



NATIONAL **FIRE** SAFETY SERVICES

FIRE SAFETY MANAGEMENT PLAN

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Unit 4 & 5 Wrens Court
Lower Queen Street
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Battery Storage Safety Management plan

Land West of Hardybarn Lane,
Buxton,
SK17 7JB.

HARDYBARN LANE

Version Control

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Information

1. Introduction

1.1 Purpose

The following information is provided to ensure that the relevant persons are aware of the risks posed by the battery storage systems and the measures taken to prevent an incident or fight a fire on the site. The plan has been developed with the safety of the public and emergency responders in mind and based on reducing the risk as far as is reasonably practicable. The fire strategy for the site is active prevention and intervention, automatically extinguishing any fire within the container, not being reactive, letting the fire spread to engulf the whole container, e.g., let it burn to be extinguished by the Fire Service (as in the Liverpool case).

The report is based on the National Fire Chiefs Council (NFCC)- Grid-Scale Battery Energy Storage System Planning – Guidance for Fire and Rescue Services (2022).

Grid-scale Battery Energy Storage Systems (BESS) are a fundamental part of the UK's move toward a sustainable energy system. The installation of BESS systems both in the UK and around the globe is increasing at an exponential rate. Several high-profile incidents have taken place, and learnings from these incidents continue to emerge and develop.

In preparing this report, regard to the NFCC recommendations and the recommended additional guidance, some of which has been updated in 2023 and 2024, has been considered within this document.

State of Victoria (County Fire Authority) (2023), Design Guidelines and Model Requirements: Renewable Energy Facilities.

FM Global (2024) Property Loss Prevention Data Sheets: 5-33 LITHIUM-ION BATTERY ENERGY STORAGE SYSTEMS

NFPA 855 (2023) Standard for the Installation of Stationary Energy Storage Systems.

Axminster decision (ref APP/U1105/W/23/3319803).

1.2 Limitations

This emergency response plan assumes in good faith that relevant Standards are complied with, maintenance and testing is carried out as required and that there is no foul play or intentional contravention of fire safety measures concerning the battery storage systems. With appropriate evidence provided to support any claims made on performance, and with appropriate standards cited for installation.

It is also assumed that those parties consulted throughout the planning application stages and those controlling the site are competent and prioritising life safety in respect of the development and management of the site.

Any alterations to the content, usage or layout of the site would require the emergency response plan to be revisited.

2 Planning application

This Fire Plan is to support the planning application following the guidelines set out in the National Fire Chiefs Council's Grid-Scale Battery Energy Storage System Planning – Guidance for FRS (2022). This guidance aims to limit the content to such matters that directly relate to facilitating a safe and effective response by the fire and rescue service to a fire or vapour cloud release from the site. This report has been prepared on behalf of S&L Energy. The Scheme is a nationally significant infrastructure project.

2.1 Information provision.

During construction and on completion, all access information and risks will be conveyed to the fire service as part of FRS planning in accordance with arrangements required under section 7(2)(d) of the Fire and Rescue Services Act (2004). Site Specific Risk Information (SSRI) should be made available to crews in the form of an effective Emergency Response Plan that will be available on-site.

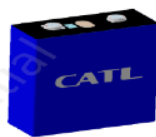
Details of any site access arrangements, such as key codes, will be provided to the FRS

3 System Design and Construction.

3.1 Battery Chemistry

The batteries on this site will be based on the following chemistries: Lithium-ion Phosphate (LFP) batteries. The form factor will be prismatic in a pouch that is combined into modules that then fit within a rack. There are 5 racks per side held within containers measuring 6.06M X 2.44 X 2.59. UL940A fire test data may be available if required. Manufactured by CATL, these are based on the EnerC Battery container.

Specification:



Item	Cell	Module	Container
Configuration	/	1P52S	10P416S
Dimension (W*D*H)(mm)	173.9*207.2*71.7	740*1050*230	2462 *6058*2896
Weight (kg)	5.36±0.30Kg	330±5kg	~35000kg
Rated Voltage (V)	3.2	166.4	1331.2
Voltage Range(V)	2.8 ~ 3.6	145.6 ~ 187.2	1164.8 ~ 1497.2
Rated Energy(kWh)	0.896	46.59	3727.36

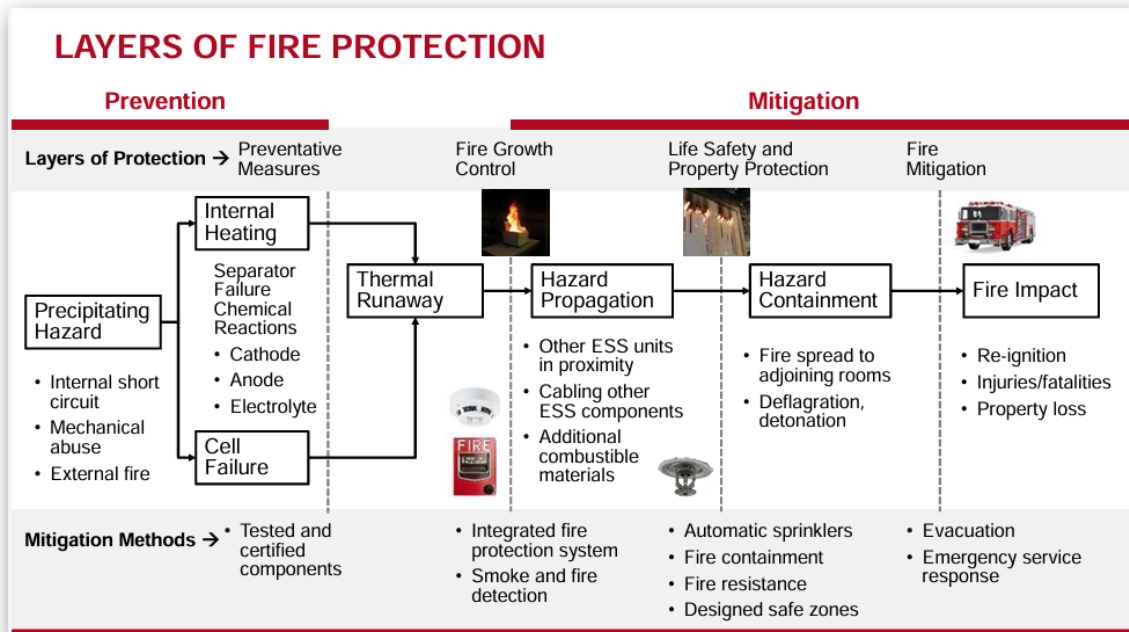


The site is a 240MW facility with 48 battery containers, 24 inverters & MVSS Skids. There will be supporting ancillary equipment, a control room, switch rooms, and a sprinkler pump container. There will be Bulk water supplies with a capacity of 850,000lts that could be used for general firefighting operations, there will be environmental containment (to contain any contaminated firewater runoff) there will be a deluge water suppression system installed within each container that will be supplied via a bulk stored water supply connected to a water utility supply, There are 2 alternative access points one on the north of the site with an alternative emergency access point to the south of the site, the site has a perimeter access road and internal roads allowing full access to all areas of the site if required for general firefighting operations there will be fire hydrants located at several locations to ensure that any hose lines used for firefighting will not exceed 60 metres.

The site has been designed around an energy pack configuration, each pack consists of 4 containers with the separation reduced based on the recommendations within NFPA 855 as well as using an internal water deluge sprinkler suppression system to prevent a cascading effect within the module/rack or container and impingement of radiated heat on adjacent containers, there will be a further 6 -metre spacing between packs as a fire break within the site, and 10 metres from the site boundary. The containers will also have 60-minute fire resistance to the walls. The container has no internal access for persons, access to the batteries is via an external access door, and will be installed with progressive layers of active and passive fire safety measures, the fire strategy for the site is to be proactive and reduce/extinguish any thermal event and fire at the earliest possible opportunity to prevent/contain an event to a single module or rack within the container and with the advanced active water suppression system within each container. This site will not be designed around a container becoming fully involved in a fire and then relying on the fire service to extinguish the fire and prevent it

from spreading to adjacent containers. Indeed, the Active water suppression system should not require any firefighting action for an incident within a container from the fire service.

The fire safety systems have been designed with multiple layers of protection.



Other facilities on the site include:

- Inverters and transformers.
- High and low voltage cabling.
- Substations
- Control room
- Boundary fencing and security measures.
- Access roads, both internal and external.
- Car Parking
- Landscaping
- Hard standings
- Bulk water Holders
- Sprinkler pump house.

Following the NFCC agreement with the Environment Agency and the memorandum of understanding, provision has been made for the containment of firewater runoff on site until disposal by a specialist contractor. There are alternative access points to the site. The principal access is via the access road to the north of the site, and the emergency access is via the south access point that will comply with Approved Document 'B' Volume 2 Buildings other than dwellings, B5 Access and facilities for the fire service. A perimeter road around the site boundary and access roads within the site will provide access to all areas of the site.



