



# **Technical Appendix 4-1 Battery Safety Management Plan (BSMP)**

**EIAR – Volume 3**

**Muingmore Wind Farm**

SLR Project No.: 501.065301.00001

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# Muingmore Wind Farm

## Battery Safety Management Plan

### RWE Renewables (Ireland)

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**Table 1-1 Organizational details of SLR Consulting**

S. No	Items	Details
1	Name of Organization	SLR Consulting
2	Main areas of business	<p>From origination through feasibility and planning, to delivery and operation and finally end of life, SLR supports their clients at every step. SLR is at the forefront of providing technical and professional services to the energy sector around the world.</p> <p>SLR offers energy, environmental, engineering, technical advisory and renewables asset management services.</p> <p>In the energy sector, SLR has experience delivering environmental, technical and advisory services across technologies including in solar, storage, onshore wind, marine energy, biomass and grid.</p>
3	Type of Organization (Firm/ Company/ Partnership Firm registered)	Company
4	Address of registered office with telephone no. & fax	7 Dundrum Business Park, Windy Arbour, Dublin, D14 N2Y7
5	Address of offices in other places	Kenya, Morocco, Namibia, Egypt, Ghana, Rwanda, South Africa, DRC, Australia, France, Germany, Ireland, Norway, Spain, USA
6	Contact Person with telephone no. & email address	David Fernandez Phone: +34 613 959057 Email: david.fernandez@slrconsulting.com



## 1.0 Abbreviations

Abbreviation	Definition
AC	Alternating Current
AESS	Alarm and Emergency Shutdown System
ALARP	As Low as Reasonably Practicable
BESS	Battery Energy Storage System
BMS	Battery Management System
BSMP	Battery Safety Management Plan
CCTV	Close Circuit Television
DC	Direct Current
EMS	Energy Management System
EoL	End-of-Life
FM	Factory Mutual Insurance Company
FPE	Fire Protection Engineer
FRS	Fire Rescue Service
FSS	Fire Suppression System
HGV	Heavy Good Vehicles
HSE	Health and Safety Executive
HVAC	Heating, Ventilation and Air Conditioning
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
ISMS	Information Security Management System
ISO	International Organisation of Standardisation
Li Ion	Lithium Ion
LFP	Lithium Iron Phosphate
MW	Megawatt
MWh	Megawatt hour
NFCC	National Fire Chiefs Council
NFPA	National Fire Protection Association
NMS	Lithium Nickel Manganese Cobalt Oxide
NPPF	National Planning Policy Framework
NMC	Lithium Nickel Manganese Cobalt Oxide
O&M	Operation and Maintenance
PCS	Power Conversion System



Abbreviation	Definition
OEM	Original Equipment Manufacturer
SoC	State of Charge
SoH	State of Health
SuDS	Suitable Drainage System
SWG	Safety Working Group
UL	Underwriters Laboratory



## 2.0 Executive Summary

This Battery Storage Safety Management Plan (BSMP) provides the foundation for the safety management processes and procedures required to meet relevant guidelines and best practices during the planning stage of the proposed Muingmore Wind Farm Battery Energy Storage System (BESS). The BSMP will be a live document as the pre-construction and construction stages advance, once the BESS technology selection and supplier have been finalised. Updates to the BSMP will incorporate a comprehensive emergency response plan aligned with the latest standards, guidelines, technological requirements, and industry best practices.

As of March 2026, in the Republic of Ireland there is not a dedicated fire safety guidance or Code for Lithium Ion (Li Ion) type of BESS. Therefore, this BSMP has been developed in alignment with the UK NFCC 2026 Grid-Scale Battery Energy Storage System Guidance<sup>1</sup> as a primary reference. The UK represents one of the most mature and extensively regulated BESS markets globally and its environmental and meteorological conditions are broadly comparable, making the NFCC guidance a robust and relevant framework for risk assessment and design considerations.

In addition to UK guidance, internationally recognised standards have also been incorporated most notably those developed by the National Fire Protection Association (NFPA), including NFPA 855 for stationary energy storage installations and associated electrical and fire-safety standards. Actually the 2026 NFCC Guidance explicitly references and draws upon NFPA 855.

This BSMP outlines the principles, design requirements, safety systems, operational controls, risk assessments and stakeholder engagement needed to support the development of the BESS from the safety perspective.

The document describes the overarching safety approach for the Proposed Project, including the identification of foreseeable hazards such as thermal runaway, fire, gas release, electrical faults and environmental contamination. It also sets out the high-level risk management framework that will be expanded and formalised during pre-construction stage, once the final technology supplier, operating parameters and container configuration have been confirmed. The BSMP highlights the importance of integrated safety systems that includes the Battery Management System (BMS), Thermal Management System (TMS), Fire Detection and Suppression Systems, Gas Detection and Ventilation.

In addition to the technical design and safety functions, the BSMP provides a preliminary operational and emergency preparedness strategy. This includes a description of the early-stage requirements for the Emergency Response Plan (ERP), communication and notification approach, stakeholder engagement and overview of operational roles and responsibilities necessary to support a safe system of work. The report emphasises the importance of competence, training and emergency drill requirements to make sure all operational and maintenance personnel are prepared to respond effectively to emergency scenarios.

This plan also assesses the Muingmore BESS layout against key UK and international fire safety design requirements such as separation distances, access routes, water supply, drainage and vegetation management. The proposed layout demonstrates strong alignment with NFCC 2026 recommendations, including dual access points, a firefighting water tank

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<sup>1</sup> [Grid scale energy storage system planning - Guidance for fire and rescue services - NFCC](#)



provision significantly exceeding minimum capacity and container separation distances compliant with NFPA and UL9540A derived requirements.

Overall, this document establishes the basis of a comprehensive battery safety management plan that will be further refined during the pre-construction stage. It will contribute to risks identification and mitigation as far as reasonably practicable (ALARP), supports regulatory engagement and forms a key component of the Proposed Project's planning and safety justification.



## 3.0 Introduction

### 3.1 Scope

The purpose of this document is to describe the guidelines and best practice for safe operation of a utility scale BESS and to identify, assess and mitigate fire safety risks associated with the installation and operation of the BESS.

This BSMP scope for the proposed BESS covers the following areas:

- Planning stage safety framework: Establishes the early-stage safety approach for the design, installation and operation of the BESS, identifying initial risks and required controls.
- Technology and system coverage: Applies to all physical and functional components of the BESS including battery containers, inverters, transformers, cooling, fire systems, monitoring and site infrastructure.
- Lifecycle stages included: Encompasses design, construction, operation, maintenance, remote monitoring, decommissioning, recycling and end of life.
- Site layout and integration: Covers placement of equipment, spacing, site access, drainage and vegetation management.
- Safety requirements and compliance: Aligns with Irish planning and regulatory frameworks and applies recognised Li Ion BESS fire safety related NFCC guidance, NFPA/UL/IEC standards and industry best practice, reflecting the absence of specific national technical guidance for utility scale BESS in Ireland.

An updated BSMP will be produced post-consent prior to the commencement of the BESS construction. The updated BSMP will incorporate the latest good practices in battery fire detection and prevention and include a comprehensive emergency response plan. Once the final technology, supplier and layout have been confirmed, the updated BSMP will be developed in line with the most up to date standards, guidelines and good practices described initially in this BSMP. From a fire safety perspective, engagement with the local Fire Authority will take place to ensure that design assumptions, access provisions and emergency response measures are aligned with local requirements from the outset.

### 3.2 Site Description

The Proposed Development, which includes the wind farm and its ancillary infrastructure and the battery energy storage system (BESS), is located within the townlands of Muingmore (An Mhoing Mhór), Doolough (Dumha Locha), Tristia (Troiste), Moneynierin (Moing an Iarainn) and Bangor (Baingear) in the administrative area of Mayo County Council.

