Meridian Solar

Meridian Solar Farm

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Other Documents

7.18 Outline Battery Safety Management Plan

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Contents

Executive Summary

For the purposes of this document a concept design has been considered that uses a BESS system based upon lithium iron phosphate (LFP) lithium-ion battery technology that is currently used on the majority of UK solar projects in development. This is considered a reasonable worst case for the purposes of the assessment in terms of safety (toxic and explosive gas production risks).

The design of the BESS and its impact are controlled in several ways. Prior to commencement of construction of the BESS, a BSMP (in accordance with the OBSMP) is required to be submitted to the relevant local planning authority and approved, in consultation with Lincolnshire Fire and Rescue Service (LFR) and the Environment Agency (EA). The Applicant must operate the BESS in accordance with the approved plan.

Further, pursuant to Requirement 6 of the **Draft DCO** (Doc Ref. 3.1), the detailed design of the BESS must be in accordance with the Outline BSMP (which includes various safety requirements for the BESS design) and the **Design Approach Document** (Doc Ref. 7.3) and the **Design Parameters** (Doc Ref. 7.4). These documents contain controls over the BESS, which include that the energy storage capacity of the BESS will be a lithium-ion battery system.

The BESS design and system chemistry type is still to be determined, and the final battery chemistry will be confirmed as part of the detailed design prior to the commencement of construction. This document details the types of safety systems available on the market at present, along with risk reduction barriers which are likely to be incorporated into the BESS design selected to be installed. It is possible that by the time of construction that a new battery chemistry may be integrated but this would be fully tested and certified to the latest BESS safety standards and this will be reflected in the final BSSMP approved by the Local Planning Authorities in consultation with Lincolnshire Fire and Rescue Service (LFR) and the Environment Agency (EA).

The BESS will be designed in accordance with the UK and internationally recognised good practice guidance available at the time. The overall approach is to follow the Health and Safety Executive’s (HSE) hierarchy of controls (Ref 1):

- Elimination;
- Substitution;
- Engineering Controls;
- Administrative Controls; and
- Personal Protective Equipment.

A summary of the anticipated BESS failure safety provisions are as follows:

- The BESS will be designed, selected, and installed in accordance with international guidance, good practice, and related standards;
- Risk assessments will be carried out for the entire system and elements across the project lifecycle;
- The location of the BESS has been chosen to minimise impacts on offsite receptors;
- Separation distances between components will be applied to minimise the chance of fire spread;
- Equipment will, where possible, be selected to be fire limiting, such as selection of transformer oils with low flammability and non-combustible BESS enclosures with high levels of thermal insulation (fire and heat resistance). The BESS facility will be designed with multiple layers of protection to mitigate and minimise the probability of a fire or thermal runaway incident;
- In the case of the BESS design, it will integrate multiple layers of prevention and mitigation features to minimise the chances of a BESS failure incident (equipment failure / burning or gas venting thermal runaway scenario);
- All equipment will be monitored, maintained, and operated in accordance with manufacturer instructions and be compliant with requisite safety standards listed in Section 1.5 Relevant Guidance (UL, IEC, IEEE, NFPA, etc.);
- The BESS design will include integrated fire and explosion prevention and protection systems. Following key industry safety standards i.e. NFPA 855 (Ref 3), UL 9540 (Ref 4), BS EN IEC 62933-5-2 (Ref 5), and based on comprehensive UL 9540A (2025, 5th Edition) (Ref 6) testing. The selected BESS, as mandated under NFPA 855 (2026 Revision), will have undertaken Large Scale Fire Testing (LSFT) as part of UL 9540A tests and / or 3rd party full scale destruction testing. This testing involves burning the full BESS system to validate safe equipment spacing and performance test active and passive mitigation systems integrated into the BESS design. A BESS system and site-specific Emergency Response Plan (ERP) will be developed at the detailed design stage, based on national and international best practice measures;
- The detailed design phase of the Scheme will consider the lifecycle of the battery system from installation (during the construction phase of the Scheme) to decommissioning. At the detailed design stage, the selected BESS design will have completed LSFT to fully inform inputs for risk assessment tools which will be

utilised together with detailed consequence modelling to provide a comprehensive site operations and emergency response safety audit;

- 24/7 remote monitoring of the system via a dedicated control facility. The control facility will have the capability to shut the system down should the need arise and will also be responsible for implementing the emergency plan and acting as a point of contact for the emergency services; and
- Communication with the local fire and rescue services (LFR) with engagement early in the project and continuing across design and construction phases. This will ensure robust emergency response planning, risk management planning and ensure all safety materials and equipment is available in an emergency for first responders.

1. Introduction

1.1. Overview

1.1.1. This Outline Battery Safety Management Plan (OBSMP) document forms part of an application by Meridian Solar Farm Limited to the Secretary of State under the Planning Act 2008 (the 'Act') for a Development Consent Order (the DCO Application) for the Scheme.

1.1.2. The DCO Application is for a Nationally Significant Infrastructure Project (NSIP) comprising the construction, operation (including maintenance) and decommissioning of photovoltaic (PV) solar panels and up to 13 km of overhead line connection into National Grid's planned Weston Marsh substation. The Scheme will also include associated infrastructure, including co-located battery energy storage systems (BESS) and inter-array connections to link together the land parcels where the solar panels are located. The BESS is associated development to ensure that energy can be stored when it is generated and not demanded. The BESS will have a direct relationship with the solar PV panels, and it will support the operation of this by storing electricity produced during times of peak capacity until it is needed.

1.1.3. The Scheme comprises a generating station of more than 100 MW and the installation of above ground electric lines greater than two kilometres in length. The Scheme therefore qualifies as an NSIP under sections 14(1)(a), 14(1)(b), 15(2) and 16 of the Act.

1.1.4. The purpose of this OBSMP is to identify how good industry practice will be used to reduce risk to life, property, and the environment from a BESS failure event. This document provides a summary of the safety related information requirements which will be provided in advance of construction of the BESS.

1.1.5. Prior to the commencement of construction of the BESS, the Applicant will be required to prepare a detailed Battery Safety Management Plan (BSMP) which must be in accordance with this OBSMP. As part of preparation of the BSMP, the Applicant will incorporate the latest good practices for battery storage safety, failure detection and prevention, along with the emergency response planning, as guidance continues to develop in the UK and internationally.

1.1.6. While the operational phase is anticipated to commence no earlier than 2033, reference to current measures and guidelines are included here. However, this document will be updated prior to construction of the BESS to take account of prevailing standards, certifications, guidance, and testing requirements.

1.2. The Scheme

1.2.1. For the purposes of this document a concept design has been considered that uses a BESS system based upon lithium iron phosphate (LFP) lithium-ion battery technology that is currently used on the majority of UK solar projects in development. This is considered a reasonable worst case for the purposes of the assessment in terms of safety (toxic and explosive gas production risks).

1.2.2. The design of the BESS and its impact are controlled in several ways. Prior to commencement of construction of the BESS, a BSMP (in accordance with the OBSMP) is required to be submitted to the relevant local planning authority and approved, in consultation with Lincolnshire Fire and Rescue Service (LFR) and the Environment Agency (EA). The Applicant must operate the BESS in accordance with the approved plan.

1.2.3. Further, pursuant to Requirement 6 of the **Draft DCO** (Doc Ref. 3.1) the detailed design of the BESS must be in accordance with the Outline BSMP (which includes various safety requirements for the BESS design) and the **Design Approach Document** (Doc Ref. 7.3) and the **Design Parameters** (Doc Ref. 7.4). These documents contain controls over the BESS, which include that the energy storage capacity of the BESS will be a lithium-ion battery system.

1.2.4. The BESS design and system chemistry type is still to be determined, and the final battery chemistry will be confirmed as part of the detailed design prior to the commencement of construction.

1.2.5. The concept design consists of the BESS enclosures and the associated transformers, circuit breakers and inverters with an onsite control room. The BESS enclosures, and auxiliary systems, such as cooling, uninterruptible power supply (UPS), fire and gas detection, explosion protection mechanisms, fire protection system, monitoring and control, etc. will be designed in accordance with internationally recognised standards and good practice guidance available at the time.

1.2.6. Once operational, the plant will be designed to operate unmanned with access required for maintenance only, and with an operational life of up to 40 years.

1.3. Potential for BESS Failure

1.3.1. Causes of battery cell failure which could lead to a thermal runaway event where a battery cell enters an uncontrolled self-heating state, include manufacturing defects (contaminants / imperfections), electrical abuse (overcharging / over-discharging), and physical or mechanical damage (puncture / crushing).

1.3.2. BESS hazards for first responders in the unlikely situation of a battery failure and thermal runaway event depend on the BESS design but are typically defined as: fire hazards, explosion hazards, electrical hazards (shock or arc flash), and chemical hazards (i.e. the release of toxic gases).

1.3.3. Regardless of the type of failure or the cause, the main potential hazard is thermal runaway where (as explained above) a battery cell enters an uncontrolled self-heating state and ultimately, if not controlled, a significant flaming or battery gas venting incident occurs. Therefore, this plan focusses on reducing fire and explosion risks associated with the BESS and managing the hazard in the unlikely event that it occurs.

1.3.4. Other electrical systems than the batteries, which form part of the BESS, can carry fire risks. However, due to the extensive historic and long-term deployment of other technology such as transformers, inverters and switchgear, these risks are better understood and regulated, through longstanding industry guidance and codes. Therefore, only the potential BESS battery or systems failure is addressed in this OBSMP.

1.4. Safety Objectives

1.4.1. The overall approach is to follow the Health and Safety Executive's (HSE) hierarchy of controls (Ref 1):

- Elimination;
- Substitution;
- Engineering Controls;
- Administrative Controls; and
- Personal Protective Equipment (PPE).

1.4.2. The safety objectives for the design of the BESS are:

- To minimise the likelihood of a failure event. This is an overriding priority;
- To minimise the consequences should an event occur;
- To restrict any event to the BESS area and minimise any impact on the surrounding areas;
- To automatically detect and begin to fight a fire as soon as possible;
- To ensure any personnel on site are able to escape safely away from the BESS area;

- To ensure that firefighters can operate in reasonable safety where necessary;
- Final BESS design and site layout should minimise the requirement for direct Lincolnshire Fire and Rescue Service (LFR) intervention in a thermal runaway incident (i.e. direct hose streams or spray directly on BESS battery systems). LFR intervention in worst case scenarios would typically be limited to boundary cooling of adjacent BESS and Energy Storage System (ESS) units (additional electrical equipment required for power generation) to prevent the fire from spreading. This strategy should be finalised with LFR and be clearly communicated in the Emergency Response Plan (ERP); and
- If the BESS system does not incorporate an automatic fire suppression system and is designed to safely burn out to remove the risk of stranded energy in the battery systems, then full scale free burn testing will have been conducted to demonstrate that loss will be safely limited to one enclosure without the intervention of the LFR.