Figure 2 fire service access plan

3.3 Fire suppression medium.

Several suppression systems using a range of media have made claims about extinguishing lithium battery fires with agents other than water, based on suppressing the initial fire but not the ability to provide sufficient cooling to prevent thermal runaway.

The NFCC guidance acknowledges that 'Efficacy relative to the hazard. There is no evidence that gaseous protection is effective in extinguishing or controlling a fire involving battery energy storage systems. Gaseous protection systems may inert or interrupt the chemical reaction of the fire, but only for the duration of the hold time. The hold time is generally ten minutes, not long enough to fully extinguish an ESS fire or to prevent thermal runaway from propagating to adjacent modules or racks.

The suppression medium recommended by the NFCC, water in this case, has a high thermal capacity so that it can absorb high quantities of heat. This makes water an ideal medium and has the benefit of being widely available. This has been confirmed in the only large-scale testing into lithium batteries and suitable suppression systems that have been undertaken by FM Global. The undertaking of large-scale testing to extinguish a Lithium Battery fire has shown that a fire within an LFP battery within a rack could be contained by reducing the temperature to below its thermal runaway temperature and prevent the effect of thermal runaway to adjacent batteries and racks within a container.

The FM Global research into suppression systems involving BESS fires has identified that a water suppression system can extinguish/prevent a battery fire within a rack spreading to adjacent modules/racks/containers, with a design density of 12mm per minute. Based on this design the system has taken into account the principal issue of thermal runaway and the cascade effect between

cells/modules and reignition, The capability of this system will ensure that the suppression system will be able to operate for as long as the fire service deems necessary, initially within an individual container for 48 hours, but if required (extremely unlikely but for added resilience) the water suppression sprinkler system could be activated within all four containers comprising of the pack.

3.3.1 Automatic water suppression system

The water suppression system has been designed following the NFCC guidance, NFPA 855 and FM Global large-scale testing of water sprinkler systems, and the FM Global Property Loss Prevention Data sheet (LITHIUM-ION BATTERY ENERGY STORAGE SYSTEMS) this has identified that lithium iron LFP batteries are relatively safer than other types of lithium batteries due to the higher temperature required to trigger thermal runaway. It is the thermal runaway that has been identified as the principal risk in BESS fires and a concern of the NFCC.

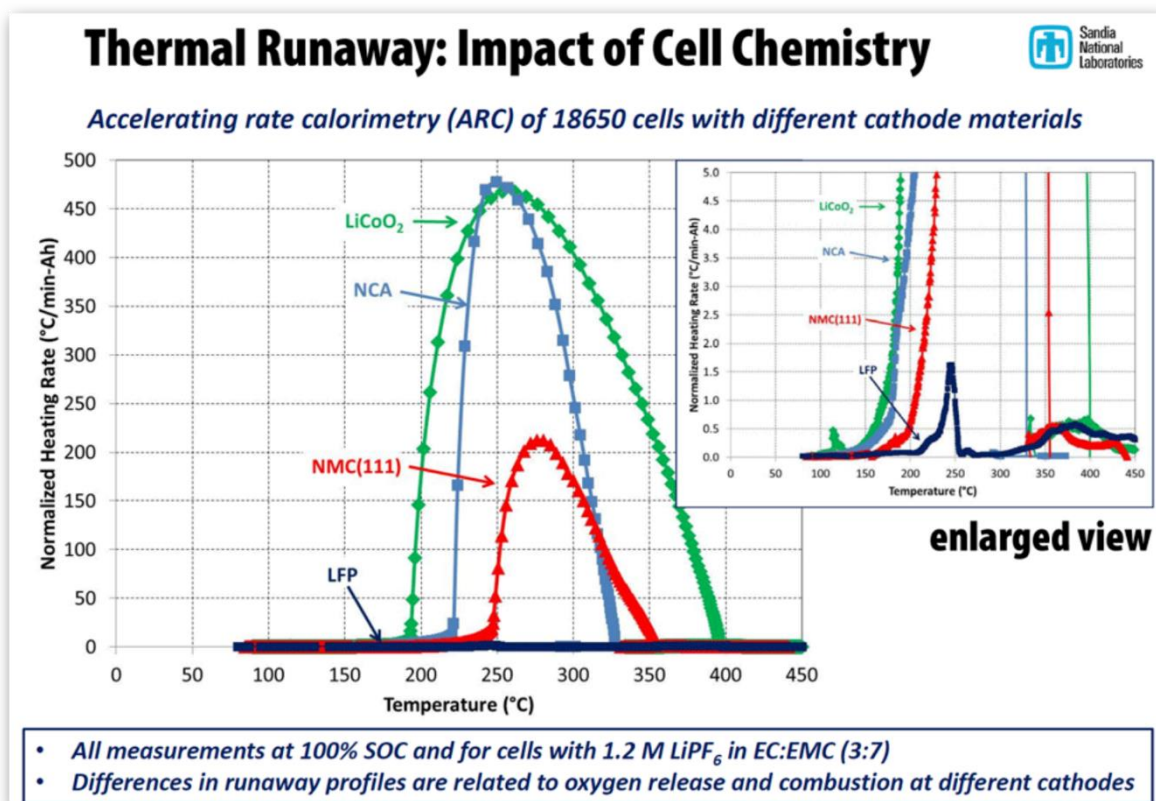


Figure 3 Battery chemistry risk

As can be seen in the above chart the battery chemistry being used on this site is regarded as being the safest type due to its ability to withstand higher temperatures before entering into thermal runaway.

The site has been designed with multiple layers of fire safety protection, with systems designed to prevent thermal runaway, a safety-first approach has been taken so that all known eventualities have been accounted for within the multi-layered approach to fire safety to ensure that the site is as safe as reasonably practicable.

If an incident occurs that may lead to a cell /module entering into thermal runaway then the off-gas detection along with the battery management system will automatically trigger the water suppression system so that a battery fire within a rack can be contained/ extinguished that will prevent the thermal cascading effect to adjacent cells/modules/racks and containers, The water drencher system follows

the design as specified in the US standards. And will be installed to British Standard BS 12845 - Fixed firefighting systems. Automatic sprinkler systems. Design, installation and maintenance.

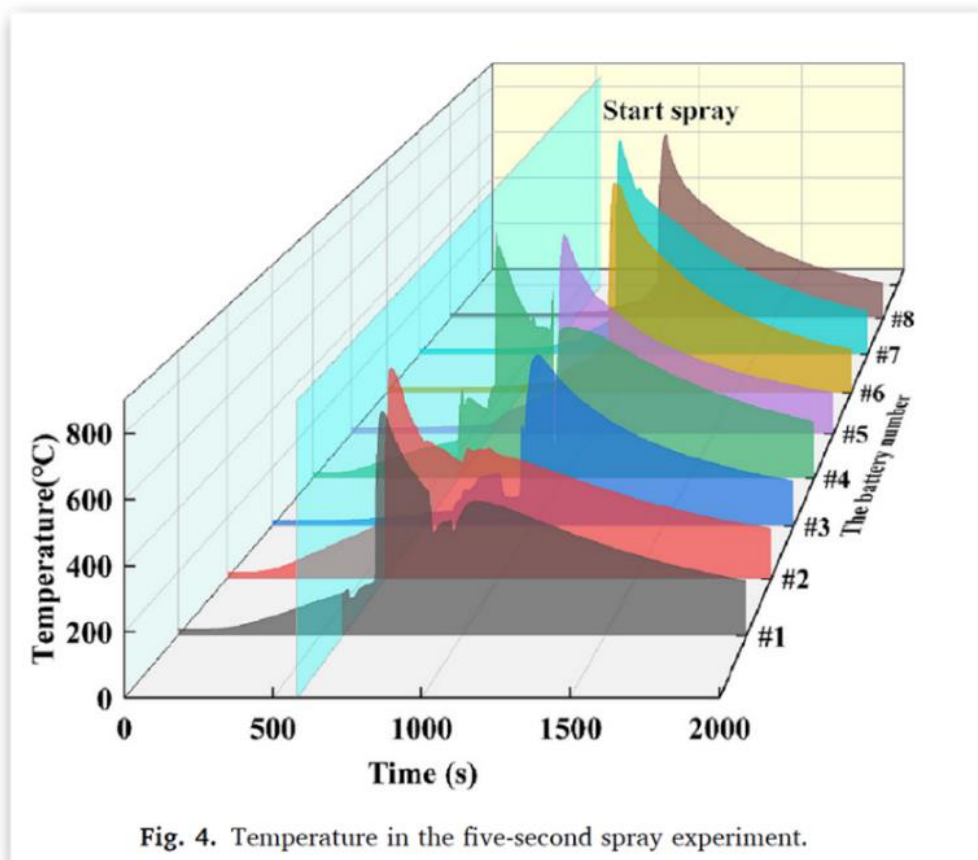
The water demand area is based on the number of sprinkler heads needed to provide adequate protection during a large-scale fire test plus a 50% safety factor.

These design parameters have been used in the specification for each container's automatic water suppression system.