The proposed BESS compound of 156m long on the northwest length, 153m long on the southeast length and 99m wide either side, secured by a 2.6m high palisade fence<sup>2</sup>, comprises a total of 120 Battery Containers and 15 Power Conversion Containers (PCS) arranged across five parallel rows, providing a uniform layout with internal road network to support operational access. The equipment is contained within a secured and fenced compound with a dedicated control and switchgear area and ancillary infrastructure such as a water tank and site entrance. The BESS will be deployed alongside a wind farm as part of a co-developed asset which includes the following infrastructure:

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<sup>2</sup> EIA Chapter 2 Muingmore WF Description of development and Site Layout (27.02.2026).dwg



- Battery containers.
- On-site substation.
- PCS to convert direct current (DC) electricity into usable alternating current (AC) power.
- Transformers.
- Internal access tracks.
- Temporary construction compound.
- Underground cabling.
- Customer station compound.
- Spares container.
- Security lighting and CCTV cameras mounted on posts.
- Access gates and perimeter fencing.
- Surface water drainage system.
- Water storage tank.

The proposed BESS layout, including the battery containers, PCS, access road and switchgear is illustrated in Figure 3-1. Further details on the design are provided in Section 10.0.

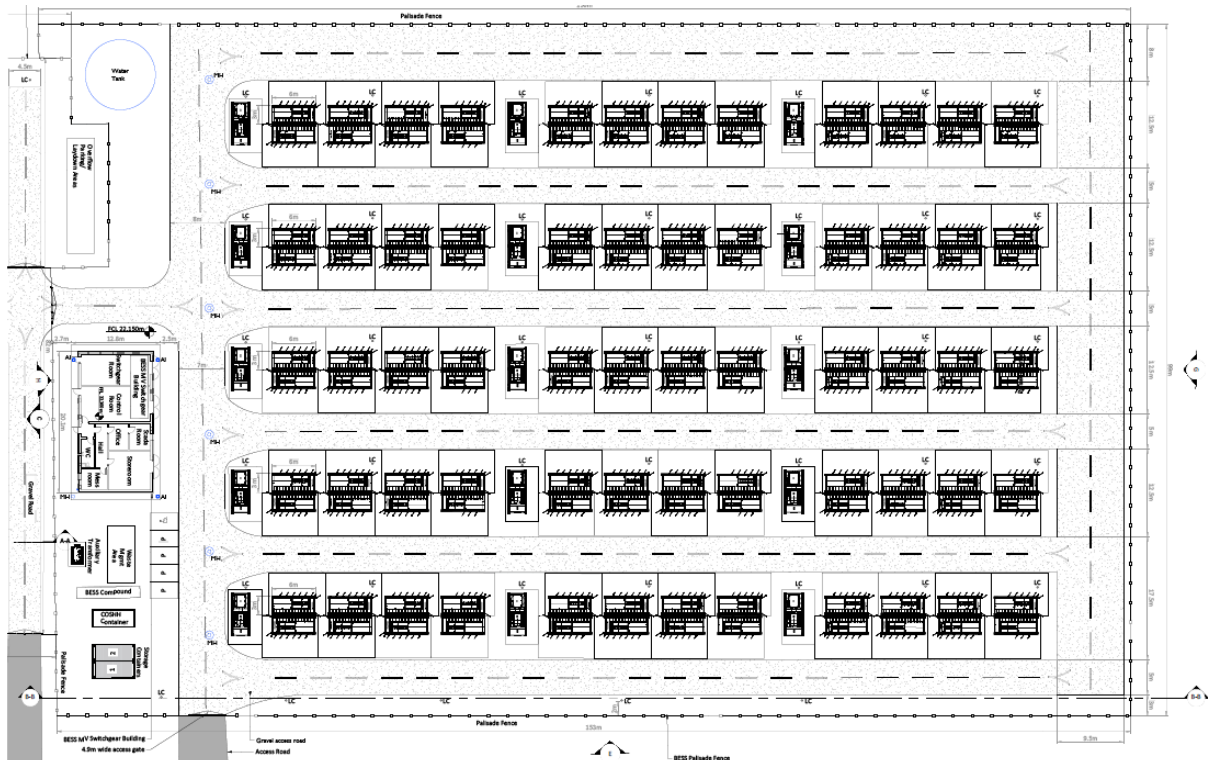


Figure 3-1: BESS Layout



It has been confirmed by the Applicant that the current design is based on battery cells comprising of lithium iron phosphate (LFP) cells, a lithium-ion battery technology recognised for its stability, safety and long cycle life. Additional information on the BESS technology and associated infrastructure is provided in Section 4.1 includes further information on the BESS technology.

### 3.3 National Policy Alignment

At national level, planning and development policy in Ireland is guided by the National Planning Framework (NPF), which forms part of the Government's long term strategic planning and suitable development for urban and rural areas to 2040. The NPF, together with the National Development Plan 2021 (NDP), combine to form Project Ireland 2040<sup>3</sup>, that have the '*core objectives of securing balanced regional development and sustainable "compact growth" approach to the form and pattern of future development.*'

However, at present, there is no dedicated national guidance in the Republic of Ireland specifically for the preparation of this BSMP for BESS. Instead, the design, operation and safety aspects of BESS developments are typically assessed through the planning system and associated frameworks.

In the absence of specific Irish guidance for utility scale BESS, developers and designers commonly rely on recognised international standards and best practice guidance to demonstrate that risks are appropriately managed. This typically includes guidance produced by organisations such as the UK National Fire Chiefs Council (NFCC), including Utility Scale Battery Energy Storage System Planning Guidance<sup>4</sup>. This guidance provides recommendations on fire safety design, emergency response planning and firefighting water supply for BESS installations.

In addition, internationally recognised standards such as NFPA 855 are frequently referenced in planning documentation to demonstrate compliance with industry standards.

The specific standards and guidance adopted for the Proposed Development are outlined in Section 4.3.

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<sup>3</sup> [National Planning Framework \(NPF\) – Project Ireland 2040](#)

<sup>4</sup> [Grid scale energy storage system planning - Guidance for fire and rescue services - NFCC](#)



## 4.0 System Architecture & Design Safety

For the development of a utility scale BESS project, it is essential to specify project requirements to support successful planning, design, construction and operation. This section will describe the fundamentals of BESS, the cell technology, main system components that typically comprise a BESS system (battery container, PCS, cooling system, fire suppression system and control) and listing of standards.

Prior to commencement of construction of the BESS, an updated BSMP (in accordance with this BSMP) is required to be prepared and submitted to the relevant local planning authority and approved, in consultation with the Health and Safety Authority (HSA) for workplace safety regulation and the Local Authority Fire Services operating under the Fire Services Act 1981 & 2003.

### 4.1 BESS Technology & System Description

#### 4.1.1 Fundamentals

Lithium-ion (Li-ion) batteries have become a dominant rechargeable energy storage technology due to their high energy density, long lifespan and lightweight nature. They are widely used in consumer electronics and electric vehicles as well as larger scale stationary energy storage applications.

Li-ion cells operate by moving lithium ions between a graphite anode and a lithium-based cathode through an electrolyte during charge and discharge. Their main components are:

- Anode: Typically, graphite or silicon;
- Cathode: Composed of various materials, in this case lithium iron phosphate ( $\text{LiFePO}_4$ );
- Separator: Avoids direct contact between anode and cathode, allowing only ions to pass through; and
- Electrolyte:  $\text{LiFePO}_4$  (LFP) chemistry offers high thermal and chemical stability, lower risk of thermal runaway compared with NMC (Lithium Nickel Manganese Cobalt Oxide) and maintains integrity at elevated temperatures.

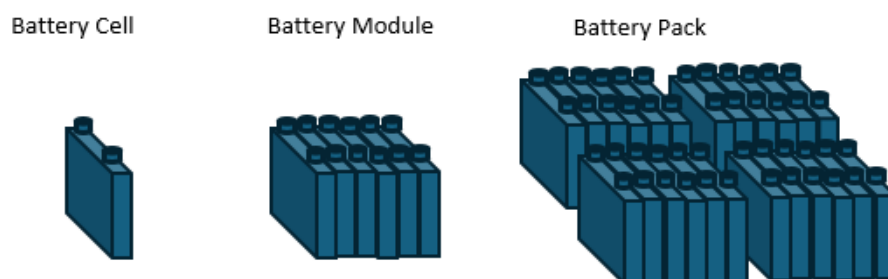
#### 4.1.2 System Components

The main components typically found in a BESS are as follows:

- Batteries: Made up of individual cells assembled into modules or packs.
- Power Conversion System (PCS): A bi-directional inverter that converts DC from the batteries to AC for the grid and vice-versa, controlling charge and discharge.
- Battery Management System (BMS): Manages battery operation by maintaining cells within appropriate voltage, current and temperature limits and tracking State of Charge (SoC) and State of Health (SoH).
- Energy Management System (EMS): Oversees and optimises overall BESS operation, including charging and discharging strategies

Includes thermal management, HVAC, fire detection/suppression and monitoring systems (including CCTV) to prevent hazards and support safe operation.





