Glenlara Power Reserve Energy Storage System Outline Fire Risk Management Plan

Neoen Renewables Ireland Limited

Glenlara, Co Cork

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Revision History

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TECHNICAL NOTE

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1. Introduction

This document details the Outline Fire Risk Management Plan (FRMP) for the proposed Neoen Renewables Ireland Limited electricity grid services facility to be located at Curraduff, Glenlara, Co Cork. The facility comprises up to 240.72 MWh Energy Storage System (ESS) and associated ancillary equipment.

The purpose of this outline FRMP is to provide a summary of the required preventive and mitigative measures to be implemented in order to protect against fires at the proposed facility. Following the detailed design phase and prior to the construction phase of the project, a detailed FRMP will be drafted incorporating the final design and specification of the ESS facility and capturing the latest best practices for battery fire protection and any update to legislation or safety standards.

2. Project Description

Neoen Renewables Ltd propose to construct an ESS facility adjacent to the Glenlara 110kV substation in the townland of Curraduff, Glenlara, Co Cork. The ESS will use Lithium Iron Phosphate (LFP) batteries in containerised units with an overall site capacity of approximately 240.72 MWh. The construction phase is estimated to take approximately 15-18 months and the operation phase of the development is expected to be 35 years.

The development will comprise the following:

- 48 no. Huawei LUNA2000-5015-8S containers (5.015 MWh capacity per container) installed on concrete plinths measuring 2.9 m high x 2.4 m wide x 6.1 m in length. The containers will be arranged in sets or 'skids' of 6 no. containers (one skid will comprise 6 no. ESS containers):
- Inverter and transformer containers measuring 2.9 m high x 2.4 m wide x 12.2 m in length. Each skid (6 containers) will have a dedicated inverter and transformer container which uses electrical inverters and transformers to alter the type of current and voltage to assist the storage process;
- Staging area comprising 3 no containers measuring 12.2 m length, 2.5 m width and 2.9 m height with a domed roof structure. The staging containers will be used to store spare parts and other electrical equipment;
- Underground electrical and communications cabling;
- 2.6 m high palisade fencing and security gate;
- Pole mounted Infrared Closed Circuit Television (CCTV) and motion sensor security lighting;
- Onsite access track; and
- Associated and ancillary site development, landscaping and reinstatement works.

The proposed development is to be located in the rural townland of Curraduff, approximately 2 km southwest of Newmarket, c. 9 km northeast of Kanturk, in northwest Co. Cork. The surrounding land use is predominately small agricultural holdings and single dwellings developed mainly along the local road network.

Figure 2-1 below illustrates the site layout.

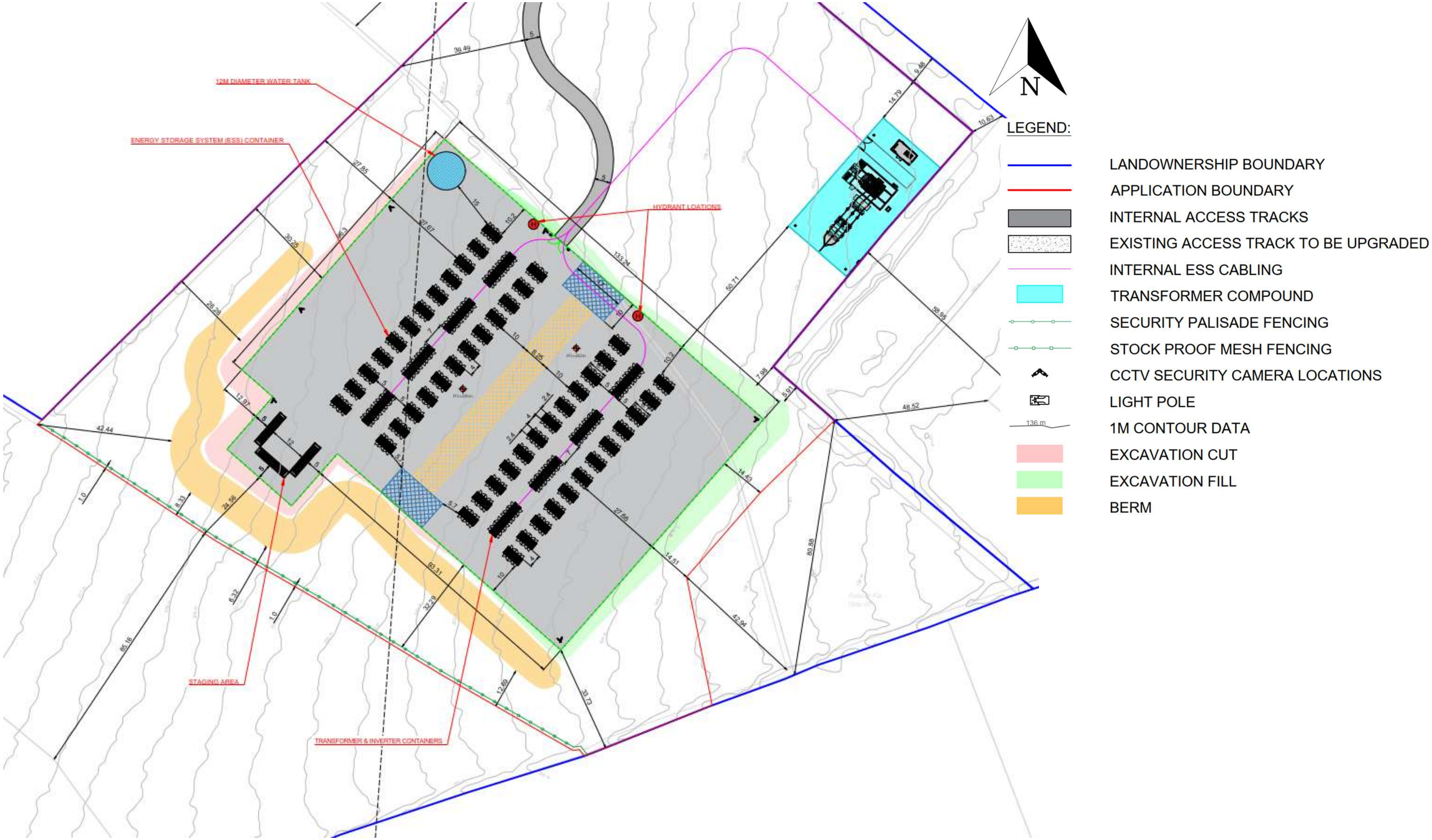


Figure 2-1 Glenlara ESS Site Layout

3. ESS Hazards

Despite their technological and environmental benefits, ESS systems have the potential to introduce a range of hazards that pose significant safety, environmental, and operational risks.