1.4.3. Final BESS design and site layout at the detailed design stage will have been validated through Large Scale Fire Testing (LSFT) mandated in NFPA 855 (2026) (Ref 3) and rigorous consequence modelling to minimise the requirement for any LFR intervention in a thermal runaway incident. LSFT must validate minimum safe equipment spacing distances to demonstrate there is no fire propagation to adjacent BESS enclosures or ESS equipment. LFR intervention in worst case scenarios would typically be limited to boundary cooling of adjacent BESS and Energy Storage System (ESS) units to prevent the fire from spreading. This strategy will be finalised with LFR and be clearly communicated in the Emergency Response Plan (ERP):

- To ensure that fire, smoke, and any release of toxic gases does not significantly impact site operatives, first responders, and the local community; and
- To ensure that firewater run-off is contained and removed by tanker to an accredited laboratory for testing or disposal.

1.4.4. A summary of the anticipated BESS failure safety provisions are as follows:

- The BESS will be designed, selected, and installed in accordance with international guidance, good practice, and related standards;
- Risk assessments will be carried out for the entire system and elements across the lifecycle of the Scheme;
- The location of the BESS area has been located to minimise impacts on offsite receptors;

- Separation distances between components will be selected to minimise the chance of fire spread;
- Equipment will, where possible, be selected to be fire limiting, such as selection of transformer oils with low flammability and non-combustible BESS enclosures with high levels of thermal insulation (fire and heat resistance). The BESS facility will be designed with multiple layers of protection to mitigate and minimise the probability of a fire or thermal runaway incident;
- In the case of the selected BESS design, it will integrate multiple layers of prevention and mitigation features to minimise the chances of a BESS failure incident (equipment failure / burning or gas venting thermal runaway scenario);
- All equipment will be monitored, maintained, and operated in accordance with manufacturer instructions and be compliant with requisite safety standards (UL, IEC, IEEE, NFPA);
- The BESS design will include integrated fire and explosion prevention and protection systems. Following key industry safety standards (e.g. NFPA 855, UL 9540, BS EN IEC 62933-5-2) and based on comprehensive UL 9540A (2025, 5th Edition). The selected BESS, as mandated under NFPA 855 (2026 Revision), will have undertaken Large Scale Fire Testing (LSFT) as part of UL 9540A tests and / or 3rd party full scale destruction testing. This testing involves burning the full BESS system to validate minimum safe equipment spacing distances and performance test active and passive mitigation systems integrated into the BESS design. A BESS system and site-specific ERP will be developed at the detailed design stage, based on national and international best practice measures;
- 24/7 monitoring of the system via a dedicated control facility. The control facility will have the capability to shut the system down should the need arise and will also be responsible for implementing the ERP and acting as a point of contact for the emergency services.
- Communication with the LFR with early engagement in the Scheme and continuing across design, construction, operation, and decommissioning phases. This will ensure robust emergency response planning, risk management planning and ensure all safety materials and equipment is available in an emergency for first responders.

- Fire water runoff containment measures will be included to prevent the discharge of any potentially polluted fire water runoff from the BESS to the ground.

1.5. Relevant Guidance

1.5.1. Guidance documents and standards considered by the Applicant have been used to inform the design of the scheme.

1.5.2. The Applicant has developed the BESS in accordance with all relevant legislation and good practice. This document takes into account the recommendations of the following good practice documentation used in the UK for similar sites, including:

- National Fire Chiefs Council (NFCC) Grid-Scale Battery Energy Storage System planning – Guidance for FRS (2026).
- National Fire Protection Agency (NFPA) NFPA 855 (2026): Standard for the Installation of Stationary Energy Storage Systems
- NFPA 68 (2023): Standard on Explosion Protection by Deflagration Venting.
- BS EN 14797 (2006): Explosion venting devices.
- NFPA 69 (2024): Standard on Explosion Prevention Systems.
- NFPA 70 (2023): National Electrical Code (NEC).
- Underwriters Laboratories, UL 9540A (2025): Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems;
- UL 1642 (2020): Standards for Lithium Batteries.
- UL 1973 (2022): Batteries for Use in Stationary and Motive Auxiliary Power Applications.
- UL 9540 3rd Edition (2023): Standard for Energy Storage Systems and Equipment.
- UL 2941 (2023): Outline of Investigation for Cybersecurity of Distributed Energy and Inverter-Based Resources.
- CSA / ANSI C800:25: Testing protocol for energy storage system reliability and quality assurance program.
- Clean Energy Associates (2025): BESS Quality Risks. A summary of the most common Battery Energy Storage System manufacturing defects of 2024.

- European Association for Storage of Energy (2025): EASE Guidelines on Safety Best Practices for Battery Energy Storage Systems.
- Department for Energy Security and Net Zero (2024): Health and Safety Guidance for Grid Scale Electrical Energy Storage Systems.
- IEEE 2686 (2025) standard: Recommended Practice for Battery Management Systems in Stationary Energy Storage Applications.
- FM DS 5-33 (2023) FM Global Datasheet. Lithium-Ion Battery Energy Storage Systems.
- UN 38.3: Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria – (Lithium Metal and Lithium-Ion Batteries).
- United Kingdom Power Networks (UKPN) Engineering Design Standard 07-0116: Fire Energy Storage Systems, 2016.
- DNV GL-Recommended Practice-0043: Safety, Operation and Performance of Grid-Connected Energy Storage Systems, 2017.
- Scottish and Southern Energy TG-PS-777: Limitation of Fire Risk in Substations, Technical Guide, 2019.
- BS 5839 Part 1 2017: Fire Detection and Fire Alarm Systems for Buildings.
- BS 9990: 2015: Non-automatic firefighting systems in buildings - Code of practice
- The Regulatory Reform (Fire Safety) Order (RRO) 2005.
- The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) Assessment.
- Fire Safety Journal (May 2025) Damilare Olugbemide / Noah Ryder: CFD analysis of performance-based explosion protection design for battery energy storage systems (BESS).
- BS EN IEC 61936, Power installations exceeding 1 kV AC and 1,5 kV DC – AC.
- BS EN IEC 62619 (2022): Secondary cells and batteries containing alkaline or other non-acid electrolytes. Safety requirements for secondary lithium cells and batteries, for use in industrial applications.
- BS EN IEC 62933-5-2 (2020): Electrical Energy Storage (EES) systems. Part 5-2: Safety requirements for grid integrated EES systems. Electrochemical-based systems.

- BS EN IEC 62281: 2019 + A2:2023: Safety of primary and secondary lithium cells and batteries during transport.
- BS EN IEC 62477-1 (2022): Safety requirements for power electronic converter systems and equipment. General.
- BS EN IEC 63056 (2020): Safety standard for lithium-ion battery systems.
- BS EN 16009 (2011): Flameless Explosion Venting Devices.
- BS EN 14373 (2021): Explosion Suppression Systems.
- BS EN IEC 61000-6-2 (2016): Electromagnetic compatibility (EMC). Generic standards. Immunity standard for industrial environments.
- BS EN IEC 61000-6-4 (2018): Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments.
- CIRIA C736 (2014): Containment systems for the prevention of pollution.

1.6. Consultation with Lincolnshire Fire and Rescue Service (LFR)

1.6.1. The local fire and rescue service, Lincolnshire Fire and Rescue Service (LFR) has been consulted during pre-application discussions and as part of the Section 42 Statutory Consultation exercise.

1.6.2. The Applicant held a MS Teams Meeting with LFR on 16 January 2026 to introduce the Scheme and to share preliminary site plans.

1.6.3. LFR emailed the Applicant on 15 February 2026 to advise that National Fire Chiefs Council (NFCC) Grid Scale Energy Storage System Planning – (Revised) Guidance for Fire and Rescue Services (2026) (Ref 2) should be incorporated into site design and safety documentation and attached an NFCC summary of changes document.

1.6.4. The Applicant emailed a response on 17 February 2026 confirming that guidance will be followed, and that any deviations will be fully discussed and agreed with LFR.

1.6.5. The Applicant confirmed that they will share the Scheme's BESS safety and site design documentation with LFR when completed after DCO submission.

2. BESS Safety Requirements

2.1. Procurement

2.1.1. The Applicant is committed to the responsible procurement of BESS systems and holds itself to the highest safety standards (UL, IEC, IEEE, etc.).

2.1.2. The Applicant only procures from leading Tier 1 BESS suppliers and integrators with proven track records of safely operated BESS systems.

2.1.3. During the BESS procurement process, suppliers' designs will be required to have successfully completed large-scale fire testing (LSFT), accreditation with the ISO 9000:2015 series of standards and be fully compliant with NFPA 855 (2026) (Ref 3). In addition, production facilities for all components should accord with ISO 14001 and 45001.

2.2. Safe BESS Design

2.2.1. The BESS will be designed to address prevailing industry standards and good practice at a time of design and implementation. BESS system and components used to construct the facility will be certified to UL 9540 (2023) (Ref 4) and/or BS EN IEC 62933-5-2 (2020) (Ref 5) standards (or any future standards which supersede this).

2.2.2. As a minimum, the battery system will have completed unit or installation level UL 9540A (5th Edition) testing (Ref 6), and the BESS unit will have completed LSFT to demonstrate that loss will be safely limited to one BESS enclosure without the intervention of the Fire and Rescue Services. UL 9540A heat flux test data can establish safe distances between BESS enclosures and ESS equipment but will not be conclusive if full propagation of the battery system does not occur in unit or installation level testing, therefore only LSFT heat flux and thermocouple data will be used to establish minimum equipment spacing distances.

2.2.3. NFPA 855 (2026) (Ref 3) provides the most comprehensive guidelines for BESS design and site installation specifications. BESS design structural integrity will be demonstrated through full-scale destruction performance testing and / or by integrating rigorously tested NFPA 69 (explosion prevention) and NFPA 68 (Explosion protection through deflagration venting) features. NFPA 855 (2026) now mandates that LSFT of the BESS system is conducted to validate safe minimum equipment spacing distances. No fire propagation can occur during these full scale burn tests and the BESS selected at detailed design must as a minimum have completed this testing under the UL 9540A test program or an accredited 3rd Party LSFT test program i.e. CSA C800:25, DNV, TUV SUD, etc. LSFT and / or full-scale destruction performance testing must demonstrate that equipment loss will be limited to one BESS enclosure without the intervention of fire fighters.

2.2.4. If the BESS design integrates hybrid systems, sparker system, Active Ignition Mitigation System (AIMS), or performance design explosion protection systems then system efficacy will be validated through BESS full-scale destruction testing, lean gas mixture testing and requisite pressure testing required by NFPA and EN standards. Full-scale destruction testing validates all active and passive protection system integrated into a BESS enclosure.