**Figure 4-1: Battery Schematic**

## 4.2 Safety Functions

This section provides a description of the safety systems required and integrated in a utility scale battery project. The BESS does require a comprehensive safety system that contributes to safe operational conditions and minimises potential risks such as thermal runaway<sup>5</sup>, fires or system failures.

### 4.2.1 Battery Management System (BMS)

The BMS is the primary safety and control mechanism in a BESS. The BMS is the main safety and control system in a BESS, monitoring battery cells in real time to prevent issues such as overvoltage, undervoltage and overheating.

Its key functions include:

- **Temperature monitoring:** The continuous measurement of cell temperatures to prevent potential overheating issues that could derive to thermal runaway.
- **Voltage and current monitoring:** Helps maintain each cell stays within safe limits and avoids overcharge/discharge.
- **State of Charge (SOC) and Health (SOH) monitoring:** Maintains optimal operation and prevents deep discharge or overcharging.
- **Cell Balancing:** Keeps cells operating uniformly to reduce degradation and system imbalance. The aim is to achieve uniform performance across all cells, thus minimising risks of premature degradation of weak cells or other system imbalances that may occur. For utility scale BESS, active balancing (which transfers energy from higher-charged cells to lower-charged ones) is increasingly the preferred method over traditional passive balancing (which dissipates excess energy as heat via resistors). Active balancing improves energy efficiency, reduces heat generation, extends usable capacity and supports longer system lifespan.

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<sup>5</sup> Thermal runaway definition: A condition where the heat generated inside a battery exceeds the ability of the BESS cooling system to dissipate that heat.



#### **4.2.2 Thermal Management System (TMS)**

The TMS maintains the battery pack within a safe temperature range to prevent overheating and reduce thermal runaway risk. Key elements include:

- Active cooling: Air or liquid-based cooling to remove heat; liquid cooling is increasingly preferred for its higher efficiency and safety.
- Passive cooling: Heat sinks, ventilation and other methods that dissipate heat naturally.
- Temperature sensors: Located throughout the BESS to detect local temperature spikes.
- Thermal insulation: This reduces the effect on the BESS of high external temperatures.

#### **4.2.3 Fire Suppression System (FSS)**

The FSS must be integrated into the BESS enclosure to detect, control and extinguish fires, especially during potential thermal runaway, preventing spread between cells and modules. The FSS includes smoke and fire detection to identify early signs such as smoke, temperature spikes or gas emissions to trigger alarms or suppression.

- Fire Suppression: Uses automatic agents (e.g., Novec 1230) and/or water mist systems designed to rapidly suppress ignition, minimise thermal runaway propagation and reduced risk to personnel, property and the environment.
- Gas Ventilation: The BESS must be equipped with a gas exhaust system to remove hazardous gases that may have been generated in a thermal runaway event which generally include hydrogen. This will reduce the risk of potential explosions.

#### **4.2.4 Gas Detection and Ventilation System**

The gas detection and ventilation system identifies hazardous gases released during thermal runaway or other failures and safely vents them outside the BESS enclosure. This prevents the buildup of flammable or toxic gases and reduces explosion and personnel safety risks.

Key features include:

- Gas Detection System: These are installed to detect various gases including hydrogen, carbon monoxide, or toxic electrolytes released when battery cells fail.
- Ventilation System: The system is automatically activated and ventilates dangerous gases to prevent the development of hazardous environment within the container.
- Pressure Relief System: If excessive pressures are reached within the battery enclosure, the pressure relief system is activated to reduce the risk of a potential explosion.

#### **4.2.5 Battery Enclosure**

The BESS enclosure protects the battery system from mechanical damage, environmental hazards and unauthorised access.

Key features include:

- Weatherproof and Fireproof Enclosures: Shields the BESS from wind, rain, fire and extreme temperatures.
- Explosion Containment and Mitigation: The enclosure prevents and mitigates BESS explosion risks from thermal runaway gases. It uses gas detection and automatic ventilation to keep concentrations below 25% LFL and venting panels safely relieve overpressure.



- Security System: This includes controls, alarm and surveillance to protect the system from tampering or unauthorised access.

#### **4.2.6 Alarm and Emergency Shutdown System (AESS)**

The AESS is required for automatic system shutdown under critical failure or hazard. The principle is to prevent further damage or potential hazard in the event of an emergency by stopping the system operations, thus mitigating the risk to personnel and equipment. The system will be equipped with the following:

- Manual Emergency Shutdown System: Allows operators to safely power down the system when needed.
- Shutdown System: Activates when real-time monitoring detects critical issues such as overheating, overvoltage, or fire.
- Alarms System: Sends immediate alerts to operators and emergency responders when hazardous conditions occur.

### **4.3 Legal Requirements and Standards**

The project goal for the BESS is to deliver a design that protects operators, maintenance teams, the public and the surrounding environment by meeting all relevant legislation and recognised best practice for utility scale BESS. These safety requirements have guided the BESS design and development process to make sure that both direct and supporting safety obligations are fully met. These expectations will be translated into specific safety requirements within the RFQs and passed on to all potential suppliers. The supplier compliance with these requirements will form part of the project's overall safety justification, showing that risks to people, property and the environment have been reduced to a level that is considered as acceptable, tolerable and ALARP.

While the Proposed Development is located in the Republic of Ireland, there is currently no dedicated national technical guidance specifically addressing the safety management of utility scale BESS projects. Instead, developments of this type are assessed through the statutory planning framework established under the Planning and Development Act 2000, with consultations undertaken with relevant bodies including the local Fire Authority. In the absence of Ireland-specific technical guidance, it is common practice for developers and designers to adopt recognise international and UK standards and established industry guidance to demonstrate risks are appropriately identified and mitigated.

#### **4.3.1 Legal Compliance**

The main legal requirements for developing a utility scale BESS in the Republic of Ireland, the UK and other international regulations are as follows:

- Planning and Development Act 2000 and Planning and Development Regulations 2001: All BESS developments require planning permission from the local planning authority.
- Fire Services Act 1981 & 2003: This is the core Irish fire-safety legislation. It grants powers to local Fire Authorities to review developments, assess fire-safety provisions, specify requirements for emergency access and water supply and make sure adequate fire-risk mitigation measures for sites such as BESS installations. In the absence of BESS specific Irish regulations, projects typically rely on established international best practice, such as NFPA 855, IEC standards, and NFCC Grid-Scale BESS Guidance (UK) as reference material.



- Safety, Health and Welfare at Work Act 2005: The primary Irish health and safety legislation requires duty holders to make sure, so far as is reasonably practicable, the safety and welfare of workers and the public, including risks associated with BESS technologies.
- Safety, Health and Welfare at Work (General Application) Regulations 2007: These include emergency procedures, hazardous substance controls, noise, vibration, PPE, manual handling and workplace safety. These apply directly to BESS construction, operation and maintenance.
- Chemical Agents Regulations and ATEX Regulations (Directive 99/92/EC): This covers the safe handling of hazardous substances, including battery electrolytes and gases such as hydrogen that may be released during thermal runaway events.
- Safety, Health and Welfare at Work (Construction) Regulations (derived from SHWW Act 2005): This applies to the construction and installation of BESS infrastructure, including contractor management, safe site layout, lifting operations and excavation works.
- Low Voltage Directive / Electromagnetic Compatibility Directive (EU): This makes sure that all electrical equipment including battery modules, inverters, transformers and switchgear is designed, installed and operated safely.
- Noise at Work, Vibration at Work, PPE Regulations, Manual Handling Regulations (General Application Regulations 2007): This applies directly to BESS operations, given exposure risks from HVAC units, inverters, heavy lifting operations and maintenance activities.
- REACH Regulation (EU Regulation 1907/2006): This governs the aspects in regards of chemical content of batteries, electrolytes and associated components used in BESS systems.
- Waste Management (Batteries and Accumulators) Regulations 2008: This sets the requirements for the collection, recycling and disposal of industrial batteries, including Li ion BESS modules.
- Environmental Protection Agency (EPA) Guidance, including GPP Fire Water and Pollution Control. This provides best practice measures for managing contaminated firefighting run-off and preventing environmental pollution in case of a BESS fire.
- Electricity Regulation Act 1999: This regulates the safe operation of electricity-generating stations, including grid-connected BESS and makes sure installations do not negatively impact the wider electricity system.