Under faulty conditions, such as mechanical damage, electrical abuse, or thermal stress, lithium ion batteries can become unstable, potentially leading to a self-sustaining exothermic reaction known as thermal runaway. Thermal runaway can result in fires and the release of toxic and flammable gas which could in severe cases result in explosions. When deployed at scale in ESS installations, these risks are amplified by high energy densities, complex control systems, and challenges associated with emergency response and system monitoring. Understanding the nature, causes, and consequences of these hazards is therefore critical for safe design and operation of an ESS facility.

3.1 ESS Hazards

In a lithium ion battery cell, thermal runaway typically initiates when abnormal events (such as internal short circuits, overcharging, mechanical damage, manufacturing defects, or exposure to elevated ambient temperatures) cause localised heating. As the temperature rises beyond critical thresholds, exothermic reactions occur within the cell, including electrolyte decomposition and breakdown of the solid electrolyte interphase. These reactions generate additional heat and gas, accelerating the temperature rise. The heat and hot gases released from a failing battery cell may propagate to adjacent cells or modules if adequate thermal barriers, spacing, and cooling are not present. This cascading effect is referred to as thermal runaway propagation and represents the primary system-level risk.

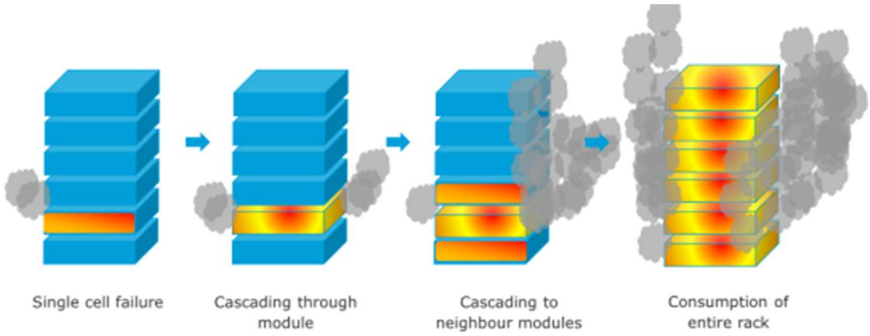


Figure 3-1 Schematic of Thermal Runaway Propagation (DNV, 2020)

The following subsections outline the potential failure mechanisms which could result in a hazardous thermal event at the ESS site.

Although other electrical components within an ESS (such as transformers, inverters, and switchgear) also present fire hazards, these risks are well characterised and effectively managed through established regulations and many decades of operational experience. Existing industry codes and guidance comprehensively address these systems. Consequently, this document concentrates specifically on the battery component of the ESS, where operational experience is limited and codes and standards are still being developed.

3.1.1 Battery Manufacturing Defects

Battery manufacturing comprises multiple processes during which defects may be introduced, such as contamination exposure or mechanical damage to electrodes, separators or cell casings during assembly. These defects may remain undetected until initial commissioning or operation, at which point they can initiate internal short circuits, leading to thermal runaway, off-gassing, and subsequent fire or explosion events.

3.1.2 Electrical Mishandling of Batteries

There are a number of mechanisms whereby electrical abuse can result in the failure of the battery at a cell level which could propagate through the battery packs (Bubbico R. et al, 2018):

- **Internal short-circuit –** internal short circuits (ISCs) can be caused by a number of mechanisms including impurities in the batteries (manufacturing defects), mechanical damage, dendrite formation at anode (due to rapid charging) and can lead thermal runaway events**.**
- **External short-circuit –** external short circuiting can be caused by physical damage to the battery casing, seal failures leading to the introduction of dust or water vapours and can result in fire events.
- **Overcharging** – both severe overcharging and repeated minor overcharging of a battery to a voltage higher than the design specification can result in damage to the electrodes, dendrite formation on the anodes which will ultimately result in a short circuit event leading off gassing and potentially to thermal runaway.
- **Over-discharge**- discharging below the manufacturing limits can lead to the breakdown of the electrodes within the battery which could lead to overheating and ultimately result in thermal runaway.

3.1.3 Thermal Abuse of Batteries

The thermal conditions to which batteries are exposed have a significant influence on cell stability and performance. Operation at temperatures below the manufacturer's specified operating range can promote lithium plating and dendritic growth on the anode surface. These dendrites may penetrate the separator, resulting in internal short circuits that can act as initiation mechanisms for thermal runaway. Conversely, exposure to temperatures exceeding the design operating range can accelerate electrolyte degradation, leading to gas generation and internal pressure accumulation within the cell. This degradation can compromise cell integrity and increase the likelihood of thermal runaway events.

3.1.4 Mechanical Abuse

Mechanical damage can occur due to external actions such as impact, dropping the battery or penetration. Depending on the severity of the impact mechanical damage can lead to electrolyte leakage, internal short circuit, cell overheating thermal runaway (Bubbico R. et al, 2018).

3.1.5 External Fire

The site is located in a remote area approximately 200 m from the nearest off site dwelling therefore there is limited potential for the ESS units to be exposed to a fire event initiated off site.

As part of the groundwork preparation for site, the limited vegetation on-site will be removed from the site boundary and the site will be secured with palisade fencing.

Within the facility itself there will be ancillary equipment such as transformers, inverters and other medium voltage electrical equipment which, should a fault occur, could initiate a fire which could impact the battery containers and potentially lead to a thermal runaway event. As discussed, the design and operation of these systems in line with established standards and experience aim to control the risk of this equipment acting as a source of external fire.