2.2.5. If a BESS fire protection direct injection (unit or rack) system without applicable codes and standards or Thermal Runaway Propagation Prevention (TRPP) system (engineered to directly access cells within battery modules) is integrated within each BESS enclosure, this will be tested to a minimum of UL 9540A unit level testing or through significant scale third party fire and explosion testing. The direct injection or TRPP system will be capable of operating effectively in conjunction with a gas exhaust / ventilation system to minimise deflagration risks. The system design must be capable to control or fully suppress a fire, without the direct intervention of LFR. Fire suppression system performance will be benchmarked against free burn testing. An independent Fire Protection Engineer specialising in BESS will review all UL 9540A test results plus any additional fire and explosion test data which has been provided and validate the suppression system design.

2.2.6. BESS enclosure single use (noncontinuous operation) fire protection systems or systems without applicable codes and standards will be tested to UL 9540A installation level testing or through significant scale third party fire and explosion testing. The system design must be capable of controlling or fully suppressing a fire, without the direct intervention of LFR. Fire suppression system performance will be benchmarked against free burn testing. An independent Fire Protection Engineer specialising in BESS will review all UL 9540A test results plus any additional fire and explosion test data which has been provided and validate the suppression system design.

2.2.7. If the BESS design does not integrate automatic fire protection systems or TRPP systems and a dry pipe sprinkler or spray system is integrated, then NFCC (2026) (Ref 2) revised guidance will be followed. Connections to any dry pipe systems that are required to be installed on the BESS area will be installed in accordance with BS 9990 Non-automatic firefighting systems in buildings code of practice (Current Edition) (Ref 7) and will be identified in accordance with BS 3251 Indicator Plates for Fire Hydrants (Current Edition) (Ref 8). If a dry pipe system is integrated for the scheme, LFR instantaneous connection points will be located at a safe distance from enclosures and clearly signed for LFR response, in accordance with NFCC guidelines. Water supply for this type of system will be separate from the water supply designated for LFR boundary cooling firefighting requirements.

2.2.8. If the BESS enclosure is a walk-in design (this is a very low probability because most BESS designs are cabinet systems that can be fully serviced without entering the enclosure), an automatic water fire suppression system must be installed. The suppression system must be capable of operating effectively in conjunction with a gas exhaust / ventilation system to minimise deflagration risks. System design and water supply requirements will be fully agreed with LFR.

2.2.9. As best practice, additional third-party fire and explosion testing will be utilised by the BESS supplier or Original Equipment Manufacturer (OEM) to demonstrate that structural integrity is maintained and toxic gas emissions to the closest receptors are below relevant public health exposure limits when the battery system is fully consumed (burnt out). An independent Fire Protection Engineer specialising in BESS will review all UL 9540A test results and any additional 3rd party fire and explosion test data which has been provided and share conclusions with LFR i.e. the need for additional water supply for boundary cooling or a dry pipe sprinkler system.

2.2.10. In addition to this, good practice guidance for electrical sites within the UK has been consulted with regards to BESS area layouts and separation distances for the transformers and inverters.

2.2.11. Safety Certifications and mitigation features typically found within battery module design, which the Applicant will commit to for the proposed BESS, include:

- Internal fuses.
- Liquid cooling system.
- Active thermal management system (TMS).
- Contactor at rack/string and bank level.
- Overcharge safety devices.
- Internal passive protection products

- Venting systems and gas channels
- Thermal or multi-sensor monitoring devices.

2.2.12. Battery cells will be certified to UL 1973 (Ref 9) and/or BS EN 62619 (Ref 10) and tested to UL 9540A unit or installation level (Ref 6).

2.2.13. Module design will be certified to UL 1973 (Ref 9) and/or BS EN 62619 (Ref 10) and tested to UL 9540A unit or installation level (Ref 6).

2.3. System Location

2.3.1. The BESS Compound was co-located with the On-Site 400kV Substation, to minimise the amount of on-site cabling required. The location also benefits from access via the A16 and Queens Bank. For the indicative design of BESS layout, consideration was given to minimising landscape and visual, flood risk and noise impacts. The BESS would be located over 350m from the closest residential property and over 450m from the closest Public Rights of Way (PRoW). Bunding is proposed around the On-Site 400kV Substation and BESS Compound to provide protection from flood risk, as described in detail in **ES Appendix 11-3: Flood Risk Assessment** (Doc Ref. 6.3).

2.4. System Layout

2.4.1. An illustrative layout for the BESS is shown in the **Indicative and Illustrative Layout Plans and Sections – Section A Solar Development Area** (Doc Ref. 2.8).

2.4.2. The BESS will be broken into discrete groups consisting of battery enclosures, inverters, and transformers. Each group will be separated from the next. LSFT data and rigorous site-specific consequence modelling will establish minimum equipment spacing distances. This separation will limit fire propagation risks regardless of the BESS failure scenario, containing a fire within a small, localised area and facilitating safe emergency access.

2.4.3. NFPA 855 (2026) (Ref 3) defines basic operation Health & Safety (H&S) protocols for all BESS site designs which should be incorporated into emergency response plans:

- Potential debris impact radius is defined as 100 feet (ft) or 30.5 metres (m) i.e. this is a typical explosion risk safe exclusion zone radius as modelling and previous BESS incidents typically show 25 m to be the maximum radius.
- Automatic building evacuation area is defined as 200 ft or 61 m from the affected BESS enclosure.

2.4.4. NFPA 855 (2026) (Ref 3) also defines five BESS hazard categories – hazards are assessed under both normal operating conditions and emergency / abnormal conditions:

- Fire and explosion hazards.
- Chemical hazards.
- Electrical hazards.
- Stored / stranded energy hazards.
- Physical hazards.

2.4.5. The separation distance between the battery enclosures and the Order Limits will be a minimum of 35 metres. The separation of the inverters and transformers will, depending on the design, be optimised at detailed design stage to minimise the likelihood of any spread of fire between adjacent components.

2.4.6. The layout of the Scheme provides adequate separation between enclosures, additional ESS equipment, and other key site structures and infrastructure. The UK NFCC 'Grid Scale Battery Energy Storage System planning – Guidance for FRS (2026)' (Ref 2) will be followed at an indicative design stage, which comprises:

- To protect BESS enclosures from exterior risks, they shall be provided with impact protection to prevent damage to battery enclosures by vehicles or construction equipment and use Damage Limiting Construction (DLC) techniques;
- The indicative BESS design and site layout conforms to NFPA 855 (2026) (Ref 3) standards allowing minimum separation distances to be established from LSFT. In line with 2026 NFCC guidance layout of 6m between BESS blocks and 6m to ESS equipment was integrated, with 0.5m between back-to-back BESS enclosures which was validated through LSFT of the indicative BESS design. This conformity to NFPA 855 (2026) testing requirements to establish safe equipment spacing distances fully complies with NFCC guidelines.

2.4.7. NFCC guidelines allow reduced separation distances if suitable design features can be introduced. The BESS system selected at detailed design will have undertaken LSFT and utilised rigorous site-specific consequence modelling reports to demonstrate that in the event of a BESS failure loss will be safely limited to one BESS enclosure without the intervention of LFR.

2.4.8. LSFT of the selected BESS design to establish minimum equipment spacing distances and site-specific consequence modelling will provide a clear, evidence-based case for the final BESS area installation plans at the detailed design phase and will be agreed with LFR. An independent Fire Protection Engineer specialising in BESS will validate all UL 9540A, LSFT and / or third party test and site-specific consequence modelling data which has been provided.

- The separation of the inverters and transformers will, depending on the architecture, be optimised at detailed design stage to minimise the likelihood of any spread of fire between adjacent components;
- Areas within 10m of BESS enclosures do not contain combustible vegetation and would not be planted with any new combustible vegetation wherever possible. Where this is not feasible a full risk assessment would be conducted, and mitigation features applied if required by the LFR. Any other vegetation on site would be kept in a condition such that they do not increase the risk of fire on site;
- The BESS enclosures would have an internal fire resistance rating of at least one hour (according to NFPA 855 (Ref 3), BR 187 (Ref 13) and FM Global Datasheet 5-33 (Ref 14));
- The BESS area would be designed to integrate pressure fed (pump driven) fire hydrants and/or static water tanks for firefighting, dependent on available water supply. Water tanks will be located at least 10m from the nearest BESS enclosure. Water access points, whether hydrants or tank connections, would be located in consultation with the LFR to provide redundancy and safe operating distances for firefighters; and
- Tanks and water outlets would be clearly labelled with appropriate signage and marked on site plans. Additionally, to avoid any mechanical damage, outlets and hard suction points would be safeguarded with bollards.

2.4.9. By adhering to the testing requirements and separation distances noted above, risk should be adequately minimised to limit a fire event to a single BESS or ESS structure.

2.5. Battery System Enclosures

2.5.1. Battery enclosures will house the battery systems, electrochemical components and associated equipment. Being either one, or multiple containers joined, or close coupled to each other. They will be mounted on a concrete foundation.

2.5.2. Each BESS enclosure will be installed by a certified and qualified installer. Each BESS enclosure will be UL 9540 (Ref 4) and / or BS EN IEC 62933-5-2 (Ref 5) certificated. Ingress protection (IP) testing of the enclosures is conducted under UL 9540 and / or BS EN IEC 62933-5-2 certification of any BESS system. IEC

Factory Acceptance Testing (FAT) or an independent manufacturing audit will be carried out to ensure the supplied BESS enclosures comply with the requisite certified Ingress Protection (IP) levels.

2.5.3. IP ratings of the enclosures will be shared with LFR at the detailed design stage so that risks associated with boundary cooling can be understood and implemented into the ERP. Potential boundary cooling water ingress points such as Heating, Ventilation and Air Cooling (HVAC) systems and deflagration vents will be considered as part of an incident response strategy.

2.5.4. Enclosure gas exhaust vents and deflagration panels must direct flaming or toxic gases away from site personnel or first responders in line with NFCC guidance (Ref 2) and NFPA 68 (Ref 11) and BS EN 14797 (Ref 12) standards; doors cannot be used as sole deflagration vents.

2.5.5. The BESS enclosures will be locked to prevent unauthorised access and will have an internal fire resistance rating of at least one hour (according to NFPA 855 (Ref 3), BR 187 (Ref 13) and FM Global Datasheet 5-33 (Ref 14)).

2.5.6. Where required, BESS enclosure walls will have a minimum one-hour fire resistance rating to BS EN 13501-2 (Ref 15) and BS EN 1364-1 (Ref 16) standards.

2.6. Detection And Fire Protection Systems

2.6.1. To achieve the safety objectives, the Scheme will employ monitoring systems that will help identify any abnormal operation and safely shutdown the system before it develops. These systems will be independent of the control systems and equipment that can cause the abnormal event and avoid the use of Safety Integrity Level (SIL) rated risk controls. Other measures include:

- Thermal monitoring of the battery enclosures and automated cut-out beyond safe parameters;
- Battery liquid cooling systems with automated fail-safe operation (air cooling systems will not be considered for the Scheme); and
- Emergency Stop – both remote and local.