3.3.2 Water Suppression Testing.

The following charts indicate the benefits of the water suppression systems. There were 2 experiments undertaken in this research to show the issue of reignition and the need for continued application of the water suppression system.

In the first experiment, the system was operated for a period of 5 seconds and then stopped to see the effect on temperature and reignition.



In the second experiment, there was continuous application of the water suppression system.

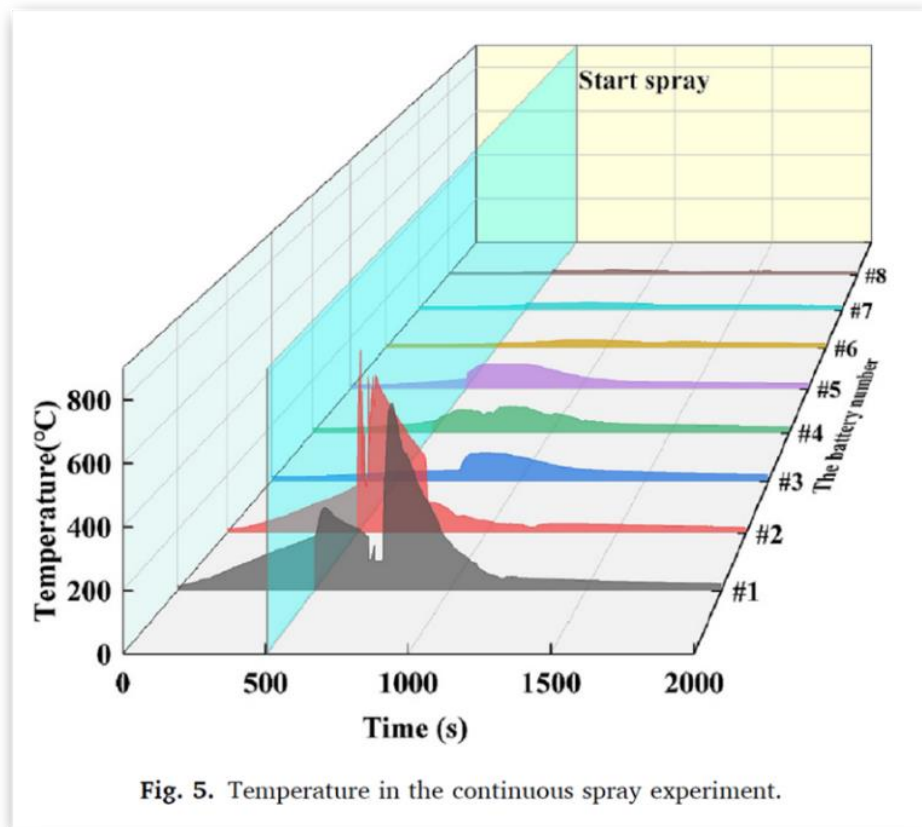


Fig. 5. Temperature in the continuous spray experiment.

This shows the advantage of water suppression as an extinguishing medium with its high heat absorption rate and rapid cooling effect on Lithium -ion LFP batteries.

3.3.3 Boundary Firefighting Water Supply

The NFCC recommends a hydrant supply or bulk water storage to supply of 1900 lpm for 120 minutes a total of 228000lts required for firefighting use for other types of fire incidents not involving the Lithium -ion batteries and boundary cooling if the container is to be left to burn out. No boundary cooling is required as the fire strategy is not to let a fire spread within the container and become engulfed, and then firefighting would be required to be undertaken a so called 'let it burn' strategy. But these active suppression systems will proactively intervene with the automatic water suppression system that will prevent any fire from becoming large enough to generate radiated heat to impinge on an adjacent container/infrastructure that would require boundary cooling.

3.3.4 On-site Water Supply

The NFCC guidance recommends water supplies for firefighting scenarios on the site (grass fires, other structure fires etc).

The NFCC guidance requests a pressure-fed supply providing 1900lts for 2 hours or bulk water supply (above-ground tanks) with a minimum capacity of 228,000lts this is for other types of fire incidents and boundary cooling purposes of adjacent containers based on a worst-case scenario that a whole container is on fire and to prevent radiated heat impinging on an adjacent container or infrastructure.

This may be suitable for a 'let-it-burn' strategy, with the detrimental effect on the environment and possible firefighting operations. The strategy for this site is to be proactive and intervene at the earliest possible time with an automatic water suppression system to prevent escalation, as was the case at Carnegie Road, Liverpool and referenced within the Axminster appeal.

Even though this boundary cooling will not be required, as the water suppression systems' high thermal capacity will absorb any heat produced within the container. This heat absorption will mean there is no radiated heat to impinge on an adjacent container. But as an additional fire safety measure and level of protection. There will be a bulk water tank supply of 850,000 lts of water located on the site, nearly 3.5 times the recommended amount.

The bulk water supply is based on the requirements of the Automatic water sprinkler system. The additional bulk water supplies have been calculated based on the FM Global Research Technical report (development of sprinkler protection guidance for lithium-ion based energy storage systems) and the NFCC reference document FM Global property loss prevention data sheet 5-33 Lithium Ion battery storage systems (revision 2024). The bulk water supplies for the internal water suppression system will require a total water supply of 777,600 litres.

A single container has been designed to operate for a minimum of 48 hours for a single container without any resupply $270 \text{ lpm} \times 60 = 16,800 \text{ lts hour} = 777,600 \text{ lts per 48 hours}$.

The fire service will have total control over the options to operate as many of the containers within a pack as required.

Total water supply over a 48-hour operation with the water sprinkler system operating within one container, water supplies a total of 850,000 lts would be available on site.

The bulk water supply tanks will comply with Loss Prevention Standard 1276 Requirements for the LPCB certification and listing of above-ground suction tanks for sprinkler systems that will have the standard fire service couplings and be confirmed as suitable by the FRS.

3.3.5 Smoke Detection

Smoke detection and air sampling detection following BS 5839 PT 1 L4/5 is provided within the ancillary buildings and battery containers for early detection in the event of a fire not related to the Lithium-ion batteries to ensure any other type of fire is identified rapidly the fire alarm system will be linked to a control panel that based on the cause and effect matrix will operate the first stage suppression system to extinguish any other type of fire not related to the lithium-ion batteries and linked to the remote monitoring station to ensure a rapid response and investigation to an alarm raised.

3.3.6 Heat Detection

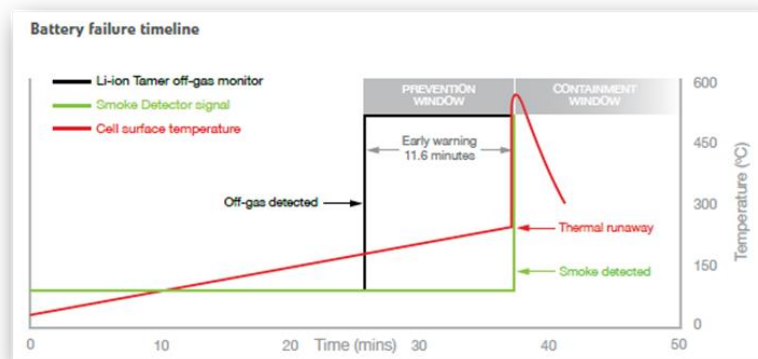
Heat detection following BS 5839 PT1 is provided as a further activation point for fire safety measures such as the water suppression system. The temperature required for activation of a heat detector would not occur early in the detection phases of an incident but is employed as a further line of defence in activating firefighting systems.

3.3.7 Off Gas Detection

Due to the reaction of the process that causes thermal runaway, The very latest research into the prevention of thermal runaway has identified an early detection system that has been proven to prevent thermal runaway this system of detecting what is termed off gas is part of the chain reaction leading to thermal runaway, this early detection of the Volatile organic compounds that make up the off-gas allows the early intervention of the BMS to cut the power to the battery/rack and container to prevent energy being supplied and therefore increasing the temperature within the battery as the state of charge is directly related to the energy and heat produced in a thermal runaway event. Therefore, the early off-gas detection in the early stage of thermal runaway of the batteries is vital in preventing an explosion and fire. The off-gas detection system is intended to detect an issue with the batteries where the separator fails before a thermal runaway occurs. Off-gas detection has been proven to detect VOCs prior to and earlier than any conventional gas detection and will be installed within each cabinet at the top and bottom of battery racks. This is due to the off-gassing being both heavier and lighter than air, depending on the compounds within the battery, ensuring the earliest possible detection and the prevention of thermal runaway.

This off-gas detection will be installed in all containers. Off-gas detection equipment detects volatile organic compounds (VOCs) associated with the degradation of the electrolyte during the early stage of cell failure. Before a cell goes into thermal runaway, VOCs produced by the degradation of the cell are released in trace amounts. This occurs at a much lower temperature than the thermal runaway threshold.