3.1.6 Vandalism

Intentional sabotage eg arson due to unauthorised persons accessing the site could result in damage to the ESS units and potentially lead to an escalated event. Section 4 provides detail on the security provisions for the site.

3.2 Summary

The sections above outlines the potential causes of a fire event on site. The causes associated with the batteries themselves present the highest likelihood of acting as an initiator and therefore these events were considered in detail to identify all reasonably practicable mitigation measures discussed within this plan.

4. ESS Fire Risk Management

The proposed ESS system adjacent to Glenlara 110kV substation has been designed specifically to minimise the likelihood of a fire from starting at the facility through battery selection and adherence to best practice guidance and standards. The design and layout of the facility aims to minimise the consequences of a fire on site should one occur and prevent any offsite impacts.

The following safety objectives have been considered in the design:

- Minimise the likelihood of a fire event through compliant system design, installation, monitoring, and operational controls in accordance with recognised industry standards and best practice.
- Limit the severity and escalation potential of fire events associated with the energy storage system.
- Prevent fire propagation beyond the point of origin and ensure fire events are contained within the Glenlara ESS site and designated fire areas.
- Minimise off-site impacts resulting from heat release, smoke, and combustion by-products.
- Provide automatic fire detection, alarm, and suppression systems to enable early identification and control of fire events.
- Ensure means of egress and site layout support the safe evacuation of all personnel in compliance with industry standards and best practice.
- Facilitate safe and effective access, spacing, and operating conditions for responding firefighters.
- Ensure fire-fighting water and contaminated run-off are contained, managed, and treated to mitigate environmental impact.

The design process has been cognisant of the following standards and guidance documents:

- NFPA 855 (Standard for the Installation of Stationary Energy Storage Systems 2023);
- UN38.3 Classification certification standards;
- UL9540a (Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems);
- IEC 62933-5-2 (Electrical energy storage (EES) systems - Part 5-2: Safety requirements for grid-integrated EES systems - Electrochemical-based systems);
- BS EN 61000-6-2 (Electromagnetic compatibility);
- IEC 62619:2022 (Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries for use industrial applications);
- IEC62477-1 (Safety requirements for power electronic converter systems and equipment – Part 1 General);
- IEC 61508 (Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General requirements;
- IEC62040-1 (Uninterruptible power systems (UPS) – Part 1: Safety requirements;
- National Fire Chiefs Council (Grid Scale Battery Energy Storage System planning – Guidance for FRS); and
- FM Global Data Sheet 5-33 (Lithium-Ion Battery Energy Storage Systems)

The following sections set out how the design of the site minimises the likelihood and reduce the severity of potential fire events on site.

4.1 Battery chemistry selection

Battery chemistry plays a crucial role in determining the thermal stability, gas generation, and severity of consequences during a thermal runaway event. Most grid scale BESS systems generally use either lithium iron phosphate (LFP) or nickel manganese cobalt (NMC) batteries, with the majority of sites using the former.

Table 4-1 below provides a comparison of the thermal stability of LFP and NMC batteries (Evro S. et al, 2024).

Table 4-1 Comparison of Properties of LFP and NMC Batteries

Property	LFP	NMC
Thermal Stability	LFP has a stable olivine structure. The strong covalent P=O bonds in the phosphate structure increases the thermal and structural stability of the battery making them less prone to overheating.	Layered oxide structure of the NMC cathodes makes them less stable under high thermal stress and more susceptible to thermal degradation and heat generation.
Mechanical stability	LFP batteries have better mechanical stability and therefore undergo minimal structural changes during cycling.	NMC cells undergo structural changes during cycling such as cracking or particle disintegration which leads to degradation, shortening the lifespan of the batteries.
Specific heat capacity	High (1000 - 1150 J Kg^{-1} K^{-1}) allowing higher heat absorption and delaying temperature rise in battery.	Lower (800 - 1050 J Kg^{-1} K^{-1}) making them more susceptible to temperature rise when under stress.
Thermal runaway threshold	Around 270 degC due to stable phosphate structure.	Between 150-200 degC due to layered oxide structure.
Heat generation	Lower heat generation due to stable structure.	Higher heat generation requiring more robust cooling systems.
Energy density	Lower energy density (90-160 Wh/kg)	Higher energy density (150-260 Wh/kg)

The proposed ESS installation will use LFP batteries cells which have higher thermal and mechanical stability and therefore a lower tendency for thermal runaway compared to NMC batteries (Evro S. et al, 2024).

4.2 ESS design

The Glenlara ESS has been designed in line with the most up to date industry standards and best practices at the time of submission. Upon construction these measures will be implemented. The design incorporates several measures for the prevention of electrical mishandling of batteries and thermal abuse, as well as robust measures to provide early detection of a fault / unsafe conditions and appropriate mitigation and containment should a fire occur to prevent propagation.

4.2.1 Cell, Module and Rack Design Standards

Huawei Smart String Grid LUNA2000 battery systems are certified to UN38.3, UL1642, IEC 62619 (IEC, 2022), UL9540A and IEC 61000.

These standards require that cells should not present significant hazards under both normal operating conditions and during foreseeable misuse (for example overcharge, overheating, short-circuit, impact). UL9540A testing has been conducted on the LUNA2000 battery systems at cell, module and rack level. It was concluded that at module and rack level observed no flames or flying fragments and no module-to-module propagation in the event of a cell going into thermal runaway. Should a thermal runaway event occur on site it is expected that the event would be limited to one module and is unlikely to spread to neighbouring containers (SUD, 2024).

The Luna2000 system has been designed to minimise the potential for thermal runaway. An overview of the Huawei Safety Design is provided in Figure 4-1 below.