2.6.2. In the event of a fire, the battery system and the transformers serving the BESS will be automatically electrically isolated when a fire is detected within a BESS enclosure. However, the batteries within the BESS enclosures will still hold charge in the event of a fire, even after the electrical system is isolated. It will not be possible to confirm that there is no residual risk from the energised batteries within the BESS enclosures, and this will inform the strategy for firefighting in the ERP to be drafted at the detailed design stage.

2.6.3. The fire and gas detection system for the Scheme will comply with NFPA 855 (2026) (Ref 3) and NFPA 69 (Ref 17) standards. This means that smoke, fire and gas detection equipment will be installed on site. BESS multi-sensor equipment which measures combinations of air temperature, hydrogen, volatile organic compounds, overpressure, shock and vibration, and moisture ingress will also be considered if fully tested with the specific BESS design. The gas detection systems should have external BESS beacon and audible alert facility. All fire detection systems should be installed and commissioned to BS EN 54 (Ref 18), BS EN 9999 (Ref 19), NFPA 855, NFPA 850 (Ref 20). The final BESS failure detection design will be validated by an independent Fire Protection Engineer under the responsibility of the Operations, Engineering and Maintenance Contractor prior to construction, and will be approved by LFR.

2.6.4. If the BESS design does not integrate internal fire and gas detection equipment in alignment with NFPA standards and instead monitors failure parameters through a local Supervisory Control and Data Acquisition (SCADA) system, then fire and explosion mitigation protection systems must be validated through full scale destruction testing and deflagration modelling i.e. Tesla Megapack 2XL design. The final fire detection design (BESS enclosure and BESS site) will be validated by an independent Fire Protection Engineer prior to construction and will be approved by LFR.

2.6.5. NFPA 855 (2026) (Ref 3) confirms that water is the most effective battery fire suppression agent, therefore a dedicated water-based suppression system may be provided within each BESS enclosure designed to control or fully suppress a fire, without the intervention of LFR. The suppression system must be capable to operate effectively in conjunction with a gas exhaust / ventilation system to minimise deflagration risks.

2.6.6. If a BESS fire protection direct injection (unit or rack) system without applicable codes and standards or Thermal Runaway Propagation Prevention (TRPP) system (engineered to directly access cells within battery modules) is integrated within each BESS enclosure, this will be tested to a minimum of UL 9540A unit level testing or through significant scale third party fire and explosion testing. The direct injection or TRPP system will be capable of operating effectively in conjunction with a Combustible Concentration Reduction (CCR) gas exhaust / ventilation system to minimise deflagration risks. The system design must be capable of controlling or fully suppressing a fire, without the direct intervention of LFR. Fire suppression system performance will be benchmarked against free burn testing. An independent Fire Protection Engineer specialising in BESS will review all UL 9540A test results plus any additional fire and explosion test data which has been provided and validate the fire protection system design. System design and any water supply requirements must be fully agreed with LFR.

2.6.7. If a BESS enclosure design does not integrate automatic fire suppression systems and a dry pipe sprinkler or spray system is integrated, then NFCC (2026) (Ref 2) guidance will be followed. Connections to any dry pipe systems that are required to be installed on the BESS Area will be installed in accordance with BS 9990 Non-automatic firefighting systems in buildings code of practice (Current Edition) (Ref 7) and will be identified in accordance with BS 3251 Indicator Plates for Fire Hydrants (Current Edition) (Ref 8). If a dry pipe system is integrated for the scheme, LFR instantaneous connection points will be located at a safe distance from enclosures and clearly signed for LFR response, in accordance with NFCC guidelines. Water supply for this type of system will be separate from the water supply designated for LFR boundary cooling requirements.

2.6.8. NFPA 855 (2026) prohibits the use of clean agent or aerosol fire suppression systems (FSS) unless a sprinkler or spray system is also integrated into a BESS enclosure. Clean agent and aerosol fire suppression systems cannot be the primary fire suppression method unless fire and explosion testing with the specific BESS design can demonstrate that use of such systems does not present a deflagration hazard. If an aerosol FSS is integrated into each BESS enclosure, then the system must be designed and certified to discharge specifically for an 'electrical fault' fire and shall not discharge in any thermal runaway scenario ensuring a gas exhaust system can remain in operation.

2.6.9. BS EN 15276-1 and BS EN 15276-2 also state that aerosols are not to be used on fires involving a range of chemicals and materials including:

- Chemicals capable of undergoing autothermal decomposition (e.g. some organic peroxides); and
- Oxidising agents (e.g. nitric oxides and fluorine).

2.6.10. The above substances are applicable to BESS LIB battery systems and preclude aerosols from consideration for BESS fire suppression systems.

2.6.11. NFCC (2026) (Ref 2) guidance acknowledges that it is increasingly common for BESS enclosures to be designed without integrated automatic fire suppression systems because high levels of thermal insulation are integrated which allows enclosures to be closely spaced whilst preventing propagation of fire to adjacent BESS. As mandated in NFPA 855 (2026), LSFT and / or full scale destruction testing to establish minimum equipment spacing distances coupled with rigorous site-specific consequence modelling will be conducted for the selected BESS design, validating site equipment spacing to demonstrate that loss will be safely limited to one enclosure without the intervention of LFR.

2.6.12. BESS LSFT as defined in NFPA 855 (2026) and conducted to UL or accredited 3rd party testing protocols (CSA C800:25, TUV SUD, DNV, etc.) may only establish minimum safe equipment distances. Additional 3rd Party fire and explosion testing may be required to also demonstrate that BESS structural integrity can be maintained and toxic gas emissions to the closest receptors are below relevant public health exposure limits when the battery system is fully consumed (burnt out). An independent Fire Protection Engineer specialising in BESS will review all UL 9540A, LSFT, and 3rd Party fire and explosion test data which has been provided.

2.6.13. A post-incident recovery plan shall be developed, as recommended by the NFCC guidance that addresses the potential for reignition of BESS battery systems, as well as removal and disposal of damaged equipment. A fire watch will be present until all potentially damaged BESS equipment batteries are removed from the area following a fire event. The water supply for suppression systems and / or firefighting will be replenished as quickly as feasible.

2.7. BESS Active and Passive Safety Systems

2.7.1. Other measures to minimise the risk and consequences of a BESS failure event that could be implemented include:

- As a minimum, a BESS Combustible Concentration Reduction (CCR) system will comply with NFPA 855 (2026) (Ref 3) / NFPA 69 (Ref 17) guidelines which require activation at no more than 10% of the Lower Explosive Limit (LEL) of the explosive gas(es). The CCR must ensure the prevention of a dangerous build-up of explosive gases (on average 25% LEL within the BESS). The CCR is considered a critical safety system and must comply with Section 4.10 of NFPA 855 concerning Emergency Power Supply Systems (EPSS) which requires emergency back-up power and system redundancy. Heating and cooling of the battery modules will be provided by an independent liquid cooling system which is separate to any HVAC system providing climate control for the BESS enclosure. Backup power for the gas detection system must have a 24-hour duration in standby and 2 hours in alarm, as demonstrated via NFPA 72 (Ref 21) compliant battery calculations and required by NFPA 855;

- When mechanical ventilation (CCR) is required to maintain concentrations below the required limits, it shall be interlocked, so that the system shuts down upon failure of the ventilation system. Where emergency ventilation is used to mitigate an explosion hazard, the disconnect for the ventilation system will be clearly marked to notify personnel or first responders to not disconnect the power supply to the ventilation system during an evolving incident;
- The CCR system will be designed to exhaust flames and gases safely outside the BESS enclosure, without compromising the safety of first responders. The CCR system will be performance tested with lean gas mixture testing (gas mixture is defined by the specific BESS UL 9540A (Ref 6) test data) to demonstrate that explosive gases do not exceed 25% LEL as required by NFPA 69 (Ref 17) standards, the system shall be provided with suitable ember protection to prevent embers from penetrating BESS enclosures (HVAC, gas exhaust, deflagration panels). An NFPA 69 compliance report will be provided to demonstrate the compliance of the gas exhaust system with NFPA 855 (Ref 3) explosion prevention system requirements;

2.7.2. Explosion protection systems not covered directly by NFPA 68 (Ref 11) and NFPA 69 (Ref 17) standards are commonly referred to as performance design explosion mitigation systems, these include automatic doors or vents which open to ventilate explosive gas mixtures and / or relieve pressure. If the BESS design integrates hybrid systems, sparker system, Active Ignition Mitigation System (AIMS), or performance design explosion protection systems it will be validated through BESS free burn testing, lean gas mixture testing and requisite pressure testing required by NFPA and EN standards. Further, the BESS enclosure will have completed UL 9540A (Ref 6) testing and / or large-scale Third-Party Fire and Explosion testing without pressure waves occurring or shrapnel being ejected. An independent Fire Protection Engineer specialising in BESS will review all UL 9540A test results and any additional fire and explosion test and modelling data which has been provided; and

2.7.3. The BESS enclosure will be designed to withstand overpressures generated by the battery system during thermal runaway. As a minimum, an explosion prevention system to NFPA 69 (Ref 17) standards will be integrated which should be complimented by an explosion protection system to NFPA 68 (Ref 11) and BS EN 14797 (Ref 12) standards. NFPA 68 design key performance requirements are:

- The enclosure strength shall exceed the vent opening pressure by a safety factor of over two (including the doors)

- The total vent size shall be selected such that the reduced deflagration pressure (Pred) is below two thirds (2/3) of the enclosure strength.

2.7.4. Most LSFT test programs do not performance test BESS active protection system, therefore any BESS explosion prevention or control / protection system will be validated through additional full scale BESS destruction testing, lean gas mixture testing and requisite pressure testing required by NFPA and EN standards. An independent Fire Protection Engineer specialising in BESS will review all UL 9540A (Ref 6) test results and any additional fire and explosion test and modelling data which has been provided.

3. BESS Construction and Operation

3.1. Safe BESS Construction

3.1.1. The BESS would be constructed in two distinct phases. Firstly, the civil works and balance of non-BESS plant and equipment construction would be started. Then at a suitable point the BESS equipment would be delivered to be installed on the foundations and connected to the balance of plant.

3.1.2. The installation would be subject to pre-requisites such as a contractor emergency protocol detailing the actions to be taken in an emergency, including a construction emergency response plan (ERP) that would be coordinated with the relevant stakeholders and emergency services. In addition, installation would not take place until practical provisions were completed such as the water tanks being installed and filled for use in an emergency.

3.1.3. The transportation of the system from the factory will be a combination of sea and land freight. The system is certified for transportation in all potential environmental conditions. The equipment will be certified for transport to UN 38.3 standards (Ref 22). Transportation will be managed in accordance with the European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR) 2019 (Ref 23) and the UK guidance on the transport of dangerous goods "Moving dangerous goods, Guidance" Government webpage (Ref 24).