As indicated in previous sections, heat and flammable and/or toxic gas production are the two basic factors to determine the hazard of the battery failure. Consequently, the safety of a battery system can be improved by first avoiding the condition leading to heat and gas generation, and secondly by managing the heat and gas generation to alleviate the effects of failure. There is a period available for early intervention and the prevention of thermal runaway.



3.3.8 Temperature Monitoring

In addition to the battery management system temperature controls, there will be further temperature measures installed within the container. This is planned to allow the FRS to identify the temperature within the container following an incident.

3.3.9 Exhaust/Ventilation Systems

A ventilation system is linked to the battery management system to ensure the container temperature is maintained within the manufacturer's recommended temperature range. There is a liquid cooling system within each rack to ensure sufficient cooling, as well as internal fans to maintain airflow. This system will also vent the containers to prevent any concentrations of gases from reaching an excessive level. Exhaust systems will be designed to prevent deflagration and should keep the environment below 25% of the Lower Explosive Limit (LEL).

3.3.10 Deflagration Venting System

In containers with no off-gassing detection capability, there is a likelihood of a possible deflagration taking place due to the delay in the detection of thermal runaway, where off-gassing has occurred due to a separator failure within the batteries, the battery container will begin to fill with explosive gasses which can reach a concentration that causes an explosion. To prevent harm to firefighters, the deflagration vents would allow the pressure to release upwards and away from the container ensuring that the ventilation and dispersion will prevent any build-up of explosive gasses and that the upper and lower explosive limits are not reached as these containers do have an off gas capability and water suppression system that will prevent the build-up of explosive gases and the likelihood of a deflagration is remote but as an additional layer of protection for firefighters explosion vents in the roof of the container will be provided to ensure any explosion has a vertical trajectory rather than horizontal, protecting any person in the vicinity.

4 Testing

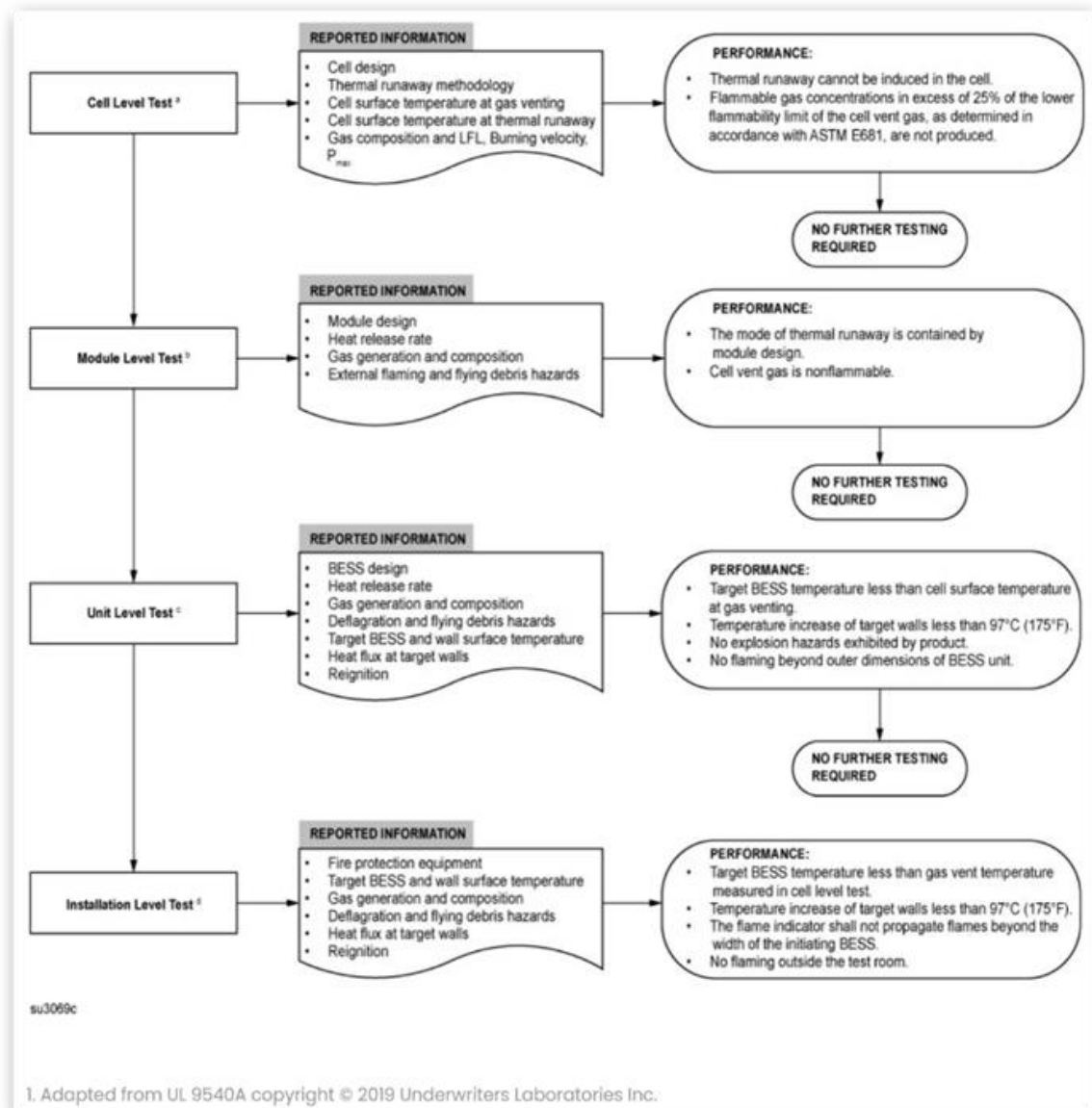
4.1 Testing UL 9450 & UL 9450A

UL 9540 is the Standard for the Safety of Energy Storage Systems and Equipment.

UL 9540A Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems.

The Installation will have certification to UL9450, which requires testing to UL 9540A as per the manufacturer's specification.

The principal concern with BESS sites is the risk of fire and the possibility of thermal runaway, which is influenced by the battery chemistry. The battery chemistry directly affects the likelihood of an event and dictates the amount of heat released during thermal runaway, the vapour cloud formation, and the toxicity of by-products. The Lithium-ion Phosphate (LFP) batteries used at this site are currently the safest chemistry available, with higher temperatures required to trigger thermal runaway and will have been assessed following UL 9540A (testing the fire safety hazards associated with propagating thermal runaway within battery systems) based on four testing scenarios: cell, module, rack and Installation.



The test results are used to establish the temperature at which thermal runaway will occur, and the likelihood of this cascading into adjacent cells. This allows us to design the fire protection systems to intervene in the reaction and prevent/reduce thermal runaway or a cascading event.

A lithium-ion battery can result in a fire due to electrical, mechanical, or thermal failures. Electrical failures occur most commonly in situations where the battery is overcharged or held in a state of undercharge. Mechanical failures occur from short-circuiting and physical issues within the battery where there has been a manufacturing defect or physical damage post-manufacture. A thermal failure can be triggered by an increase in the temperature within the battery/module/rack or container.

Fire can erupt in a lithium-ion battery once it undergoes one of the failures. A thermal, electrical, or mechanical failure, or a combination of these, can lead to thermal runaway. Thermal runaway is defined as a condition where cell temperature reaches a threshold that causes an uncontrollable, rapid release of energy and corresponding temperature rise, resulting in a thermal event, such as an explosion and fire. The stability of a lithium-ion cell is primarily dependent on temperature. The temperature of the cell is determined based on the heat generation/dissipation rates. If the heat cannot

be dissipated linearly at an equivalent rate of generation, then the internal chemical reactions become stimulated by the increasing temperature and induce the cells into thermal runaway.

Thermal runaway typically occurs at 180°C with low states of charge, 120°C at 100% state of charge, or 80°C when overcharged. The thermal runaway temperature of these LFP batteries have been tested to UL9540A and thermal runaway begins at 215°C Understanding Lithium-ion Battery Failure is crucial. This allows advanced fire protection measures to be used proactively rather than reactively. There are 2 main windows of opportunity to implement fire protection measures and reduce or prevent a cascading thermal event.

One of the most important signs of a cell going into thermal runaway is the phenomenon of off-gas generation. This should be considered as the critical window of opportunity to take action to prevent thermal runaway or a fire condition in a cell/module/rack. Results from independent testing suggest an average of 11-12 minutes between the detection of off-gas and thermal runaway. If proactive measures are unsuccessful and a damaged lithium-ion battery transitions into thermal runaway, measures must be put in place to contain the resulting thermal runaway and minimise the potential for propagation to other battery modules/racks or, in the worst case, the complete container within the site.

There are 4 main phases of lithium-ion battery failure:

1.0) Battery Abuse

The cause of cell damage could be thermal, electrical or mechanical.

2.0) Off-Gas

Minute quantities of off-gassing (a combination of Volatile Organic Compounds) and other cell vapours are generated, resulting in heat release.

3.0) Smoke

Catastrophic failure is imminent, the level of heat is likely to result in ignition, deflagration and thermal runaway.

4.0) Fire

The likelihood of propagation dramatically increases.