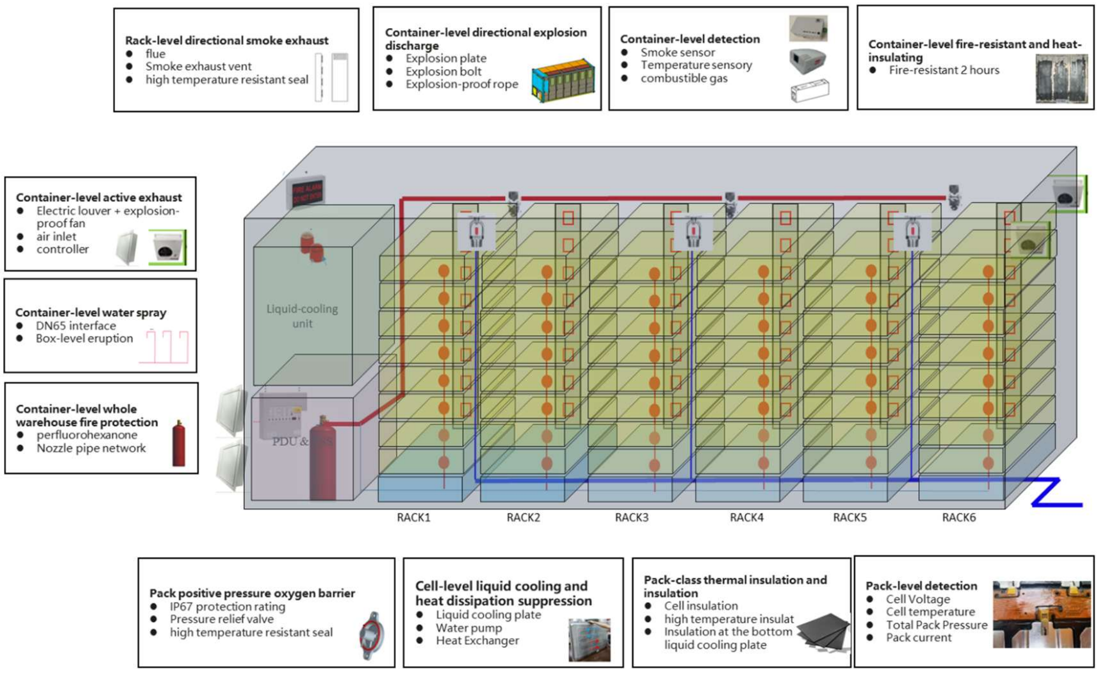
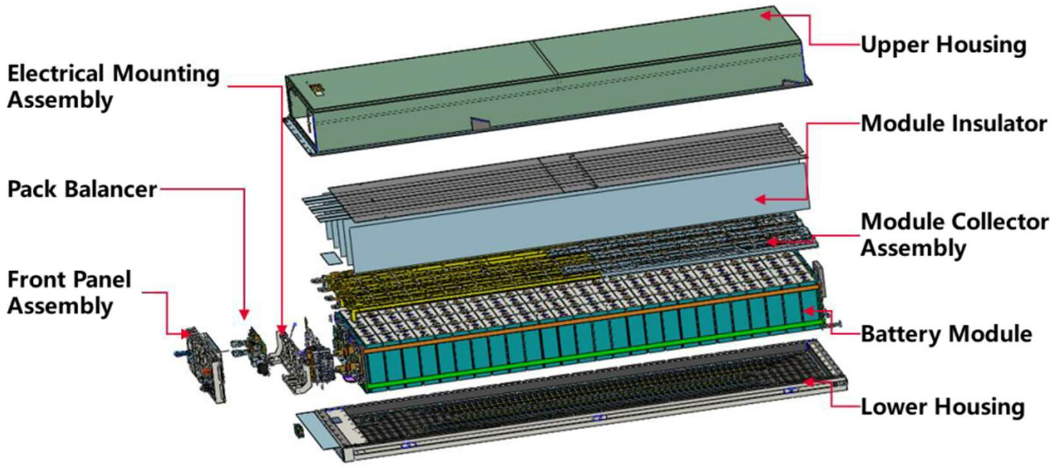


Figure 4-1 Huawei ESS Safety Design Overview

The pack comprise the following components:
Lower Frame Assembly: includes the liquid cooling plate and waterproof sealing strip.
Cell Module: comprises battery cells, insulation components, expansion force constraint components and current carrying components.
Upper Housing Assembly: contains upper housing and insulation sheets.
Front Panel Assembly: contains the Battery Management Unit (BMU) components, fuse and current carrying components



The liquid cooling compartment (within the lower housing) is designed to achieve internal electrical isolation to prevent cooling liquid leakage from entering the battery or electrical compartments. The front end of the battery modules is separated from the electrical compartment by a non-metallic pressure plate, preventing electrolyte or high-temperature gases from spraying into the electrical compartment in the event of thermal runaway.

The pack design employs a minimal Cell Contacting System (CCS) component configuration to reduce the potential for components coming into contact with end plates or casing which could result in short circuits or arcing. The pack is designed with a smoke venting channel above the cell explosion vents to quickly direct high temperature gases out of the pack.

Thermal paste and high-temperature insulation coating are used to protect the area between the bottom surface of the cell and the cooling plate. High temperature insulating material are placed on both sides of the cell module and between cells to prevent heat transfer between them.

The insulating coating used for the surface of the liquid cooling plate has been tested to ensure that it does not degrade when in contact with electrolyte and can withstand temperature of 350 degC for more than 10 minutes without any changes thus reducing the risk of short circuit or arcing between cells and the cooling plate.

Pack Level thermal propagation protection is achieved by using insulating thermal barriers which can withstand above 450 deg C. The pack shell has a temperature resistance of 1538 degC preventing thermal runaway propagation.