3.1.4. The appointed contractor will ensure the transported BESS equipment will have undergone Factory Acceptance Testing (FAT) to IEC 62933-5-2 (Ref 5) standards. Site Acceptance Tests (SAT) will follow IEC 62933-5-2 and / or IEEE P2962 (2025) (Ref 26) standards and protocols.

3.1.5. By following a logical sequence of works with each step being built upon the preceding one, the system can be safely assembled with minimal risk, and all mitigations against residual risk in place, before the next step occurs.

3.2. Safe BESS Operations

Control Room

3.2.1. The BESS area will be monitored by the on-site control facilities, as well as 24/7 monitoring by a remote-control facility provided by the BESS manufacturer or operator. Operations would be controlled as follows:

- The control room (during operational hours) will be responsible for the security of the BESS site with detection and monitoring systems fully compliant with NFPA 855 Standards and NFCC Guidance. These can be repurposed in an emergency to support first responders.

- The control room will have the ability and authority to immediately shut the system down should the need arise.
- The control room (during operational hours) will be responsible for the implementation of the Emergency Response Plan (ERP), acting as a point of contact to emergency services.
- Staff will be fully trained and familiar with the BESS technologies and will be responsible for alerting LFR and, if required, for connecting LFR with BESS incident Subject Matter Experts (SMEs).
- The 24/7 remote control facility will monitor the security of the BESS area, and monitoring and detection systems will be repurposed in an emergency to support first responders. NFPA 855 (2026) (Ref 3) defines the minimum monitoring and control standards.
- The 24/7 remote control facility will have the capability to immediately shut the system down should an incident occur, and the need arise. It can also implement the ERP, acting as a point of contact to the emergency services.
- In some circumstances it will be necessary to discharge stored electricity from the batteries to enable the first / second responders to deal with the incident. This capability could potentially be achieved through the 24/7 remote control facility. The precise methodology in this regard will be agreed in the ERP and also documented in the BSMP once the detailed design of the BESS is known. This will be prepared in conjunction with LFR.

3.2.2. Signage should be installed in a suitable and visible location on the outside of the BESS units, identifying the presence of a BESS system. Signage would be as per NFCC guidelines (Ref 2) and will also include details of:

- Relevant hazards posed i.e., the presence of High Voltage DC Electrical Systems is a risk, therefore their location should be identified.
- The type of technology associated with the BESS.
- Any suppression system, direct injection system, or TRPP system fitted.
- 24/7 emergency contact Information.
- Signs on the exterior of a building or enclosure will be sized such that at least one sign is legible at night at a distance of 30m or from the site boundary, whichever is closer.

Control Architecture

3.2.3. NFPA 855 (2026) (Ref 3) stipulates that a Battery Management System (BMS) should at a minimum provide the following safety functions:

- High cell temperature trip to isolate the module or rack when detecting cell temperatures that exceed limits;
- Thermal runaway trip to isolate the battery system when a cell is detected to have entered a thermal runaway condition;
- Rack switch fail-to-trip to disconnect the rack if any failure is detected. Inverter/charger fail-to-trip to isolate the BESS enclosure at the breaker if the inverter/charger fails to respond to a trip command; and
- Inverter/charger fall-to-trip (supervisor level): This function initiates a trip command to an upstream breaker to isolate the ESS if the inverter/charger fails to respond to a trip command. The 'supervisor' control system controls the entire system, including the combination of racks, the environmental support systems, and the charging/discharging status. The supervisor level should isolate the ESS if the inverter/charger fails to trip on an appropriate signal, or if communication is disrupted between the inverter/charger and the supervisor control.

3.2.4. Energy Management Systems (EMS) / BMS controls would as a minimum incorporate NFPA 855 (2026) (Ref 3) monitoring and control features and conform to the new IEEE 2686 (2025) standard (Ref 25): Recommended Practice for Battery Management Systems in Stationary Energy Storage Applications. Additional IEEE standards in development (IEEE P2688 (Ref 27) and IEEE P2962 (Ref 26)) should also be adopted by the BESS system provider, these cover BESS data analytics, electrical controls and maintenance / replacement of battery components / systems.

3.2.5. If data analytics are not directly integrated by the BESS OEM or BESS integrator, the Applicant will ensure a Data Analytics package is integrated to provide a greater range of performance and safety data i.e. predict ageing of the cells in battery systems, alert BMS faults or malfunctions, identify electrical abuse during operations, alert the operator when modules need maintenance or decommissioning. Data Analytics facilitate more accurate assessment of operating temperature variations, voltage anomalies, State of Charge (SOC), and State of Health (SOH). Data Analytics can also monitor complimentary BESS safety features i.e. smoke and gas sensors, BESS multi-sensor equipment, ground fault detectors, etc.

3.2.6. Cybersecurity will form a fundamental part of the system design and architecture as there is an increasing focus in this area from national and international regulatory bodies. International standards such as IEC 62443 (Ref 28), UL 1741 (Ref 29), IEEE 1815 (Ref 30), and IEEE 1547.3 (Ref 31) will be consulted and guidance from national sources such as National Cybersecurity Centre inform the implementation and protection measures. Reference would be made to the Health and Safety Executive (HSE) Operational Guidance document OG86 (Ref 32).

3.2.7. UL published 'UL 2941 (2023) Outline of Investigation for Cybersecurity of Distributed Energy and Inverter-Based Resources' (Ref 33). UL 2941 provides testable requirements for photovoltaic inverters, electric vehicle chargers, wind turbines, fuel cells and other resources essential to advancing grid operations. These new requirements prioritise cybersecurity enhancements for power systems that deal with high penetration inverter-based resources, including those interfacing with bulk power systems for periods of instantaneous high wind, solar and hybrid/storage generation. UL 2941 promotes the necessity to have cybersecurity designed into new inverter-based resources (IBR) and distributed energy resource (DER) systems, and the Scheme at the detailed design stage will conform to these requirements.

Security

3.2.8. The Scheme's security profile will be assessed by the Applicant's security contractor and the output from this assessment will inform the level of security measures used.

3.2.9. Where practical and required by LFR or risk assessment, the BESS compound will have security fencing with a minimum of two points of ingress / egress for first responders and will be clearly signed, with incident emergency response contact details, clear identification of BESS site hazards, details of site access arrangements such as key codes, which will be provided to the LFR.

3.2.10. Depending on the outcome of the future risk assessment, the BESS site may require Thermal Imaging Cameras to alert and locate on site fire risks and integrate high-definition CCTV with video analytics to alert and respond to unauthorised site access.

Maintenance

3.2.11. The BESS will be maintained and operated by skilled personnel ensuring that the system is in optimal condition and that all parts of the system are fully serviced and functional at all times.

3.2.12. Routine maintenance will be undertaken on the BESS equipment depending on the risk profile of the equipment to be selected. This typically consists of a major maintenance period and a minor maintenance period. This will encompass all BESS and supporting equipment supplied by the Original Equipment Manufacturer (OEM) including the fire protection and explosion prevention system. Minor maintenance is typically a visual inspection and rectification of any accumulated noncritical defects. All maintenance will be undertaken in a carefully controlled manner, following the site safety rules and in accordance with the Operational Environmental Management Plan approved pursuant to DCO Requirement.

3.2.13. During operation, all works on the site will be controlled under safe systems of work. This will mean all work is risk assessed to protect both personnel and equipment. Therefore, safety systems such as fire systems will not be stopped or taken out of service without appropriate mitigation, following the system being made safe so far as is reasonably practicable, and only for the minimum time required to undertake any specific maintenance tasks.

End of Life Disposal

3.2.14. Regarding the decommissioning of the BESS, the requirements will be determined at the procurement contract stage, with the contractor remaining clear that they are the producer of the battery components and as the party placing the battery components on the UK market, pursuant to the Waste Batteries and Accumulators Regulations 2009 (Ref 34) (or such equivalent regulations in force at the time of decommissioning), they have certain obligations in respect of battery disposal.

3.2.15. In the event of a defective battery module or cell being identified, the defective module shall be immediately placed out of service and be electrically disconnected from the system. A specific risk assessment shall be conducted prior to the removal of the defective module to ensure the safety of employees and contractors. Specific protocols for storage and removal will fully align with the supplier's maintenance, decommissioning, and warranty stipulations.

3.2.16. Once a defective module is safely discharged or removed in accordance with the specific risk assessment, it shall be stored in an approved protective container suitable for the safe storage of BESS battery components prior to being transported from the defective unit to a dedicated safe location for inspection by an authorised manufacturer's representative.

3.2.17. All components replaced during the defects notification and warranty period will be returned and recycled.

3.2.18. The Applicant will follow the hierarchy of waste management through the life of the scheme as follows:

Reduce – the lithium-ion batteries have finite life based on a number of factors, primarily the total number of cycles undertaken. The operation will attempt to manage the degradation by the selection of services and cycling that maximises the overall life. Consideration will be given to supplementation of the equipment or operation at a lower output.

Recycle – The supplying manufacturer will have obligations under the Waste Batteries and Accumulators Regulations 2009 (as amended) (or such equivalent regulations in force at the time of decommissioning) and will be contractually obliged to offer a recycling service.

Recovery – The recycling should allow any useful materials to be recovered and re-enter the supply chain.

Disposal – Any disposal of batteries shall be undertaken in compliance with all applicable laws and all regulatory requirements, product stewardship, registration disposal and recycling or take back requirement.

4. Firefighting

4.1. Fire Service Guidance

4.1.1. Guidance for the Fire Service for dealing with sites such as powerplants, substations etc. is contained in the Fire Service Manual Volume 2 Fire Services Operations – Electricity (Ref 35).

4.1.2. The Fire Service Manual stipulates that in all cases involving electrical apparatus, it is essential to ensure, on arrival, that the apparatus is electrically isolated and safe to approach. This would be carried out by the operator at the premises concerned. It is strongly advised that electrical or associated equipment should not be touched or even approached unless it is confirmed to be isolated and safe.

4.1.3. BESS hazards for first responders, and site operatives once a BESS failure event occurs, depend on both the failure scenario and the BESS design but are typically defined as: fire, explosion, chemical hazards, carbon monoxide, carbon dioxide, hydrocarbon gases, and hydrogen. Full PPE must be worn, and operations would not generally be conducted within any identified blast exclusion zones (close proximity to doors and deflagration vents).

4.1.4. Fire Hydrants and connections to any dry pipe systems that are required to be installed as part of the BESS, compound would be installed in accordance with BS 9990 (Nonautomatic firefighting systems in buildings - Code of Practice) (current edition) (Ref 7) and should be identified in accordance with BS 3251 Indicator Plates for Fire Hydrants (current edition) (Ref 8).

4.1.5. In the event of a BESS failure, the battery system and the transformers serving the BESS will be automatically electrically isolated when a burning or venting thermal runaway incident is detected within an enclosure. However, the batteries within the enclosures will still hold charge in the event of a fire, even after the electrical system is isolated. It will not be possible to confirm that there is no residual risk from the energised batteries within the enclosure, and this will inform the strategy for firefighting in the emergency plans.