4.2 Design

The container is the same size as a 20 ft shipping container, with the container separated into sections with door access to the five battery racks from either side and door access at each end to access other infrastructure. There is no internal access for persons.

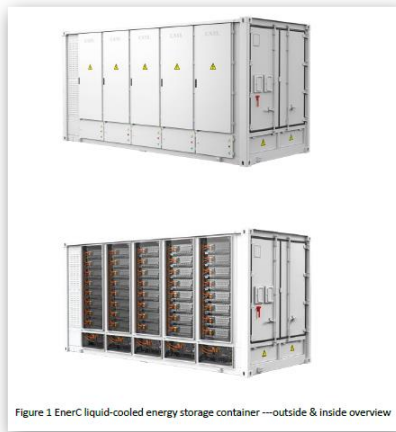


Figure 4 Container Design no internal access.

4.2.1 Battery Management.

The battery management system is intended to identify any electrical issues that may be occurring with the batteries. This includes identifying where a battery may be overcharging, undercharging, or experiencing other electrical faults. As per *NFPA 855*, this will include a high cell temperature trip, thermal runaway trip, rack switch trip, inverter trip and voltage protection measures.

There will also be online condition monitoring that will provide online monitoring systems that will monitor battery room temperature and the following parameters, as a minimum, at the battery module and/or cell level:

- Charging and discharging voltage and current.
- Temperature.
- Internal ohmic (resistance).
- Capacity.
- State of charge (SOC).
- State of health (SOH).
- Alarm or fault log.

Note: Where a failed separator is the cause of the battery issue, this is unlikely to be recognised by the BMS. In instances where it is detected, the shutting down of power to the battery is not sufficient to prevent off-gassing and thermal runaway.

There will also be detection of other types of fire that do not involve thermal runaway (for example, fires involving electrical wiring). This will be via smoke detection installed to BS 5839 PT 1 *Fire detection and fire alarm systems for buildings - Code of practice for system design, installation, commissioning and maintenance*. There will be off-gas detection and ventilation to prevent any vapour cloud from being formed.

There will be an external indication via a strobe light for easy identification of the container that may have an issue. All the detection and monitoring will be relayed to the on-site control room and the remote monitoring station to provide early warning and inform the fire service.

This will enable first responders to understand what the warning is in relation to. This will aid in their decision-making.

The NFCC guidance recommends that fixed suppression systems be installed in units to help prevent or limit propagation between modules. This has been followed on this site with a two stage suppression strategy, the first stage would be triggered by any type of fire scenario but primarily to extinguish any type of fire other than a Lithium battery fire this will be achieved by an Aerosol suppression system as the first stage suppression system, if this is unsuccessful as in a battery thermal runaway then the second stage automatic water suppression system would operate and extinguish/prevent any further event.

4.2.2 Cooling

The water suppression system, based on the 2024 FM Global research that a sprinkler system designed with a density of 12mm will extinguish and cool surrounding batteries to below their thermal runaway temperature for a fire within a container in a rack in approximately 45 minutes. The design on this site is for not one sprinkler head but 10 drencher system heads supplying a design density of not 12mm per minute but 18mm per minute for the water suppression system to be able to operate in a single container for 48 hours. Therefore, protecting any adjacent containers from radiated heat and ensuring that reignition will not occur.

In accordance with the latest FM Global research into large-scale BESS fires, gas suppression systems are not recommended due to the failure to stop reignition. Therefore as part of the fire protection multi layered approach a water suppression system will be installed capable of providing a design density of 12mm per minute discharge capacity over the total container as per point 2.4.1 of the FM Global research report that has proven that an LFP battery fire within a rack can be extinguished using a single sprinkler head above a single rack, due to the volume of water spray used that absorbs and reduces the heat from the fire and prevents thermal runaway of the LFP batteries. The FM Global test operated a single sprinkler head. As an added layer of protection, this design will use open sprinkler heads (reducing the time to operation as no heat is required to operate the bulb within the sprinkler head). With not one but all 10 heads will operate at the same time, completely flooding the container to prevent any cascade effect and fire development.

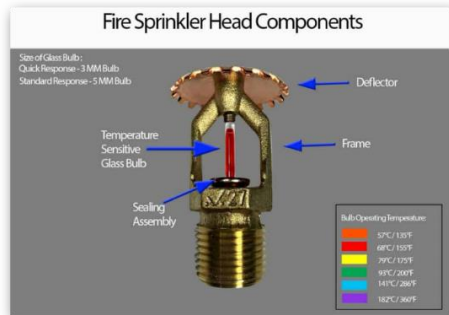


Figure 5 Closed head - Heat Activated



Figure 5 Open Head - automatically activated

The advantage of water suppression systems is that they have several benefits, one is commonly called scrubbing (removal of contaminants within the smoke plume by water droplets) This has been established following government-sponsored research undertaken by the British Automatic Fire Sprinkler Association - report on the benefit of sprinkler systems in residential accommodation (this was undertaken to establish the survivability of persons in the same room as a fire in which the water suppression system operated). There will be no persons within the containers as the design is for external access through access panels.

The water suppression system will also prevent the effect of radiated heat impinging on adjacent containers, this is due to the high heat capacity of water, the reduction in radiated heat can be used to allow a reduced spacing there is a recommended 6m spacing between containers based on a let it burn fire strategy, as has already been stated the fire strategy is prevention and early intervention within this site. This reduction has been limited to spacing within a pack of four containers with 5.5m between packs as an additional layer of protection for the site.

Note: The suppression system will reduce the temperature of the battery, therefore re-ignition is not likely to occur, and the effect on any boundary conditions will be prevented.

4.2.3 Aerosol suppression

The aerosol suppression system is a first-stage medium to extinguish any other type of fire scenarios not involving Lithium-ion batteries within the container, this is a good first-stage suppression system but not recognised for controlling a fire within the battery racks due to the limited Hold time.

4.3 Deflagration Prevention and Venting

The fire safety systems that have been designed within the containers on this site are based on early intervention and preventing the possibility of the production of explosive gases being produced and therefore the hazard is extremely low, but as a further fire safety measure the containers will be installed with a ventilation system that has been designed to keep the environment below 25% of the Lower Explosive Limit and as further additional fire safety feature Deflagration vents will be installed within the roof.

4.4 Access

4.4.1 Site Access

The site access follows the NFCC guidance in that there are 2 separate access points at the north and south of the site. The roads will be constructed following the building regulations and approved document B B5 access and facilities for the fire service with a minimum road width of 3.7 metres and a load-carrying capacity of 12.5 tonnes.



Figure 6 fire brigade facilities

4.4.2 Signage

The site will be installed with all signage as recommended by the NFCC guidance and will include details of

Relevant hazards posed

- The type of technology associated with the BESS
- Any suppression system fitted
- 24/7 Emergency Contact Information

Signs will be on the exterior of a building or enclosure and sized such that at least one sign is legible at night at 30 metres or from the site boundary, whichever is closer.

4.4.3 Other Firefighting Action.

There is a water supply and access to deal with other types of fire that may include other infrastructure elements as well as grass or vegetation these do not require any additional fire safety measures as they are the normal type of incident that is commonly dealt with by the Fire service the water supplies on site exceed those recommended for bulk storage in the building regulations approved document 'B' B5 of 45000lts. There will be 850,000lts that would be available.

4.4.4 Access routes

The NFCC guide recommends two access routes based on the assumption that a fire and toxic smoke plume will develop as per the Liverpool incident. The principal difference between the sites is that the Liverpool site did not have to comply with any guidance as it predated the NFCC guidance and was not installed with an internal water suppression system but a gaseous suppression system that has now been discredited as not being suitable for preventing a thermal runaway event. This site has 2 alternative access routes and the water suppression system will prevent any fire plume from preventing access.

4.4.5 Signage

Signage should be installed in a suitable and visible location on the outside of BESS units identifying the presence of a BESS system. Signage should also include details of:

- Relevant hazards posed.
- The type of technology associated with the BESS.
- Any suppression system fitted.
- 24/7 Emergency Contact Information.

Signs on the exterior of a building or enclosure should be sized such that at least one sign is legible at night from 30 metres or from the site boundary, whichever is closer. There will be a fire brigade information box adjacent to the access gate for any first responders so that all information on the site will be available. Both for contingency planning and firefighting operations.

4.4.6 Firefighting water/contaminated water

The prevention and disposal of contaminated water have been identified within the NFCC Guidance and the NFCC guidance and memorandum of understanding signed with the environmental agency have been followed to ensure best practice, All of the water used for firefighting operations will be prevented from entering the ground and contained within the site via the containment Tank and drainage infrastructure that has been designed based on the exceptional occurrence of both rainfall and water used for firefighting occurring at the same time, safe disposal of any contaminated water following testing will be disposed of through a Licensed site capable of treating the contaminated water. No water will permeate into the ground or water courses.