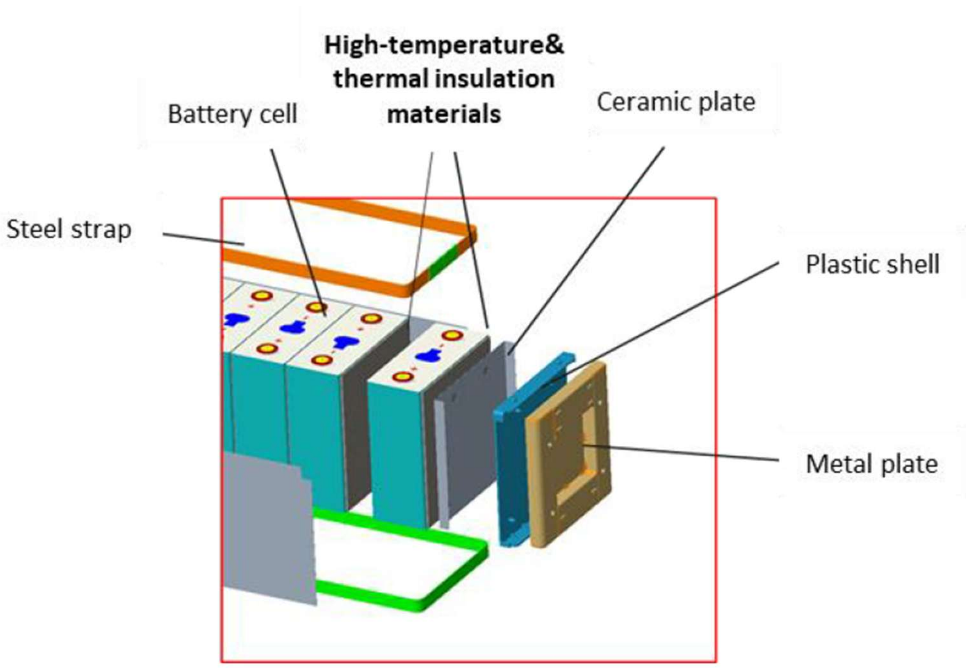


Figure 4-2High Temperature Resistant Insulating Thermal Barrier between Battery Cells

The Luna2000 packs are fitted with a positive pressure oxygen-blocking system which uses an explosion-proof valve on the casing combined with a metal upper cover and high -temperature sealing design (to IP65 standard). In the event of thermal runaway and gas production, the pack casing remains sealed and the explosion proof valve opens to relieve pressure directing the high temperature gases to the container smoke duct thus preventing spread of high temperature gas and reducing risk of escalation. The explosion proof valve reseats to block the entry of oxygen into the pack ensuring no risk of fire or flash explosion (Huawei, 2024).

The batteries electrical safety design includes AC/DC real-time insulation resistance detection. Residual Current Device (RCD), Molded Case Circuit Breakers (MCCB), shunt trip (tripping time 0.3 s), an internal high speed DC fuse is included in the modules for safety protection if a fault or hazardous condition occurs (Huawei, 2024). On detection of over current, the PCS will shut down and the contactor will open, if the PCS cannot shut down then the circuit breaker will trip followed by the circuit breakers shunt trip and the fuse opening.

The PCS dual-stage architecture ensures that no back feed current enters the battery and the ESS is safe.

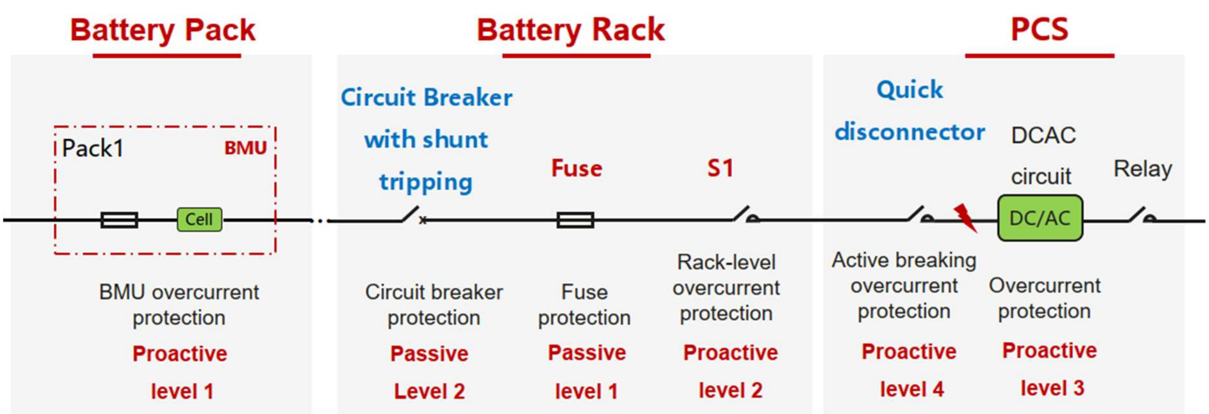


Figure 4-3 Huawei Smart String Electrical Protection Concept

4.2.2 Containers

The batteries are housed in custom protective non-walk-in containers designed to be compliant with NFPA 855 and measuring c. 2.9 m x 2.4 m x 6.1 m in length.

The containers have been designed to provide the following protection against hazardous conditions:

- Protect against ingress of moisture and dust (IP55-rated).
- Prevent access to hazardous parts of the batteries.
- Provide protection from internal projectile of cells.
- Limit the spread of fire with fire detection and suppression system and fire alarm system including visual and audio alarms.
- Explosion protection according to NFPA 855 and explosion prevention with venting panels.
- Protection against corrosion (C5 rated protection according to ISO 12944 Certified Coating).
- Each container has an internal ventilation system (which complies with NFPA 69 standards) which on detection of combustible gas (lower than 25% LEL) initiates the exhaust fans to remove the combustible gas.
- The container walls comply with EN1364-1:2015 and are fire rated to 120 mins.

The container system is pre-loaded with the battery modules prior to being brought to site therefore limiting the potential for drops or impacts during the installation stage. The container units will be installed using qualified operators and will follow the procedure set out in the OEM manual.

4.2.3 Battery Management System (BMS)

As per EIC 62619, each rack is fitted with a dedicated Battery Management System (BMS) which provides essential functions such as battery safety protection, cell balancing, state monitoring, thermal management system, data acquisition, and energy management.

The BMS will communicate alarms and status of each rack to a control subsystem in order to detect abnormal conditions such as undervoltage, overdischarge, overvoltage, overtemperature, and overcurrent in advance and initiate remedial action. The BMS shall electrically isolate the components of the ESS or place it in a safe conditions in the event that limits are exceeded or an internal fault is detected.

The BMS conforms to functional safety standard IEC 61508, SIL2 providing protection under single component failure or software failure in the BMS. As the primary control unit for the ESS, the BMS is equipped with an Uninterruptible Power Supply (UPS) to sustain normal operations during temporary power outages.