4.1.6. If a dedicated automatic water-based suppression system or TRPP system (engineered to directly access cells within battery modules) is provided within each BESS enclosure, this will be tested at UL 9540A (Ref 6) unit / installation level or through significant scale third-party fire and explosion testing. The suppression or TRPP system will be capable of operating effectively in conjunction with a gas exhaust / ventilation system to minimise deflagration risks.

The system design must be capable to control or fully suppress a fire, without the direct intervention of LFR.

4.1.7. The Applicant has consulted NFCC guidelines (Ref 2) and engaged with LFR throughout the pre-application phase and will ensure that the detailed BSMP will reflect any subsequent revisions made to NFCC guidelines. Close consultation will continue with LFR throughout the application and post consent stages.

4.2. Fire Service Access

4.2.1. UK National Fire Chiefs Council BESS planning guidance document (Ref 2) stipulates that suitable facilities for safely accessing and egressing the BESS compound should be provided. Designs would be developed in close liaison with LFR, as specific requirements may apply due to variations in vehicles and equipment.

4.2.2. Access will be designed such that emergency services are able to access the BESS Area easily with access roads being clearly laid out and signed in accordance with the following:

- The proposed access-route width around the BESS area will be 5m and there are no dead-end access routes or extremes of grade (accessible in all weather conditions). Turning circles, passing places etc size to be advised by LFR depending on fleet.
- Road networks within the Order Limits will enable unobstructed access to all areas of the BESS sites, two separate LFR access points to the BESS sites have been integrated to ensure firefighters do not have to drive through a smoke or gas plume to access the BESS.
- Emergency access route plans for first responders will be included in the Emergency Response Plans (ERP) and hard copies will be available on site. Route sign requirements will be agreed with LFR.
- Signage will be installed in a suitable and visible location on the outside of BESS enclosures identifying the presence of a BESS system. Safety signage will be installed in accordance with Health and Safety (Safety Signs and Signals) Regulations 1996 (Ref 36). Signage will include details of:
    - Relevant hazards posed;
    - The type of technology associated with the BESS;
    - Any suppression system fitted; and
    - 24/7 Emergency contact information.

- Signs on the exterior of a building or enclosure should be sized such that at least one sign is legible at night at a distance of 30 metres or from the Order Limits, whichever is closer.

4.2.3. In accordance with NFCC revised guidance (2026) (Ref 2), the final BSMP will include a site plan that shows all sensitive receptors within a 1 km radius of the Order Limits that could be affected by a fire. The plan will have a compass rose showing north and the prevailing wind direction.

4.2.4. A site plan will be provided at the detailed design stage to LFR that may include, as relevant:

- The layout of buildings.
- Any areas where hazardous and flammable materials are stored on site (location of gas cylinders, process areas, chemicals, piles of combustible wastes, oil and fuel tanks).
- All permanent ignition sources within the Order Limits and show they are a minimum of 6 m away from combustible and flammable waste.
- Any areas where combustible waste is being treated or stored including non-waste material.
- All separation distances.
- Any areas where combustible liquid wastes are being stored.
- Any area where depollution of end of life vehicles (ELVs) takes place.
- Any area where crushing, shredding, baling of metals or ELVs takes place.
- Main access routes for fire engines and any alternative access.
- Access points around the perimeter of the Order Limits to assist firefighting.
- Hydrants and water supplies.
- Areas of natural and unmade ground.
- Drainage runs, pollution control features such as drain closure valves, and fire water containment systems such as bunded or kerbed areas (this may be easier to show on a separate drainage plan). Measures such as attenuation tanks and pollution control automatic penstock values (with manual back option) will also be shown on the **Indicative and Illustrative Layout Plans and Sections – Section A Solar Development Area** (Doc Ref. 2.8) and described within **ES Appendix 11-4: Outline Drainage Strategy** (Doc Ref. 6.3)

- Storage areas with pile dimensions and fire walls (where applicable) – this includes wastes stored in a building, bunker, or containers – include indicative pile layouts and ensure it is geographically representative.
- The location of fixed plant or storage location of mobile plants when not in use.
- The location of spill kits.
- The quarantine area.
- Anything site specific considered needing to be added.

4.3. Firefighting Water Supply

4.3.1. The BESS area will be designed to integrate pressure fed (pump driven) fire hydrants and / or static water tanks for firefighting, depending on available water supply. Water provision will be designated for the cooling of adjacent BESS or ESS equipment. Water tanks will be located at least 10m from the nearest BESS enclosure. Water access points, whether hydrants or tank connections, would be located in consultation with the LFR to provide redundancy and safe operating distances for firefighters. They will be easily accessible to LFR vehicles, and their siting should be considered as part of a risk assessed approach that considers potential fire development / impacts. Outlets and connections will be agreed with LFR, no BESS enclosure will be further than 90m from a fire hydrant. Tanks and water outlets would be clearly labelled with appropriate signage and marked on site plans. Additionally, to avoid any mechanical damage, outlets and hard suction points would be safeguarded with bollards.

4.3.2. The firefighting water requirement will be fully assessed by an independent Fire Protection Engineer at the detailed design stage based upon analysis of LSFT of the BESS design plus any additional fire and explosion test data provided, water storage volumes will be fully agreed with LFR.

4.3.3. The BESS area design will contain a minimum of two firefighting water storage units with a total capacity of no less than 360,000L in total, capable of delivering 1500 litres per minute for 4 hours (exceeding NFCC guidance).

4.3.4. Water storage will either be in sectional steel panel tanks, or cylindrical steel tanks, above ground, tanks will be supported on structural concrete slab foundations to a maximum depth of 1m.

4.3.5. Fire hydrants and connections to any dry pipe systems that are installed on the BESS compound will be installed in accordance with BS 9990 Non-automatic

Firefighting Systems in Buildings Code of Practice (Current Edition) (Ref 7) and should be identified in accordance with BS 3251 Indicator Plates for Fire Hydrants (Current Edition) (Ref 8).

4.3.6. Site and BESS design principles and ERP content will ensure that the LFR are expected to employ a defensive strategy i.e. only boundary cooling should be employed for cooling of adjacent BESS or associated supporting equipment, this ensures that environmental pollution risks are minimised. Boundary cooling typically involves firefighters directing water fog or spray pattern discharge to ensure the incident does not spread to adjacent BESS enclosures. NFCC guidance (Ref 2) states: "*If it can be confirmed that the recommended firefighting tactic for the BESS is to defensively fire fight and boundary cool whilst allowing the BESS to consume itself, this will reduce the water requirements, and thus the drainage/environmental protection requirements significantly*." A BESS design which may require direct LFR firefighting engagement tactics will not be selected for this facility.

4.3.7. The BESS scheme will integrate an external firefighting water capture drainage system. In the event of a fire a system of automatically self-actuating penstock valves (with manual backup) at the outfalls from the BESS areas will be closed, isolating the BESS areas drainage from the wider environment. The entire BESS compound will include an impermeable lining to ensure no polluted runoff will infiltrate to ground. Fire water runoff may contain particles from a fire; in the unlikely event of fire water being discharged, the runoff will need to be contained so it can be sampled and tested by a UKAS accredited lab. The water contained by the valves will be tested and removed by tanker and treated offsite (in consultation with the relevant consultees at the time). Pollution analysis will always be conducted before removing from site.

4.3.8. If an internal BESS water based fixed suppression system (automatic or dry pipe) is integrated in the BESS enclosures, a separate water supply and water containment system will be integrated, water runoff is likely to contain higher levels of pollutants compared to water used for external boundary cooling of BESS and ESS equipment. All process water used in the system shall be prevented from contaminating potable water sources, in accordance with local regulations through the use of check valves or other means as part of the system design. Pollution analysis will be conducted before removing and treating offsite.

4.4. Emergency Planning

4.4.1. The proposed BESS will have a robust and validated emergency plan, developed in consultation with LFR. Some example BESS and site design information which is anticipated to be shared with LFR, to establish a risk profile for first responders, is listed below:

- Battery chemistry integrated into BESS – can provide fire and explosive risk profile;
- Battery form factor (cylindrical, pouch, prismatic);
- Battery energy Wh / kWh – confirmation of new battery cell (second life cells will not be accepted);
- Battery module cooling system details (e.g., liquid cooling design, air cooling design) – cooling system capability assessment to stop or reduce battery cell thermal runaway propagation. Air cooled designs will not be accepted;
- Battery module vent or gas exhaust specifications;
- Battery module kWh energy + number of cells contained in the module + battery circuitry details (number of cells in series vs number of cells in parallel);
- Direct suppression system details – direct module TRPP or rack level FSS integration;
- Rack design – number of modules and kWh / MWh energy, spacing between modules, passive protection features, gas exhaust features, electrical isolation functions, heat or thermal runaway sensor integration, etc;
- Rack configuration – spacing to adjacent racks, number of racks in BESS, spacing to walls, doors, gas vents and roof;
- Type of BESS enclosure design e.g., container or cabinet, gas exhaust / ventilation features, deflagration vent design features, BESS enclosure level fire protection and suppression system details (proof of testing with BESS design and test data), additional fire or explosion protection features i.e., thermal barriers;
- EMS / BMS data monitoring capabilities and incident response integration capacity;
- Number of BESS enclosures on site;
- Size and MWh capacity of each BESS enclosure;

- BESS and ESS equipment spacing; spacing to other equipment, boundaries, vegetation, roads or access routes, fire hydrants / water tanks, site building structures, etc;
- Access routes, observation points, turning areas, FRS equipment and assets, water supply locations and capacity, drainage, and water capture design; and
- Definition and frequency of BESS equipment testing and maintenance requirements.

4.4.2. Digital provision of safety information and procedures must be provided to site operatives, first responders and Subject Matter Experts (SMEs) during BESS incident response – hard copy printed materials must be available onsite (location agreed with LFR). As a minimum content should include:

- Digital emergency response plans;
- Remote emergency shutoff procedures;
- SDS / Hazardous material documentation;
- Maps or design drawings;
- Gas detection capabilities; could include multi-sensor data metrics e.g., Carbon Dioxide (CO2), Carbon Monoxide (CO), Hydrogen (H2), VOC off gas + overpressure + local temperatures;
- Fire protection system data e.g., temperature, alarming, suppression status, etc. – establish discharge warrantee clauses, emergency BESS venting procedures, discharge times, impact on ventilation and detection systems, etc;
- ERP training drills for site operatives + FRS engagement (site familiarisation + training drills) + SME engagement (fire protection experts or battery experts); and
- Other documentation as required by specific BESS project i.e., local response stipulations, contact information for nominated response personnel, community contacts, etc.