4.5 Spacing/Separation distances between containers.

The NFCC guidance recommends a spacing of 6m between containers. This is based on a worst-case scenario of a container becoming fully involved, and the fire service will have to extinguish the fire and prevent the radiated heat from impinging on an adjacent container. The NFCC guidance (2022) was based on several documents that have all been updated since the NFCC guidance was published, due to further research and learning from incidents. This includes the FM Global 5-33 Property Loss Prevention Data Sheet – Lithium-ion Battery Storage Systems. This guidance has been updated, which, depending on the battery chemistry, has reduced separation distances between containers.

FM GLOBAL 5-33 Lithium-ion battery storage systems

2.3.3 Outdoor lib-ess Enclosures and Containers.

2.3.2.2 For containers of Lib-Ess comprised of lithium-ion phosphate (LFP) cells, provide aisle separation of at least 1.5 meters on sides that contain access panels, doors or deflagration vents.

The containers on this site have enhanced safety measures with the automatic sprinkler system installed adding a further layer of protection.

5 Procedures & Management

5.1 Preplanning

There will be regular updates with the fire service during construction, and on completion, all access information and risks will be conveyed to the fire service as part of FRS planning in accordance with arrangements required under section 7(2)(d) of the Fire and Rescue Services Act (2004). Site Specific Risk Information (SSRI) should be made available to crews in the form of an effective Emergency Response Plan that will be available on-site.

Details of any site access arrangements, such as key codes, will be provided to the FRS

5.2 Employee Training

Sufficient fire safety training should be undertaken with all employees who are based at or will attend the site. This training will cover all aspects of fire safety, including highlighting the risks and hazards of fire at the site, emergency procedures, basic fire prevention and firefighting as well as how to assist others if required. Any fire safety systems the employee is expected to operate or troubleshoot should also be covered.

5.3 Emergency Management

An Emergency Management Plan will be developed during the detailed design phase of the project.

Although there has only been one occurrence of fire in relation to BESS in the UK (Carnegie Road BESS, located in Liverpool, on 15 December 2020), lessons learned from the incident reports of this event highlight the need to ensure emergency services can have a vision of what is taking place inside the battery storage units without entering those units. This comprises of practices such as the remote monitoring of battery rooms and avoiding key risks such as radiated heat, toxicity and chemical risk. The BESS containers proposed for this development are not walk-in units; as such, there will be no need to access the containers in the event of a fire. The Applicant will continue to have ongoing conversations with the FRS around all matters regarding fire safety and mitigation, including bringing members of the FRS to the proposed development to walk them through important facets of the site, the detailed nature and specification of the chosen battery equipment and to confirm the on-site fire safety equipment is suitable and detail the storage arrangements of this equipment, and provide opportunities to ask questions. Access to the site will be made available to the FRS for regular training exercises as required.

5.4 Emergency Response Procedures

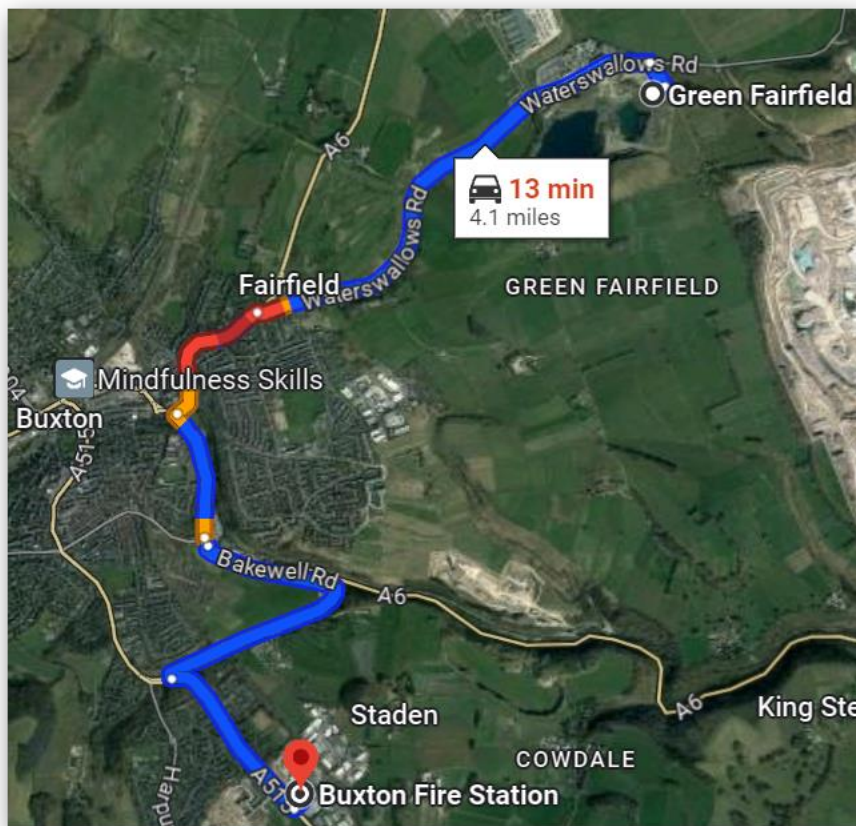
There are no longer defined attendance times for the fire service, but more of an ideal time following the decision to dispense with a risk-based categorisation of attendance time. Historically, this was based on an attendance time of 5 minutes for high-life risk premises to 20 minutes for other types of non-life risk premises, with remote rural locations having no classification apart from as soon as possible. While these attendance times are no longer required to be met, the general approach is that they are still good guidelines to follow.

The response to a fire incident would be dependent on the location and source of the fire. A fire not contained within a battery container poses different immediate and delayed risks to a fire within a container unit. These sites are remotely operated, and the life risk is low due to the occasional maintenance personnel visiting the site.

The nearest fire station is located at Rayleigh Weir, a wholetime fire station that would probably take 6-15 minutes to arrive on site (Google Maps). And a further 10 minutes to establish the type of incident, undertake a dynamic risk assessment, before establishing a strategy for tackling the incident. The automatic water suppression system would have been operating for some 25 minutes. The automatic water suppression system will operate as the remote monitoring station will be contacting the fire service, an event within a container would be in its incipient stage of development and be contained or extinguished by the water suppression system installed in each container. This would also prevent any toxic smoke plume from developing before the arrival of the fire service.

There will be no initial requirement for offensive firefighting measures due to the active fire suppression system installed within each container. There will be no production of a fire plume, preventing the fire service from using any of the access routes as the fire prevention systems will have mitigated any effects believed to be caused by the strategy of letting the fire evolve and engulf the container, requiring the fire service to intervene or to use cooling sprays on adjacent containers (as with the Liverpool incident). On this site, rapid intervention of the automatic fire suppression systems will prevent any large-scale event from occurring. The bulk water supplies on site will allow the fire service to operate for 48 hours before considering if further water supplies are required. The nearest

fire station is at Buxton and is a Wholetime fire station with Ripley and Crich fire station on-call stations supporting.



The access roads and fire hydrants on site are situated in such a way that fire service hose laying distances will not have to run a length of hose exceeding 20 metres from their point of connection (firefighting appliance/on-site hydrant), less than the 60-meter recommended hose laying distance within the NFCC guidance.

The design of multiple layers of protection of the fire safety systems should prevent any fire from developing and the production of a toxic smoke plume that could affect firefighting operations will not occur on this site, the design of the water suppression system (following NFCC and NFPA and FM Global guidance) would mean that no firefighting personnel would need to approach any container until extinguished, this safety margin should ensure the safety of firefighters and relevant persons to ensure either no or minimal fire/toxic plume is produced that would consist of mainly water droplets due to evaporation. The battery containers will also have a 60-minute fire rating ensuring that every fire safety measure has been taken to ensure that the risk is as low as reasonably possible.

Areas within 10 metres of BESS containers will be cleared of combustible vegetation and any other vegetation on site should be kept in a condition such that they do not increase the risk of fire. There will be no grass or vegetation within proximity to any container or associated infrastructure. There will be reduced spacing between containers within each pack of four containers with a 5.5-metre spacing

between packs, the water suppression system and fire rating of containers as mitigation for any possible radiated heat and following NFCC, NFPA 855 and FM global recommendations.

5.4.1 Battery Fire (Internal)

Where a fire occurs within a battery container, the following steps should be taken:

1. The automatic detection systems should operate and automatically alert the control room and fire service, as well as initiate the fire procedure that will electrically isolate the site, and automatically operate the fixed suppression systems for anywhere between 12 and 48 hours.
2. Ensure the immediate surrounding areas are cleared of any occupants and report to the fire assembly point if free from danger.
3. Contact the emergency services and confirm a fire event, provide the full address of the facility.
4. Contact the relevant person who oversees fire safety for the facility.
5. Ensure access to the facility and the fire location is clear of obstructions such as vehicles or storage.
6. Perform a sweep of all areas of the facility to ensure all occupants are at the assembly point.