4.2.4 Thermal Management System (TMS)

The system is equipped with a Thermal Management System (TMS) (consisting of a chiller and liquid cooling pipes distributed across each module) which is responsible for effectively cooling or heating the battery cells and other components within the battery module to maintain the operating temperature within the desired range. The TMS is controlled by the BMS which sends startup or shutdown signals to the cooling unit depending on the temperature of the battery.

4.3 Control room

At operational stage, the site will be generally unmanned and will be operated and controlled remotely by the facility's SCADA system. The SCADA system will be connected to the ESS's automated management system and any matters arising in the operation of the facility will be relayed to the off-site site management team. Parameters will be continuously monitored and recorded including current, voltage, temperature and operational efficiency. In the event that an issue is identified with an individual battery or battery rack/array, the automated management system will enact the necessary procedures including isolation and notify the site management team via the SCADA system.

4.4 Detection and suppression

Fire detection and suppression is provided via the Fire Suppression System (FSS) which mitigates the risk of thermal runaway within the ESS containers through advanced detection and extinguishing capabilities, especially minimizing damage in the event of a fire.

The FSS system consists of the following elements per container:

- 2 x smoke detectors (within the battery compartment);
- 2 x heat detectors;
- 2 x Combustible gas detectors (H_2 and CO);
- Fire alarm control panel (FACP);
- Fire alarm strobe/horn;
- External manual alarm
- Aerosol based suppression systems (NOVEC 1230);
- Dryrise pipe system;
- Smoke exhaust ventilation system;

A general arrangement of the fire detection and suppression system within a container is illustrated in Figure 4-4 below and the container fire safety system mechanism is illustrated on Figure 4-5.

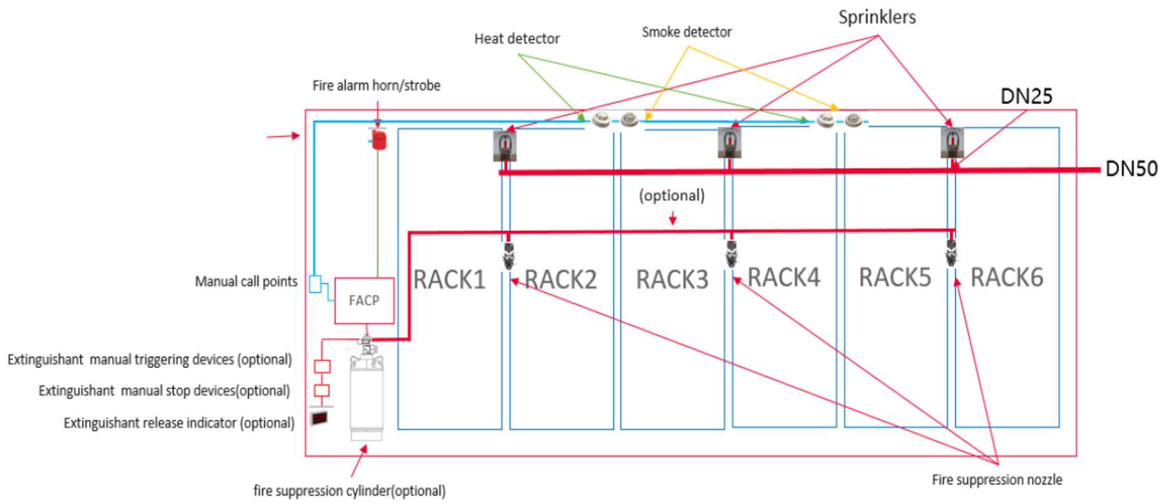


Figure 4-4 Fire Detection and Suppression System Layout

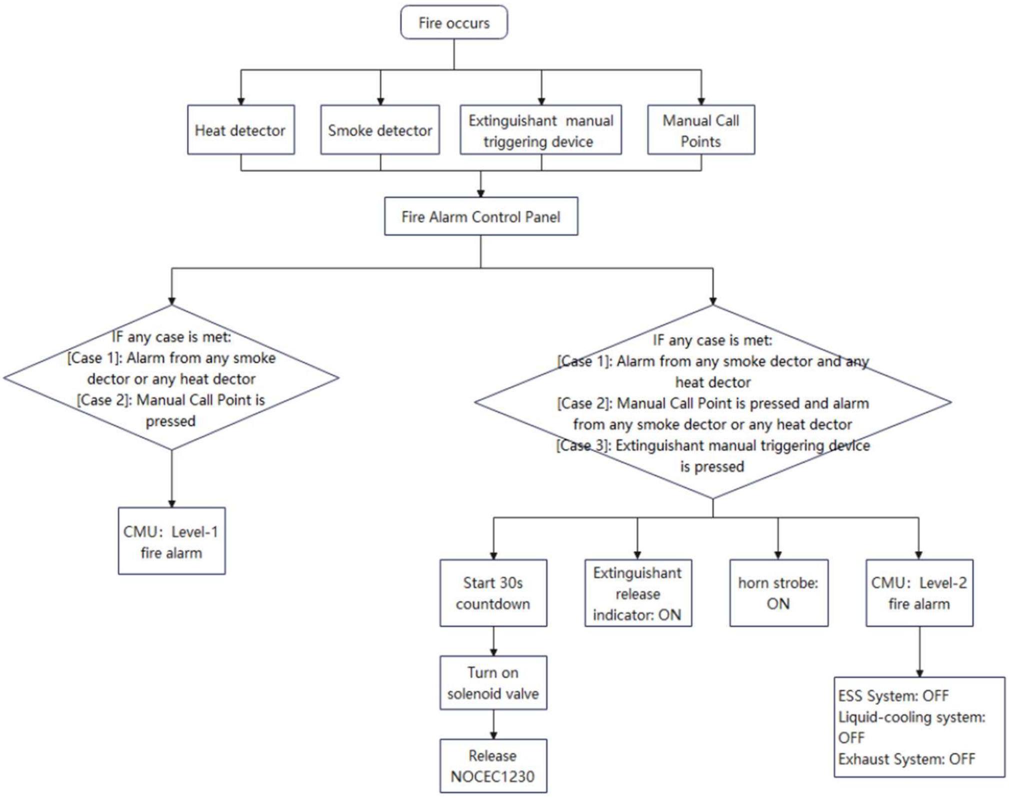


Figure 4-5 Fire Safety System Mechanism

The fires safety systems are self-operated and do not need activation from an external fire detection system.