#### **4.3.2 Standards for Li Ion Battery Technology**

The Proposed Development must comply with several standards, certifications and guidance for safe and resilient operation.

- UL 9540 (2025) – Standard for energy storage systems and equipment;
- NFCC Guidance (2026) – Grid-scale BESS planning guidance for Fire and Rescue Services;
- NFPA 855 (2023) – Standard for installation of stationary energy storage systems.

Compliance with component-level safety standards is essential to mitigate risks such as electrical faults, thermal runaway, fire and explosion. Note that these standards may be updated or superseded in future versions.



#### 4.3.2.1 Battery Cells and Modules

The battery modules will demonstrate compliance with following standards:

- UL 9540A: Tests thermal runaway and propagation to make sure failures do not spread between cells or modules or generate dangerous gases.
- UL 1973: Covers safety of stationary batteries, including mechanical integrity, electrical fault tolerance and thermal performance.
- IEC 62619: International safety standard for industrial rechargeable batteries, focusing on preventing thermal runaway, overcharging and electrical hazards.
- UN 38.3: Transportation standard ensuring batteries can withstand shock, pressure changes and temperature extremes during shipping.

#### 4.3.2.2 Battery Management System

The BMS will demonstrate compliance with following standards:

- UL 991: Make sure BMS electronics reliably detect faults and protect against unsafe voltage, current and temperature conditions.
- UL 1998: Make sure BMS software performs safely and manages charging/discharging correctly under all operating conditions.
- IEC 61508: Functional safety standard ensuring the BMS can tolerate faults and execute safe shutdowns in critical situations.
- IEC 62040: Covers safety and performance requirements for power systems, ensuring proper integration between the BMS and power conversion equipment.

#### 4.3.2.3 PCS/Battery Inverters

The PCS manages energy flow between the battery, grid and connected loads, enabling DC/AC conversion for efficient charging and discharging. It must comply with the following key standards:

- UL 1741: Safety requirements for inverters in distributed energy systems, including protection against electrical faults.
- IEC 62109: Make sure inverter safety through electrical shock protection, thermal management and insulation standards.
- IEEE 1547: Defines safe grid-connection requirements, including synchronization and disconnection during faults.
- IEC 62116: Specifies anti-islanding protections to make sure PCS disconnects during grid outages.
- IEC 61000: Electromagnetic compatibility requirements for emissions and immunity.
- ISO/IEC 27001: This standard is not specific to PCS but outlines best practices for information security management systems (ISMS).
- IEC 61850: Communication protocols for grid and substation automation, enabling secure, standardised PCS communication.

#### 4.3.2.4 Energy Management System (EMS)

The EMS will demonstrate compliance with following standards:



- IEC 62443: Make sure cybersecurity for industrial automation systems, including EMS, to prevent cyberattacks that could disrupt BESS operations.
- ISO 27001: Focuses on information security management, ensuring that the EMS can protect critical operational data.
- IEC 61508: Functional safety for EMS systems to make sure that safety-critical processes within the BESS, such as dispatching power and controlling inverters, are reliable.

#### 4.3.2.5 Fire Detection and Suppression Systems

The fire detection systems will demonstrate compliance with following standards:

- NFPA 855: Provides fire safety requirements for the installation of energy storage systems.
- UL 9540: Focuses on system-level safety for energy storage systems.
- UL 9540A: Tests the system's ability to handle thermal runaway and limit fire propagation.
- FM Global Datasheet 5-33: Offers guidelines for fire protection and hazard mitigation specific to Li- ion battery systems.
- Grid Scale Battery Energy Storage System planning - Guidance for FRS (2026).
- FM Global Research: States that cooling of the surroundings under a fire event is critical to protect the surrounding infrastructure but as well because it is currently not possible to extinguish a BESS fire with sprinklers. Furthermore, gaseous protection systems do not provide cooling of the ESS or the surrounding occupancy.

Selection of the fire suppression system must consider risk assessments, environmental impacts and facility-specific operational needs, including involvement of Fire Protection Engineer (FPE) who has experience in fire suppression systems, particularly for utility scale BESS as is the case at the Proposed Development.

Calculation of the water supply requirements to determine the flow rates and volumes needed for the type of suppression system selected and the potential for fire spread and the required coverage area. It shall be noted that the lack of sufficient water supplies at a particular site location will not be considered as the basis for a suppression system choice. The consideration of alternative solutions will be investigated.

#### 4.3.2.6 Battery Enclosures

The enclosures will demonstrate compliance with following standards:

- UL 9540: System-level safety standard ensuring enclosures protect BESS components from electrical faults and environmental risks.
- NFPA 68: Explosion-protection standard requiring deflagration venting to safely relieve internal pressure without catastrophic damage.
- IEC 60529: Defines Ingress Protection (IP) ratings; outdoor BESS enclosures must provide high resistance to water, dust and contact.
- BS EN 13501-2: European fire-resistance standard ensuring enclosure materials provide adequate containment during a fire.
- NFPA 855 Requires fire-rated barriers, including:
  - 1hour fire resistance rating for barriers within BESS installations or between individual BESS compartments; and



- 2hour fire resistance rating for walls separating BESS from other occupancies or critical infrastructure.

#### **4.3.2.7 Cabling and Electrical Connections**

The cabling and electrical connections will demonstrate compliance with following standards:

- UL 6141: Safety standard for wiring and connections in energy storage and photovoltaic systems, ensuring proper insulation, grounding and fault protection.
- NFPA 70 (NEC Article 690): Defines electrical installation requirements for battery systems to prevent shock and fire hazards.
- IEC 60502: International standard for medium-voltage power cables, addressing their performance and safety in energy systems.

#### **4.3.2.8 Cooling and Ventilation Systems**

The cooling and ventilation systems will demonstrate compliance with following standards:

- ASHRAE 90.1: Standards for the energy-efficient design of buildings.
- NFPA 69: Provides guidelines for prevention of explosion, focusing on managing gas buildup (e.g., hydrogen release from faulty Li-ion batteries) through proper ventilation and explosion venting systems.
- UL 9540A: Includes testing for heat and gas management in energy storage systems to prevent explosions or fires caused by thermal runaway.

## **5.0 Risk & Operational Management**

### **5.1.1 Risk Management Process**

A Risk Management Plan (RMP) will be developed to provide a systematic, evidence-based approach to identify, assess, mitigate and monitor risks associated with the design, construction, operation and decommissioning of the installation. The RMP will be fully developed and formalised at pre-construction stage, once the specific BESS technology, supplier, and system configuration are defined. At this point, detailed hazard identification, risk assessment and technology specific mitigations will be based on the actual equipment specifications, technical documentation, control system logic, UL 9540A test results and final engineering design drawings. The RMP is then updated again during construction and commissioning to reflect the actual installation details and will continue to evolve throughout the operational life of the BESS as part of a live safety management system.

The RMP will be key in supporting compliance with key legislative requirements, standards and NFCC guidance that will form the foundation for demonstrating that risks have been reduced to a level that is tolerable and ALARP.

### **5.1.2 Risk Management Framework**

The RMP begins with setting out the governance framework, defining roles, responsibilities and accountability for risk management across the project team, contractors and suppliers. This includes establishing a Safety Working Group (SWG) to oversee hazard identification, ensure compliance, ensure adequate documentation is maintained and review emerging risks as the project progresses.



### **5.1.3 Hazard Identification Process – Hazard Log**

A formal hazard identification process (HAZID) will be undertaken covering all phases of the BESS lifecycle. This includes technological hazards such as thermal runaway, gas generation, fire, explosion, electrical failures, cooling system failures, cybersecurity vulnerabilities and environmental impacts. It also considers construction risks, operational risks, maintenance hazards and end of life battery handling or recycling hazards. The output feeds directly into a structured Hazard Log.