5.4.2 Battery Fire (External)

Where a fire occurs outside of a battery container, the following steps should be taken:

1. Raise the alarm by activation of a manual call point or the automatic fire detection system, ensure the immediate surrounding areas is cleared of any occupants and report to the fire assembly point.
2. Contact the emergency services and provide the full address of the facility
3. If possible, use portable fire extinguishing appliances to tackle the fire.
4. Contact the relevant person who oversees fire safety for the facility.
5. Ensure access to the facility and fire location are clear of obstructions such as vehicles or storage.
6. Perform a sweep of all areas of the facility to ensure all occupants are at the assembly point.
7. Meet the fire service on arrival and brief the officer in charge.

5.4.3 Inverter Fire

If a fire occurs due to the inverter units, the following steps should be followed:

1. Ensure the immediate surrounding areas is cleared of any occupants and report to the fire assembly point if free from danger.
 2. Perform a sweep of all areas of the facility to ensure all occupants are at the assembly point.
 3. Contact the emergency services and provide the full address of the facility.
 4. Contact the relevant person who oversees fire safety for the facility.
-

5. Ensure access to the facility and the fire location is clear of obstructions such as vehicles or storage.
6. Meet the fire service on arrival and inform the officer in charge of the situation.

5.4.4 Roles & Responsibilities

5.4.4.1 Site Manager

The site manager will be responsible for the overall fire safety of the site. In the event of a fire incident, the site manager will be required to notify any other stakeholders, as well as liaise with the fire service as to aid firefighting efforts and relay any other information that may be of assistance or relevant to any hazards that may pose a risk to surrounding infrastructure and members of the public.

5.4.4.2 Employees

If an employee is attending the site at the time of a fire incident, they will be responsible for notifying the fire service and site manager at the earliest opportunity so that firefighting efforts can begin promptly, and any other relevant stakeholders can be notified.

6 Post-Incident Recovery

6.1 De-energising & Removal

Following firefighting efforts, there is a reasonable expectation that the batteries will pose non-fire-related risks to personnel involved in the disposal or recovery of the batteries.

The hazard procedures in place for the site should be consulted for the removal and/or recovery of the batteries following an incident.

6.2 Disposal

6.2.1 Batteries

The disposal or recycling of the batteries will be undertaken by the manufacturer or a suitably appointed accredited contractor.

6.2.2 Contaminated Fire Water

The management of contaminated water following a fire incident will be carried out as per the principles of the joint document (2018) issued by Water UK, Environment Agency, NIEA, Natural Resources Wales, DWI, Fera, Defra's CBRN Recovery Team and NFCC National Resilience. This document breaks down the process into four main steps.

6.2.3 Contain

The contaminated water should be contained at source or as close to the source as possible. The contaminated water run-off will be drained into a holding pond with a maximum capacity of 1,000,000lts

6.2.4 Identify

Due to the formulation of the batteries, other materials on site and the firefighting mediums, the contaminated water run-off is expected to contain the following substances:

Substance	Type	Risk
Cobalt	Heavy Metal	High
Nickel	Heavy Metal	Low

6.2.5 Treat

An assessment of the contaminated water will be undertaken by a competent professional to ascertain if treatment is required or feasible.

6.2.6 Dispose

The contaminated water will be disposed of, or further assessment carried out based on an evaluation by a competent professional in cooperation with the relevant local authorities.

Conclusion.

This site has Complied with and enhanced the recommendation of the National Fire Safety Council recommendations based on revised guidance and research following the updated (2023/24) NFPA and Australian guidance, and Axminster findings, the NFCC guidance is under review and as knowledge improves and more research is undertaken new recommendations are made but currently, this site meets the HSE requirement of ensuring any risks are as low as reasonably possible.

7 Appendix A – Axminster findings

The paragraphs follow the findings of the Axminster decision (ref APP/U1105/W/23/3319803).

53. There was no containment strategy for the contaminated water at Axminster; that is not the case with this site, as the firefighting water and sprinkler water are to be contained within the drainage strategy until safe disposal. At Axminster, there were concerns about air pollution. Axminster was designed around reactive fire precautions that would allow a fire to grow until intervention by the fire service or the container was allowed to burn out (as per the Liverpool fire). That is not the case with the fire strategy on this site; the design is around early detection and intervention with vast amounts of water spray as per the recommended FM Global guidance 5-33 for lithium battery fires. This will detect and contain /extinguish any fire within its incipient stages and therefore no or little smoke plume or toxicity will be produced.

55 No firewater was contained, allowing contamination of groundwater. That is not the case with this site all contaminated water will be contained on site, awaiting safe disposal.

56 There is a risk of a fire involving lithium-ion batteries. This is a generic statement and while true the batteries used on this site are of the recognised safest type, being (LFP). This has been reduced to as low as is reasonably practicable with the adoption of all the very latest research and recommendations based within the NFCC guidance.

57 While there is no UK standard, the NFCC guidance recommends the adoption of USA and Australian standards; this has been followed within the design of this site.

58 The degradation of a cell can occur and at Axminster, the strategy was for the container to burn and let the fire service deal with an incident, on this site the safety systems have been designed proactively to identify any thermal runaway at the earliest opportunity with off-gas detection that can detect degradation before thermal runaway and therefore isolate the cell to prevent further degradation if this continues then the provision of the water suppression system will remove all radiated heat created by the thermal runaway of the cell preventing any cascading effect caused by radiated heat with no requirement for the fire service to commence offensive operations.

61 The spreading of fire between containers is caused by radiated heat due to the fire being allowed to fully develop and engulf all the batteries within the container, creating a Heat release rate high enough for conducted heat to impinge on an adjacent container. This was the reason for establishing a 6m spacing. The NFCC guidance allows for a reduction in this spacing based on a reduced radiated heat output from a fire, as in this site, where there is a water suppression system installed.

62 At Axminster it may have been that any fire would radiate onto adjacent containers as in the Liverpool incident. On this site there will be no radiated heat to impinge on adjacent containers, the recommendations of the NFCC through the referenced document that has been revised for 2024, allow for the spacing to be reduced to 1.5m (FM Global property loss prevention data sheets 5-33 2024 2.3.2 Outdoor LIB-ESS Enclosures and Containers), and preventing any fire spreading within the container by following the NFCC Guidance and FM GLOBAL DATA SHEET 3-55 and NFPA 855 with the installation of an automatic water sprinkler suppression system that will prevent any fire spread within the container or impingement on adjacent containers.

63 Separation distance is based on doors being located on only one side of the enclosure and no vents or unprotected openings on any other sides. It is also based on active systems (HVAC or liquid

cooling), maintaining cell or module temperatures in the target enclosure or container. 2.3.2.2 For containerised LIB-ESS comprised of lithium iron phosphate (LFP) cells, provide aisle separation of at least 5 ft (1.5 m) on sides that contain access panels, doors or deflagration vents.

64 The battery technology was not known; on this site, the battery technology is known and has been identified within the report as LFP battery chemistry.

65 At Axminster, there was a single access point; on this site, there are 2 separate access points available.

69 At Axminster, there was no containment of the firefighting water on the site, with contamination of groundwater and water wells likely. The storage of firewater runoff has been based on the NFCC, NFPA 855 and FM Global 5-33, there will not be any requirement for additional firefighting as was the rationale at Liverpool to leave the container to burn which is why it required firefighting for 59 hours, this site uses the opposite fire strategy of rapid intervention and extinction at the module/rack stage. And not allow the whole container to catch fire and burn out or require fire service intervention, but as an additional safeguard, there will be on-site storage for containment of firewater runoff.

70 The containment strategy will allow the water to be held on-site until all firefighting operations have been concluded, and then it will be tested, and the best option for disposal in conjunction with the environment agency will be undertaken through a licensed site.

71 At Axminster, the firewater runoff was planned to be removed during an incident. There is no requirement for the contaminated water to be removed during firefighting operations, and it can be stored until safe to remove. There will be no risk to tanker drivers from fire or toxic smoke due to the suppression system and containment strategies, and no tankers will be on-site during an incident.

72 There was no containment of contaminated water at Axminster; there is containment on this site following the National Fire Chiefs Council memorandum of understanding with the environmental agency. The containment of firewater can be demonstrated.

73 There is no requirement to reuse any of the firewater. The site at Axminster had no adequate suppression system, unlike this proposal.

74 There will be water supplies on this site, this site will have a capacity for 850,000lts, far more than 450,00 and let it burn strategy at Axminster that may have required far more water.

75 The attendance time at Axminster to accumulate enough resources and water was identified as an issue, The attendance time of the fire service is not essential as the strategy is to contain and automatically extinguish any incident within a container which is the opposite of Axminster (let it burn and dealt with by fire service), which would need the resources to contain and extinguish.

76 No Grampian conditions are required.

77. There was no Battery Safety Management plan provided at Axminster. The battery management plan is available for this site.

84 The site at Axminster was not sealed and would have been contaminated. This site will be sealed and contained; there will not be any contamination of water courses, and the design follows the best practices of the NFCC.

93 At Axminster, there was a single access road. This project follows all current guidance. There are two access points, and the inclusion of a water-based suppression system is best practice.