The fire suppression strategy is organized into two distinct levels:

- Level 1: alarm warning
- Level 2: sounds horn strobe and starts the pre-discharge countdown, shuts down non-firefighting power supply such as liquid cooling unit and exhaust system. When the countdown ends the cylinder electrical actuator actuates releasing aerosols to extinguish the initial fire

The detectors will be connected via loop cable to a fire control panel located in the BCP (Battery Combiner Panel). From there, the fire alarms can be relayed to a constantly manned area (remote control room). All upcoming alarms will be responded to immediately and investigated. Resetting is only permissible after thorough investigation of the cause.

The containers are fitted with an exhaust system which will reduce the concentration of combustible gas (less than 25% LEL) in the event of thermal runaway. The exhaust controller (CMU) receives instructions from the combustible gas detector to start or stop the fans. The exhaust fans activate when the hydrogen concentration at the detector reaches 600 ppm or the CO concentration reaches 200 ppm for 3 seconds.

In the event of an initial fire in the battery compartment, a fire alarm signal will be raised, and the fire extinguishing system will automatically discharge aerosols. The aerosol suppression agent is composed of ultra-fine potassium salt particles and inert gas which can quickly consume OH, H and O radicals preventing the combustion proceeding.

In addition to the aerosol system, the ESS containers are fitted with a dry riser system which if necessary, firefighters can manually initiate the water sprinkler system in order to cool down the ESS container preventing the spread of fire to adjacent containers.

Manual call points and alarming devices will be distributed over the plant at strategic locations. Thus, a fire alarm can be triggered by staff on site and fire alarms will be audible and responded to quickly.

The fire alarm system will be analogue addressable so that the location of each fire alarm will be shown on the fire alarm panel. If required, the fire alarm can be connected to the nearest fire brigade.

4.5 Layout and separation

The ESS facility layout has been configured to ensure that appropriate separation is provided between the ESS containers and electrical subsystems in order to mitigate against propagation of a fire event from container to container or from impacting off site receptors. The separation distances are detailed below and comply with the requirements set out in NFPA 855 (NFPA , 2020), the FM Global Property Loss Prevention Data Sheet 5-33 (FM Global , 2017) and NFCC guidance (NFCC, 2026).

The ESS units are grouped together in ‘Skids’ each comprising 6 ESS containers and 2 Inverter/Transformer containers with internal Power Control System (PCS). The skids are separated from one another by 4 m aisles on sides that contain an access panel, doors or vents, limiting the spread of fire and allowing primary and secondary emergency access where required. This exceeds the recommended 1.5 m aisle separation for containerised LFP cells set out by section 2.3.2.2 of FM Global (FM Global , 2017). Separation distances between adjacent Inverter/Transformer containers exceed 6 m.

The separation distance between the battery containers and the site boundary exceeds NFPA guidance (3.5 m), with the shortest distance to the boundary being 10 meters.

All areas within 10 metres of ESS units will be cleared of combustible vegetation and any other vegetation on site will be kept in a condition such that they do not increase the risk of fire on site.

Any flammable material on site including oil for transformers will be stored appropriately in designated storage areas away from the battery container and any other potential hazard to limit the potential of fire impacting the ESS units.

The nearest ESS unit is separated from the nearest residential dwellings by approximately 190 m which exceeds the minimum distance as set out in the NFCC guidance (25 m). The likelihood of a fire off site impacting the ESS containers is considered extremely low.

Notwithstanding compliance with recommended separation distances, consequence modelling has been carried out to assess whether the hazard ranges of a thermal event at an ESS container would extend to any off-site receptors. Although ESS sites do not fall under the scope of the COMAH regulations, the assessment was completed in line with the general methodology set out in the Health and Safety Authority’s (HSA) *Guidance on technical land-use planning advice for planning authorities and COMAH establishment operators* (HSA, 2023) which outlines the methods for assessing major accident hazards

The consequences of an external jet fire at a container vent were assessed. UL 9540A testing of the Huawei LUNA2000 system concluded that no module to module or rack to rack propagation is observed however for the purposes of this assessment the release was conservatively based on a thermal event involving 1 module. Distances to the thermal radiation levels of concern as set out in (HSA, 2023) were determined for two weather categories, D5 and F2, representing typical daytime and nighttime conditions respectively. Results are provided in Table 4-2. Thermal radiation levels corresponding to 1% fatality outdoor do not extend to any offsite receptors.

Table 4-2 Distances to Thermal Endpoints of Concern

Thermal Radiation Level (kW/m^2)	Impact Definition	Distance (m)	
		F2	D5
Length of flame footprint	-	17	13
8.02	1% fatality outdoors	21	17
15.9	50 % fatality outdoors	Not reached	15
25.6	Minimum heat flux to ignite wood at indefinitely long exposures (non-piloted)	Not reached	14

4.6 Site security

Security fencing will be installed around the perimeter of the proposed development. The security fencing will comprise 2.6 m high palisade fencing. A number of pole-mounted closed-circuit television (CCTV) cameras shall be installed at specific locations within the site to monitor the proposed development site for unauthorised access.

4.7 Maintenance

The site itself will be remotely monitored 24/7 by personnel, with 1-2 site visits per month for maintenance and operational reasons. Maintenance on the battery systems will be completed by suitably qualified maintenance operators working under OEM procedures and risk assessment.

4.8 Protection against adverse weather

The ESS system includes a lightning protection system (Type II protection class according to IEC / EN 61643-11) to mitigate against any risk of failure due to lightning strike.

4.9 Construction and commissioning

Construction will be managed in line with the Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013).

During the construction phase of the development, dynamic risk assessments will be undertaken to mitigate the fire risk associated with the ESS where the safeguards have not yet been put in place (for example fire detection and suppression systems). Where necessary, temporary measures such as portable fire detection and fire fighting equipment will be utilised.