For each identified hazard, an evaluation will be carried out using a qualitative or semi-quantitative risk-assessment methodology based on good practice. The likelihood of occurrence and consequence will be assessed to determine inherent risk, enabling prioritisation of hazards requiring immediate or enhanced controls. Consequences consider impacts on people, environment, property, network resilience and emergency responders.

### **5.1.4 Monitoring and Reporting**

The RMP will include the processes for monitoring of risk controls during plant operation, this includes real time monitoring via BMS/EMS, routine inspections, maintenance activities and auditing processes. The SWG will periodically review risk performance, update the Hazard Log to make sure that new data, potential changes or incidents are captured.

### **5.1.5 Control Measures and Mitigations**

For each hazard, the RMP documents the design, operational and procedural controls that will be used to mitigate risk.

These include:

- BMS, EMS, fire detection and suppression systems.
- Electrical protection systems.
- Container separation distances and site layout.
- Deflagration venting, ventilation and cooling systems.
- Operational procedures, maintenance regimes and training.
- Emergency response arrangements.

### **5.1.6 Emergency Response Plan Interface**

The RMP interfaces directly with the Emergency Response Plan (see section 7.0) to make sure that the emergency scenarios identified are supported by operational procedures, clear communication protocols and local Fire Authority engagement.

### **5.1.7 ALARP and Regulatory Compliance**

The final stage of the RMP consolidates evidence-design controls, risk assessments, supplier certifications, testing results, operational procedures and emergency arrangements to demonstrate that risks have been reduced to a level that is ALARP. This provides the basis for compliance with Irish safety legislation and supports planning submissions, local Fire Authority consultation and internal governance.



## 6.0 Roles, Responsibilities & Competence

The definition of the organisational structure of the team, responsibilities and competence requirements are essential for the safe operation and emergency management of the BESS installation. For each of the roles from Asset Owner and Incident Controller to the Authorised Person, Competent Person, Control Room Operator, Environmental Manager, Security Personnel and local Fire Authority the duties will be clearly defined to make sure an effective coordination during routine operations and emergency situations are efficiently resolved.

Competence is essential to maintaining a safe system of work. Therefore, the involved personnel must be appropriately trained, authorised and capable to performing their tasks, particularly where electrical, thermal, chemical or fire hazards exist. The training requirements include BESS hazard awareness, emergency procedures, equipment-specific training, electrical safety, communication protocols and joint drills with emergency services.

## 7.0 Emergency Response & Stakeholder Engagement

The purpose of this section is to provide an overview of the required approach to emergency preparedness, response and communication process for the BESS.

### 7.1 Communications Plan

A Communications Plan will be developed prior to operation, to describe how information will be communicated during normal operation, abnormal events and emergency scenarios at the BESS. It establishes the channels, responsibilities and protocols required to ensure effective and timely communication between site personnel, the Control Room, the Asset Owner, the local Fire Authority, the Network Operator and other external stakeholders. This plan will align with the NFCC 2026 BESS Operational Guidance<sup>6</sup>, the Management of Health and Safety at Work Regulations 1999 and internal organisational procedures for emergency communication, incident management and reporting.

### 7.2 Emergency Response Plan

#### 7.2.1 Introduction

An Emergency Response Plan (ERP) will be developed during the pre-construction stage, when the specific BESS technology, product supplier, container configuration and safety systems have been selected. This information will develop a tailored ERP that reflects the exact features of the selected BESS system, fire detection and suppression system, enclosure design but as well the site-specific design layout. Furthermore, the ERP will be in line with Irish legislation, relevant guidance that includes the NFCC Grid-Scale Battery Energy Storage System Planning Guidance as well relevant standards and requirements described in the updated BSMP.

#### 7.2.2 Approach

The approach when developing the ERP start with risk assessment that identifies the credible emergency scenarios based on the chosen BESS solution and site features. These may include events such as thermal runaway, fire, off-gas events, electrical faults, leakage, security breaches and releases of discharge of hazardous substances into the surrounding environment. The ERP will then define the action plan with the measures for each scenario,

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<sup>6</sup> [Grid scale energy storage system planning - Guidance for fire and rescue services - NFCC](#)



covering detection, alarm behaviour, system shutdown, isolation procedures and evacuation. The detailed container layout, access routes, water supplies, separation distances and control systems are completed; these will be integrated into the plan to make sure the operational actions are suitable with the physical and operational configuration of the site.

A key aspect when developing the ERP is consultation with the local Fire Authority. This engagement will make that aspects such as access routes, equipment spacing, firefighting water supplies, signage and incident information align with the local Fire Authority operational requirements. The ERP will also establish clear communication procedures, outlining how alarms are escalated, how operators contact emergency services, how information is shared during an incident and how the site moves into recovery and post-incident evaluation.

### **7.2.3 Objectives**

The main priorities of an ERP are as follows:

1. To protect life for onsite personnel and first responders, through a clear evacuation strategy and safe access procedures.
2. To limit a potential escalation by providing clear actions to manage fire, off-gas events and electrical hazards.
3. To support emergency services with accurate site information, access routes, equipment identification and systems behaviour.
4. To safeguard the environment by addressing containment of contaminated firewater and management of damaged battery units.
5. To enable a safe recovery through structured post-incident procedures and inspection requirements.

By developing the ERP at the pre-construction stage, the document will be fully aligned with the selected technology, site layout and supplier specifications, ensuring a robust and realistic emergency response aligned with UK regulatory expectations and best practice.

### **7.2.4 Training & Emergency Drills**

The performance of emergency training and drills are a critical component of the site's ERP, make sure that all personnel working on or supporting the BESS installation are prepared to respond effectively to hazardous events. Although the BESS facility is normally unoccupied, maintenance activities introduce periods where personnel are present, making regular training essential to maintaining safety and compliance.

The primary purpose of training drills is to validate the effectiveness of the ERP, identify gaps in procedures and ensure that all participants understand their roles during an emergency. These drills simulate realistic scenarios such as fire outbreaks, thermal runaway events, toxic gas releases, electrical faults, chemical spills, environmental contamination, medical emergencies and cyber-security incidents.

Training drills involve key personnel from the operational workforce, including the Incident Controller, O&M teams, environmental staff, remote operators, security personnel and external emergency responders such as the local Fire Authority. Their involvement make sure that communication, coordination and decision-making processes are well-rehearsed and consistent with site safety standards.

Overall, the emergency training and drills programme provides a systematic, repeatable and continuously improving approach to BESS emergency preparedness, ensuring that personnel remain competent, responsive and aligned with the site's established safety framework.



## 7.3 Fire Authority Consultation

Discussions with the local Fire Authority will take place prior to progressing the Proposed Project to construction stage, allowing review of the proposed facility layout, emergency access arrangements, confirmation of firefighting water requirements, etc., in accordance with the Fire Services Acts 1981 and 2003.

These discussions also make sure that both parties are fully aware of the risks associated with firefighting in a BESS facility and the limitations and assumptions of both parties in the event of a fire in the facility. This approach not only enhances safety but can also streamline approvals and build positive relationships with the local authority.

## 8.0 Operation and Maintenance Requirements

The Operation and Maintenance (O&M) for a BESS is crucial for both plant performance and safety. Methods and procedures impacting project safety must comply with up-to-date standards and regulations. Furthermore, O&M must contribute to optimal system performance and lifecycle; and maximise system availability through the minimisation of potential plant downtime.

### 8.1 Operational Requirements

- The BESS operation will be continuously monitored to support optimal performance, early issue detection and safe operation. Monitoring will include Battery Management System (BMS) Operational Monitoring:
  - Tracks State of Charge (SoC), State of Health (SoH) and cell/module temperatures, supporting operation within safe voltage and current limits.
- Energy Management System (EMS) Operational Monitoring:
  - Monitoring the charge/discharge cycling to optimise system efficiency and revenue (e.g. energy arbitrage, frequency regulation, peak shaving).
  - Monitoring and control of the interaction between the BESS and the grid to support the provision of contracted grid services without compromising battery health.
- Remote Monitoring and Alerts:
  - Provides real-time remote oversight and automated alerts.
  - Flags key safety issues such as overheating, deep charge/discharge events, or system failures (e.g., cooling system faults).