94 At Axminster, there was a pollution risk and contamination of aquifers. This site will prevent any contamination of the ground as it will be a sealed site, and all contaminants will be contained on site.

8 Appendix B – Water calculations

SITE WATER SUPPLIES REQUIRED

Container Suppression

Design density of 18mm min over the floor area + 946 lpm for firefighting jets (not required but an additional measure).

(Firefighting 2hrs NFCC = 228000 LTS)

Standard 20ft Container w 2.43 x l 6.06 x h 2.59 area = $2.43 \times 6.06 = 14.72$ (15m²).

$18\text{mm min} \times 15\text{m}^2 = 270 \text{ lpm} \times 60 = 16,800\text{-hour} \times 12 \text{ hours} = 194,400\text{Lts per container} \times 4 \text{ container} = 777,600 \text{ Lts}$

Water required 777,600 Lts, based on one container with a water suppression system operating for 48 hours.

The recommended design density in the large-scale testing undertaken by FM GLOBAL was based on a single sprinkler head at 12mm per minute. This design, NFSS5818 has 10 drencher heads operating at 18mm per minute.

9 Appendix C - Plans



Figure 7 Site Location



Figure 8 Fire service plan

10 Appendix D Relevant Statutory Instruments.

At the time of writing the following is applicable.

- Health and Safety at Work etc. Act 1974;
- Management of Health and Safety at Work Regulations 1999 Regulation 3;
- Electricity Safety, Quality and Continuity Regulations 2002;
- The Workplace (Health, Safety and Welfare) Regulations 1992;
- Regulatory Reform (Fire Safety) Order 2005 for the fire safety management in buildings compliance;
- Construction, Design Management Regulations 2015 (CDM);
- IEC 62619:2022 Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications;
- IFC 2021 International Fire Code (IFC).

The Applicant will appoint a suitably qualified Principal Contractor and Principal Designer to fulfil the respective roles under the CDM Regulations and discharge their Client duties. Following construction, OWC notes that there will be ongoing operational requirements relating to the design, selected technology, planning and statutory obligations, and various stakeholders which will require ongoing management.

The following guidance documentation has also been reviewed:

- Project technical documentation;
 - Health and Safety Executive (HSE) Design standards;
 - UK and EU (ADR Orange Book) HSE;
 - Building Regulations 2010 – Approved Document B (volume 2 – 2019 edition);
 - Regulatory reform (fire safety) order 2005;
 - UL 9540, 2nd Edition, February 27, 2020 – UL Standard for Energy Storage Systems and Equipment;
 - UL 1973, 3rd Edition, February 25, 2022 – UL Standard for Safety Batteries for Use in Stationary and Motive Auxiliary Power Applications;
 - National Fire Prevention Association (NFPA) 855 (2023), Standard for the Installation of Stationary Energy Storage Systems;
 - NFPA 69, Standard on Explosion Prevention Systems;
 - UL 1642, 6th Edition, October 12, 2022 – UL Standard for Safety Lithium Batteries; and
- National Fire Chiefs Council Grid Scale Battery Energy Storage System Planning – Guidance for FRS.

11 References

11.1 Building Regulations

11.1.1 Approved Document B of the Building Regulations

Approved Document B of the Building Regulations provides basic, prescriptive guidance on fire safety in buildings including the construction, location and occupancy characteristics. Approved Document B is primarily used within this plan for firefighting access, water supplies and other firefighting provisions.

11.1.2 Electrical

11.1.2.1 BS 7671

Also known as the IET Wiring Regulations, BS 7671 provides essential guidelines for electrical installations in the UK.

11.1.3 Fire Detection & Alarm

11.1.3.1 BS 5839-1

Addresses fire detection and fire alarm systems for buildings. It offers guidance on designing, installing, and maintaining these systems to ensure early detection and warning of fires.

11.1.3.2 BS 5266

Focuses on emergency lighting systems in buildings. It outlines requirements for the design, installation, and testing of emergency lighting to provide illumination in the event of power failure.

11.1.3.3 BS EN 60079-29-2

Part of the series for explosive atmospheres, this standard specifies performance requirements for gas detectors. It ensures that gas detection equipment used in potentially explosive environments functions reliably to prevent hazardous situations.

11.1.4 Firefighting

11.1.4.1 BS 9990

Guidelines for non-automatic fire-fighting systems in buildings. It covers the design, installation, and maintenance of such systems, focusing on aspects like hose reels, hydrants, and dry risers. This standard ensures that fire-fighting equipment is readily available and functional in case of emergencies, enhancing overall fire safety.

11.1.5 Portable fire extinguishers

11.1.5.1 BS 5306

Standards for fire extinguishing installations and equipment. It offers guidance on the selection, installation, commissioning, and maintenance of fire extinguishers, hose reels, and other fire-fighting equipment.

11.1.5.2 BS EN 12845

Aligned with European standards (EN), the standard specifies the design and installation requirements for automatic sprinkler systems in buildings. It covers various aspects of sprinkler systems, such as water supplies, pipe sizing, and system components.

11.1.5.3 BS EN 14972-1

Focusing on fixed firefighting systems, this specific part deals with the design and installation of gas extinguishing systems. It provides guidelines for designing systems that utilize gases like carbon dioxide or inert gases to suppress fires.

11.1.6 Product Safety

11.1.6.1 *BS EN 62619*

Pertains to electrical energy storage systems (EESS) safety requirements. It outlines guidelines for ensuring the safety of EESS installations, covering various energy storage technologies.

11.1.7 EMC Safety

11.1.7.1 *BS EN IEC 61000-6-1*

Addresses electromagnetic compatibility (EMC) for industrial environments. It provides guidelines for reducing electromagnetic interference in industrial settings.

11.1.7.2 *BS EN IEC 6100-6-3*

This standard focuses on the emission of radio-frequency disturbances from equipment in residential, commercial, and light-industrial environments.

11.1.8 Guidance and Recommendations

11.1.9 NFCC

The National Fire Chiefs Council issued a guidance document detailing the current outlook for BESS within the UK, relating specifically to open air environments. Much of the guidance, which covers design, suppression, site access and emergency plans, is taken from some of the guidance mentioned below such as the NFPA guide, FM Global Guides and CFA guides from Australia.

11.1.10 FPA guides

The FPA in conjunction with the RISC Authority, issued a guide in 2022 titled RE1. This guide covers the hazards of a Lithium-ion batteries and the risk control recommendations.

11.1.11 FM Global Data Sheets

5-33 LITHIUM-ION BATTERY ENERGY STORAGE SYSTEMS

The primary FM Global data sheet consulted throughout the design and planning of the site is the Property Loss Prevention Data Sheets originally published in January 2017 and revised in July 2023 and January 2024 the guide covers site layout recommendations, fire safety installations and measures to prevent or restrict fire.

11.1.12 NASA Fire and Gas Characterization Studies for Lithium-ion Cells and Batteries (2020)

The report contains similar content to many of the others referenced, including testing of different cell chemistries with venting gas and other test result breakdowns, as well as the impact of fire resisting measures applied to lithium-ion storage systems.

11.1.13 NFPA 855

NFPA 855 is a safety standard developed by the National Fire Protection Association (NFPA) for the design and installation of on-site energy storage systems, particularly energy storage systems (ESS) like batteries. It provides comprehensive guidance to address the unique safety concerns associated with ESS installations, including fire protection, electrical, and structural aspects.

Battery Technologies: It addresses various battery technologies, such as lithium-ion, lead-acid, and more, offering specific safety requirements for each type.

12 Glossary

Glossary

Acronym	Definition
BESS	Battery Energy Storage System
BMS	Battery Management Systems
BMSP	Battery Management Safety Plan
CCTV	Closed-Circuit Television
CDM	Construction, Design Management
DRM	Design Risk Management
ECFRS	Essex County Fire and Rescue Services
EPA	Environment Protection Authority
ESS	Energy Storage System
FAT	Factory Acceptance Testing
FRS	Fire Rescue Services
GW	Gigawatt
HAZID	Hazard identification
HAZOP	Hazard Operability Analysis
HSE	Health, Safety and Environment
HV	High Voltage
HVAC	Heating, Ventilation, and Air Conditioning
IFC	International Fire Code
KL	Kilolitres
kV	Kilovolts
LPA	Local Planning Authority
LiFePO 4/ LFP	Lithium iron phosphate
LV	Low Voltage
MV	Medium Voltage
MW	Megawatt
MWh	Megawatt hour
NFCC	National Fire Chiefs Council

Acronym	Definition
NFPA	National Fire Prevention Association
NMC	Nickel, Manganese, Cobalt
OEM	Original Equipment Manufacturer
PCS	Power Conversion System
PPBMSP	Planning Phase Battery Management Safety Plan
PRMS	Pressure Reducing Metering Station
QHSE	Quality, Health, Safety and Environment
SAP	Senior Authorised Person
SAT	Site Acceptance Testing
SCADA	Supervisory Control and Data Acquisition
SoC	State of Charge
VBB	Victoria Big Battery