Although batteries may be present on site for a period of time before they are brought into operation, the ESS will never be operational without all the prevention measures in place, and therefore it is considered that the fire risk at pre-commissioning stage will be low. Temporary measures to cover a spontaneous failure due to damage will be implemented including a procedure for inspecting the batteries / racks on receipt to ensure there has been no damage during transport.

5. Fire Response Strategies

5.1 Access to site and for emergency service

The Glenlara site is accessed via an existing agricultural access point off the L5039 local road. This road will be maintained as part of the planning application to ensure suitability for Heavy Goods Vehicles and fire appliances.

Within the site boundary, the site layout has been designed to enable safe access by the emergency services to all ESS containers, fire hydrants and ancillary equipment. The proposed development provides for the minimum necessary dimensions for accessibility for pumping appliances as set out in Section 5.2.4 of the Fire Safety Technical Guidance Document B (Department of Housing, 2024). The internal access road measures 5 m wide allowing suitable access of fire service vehicles throughout the site.

5.2 Emergency Planning

An emergency response plan (ERP) will be developed in consultation with Cork County Council Fire Service prior to construction. The ERP will follow NFCC guidelines and will outline steps to be taken in response to an incident on site. The ERP will contain the following information:

- A description of the facility, outlining its infrastructure, operational activities, workforce numbers, and normal operating hours.
- A site plan showing all key infrastructure, including access points and internal roadways; firefighting assets (such as water tanks, pumps, booster systems, hydrants, and hose reels); drainage systems; and neighbouring land uses or properties.
- The method by which the fire service will be notified in the event of an emergency.
- Information on available emergency resources, including fire detection and suppression systems, gas detection equipment, emergency eye-wash, spill control equipment, emergency warning and communication systems, personal protective equipment, and first-aid supplies.
- Current contact information for on-site personnel as well as any off-site specialists who may provide technical support during an emergency.
- An inventory of all dangerous goods stored at the facility.
- Detailed site evacuation procedures.
- Emergency response procedures for all foreseeable hazards and risks, including structural, infrastructure, and vehicle fires, as well as grassfires and bushfires.

5.3 Water supply

Firefighting water is supplied via a 271 m^3 capacity water supply tank which will feed 2 hydrants on site. The tank has been designed to have sufficient capacity for two hydrants to be used at a time.

5.4 Fire water run off protection

The site's firefighting water management system is designed in line with the UK National Fire Chiefs Council (NFCC) guidance (used in lieu of Irish guidance), which requires that firewater be prevented from entering surface or groundwater pathways.

Containment of contaminated fire water generated in a fire event is based on the storage of water within the lined attenuation basin and the top layer of the ESS subbase with infiltration to ground or loss to the surface water prevented by the installation of an impermeable geomembrane at the formation level of the ESS subbase and basin. Contaminated water will preferentially follow lateral drainage pathways within the site drainage network and be directed to the lined attenuation basin, the outflow of which is controlled by an emergency shut off isolation valve (McCloy Consulting, 2026). The pollution control valve will be interlocked with the fire alarm system on site, closing automatically on activation of the alarm.

A total storage volume of 1,183 m^3 is available in the lined gravel subbases and attenuation basins exceeding the minimum requirement of 180 m^3 firefighting water (based on flowrate of 25 litre/s for 120 minutes) for boundary cooling as set out in the UK National Fire Chiefs Council (NFCC) guidance.

If firefighting water becomes contaminated, it will be held on-site long enough to allow pumping out by a licensed waste management contractor for off-site disposal.

6. Risk Evaluation

The sections herein have outlined the fire hazards associated with grid-level BESS installations, their potential initiating events and the methods which will be employed to prevent and mitigate against a fire event at the proposed Glenlara ESS facility. Table 6-1 below provides an evaluation of the residual risk of fire events at the site.

Table 6-1 Risk Evaluation

Causes of fire hazard	Preventive Measures	Mitigation	Risk Evaluation
Battery Manufacturing Defects	Use of accredited suppliers for the procurement of battery technology. Use of lower risk technology (LFP vs NMC) UL testing of batteries	Automatic isolation of defective batteries systems. Use of thermal insulation materials between cells to block propagation of heat between batteries. Initiation of emergency response measure. Fire detection and suppression systems Site layout (separation)	The risk from this has been designed to a minimum due to procurement of battery technology from accredited suppliers, requiring rigorous quality assurance evidence, and ensuring components meet certified safety and performance standards. The use of a lower risk technology (LFP)
Electrical Mishandling of Batteries	Batteries used in the ESS are designed according to current industry standards. BMS TMS Maintenance	Automatic isolation of defective batteries systems. Initiation of emergency response. Fire detection and suppression systems Site layout (separation)	The residual risk of a thermal event occurring on site due to electrical mishandling of batteries is reduced to a minimum via the presence of BMS and TMS systems providing battery safety protection, cell balancing, state monitoring and thermal stability management.
Thermal Abuse of Batteries	Use of lower risk technology (LFP vs NMC) BMS TMS	Initiation of emergency response. Fire detection and suppression systems Site layout (separation)	The residual risk of a thermal event occurring on site due to excursions beyond safe temperature limits is reduced to a minimum due to the use of thermally stable LFP chemistry and the consistent monitoring and control provided by the BMA and TMS systems.
Mechanical impact	Container design Construction management	Fire detection and suppression systems Initiation of emergency response Drop tested to 1 m Site layout	The risk of a thermal event being initiated by mechanical impact is considered very low due to the minimal manual interaction with the battery units when on site and protection provided by the container enclosure.
External Fire	Layout Control of combustible material on site	Fire detection and suppression systems	The risk of a thermal event being initiated by an external fire source is considered to be very low due to the

Causes of fire hazard	Preventive Measures	Mitigation	Risk Evaluation
	including vegetation growth and flammable material.	Initiation of emergency response	separation distances on site and separation distance from off site receptors, appropriate storage of flammable materials on site and maintenance of vegetation.
Vandalism	Access control and site security	Site layout (separation) Fire detection and suppression systems Initiation of emergency response measure	This is considered to be a low risk because the site has sufficient security and access arrangements.

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