4.4.2. An ERP will be developed post grant of development consent to facilitate effective and safe emergency response. It will follow UK NFCC (Ref 2) and NFPA 855 (Ref 3) guidelines and will include as a minimum:

- How the fire service will be alerted and incident communications and monitoring capabilities;

- Facility description, including infrastructure details, operations, number of personnel, and operating hours;
- Site plan depicting key infrastructure;
- Site access points, internal roads, agreed access routes, observation points, turning areas, etc;
- Firefighting facilities (water tanks, pumps, booster systems, fire hydrants, fire hose reels etc);
- Water supply locations and capacity; and
- Drainage and water capture design and locations.
- Up-to-date contact details of the emergency response co-ordinator including the subject matter expert (SME) for the Order Limits;
- Safe access to and within the facility for emergency vehicles and responders, including to key site infrastructure and fire protection systems;
- Details and explanation of warning systems and alarms on site and locations of alarm annunciators with alarm details (smoke, gas, temperature);
- Hazards and potential risks at the facility and details of their proposed management;
- The role of the FRS at incidents involving a fire, thermal event or fire spreading to the Order Limits;
- Emergency shutoff or isolator locations;
- A list of dangerous goods stored on site;
- Site evacuation procedures;
- Site operation Emergency Management protocols - 4 phases: discovery, initial response / notification, incident actions, resolution and post incident actions / responses;
- Emergency procedures for all credible hazards and risks, including building, infrastructure and vehicle fire, wildfires, impacts on local respondents, impacts on transport infrastructure; and
- The operator will develop a post-incident recovery plan that addresses the potential for reignition of the BESS and de-energizing the system, as well as removal and disposal of damaged equipment.

4.4.3. The Site owner during design development, as well as the operator once appointed, will work closely with LFR to provide all relevant information on BESS and site design features to inform all necessary hazard and risk analysis studies and assist in the development of comprehensive Risk Management Plan and ERP.

4.4.4. Information will be supplied as early as possible in the detailed design stage to allow an initial appraisal of the BESS to be made. This information will be provided to LFR with appropriate evidence provided to support any claims made on performance, and with appropriate standards cited for installation. Such information should also be made available to LFR for inclusion in Site Specific Risk Information (SSRI) records.

4.4.5. A Risk Management Plan shall be developed with LFR post consent at the detailed design stage as part of the BSMP which, as a minimum, will provide advice in relation to potential emergency response implications including:

- The hazards and risks to the facility and their proposed management;
- Any safety issues for firefighters responding to emergencies at the BESS facility;
- Safe access to and within the facility for emergency vehicles and responders, including to key site infrastructure and fire protection systems. Establishment of response times and site arrival protocols;
- The adequacy of proposed fire detection and suppression systems e.g., water supply on-site; and
- Natural and built infrastructure and on-site processes that may impact or delay effective emergency response i.e., firefighting water runoff capture.

4.5. Firefighting consequences

Firefighting Techniques

4.5.1. Due to the BESS not having personnel access into the battery enclosures, there is unlikely to be any immediate threat to life arising from a BESS failure event.

4.5.2. LFR in foreseeable and credible emergency response scenarios, would most likely adopt a defensive firefighting strategy by using water on neighbouring areas such as battery enclosures and structures to cool down and prevent further fire spread. As mandated by NFPA 855 (2026) (Ref 3), the Scheme will select a BESS design that has undertaken LSFT to demonstrate thermal insulation protection capabilities of the BESS enclosure design, validate minimum equipment spacing distances, and demonstrate that deflagrations do not occur and / or can be safely constrained. In accordance with NFCC guidance (Ref 2), the Scheme will be managed in such a way so as to prevent a fire spreading to the BESS or inadvertently fire loading, by providing a 'bridge' or path between BESS enclosures to transmit flaming or radiant heat.

4.5.3. As recommended in NFCC revised guidance (2026) (Ref 2), it is not anticipated that firefighting techniques will require direct hose streams or spray directly on battery systems, and techniques will be limited to boundary cooling of adjacent BESS enclosures and supporting equipment to prevent the fire from spreading. Ingress Protection (IP) ratings of BESS enclosures will be shared with LFR so that risks associated with boundary cooling can be understood. This strategy will be finalised with the LFR at the detailed design stage and be clearly communicated in the ERP.

4.5.4. LFR would most likely commit to fighting fire by using water on neighbouring areas such as other BESS enclosures, trees, and structures to cool down and prevent further fire spread.

Surface Water Runoff

4.5.5. A fire affecting the BESS has the potential to mobilise pollutants in surface water runoff. As set out in **ES Appendix: 11-4 Outline Drainage Strategy** (Doc Ref. 6.3), the BESS drainage system will be designed to isolate and contain such flows to prevent pollution of the surrounding environment. Outfalls from the BESS drainage system will be fitted with automatically actuated valves, which are connected to the BESS fire alarm system. In the event of a fire, these self-actuating valves will close, isolating the BESS drainage system and containing firewater runoff locally.

4.5.6. The surface water drainage system will be designed to attenuate runoff from the 1 in 100 year storm event plus a 40% climate change allowance. This capacity is expected to accommodate a reasonable scenario involving firewater runoff combined with a 1 in 2 year storm event. The BESS area design will contain a minimum of two firefighting water storage units of no less than 180,000 litres in capacity, capable of delivering 1500 litres per minute for 4 hours (exceeding NFCC guidance). This equates to a total volume of 360 cubic metres for the BESS area. Accordingly, the drainage design will provide sufficient capacity to contain either the full firefighting volume in combination with the 1 in 2 year storm event, or the 1 in 100 year plus climate change event on its own, whichever scenario is more onerous. Additional attenuation features can be incorporated within the Order Limits where required, and final storage requirements will be agreed with the Fire and Rescue Service.

4.5.7. The firewater basin will be controlled by a penstock valve that can be closed before a fire is put out. The penstock valve will be located in proximity to the access road so they can be easily reached in the event of a fire. The system will include a manual backup redundancy for the automated controls linked to the fire detection systems, allowing personnel to manually override the valve in the event of an automation failure.

4.5.8. Following a fire event, the automated penstock valves will remain closed such that potentially contaminated firewater runoff be retained. This will allow runoff to be sampled and analysed to confirm whether pollution has occurred. Firewater will be captured and removed from site by tanker for treatment at an appropriate offsite facility. This approach ensures that environmental protection is maintained under both normal and emergency conditions.

4.5.9. If an internal BESS water based fixed suppression system (automatic or dry pipe) is integrated in the BESS enclosures, a separate water supply and water containment system will be integrated, water runoff is likely to contain higher levels of pollutants compared to water used for external boundary cooling of BESS and ESS equipment. All process water used in the system shall be prevented from contaminating potable water sources, in accordance with local regulations through the use of check valves or other means as part of the system design. Pollution analysis will be conducted before removing and treating offsite.

Smoke Plume Impacts

4.5.10. The **ES Appendix 16-4: Unplanned Atmospheric Emissions from Battery Energy Storage Systems** (Doc Ref. 6.3) scope of study has considered:

- A review of potential emissions to air from a single BESS enclosure thermal event within a single cabinet (battery rack) and within multiple cabinets (batter racks);
- Consideration of the potential magnitude of emissions;
- Consideration of likely rates of dilution between potential emission locations and sensitive receptors located outside the Site; and
- Consideration of the likely consequences of emissions to air from the proposed BESS.

4.5.11. The UK has air quality objectives and targets to protect public health from exposure to air pollutants including NOx when present as nitrogen dioxide (NO2), particulate matter (size fractions PM10 and PM2.5), SO2, CO and hydrocarbons. These objectives and targets are mostly based on long averaging periods, such as 24hr mean concentrations and annual mean concentrations. A single event, only lasting a few hours, is incapable of materially effecting such long-term average concentration values, used to measure ongoing exposure from the combined contributions of background and local emissions sources. Even short-term objectives, such as the hourly mean concentration of NO2 is based on a percentile of hourly values that can be exceeded a small number of times per year. It has been established that lithium-ion battery fires may produce carbon monoxide (CO), hydrogen cyanide (HCN), hydrogen chloride (HCl), hydrogen bromide (HBr), hydrogen fluoride (HF), sulphur dioxide (SO2), NOX (nitrogen oxides), hydrocarbons, and particulate matter. The prevalent gas production mainly comprises CO, CO2, hydrogen and hydrocarbon gases, with most of the toxic gases referenced generally only detected as trace elements.

4.5.12. HF is the primary toxic emission of concern for the plume analysis study, based upon the studies referenced in the assessment, it is likely to be present within a BESS fire at concentrations of concern at distances of more than a few tens of metres from the fire. It is also highly toxic. It is considered that HF has the greatest potential for harm compared to other products of combustion and therefore modelling of HF represents worst case impacts and modelling of other pollutants was not conducted.

4.5.13. Typically, a BESS fire would be a relatively short-term incident, the plume study therefore compared predicted concentrations against Acute Exposure Guidance Levels (AEGLs), which have higher threshold concentrations than the national air quality objectives and are relevant to short term releases. AEGLs are expressed as concentrations of a substance above which it is predicted that the general population could experience, including susceptible individuals:

- Level 1 - Notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure;
- Level 2 - Irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape; and
- Level 3 - Life-threatening health effects or death.

4.5.14. Based on the factors of distance to the nearest property of more than 350m and public rights of way (PROW) over 450m, and the anticipated short-term nature of a fire incident, the assessment concludes that there will not be adverse effects at the closest receptor locations because of a BESS fire incident. Notwithstanding, at the detailed design stage a BESS system and site specific Plume Analysis study will be conducted to assess the environmental impact of a site incident to sensitive receptors within a 1 km radius. Toxic gas emissions to sensitive receptors must be below relevant public health exposure limit guidelines when the battery system of a BESS is fully consumed (burnt out), production of

Particulate Matter (PM) and a visibility impact assessment on any transport links within a 1 km radius of the BESS area will also be included. The emergency response plan (ERP) produced at the detailed design stage (template outlined in section 4.4.3) will incorporate all necessary emergency response procedures and actions based upon thermal runaway test data supplied by the BESS system provider.

4.5.15. The Plume study identifies the closest residential receptor is more than 350 metres from the BESS area, meaning HF levels at sensitive receptor locations will below AEGL 1 level. The effects of the fire are restricted to the proximity of the BESS, and the applicant selected the BESS site to incorporate conservative buffer zones to ensure minimal off-site impacts in credible BESS failure scenarios.

5. Pre-Construction Requirements

5.1. Summary

5.1.1. The detailed design phase of the Scheme will consider the lifecycle of the battery system from installation (during the construction phase of the Scheme) to decommissioning. At the detailed design stage, the selected BESS design will have completed LSFT to fully inform inputs for risk assessment tools which will be utilised together with detailed consequence modelling to provide a comprehensive site operations and emergency response safety audit.

5.1.2. The battery system mitigation measures adopted in a final BSMP, will reflect the latest BESS safety codes and standards applicable at that time. Mitigation measures will be discussed and coordinated with Lincolnshire Fire and Rescue Service (LFR).