### 8.2 Maintenance Requirements

#### 8.2.1 Preventive Maintenance

Preventative maintenance for BESS involves scheduled actions to reduce failure risk, extend system life and improve reliability and efficiency. It limits unplanned downtime, reactive repairs and unnecessary component replacements. The maintenance regime will include:

- Battery System:



- Visual examination: Routine checks for physical damage, leaks, or corrosion.
- Thermal Inspection: Infrared thermography to identify hotspots such as poor electrical connections
- Capacity Testing: Regular discharge tests to verify actual capacity and performance, in line with BS EN 62620. (For example, UK Capacity Market participation typically requires annual capacity and performance tests.).
- Regular cleaning: This is to support that battery terminals and general connections are clean to avoid poor connections.
- PCS
  - Battery inverter testing: Regular testing and recalibration to support efficiency and safe operation.
  - Firmware Updates: Regular software updates to apply new releases or bug fixes are applied.
  - Visual examination: Undertake inspections to identify potential damage to connectors, cables, connectors, etc.
- Cooling and HVAC System Maintenance
  - Air filters maintenance: Maintain filters are regularly cleaned or replaced to guarantee optimal cooling performance.
  - Fans and Ventilation System Inspection: Inspect ventilation fans and airflow paths for blockages and support proper air circulation.
  - Coolant Levels: For liquid cooling systems, verify coolant levels and test for potential system leaks.
- Fire Suppression System Maintenance
  - Functional System Testing: This involves periodical fire tests to verify that the system performs as expected.
  - Smoke and Gas Detectors Testing: This involves periodical tests to verify early detection of any hazardous situations.
  - Alarm system testing: This involves periodical tests to confirm the alarm notification is triggered under a potential fire event.

### **8.2.2 Corrective Maintenance**

This refers to the activities that are undertaken to rectify or address system failures or faults that have been identified. This may include:

- Battery Replacement or Reparation
  - Cell Replacement: Addresses degradation from use, defects, or environmental factors.
  - Battery Rebalancing: Restores uniform cell voltages to prevent accelerated degradation and capacity loss
- Cooling System Repair



- HVAC Unit Repair: Fix or replace faulty HVAC units to maintain safe operating temperatures.
- Leak Repair: Critical for liquid-cooled systems to prevent overheating or electrical hazards.
- PCS/Inverter Repair
  - Electrical Faults: Correct any detected electrical faults, such as short circuits, ground faults, or voltage imbalances, in order to prevent damage to the BESS.
  - Fault Diagnosis: If the inverter is underperforming or failing then the inspection is required; causes may include firmware or hardware malfunctions. This may necessitate repairs or replacement of the faulty component.
- Compliance with Standards: The standards compliance contributes to the BESS safety, performance and reliability:
  - Regulatory Inspections: This is to make sure that the BESS meets safety regulations, such as NFPA 855, UL 9540/9540A (for system safety testing) and IEC standards.
  - Environmental Compliance: This is to make sure the system meets environmental regulations regarding noise levels, system efficiency and materials disposal amongst others.
- Battery End-of-Life (EoL) Management: Determining the retirement of a BESS at EoL involves assessing several factors, including performance, safety, etc. Considerations include:
  - Monitoring of the BESS: As battery cells degrade over time this will track the capacity reductions and thus estimate when they will be potentially retired or replaced depending on the SoH.
  - Recycling Program: A proper recycling and disposal program will be developed in line with environmental regulations, this will contribute to the safe disposal of hazardous materials.
- Component Lifecycle Planning: Within a BESS each component has its own lifecycle, therefore it is fundamental to undertake careful component replacement planning. This will help maintain full system operation with minimal disruptions. The aim is to contribute to plant performance but also safety and plant reliability, e.g. inverters typically require replacement every 15-20 years based on typical cycling, auxiliary systems like sensors, fuses, etc may have different life expectancies.

## 9.0 Environmental and Spill Management

The assessment of potential environmental and or spillage from fire water run-off, electrolyte leakage or contaminated drainage resulting from a thermal event, suppression activity or maintenance incident is crucial for the BESS. This BSMP is principally focused on the safety of emergency personnel and the public. However, planning authorities and environmental regulators may also require BESS developments to incorporate suitable containment measures to prevent uncontrolled pollution, consistent with recognised good-practice



frameworks such as EPA Guidance on Retention Requirements for Firewater Run-off<sup>7</sup>, and must be aligned with the Emergency Response Plan.

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<sup>7</sup>[https://www.epa.ie/publications/licensing--permitting/industrial/ied/EPA\\_Guidance\\_Retention\\_Firewater\\_Runoff.pdf](https://www.epa.ie/publications/licensing--permitting/industrial/ied/EPA_Guidance_Retention_Firewater_Runoff.pdf)



## 10.0 Site Layout & Facility Design

### 10.1 Description

The layout for the Proposed Development's BESS is shown in Figure 10-1. The Figure shows a design composed of 120 battery containers (60 pairs of batteries in a back to back configuration) involving 20 ft containers. A standard 20 ft container measures approximately about 6.10 m long, 2.44 m wide and 2.59 m high. The BESS compound has a total of 15 PCS, with the target of achieving a power capacity matching the wind farm capacity. Additionally, there is a 180,000L water storage tank, switch gear room, Control Room, BESS MV Switchgear, SCADA room, storage room, small plant rooms, waste management area, COSHH Container, battery container, MV transformer and Auxiliary Transformer.

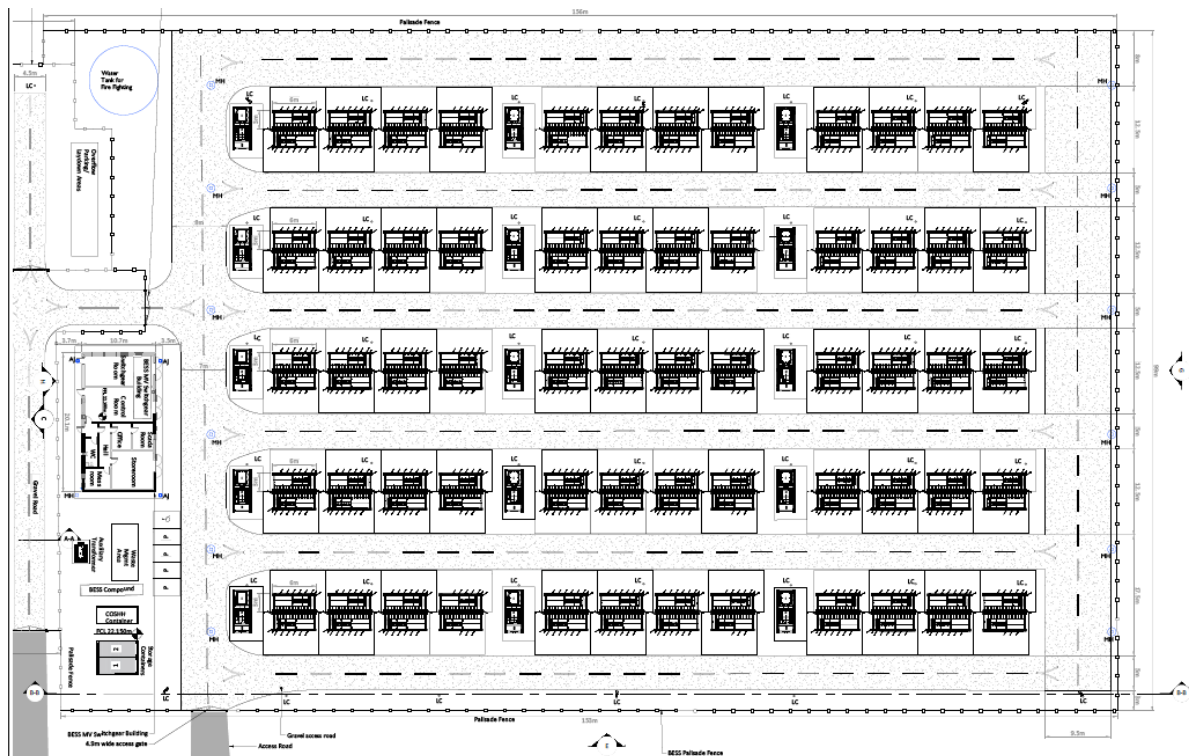


Figure 10-1: BESS Layout



## 10.2 Design Guidelines

Table 10-1 lists the main BESS fire safety design guidelines and how the Proposed Development adheres to these.

