments is considered at a strategic level, focusing on whether a site can accommodate appropriate risk management rather than fixed technical design solutions. This reflects the early stage of project development, where system specifications and detailed engineering approaches may still evolve.

As a result, developers are opting to use a parameter plan (Rochdale envelope approach), which defines the overall limits of the development while allowing flexibility in how detailed fire safety measures are ultimately defined.

For decision makers, the key consideration is whether the proposed parameters provide a robust framework for effectively managing fire risk through subsequent design development and operational controls, rather than technical system specifications.