5.1.3. As stipulated in NFPA 855 (2026) (Ref 3), a Failure Modes and Effects Analysis (FMEA) of the BESS (BS EN IEC 60812 (Ref 37)), or Layer of Protection Analysis (LOPA) of the BESS, will be conducted to lay the foundation for predictive maintenance requirements and will complement the fault indicator capabilities of the BMS data analytics system. This key analysis minimises the probability of a BESS failure in relation to the specific BESS system and site design and analyses key mitigation solutions to minimise the impact of a BESS failure in the unlikely event that this would occur. These types of risk analysis provide confidence to demonstrate that under day-to-day operation there is a low risk of a BESS failure incident, and in the event of an incident the credible hazards are understood and have been evaluated both at the illustrative and detailed design stages, to demonstrate that the risk to site operatives, first responders, and the local population remains very low.

5.1.4. Comprehensive Hazard Mitigation Analysis (HMA) will be conducted by a BESS specialist independent Fire Protection Engineer following NFPA 855 (2026) (Ref 3) guidelines and recommendations to cover BESS system and site-specific safety issues. Typically, the main components of an HMA are:

- BESS Information (design and site layout);
- Code Analysis (BESS safety and fire standards);
- UL 9540A testing (Ref 6), LSFT, 3rd party fire and explosion test results, consequence modelling (heat flux analysis, NFPA 68 (Ref 11) deflagration analysis, etc.) reports; and

- Failure Modes and Effects Analysis (FMEA).

5.1.5. A BESS system and detailed-design specific plume analysis study will be conducted to assess the environmental impact of a site incident to sensitive receptors within a 1 km radius. This analysis will ensure that toxic gas emissions to sensitive receptors arising from the detailed design of the scheme remain below relevant public health exposure limit guidelines, when the battery system of a BESS enclosure is fully consumed (burnt out). Production of Particulate Matter (PM), and a visibility impact assessment on any transport links within a 1 km radius of the BESS compound, will also be included.

5.1.6. A range of studies will be undertaken, with a primary focus on fire and explosion risk including (but not limited to) risk analysis and management tools to inform the overall design solution include:

- Hazard and Operability Analysis (‘HAZOP’)
- Hazard Identification (‘HAZID’)
- Fire Risk Analysis (FRA)
- Explosion Risk Analysis (ERA)
- Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) (Ref 38)

5.1.7. A non-exhaustive list of additional BESS system risk analysis reports frequently provided by Tier 1 BESS suppliers, which can inform key risk analysis studies (listed in 5.1.4 and 5.1.5) and provide LFR with detailed insights into capability of BESS system hazard mitigation systems (burning and venting thermal runaway scenarios), and provide guidance for evaluating site-specific equipment spacing templates, are listed below:

- NFPA 69 (Ref 17) Explosion Prevention Compliance report
- Deflagration analysis report
- FDS gas ventilation analysis report
- Heat Flux and flame tilt analysis report
- Full scale fire test (LSFT and / or fire and explosion testing) report(s)
- LSFT interpretation reports
- Full scale destruction testing interpretation reports
- Firefighting water analysis report
- UL 9540A (Ref 6) test interpretation reports

- Emergency Response Plan (ERP) templates
- Decommissioning Plan templates

5.1.8. If the BESS system supplied differs from the specification considered for risk assessments and consequence modelling, then a full safety audit will be repeated for the new BESS system specification. These studies will be completed and signed off before construction commences.

5.1.9. The detailed design phase will determine the approach to addressing the following specific requirements, which will be updated prior to construction of the BESS and submitted to Lincolnshire County Council as a final BSMP, prior to the commencement of construction. The BSMP must include:

- The detailed design, including drawings of the BESS;
- A statement on the battery system specifications, including fire detection and suppression systems;
- A statement on operational procedures and training requirements, including emergency operations;
- A statement on the overall compliance of the system with applicable legislation;
- An environmental risk assessment to ensure that the potential for indirect risks (e.g., through leakage or other emissions) is understood and mitigated; and
- Emergency Response Plan(s) covering construction, operation and decommissioning phases will be developed once a construction team, and an operator have been appointed. These plans will be developed in consultation with LFR and other local emergency services to include the adequate provision of firefighting equipment onsite and ensure that fire, smoke, and any release of toxic gases from a thermal runaway incident does not significantly affect site operatives, first responders, and the local community.

5.1.10. Provision of the above information will demonstrate prior to construction that all the considerations and requirements in this document have been addressed, and the BESS installation is safe.

5.1.11. Safe decommissioning of the BESS will be addressed prior to decommissioning of the Scheme in a Decommissioning Environmental Management Plan, and in accordance with the **Outline Decommissioning Environmental Management Plan** (Doc Ref. 7.12) submitted as part of the DCO Application.

6. Conclusion

6.1. Summary

6.1.1. This OBSMP has demonstrated in a systematic way the mitigation of the safety risks posed by the BESS in the Scheme.

6.1.2. The Applicant is committed to developing a BESS which incorporates equipment which provides optimal levels of performance and safety during its lifecycle and accords with the relevant guidance.

6.1.3. This OBSMP demonstrates that the Applicant has relevant experience of BESS systems, and that the relevant stakeholders have been consulted, and therefore safety will be inherent in the overall design, minimising the risk of a BESS failure event occurring, and reducing the impact of such an event should it occur.

6.1.4. The implementation of this OBSMP is secured through Requirement 6 in Schedule 2 of the **Draft Development Consent Order** (Doc Ref. 3.1). This provides that a detailed Battery Safety Management Plan (BSMP) will be submitted to Lincolnshire County Council for approval following consultation with LFR and the EA prior to the commencement of the works for the BESS. The final BSMP plan will be substantially in accordance with this OBSMP.

7. References

Ref 1 The Health and Safety Executive 2024, Using personal protective equipment (PPE) to control risks at work. Available at: https://www.hse.gov.uk/ppe/managing-risk-using-ppe.htm (accessed 31/09/2025)

Ref 2 National Fire Chiefs Council (NFCC) 2026, Grid Scale Battery Energy Storage System planning – Guidance for FRS. Available at: https://nfcc.org.uk/our-services/building-safety/grid-scale-energy-storage-system-planning-guidance-for-fire-and-rescue-services/ (accessed 10/03/2026).

Ref 3 NFPA 855 (2026), Standard for the Installation of Stationary Energy Storage Systems.

Ref 4 UL 9540 3rd Edition (2023): Standard for Energy Storage Systems and Equipment.

Ref 5 BS EN IEC 62933-5-2 (2020), Electrical Energy Storage (ESS)_systems – safety requirements for grid-integrated ESS systems.

Ref 6 UL 9540A (5th Edition 2025), Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems.

Ref 7 BS 9990 (2015), Non-Automatic Fire fighting Systems in Buildings Code of Practice.

Ref 8 BS 3251 (1976), Indicator Plates for Fire Hydrants and Emergency Water Supplies.

Ref 9 UL 1973 (2022), Batteries for Use in Stationary and Motive Auxiliary Power Applications.

Ref 10 BS EN 62619 (2017), Secondary cells and batteries containing alkaline or other non-acid electrolytes. Safety requirements for secondary lithium cells and batteries, for use in industrial applications.

Ref 11 NFPA 68 (2023), Standard on Explosion Protection by Deflagration Venting.

Ref 12 BS EN 14797 (2007), Explosion Venting Devices

Ref 13 BR 187 (2nd Edition) (2014), External Fire Spread: building separation and boundary distances.

Ref 14 FM Global, Datasheet 5-33 Electrical Energy Storage Systems, factory Mutual Insurance Company, 2020.

Ref 15 BS EN 13501-2 (2016), Fire Classification of construction products and building elements – Classification using data from fire resistance tests, excluding ventilation services.

Ref 16 BS EN 1364-1 (2015), Fire Resistance Tests for Non-loadbearing Elements.

Ref 17 NFPA 69 (2024), Standard on Explosion Prevention Systems.

Ref 18 BS EN 54 (2021), Fire Detection and Alarm Systems.

Ref 19 BS EN 9999 (2017), Code of Practice for Fire Safety in the Design, Management and Use of Buildings.

Ref 20 NFPA 850 (2020), Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations.

Ref 21 NFPA 72 (2025), National Fire Alarm and Signalling Code. Available at:

Ref 22 United Nations, Section 38.3 (2023), UN Manual of Tests and Criteria. Available at https://unece.org/transport/standards/transport/dangerous-goods/un-manual-tests-and-criteria-rev8-2023 (accessed 31/09/2025)

Ref 23 United Nations, The European Agreement concerning the International Carriage of Dangerous Goods (ADR) (2021). Available at: https://unece.org/adr-2019-files (accessed 31/09/2025)

Ref 24 Department for Transport, UK (2024), Transporting Dangerous Goods. Available at: https://www.gov.uk/government/collections/transporting-dangerous-goods#:~:text=If%20you%20transport%20dangerous%20goods,Office%20for%20Nuclear%20Regulation%20website. (accessed 31/09/2025)

Ref 25 IEEE 2686 (2025) standard: Recommended Practice for Battery Management Systems in Stationary Energy Storage Applications.

Ref 26 IEEE P2962 (2020), Recommended Practice for the Installation, Operation, Maintenance, Testing and Replacement Lithium-Ion Batteries for Stationary Applications.

Ref 27 IEEE P2688 (2021), Recommended Practice for Energy Storage Management Systems in Energy Storage Applications.

Ref 28 IEC 62443 Standards (2020), Series of Industrial Automation and Control Systems.

Ref 29 UL 1741 (2025), Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources.

Ref 30 IEEE 1815 (2012), The Standard for Electric Power Systems Communications- Distributed Network Protocol.

Ref 31 IEEE 1547.3 (2023), Guide for Cybersecurity of Distributed Energy Resources Interconnected with Electric Power Systems.

Ref 32 Health and Safety Executive (2017), OG86 Cyber Security for Industrial Automation and Control Systems (IACS). Available at: https://www.hse.gov.uk/foi/internalops/og/og-0086.pdf (accessed 31/09/2025)

Ref 33 UL 2941 (2023), Outline of Investigation for Cybersecurity of Distributed Energy and Inverter-Based Resources.

Ref 34 United Kingdom Waste Batteries and Accumulators Regulations (2009). Available at: https://www.gov.uk/guidance/waste-batteries-and-accumulators-technical-guidance#:~:text=Producer,the%20public%20or%20to%20retailers (accessed 31/09/2025)

Ref 35 Fire Service Manual (2008), Volume 2 Fire Services Operations – Electricity.

Ref 36 The Health and Safety Executive (1996), Safety Signs and Signals Regulations.

Ref 37 BS EN 60812 (2018), Failure Modes and Effects Analysis (FMEA and FMECA).

Ref 38 The Health and Safety Executive (2002), The Dangerous Substances and Explosive Atmospheres Regulations. Available at: https://www.hse.gov.uk/fireandexplosion/dsear.htm (accessed 31/09/2025)