**Table 10-1 Listing of design requirements**


Design Requirement	Adherence of the proposed design layout
<p>The proposed layout involves a back to back (side to side) layout design. As per NFPA (2026), if the space separation between enclosures is less than 6m then a thermal barrier rated at a minimum of 1 hour will be provided on the inside or outside of the enclosure.</p> <p>The NFPA (2026) also states that the clearance to other structures than buildings may be reduced to 0.914m (3 foot). However, the fire and explosion testing in accordance with UL9540A would then demonstrate that a fire within the BESS enclosure will not generate radiant heat flux sufficient to ignite stored materials in the surroundings or otherwise threaten the exposure.</p>	<p>The distance between paired containers in the proposed design layout is 2m. However, the clearance between the back to back enclosures is 0.3 m<sup>8</sup> (see drawings below). The NFPA 855 (2023) states that individual energy storage units shall be separated by a minimum of 3 ft (914 mm) unless smaller separation distances are documented to be adequate based on fire and explosion testing in accordance with UL 9540A (Section 15.3.1 and 15.13).</p> <p>The Sungrow PowerTitan 2.0 BESS NFPA 855:2023 Compliance Test Report<sup>9</sup> shared confirms that it is a NFPA 855 compliant unit at product level.</p> <p>Additionally, PowerTitan 2.0 demonstrates that under a provoked thermal runaway event and with containers installed at a minimum back to back separation of 150 mm, no fire or thermal runaway propagation occurred to adjacent units. Adjacent containers remained structurally intact, electrically operational, and within safe temperature limits throughout the test duration, with no conditions that would trigger cell venting.</p> <div data-bbox="603 1232 1380 1691" style="text-align: center;"> <p>(Figure of Burn Test Report Schematic<sup>10</sup>)</p> </div>

<sup>8</sup> File drawing: Site Layout (27.02.2026).dwg

<sup>9</sup> File name: CN25LCLH 001 NFPA 855\_signed.pdf, TUV Rheinland, 27<sup>th</sup> October 2025

<sup>10</sup> File name: TR\_ PowerTitan 2.0 Large Scale Burn Test Report\_10522343-SHA-R-01\_EN\_2025.04.22.pdf



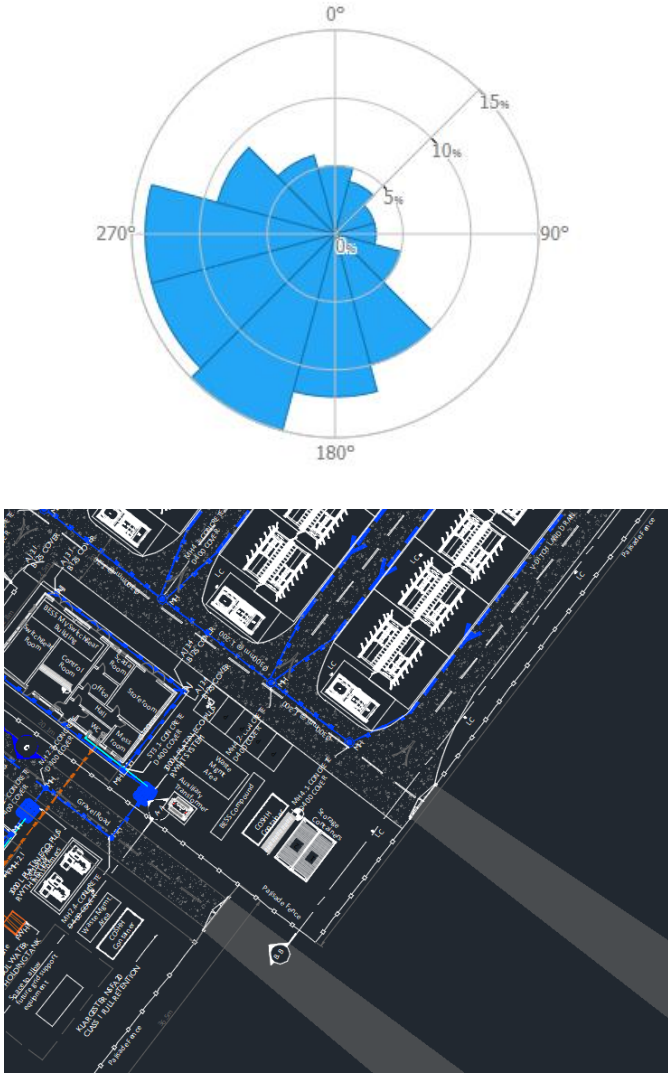
Design Requirement	Adherence of the proposed design layout
	<p>The proposed design adopts a back to back separation distance of 300 mm, which is greater than the tested configuration shown above, thereby providing additional spatial margin beyond the validated worst case scenario. When considered alongside the confirmed NFPA 855:2023 product level compliance, this evidence demonstrates that the design under assessment is compliant with applicable fire safety intent and that container separation distances are conservative relative to those proven through full scale testing.</p> <p>The applicability of the relevant test results to the site specific layout will take place following the selection of the Original Equipment Manufacturer (OEM) in the post planning phase.</p>  <p>(Figure of Proposed Design Layout)</p>
<p>NFPA 855 advises that the potential impact radius, and therefore the separation distance between a BESS and occupied buildings in the case of a potential explosion event, is of at least 23m. The standard nevertheless recommends increasing this clearance to 30.5m. The Grid Scale Battery Energy Storage System planning - Guidance for FRS (2026)<sup>5</sup> based on the NFPA855</p>	<p>The distance from the battery containers to the nearest occupied buildings is greater than 30.5m therefore compliant with NFCC 2026 and NFPA855.</p>



Design Requirement	Adherence of the proposed design layout
<p>recommends an initial minimum separation distance of 30m prior to any mitigation measure such as blast walls.</p>	
<p>The layout design will consider the Grid Scale Battery Energy Storage System planning - Guidance for FRS (2026) which states that areas within 3m of the BESS units should be cleared of vegetation to minimise the risk of fire spreading.</p>	<p>The BESS design layout has maintained a minimum distance of 3m away from the vegetation.</p>
<p>The provision of two separate access points to the site is recommended, with the intention that at least one is upwind of the prevailing wind direction as per Grid Scale Battery Energy Storage System planning - Guidance for FRS (2026). The 2026 FRS Guidance indicates it is preferable to have an alternative access point taking account of the likely wind direction.</p>	<p>The BESS design layout includes two access points to the BESS compound. This is in line with NFCC (2026). In this case, the positioning of the access points has been driven by various considerations such as ease of entry, land availability and wider site constraints. Both entries are on the same side of the fence separated 20m.</p> <p>The Global Wind Atlas<sup>11</sup> (see wind rose for location below) shows that the prevailing wind directions are from the west-southwest (approximately 240°–270°) and southwest (210°–240°), as shown by the longest segments on the wind rose.</p> <p>The proposed design layout places both access points at the south-east corner, this means they are not directly exposed to the prevailing winds from the south-west. Although there is some exposure to winds from the north-west, however these are significantly lower compared with the dominant south-west and east wind patterns.</p> <p>The final detailed plume dispersion assessment (if required) will be undertaken in accordance with any planning conditions imposed by the Local Planning Authority following consultation with the Local Fire Authority.</p>

<sup>11</sup> <https://globalwindatlas.info/en/>



Design Requirement	Adherence of the proposed design layout
	 <p>The figure consists of two parts. The top part is a wind rose chart showing wind frequency by direction. The chart has concentric circles representing frequency percentages at 5%, 10%, and 15% intervals. The directions are marked at 0°, 90°, 180°, and 270°. The highest frequency is shown in the West-Northwest quadrant, reaching approximately 15%.</p> <p>The bottom part is a site plan showing the layout of the BESS compound. Blue lines and arrows indicate the placement and orientation of various structures and infrastructure within the site boundaries.</p>
<p>The Grid Scale Battery Energy Storage System planning - Guidance for FRS (2026) recommends that hydrant supplies for boundary cooling purposes should be located close to BESS containers and be able to deliver no less than 1,500 litres per minute for at least two hours.</p>	<p>The BESS compound will incorporate one water storage tank. In case of fire, reference will be made to the Grid Scale Battery Energy Storage System Planning Guidance. The 2026 guidance recommends a minimum supply of 1,500 L per minute for at least two hours (i.e. 180,000 L).</p> <p>The layout indicates that tank can hold a volume of 180,000 L. This complies with minimum that the guidance and is therefore acceptable.</p>
<p>Self-Containment</p>	<p>It has been confirmed that the BESS fire risk mitigation is based on a self-containment strategy and the water storage tank is included as a secondary system for exposure protection and boundary cooling, rather than for direct fire suppression.</p>



Design Requirement	Adherence of the proposed design layout
	<p>Based on the high voltage electrical nature of the facility and the characteristics of lithium ion battery fires, traditional direct firefighting methods such as applying large volumes of water hoses directly into burning containers are generally not appropriate or effective as a primary response. The strategy would instead focus on cooling adjacent containers to prevent propagation and protecting the site boundaries. The design allows for an onsite water storage tank to support firefighting activities. In practice, firefighting at the facility would primarily involve preventing fire spread beyond the BESS compound.</p> <p>Modern fire-suppression strategies for BESS focus on containing and controlling fires rather than relying on automatic internal suppression. The goal is to allow a controlled burn out of affected cells or modules, reducing risks from stranded energy (remaining charge after a fire) and simplifying post incident handling and disposal. This approach also eliminates the need to dispose of water or chemical agents that would otherwise be used during automatic suppression.</p> <p>Instead of internal suppression systems, BESS cabinets use a dry pipe sprinkler system, where pipes remain empty until manually activated. This reduces accidental discharge and water damage. The firefighters or responders can choose to activate the system if suppression is deemed necessary during thermal runaway or fire, so that intervention is applied only when appropriate.</p>
Monitoring	<p>It has been confirmed the inclusion of remote and onsite monitoring systems, combined with advanced battery management, will contribute to the reduction of the likelihood of a fire occurring within the facility. The integrated fire detection and suppression systems are designed to restrict its growth and limit a potential fire event to container level. It shall be noted that the likelihood of a fire event in a modern utility scale LFP based BESS is low, particularly when the system uses certified equipment (e.g., UL 9540 / UL 9540A tested), proper integration, monitoring and adherence to standards like NFPA 855 principles. Therefore, the likelihood of a significant release of toxic smoke or other harmful byproducts is also considered low.</p>



Design Requirement	Adherence of the proposed design layout
<p>NFCC indicate that static firefighting water tanks must be situated at least 10 m away from the BESS units, in a clearly marked and easily accessible location for Fire and Rescue Service personnel. Additionally, these tanks will be safeguarded against accidental impact, utilizing protective measures such as bollards or similar structures.</p>	<p>The layout shows that the water tank is situated over 10m away from the BESS unit and therefore compliant with this requirement.</p>
<p>Access routes will minimise reversing distances (not exceeding 20m where practicable). Access roads will typically provide a minimum width of 3.7m and suitable turning facilities with turning circles generally between 16.8m and 29m in diameter to accommodate Fire and Rescue Service appliances.</p>	<p>The road layout design shows a width of 5m, which exceeds the minimum requirement of 3.7m for fire appliance access.</p> <p>A swept path analysis drawing has been provided (300101402-C-DR-1030-P4_BESS Swept Path Analysis - Fire Truck.pdf) layout using the FRS Dennis Sabre LWB showing that the vehicle can enter, navigate inside the compound with a curb to curb turning radius of 7.4 m. The tracked paths demonstrate that the vehicle can navigate the proposed access roads, enter and exit the BESS compound, and maneuver around the container layout.</p>
<p>The NFCC (2026) guidance highlights the importance of managing contaminated firefighting water generated during a BESS incident. As such, site design will consider measures to control and contain runoff, preventing uncontrolled discharge to surrounding land, watercourses, or drainage systems.</p>	<p>A BESS drainage layout plan has been provided and is presented as a Planning Application drawing showing how surface water, stormwater and potentially contaminated runoff will be managed across the Main Wind Farm Site<sup>12</sup>. A further Planning Application drawing provided demonstrates how collected surface water runoff will be conveyed to the attenuation basins, along with the overall layout of the drainage system and attenuation basins.<sup>13</sup>.</p>
<p>Space for a Welfare Unit would be recommended to be provided on site, if required for operational purposes.</p>	<p>The layout includes a designated on site welfare unit.</p>

<sup>12</sup> Planning Application Drawing: 300101402-C-DR-1007-P7\_BESS Drainage Layout Plan.pdf

<sup>13</sup> Planning Application Drawing: 300101402-C-DR-0008-P1\_Site Drainage Attenuation Basins Layout Plan.pdf



Design Requirement	Adherence of the proposed design layout
<p>A spares container is not strictly required for a BESS site but recommended for larger sites. This is not stipulated in NFPA 855 but the document does state the requirement to maintain high standards of safety, performance and reliability. Critical components for fire safety, thermal management, electrical integrity and operational efficiency will be determined and be available on site to rapidly address potential system failures.</p>	<p>A 20ft spares container has been included within the BESS compound.</p>
<p>The allowance of a space for service vehicle parking is recommended.</p>	<p>There is a designated area for parking vehicles.</p>
<p>CCTV and Fencing covering the BESS compound is strongly recommended to enhance site security.</p>	<p>CCTV camera locations are indicated within the Proposed BESS design layout.</p>
<p>Roads and Hardstanding</p>	<p>All internal service roads will be built to withstand Heavy Goods Vehicle (HGV) loads for both construction and operational, which is necessary for transporting containers and similar equipment.</p>
<p>Signage</p>	<p>Signage will be installed at the site entrance. The exact details will be fully captured within the Emergency Response Plan.</p>
<p>Emergency Plans</p>	<p>An updated version of this BSMP will incorporate the Detailed Operational Emergency Response Plan. This will include information on notification procedures for the fire and rescue service, site details, staffing details and an updated site plan</p>



## 11.0 Conclusions

### 11.1 Conclusions

This BSMP establishes the basis of a comprehensive battery safety management framework that will be updated during the pre-construction stage. It will contribute to risk identification and mitigation as far as reasonably practicable (ALARP), supports regulatory engagement and forms a key component of the Proposed Project's planning and safety justification, with the following points to be noted:

- The proposed design layout adopts a distance of 2m between paired containers and a back to back clearance of 0.3m. In line with the test reports provided, the design layout demonstrates NFPA 855 compliance and UL 9540A verified regarding non propagation performance for the Sungrow PowerTitan 2.0.
- The proposed BESS fire risk mitigation is based on a self-containment strategy which is considered reasonable, as direct fire extinguishing is generally neither appropriate nor effective. A water storage tank is included as a secondary system for exposure protection and boundary cooling, rather than for direct fire suppression. Furthermore, the BESS firewater containment design will ensure that any potentially contaminated runoff is effectively controlled and managed in accordance with environmental regulations.
- The proposed layout positions both access points at the south-east corner, minimising exposure to the dominant south-west winds. Any further plume dispersion assessment (if required) will be undertaken in accordance with planning conditions imposed by the Local Authority after consultation with the Local Fire Authority. The 3m vegetation clearance around BESS units is confirmed.
- The proposed internal road layout has a width of 5 m, which is greater than the minimum requirement of 3.7 m for fire appliance access.
- A swept path analysis has been carried out using the Fire and Rescue Service's Dennis Sabre LWB fire appliance. The analysis shows that the appliance can enter the site, navigate the internal roads with a curb-to-curb turning radius of 7.4 m, manoeuvre around the battery containers and exit the compound.

In line with NFCC guidance, the local Fire Authority will be engaged at the earliest practical opportunity to discuss the proposed BESS design. This early and continued consultation will enable the incorporation of any relevant fire safety inputs or considerations and support the collaborative development of the BESS site from planning to pre-construction stage.

This BSMP provides a solid foundation for the next phase of safety at pre-construction stage, so that the BESS can be delivered and operated following safety principles throughout its lifecycle.



