Fosse Green Energy

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EN010154

7.17 Framework Battery Safety Management Plan (Tracked)

VOLUME

7

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Fosse Green Energy

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7.17 Framework Battery Safety Management Plan

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1. Introduction

1.1 Scope of this Document

1.1.1 This Framework Battery Safety Management Plan (FBSMP) has been prepared on behalf of Fosse Green Energy Limited (hereafter referred to as 'the Applicant'). This document outlines the key fire safety provisions for the Battery Energy Storage System (BESS) proposed to be installed as part of Fosse Green Energy (hereafter referred to as 'the Proposed Development') and includes measures to reduce fire risk and fire protection measures.

1.1.2 The Proposed Development will comprise the construction, operation and maintenance, and decommissioning of a solar photovoltaic (PV) electricity generating facility, with an on-site Battery Energy Storage System (BESS) and other associated infrastructure, with a total capacity exceeding 50 megawatts (MW), along with an import and export connection to the national transmission network at the proposed National Grid substation near Navenby.

1.1.3 The Proposed Development is further described in **Chapter 3: The Proposed Development** of the Environmental Statement (ES) **[EN010154/APP/6.1]**. An overview of the Proposed Development and its environmental impacts is provided in the ES Non-Technical Summary **[EN010154/APP/6.4].**

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

1.1.5 Prior to the commencement of construction of the BESS, in accordance with Requirement 7 of Schedule 2 of the draft **Development Consent Order [EN010154/APP/3.1]** the Applicant will be required to prepare a Battery Safety Management Plan (BSMP) which must be substantially in accordance with this Framework BSMP. As part of the preparation of the BSMP, the Applicant will take into account the latest good practices for battery system failure prevention and detection, consequence modelling, risk analysis, and emergency response planning, as guidance continues to develop in the UK and around the world.

1.1.6 As the operation and maintenance phase is anticipated to commence in 2033, reference to current measures and guidelines are included here. However, this document will be updated and will form the final Battery Safety Management Plan prior to construction of the BESS to take account of prevailing guidance.

1.2 Proposed Development Description

1.2.1 The Proposed Development is located approximately 9km to the south and south west of Lincoln City Centre, in proximity to the villages of Thorpe on the

Hill, Witham St Hughs, Haddington, Thurlby and Bassingham, extending towards Navenby.

1.2.2 The Proposed Development will comprise the installation of solar photovoltaic (PV) panels, an on-site BESS, other associated infrastructure including but not limited to: access provision, an Onsite Substation, underground cabling between different areas of solar PV arrays and landscaping and biodiversity enhancement measures. The Proposed Development will export and import electricity to the national electricity transmission network via a buried 400 kilovolt (kV) import and export cable circuit of approximately 10km in length, connecting to the national electricity transmission network at the proposed National Grid substation near Navenby.

1.2.3 The Proposed Development comprises two distinct parcels of land, collectively defined as the 'DCO Site' (as shown on **Figure 1-2: DCO Site** of the ES **[EN010154/APP/6.2]**), which are:

a. the 'Principal Site', which in turn includes the 'Solar PV Array Areas', 'Interconnecting Cable Corridors', Onsite substation and on-site BESS, comprising approximately 1,070 hectares (ha) of land; and

b. the 'Cable Corridor', which is approximately 10km in length and will comprise the underground electrical infrastructure required to connect the Principal Site to the proposed National Grid substation near Navenby. The Cable Corridor partly overlaps with the Principal Site and is approximately 351ha.

1.2.4 The design of the BESS and its impact are controlled in several ways. Prior to commencement of construction of the BESS, a BSMP (substantially in accordance with this Framework BSMP) is required to be submitted to North Kesteven District Council and approved, in consultation with Lincolnshire County Council (LCC), the Environment Agency (EA) and Lincolnshire Fire and Rescue Service (LFR), in accordance with Requirement 7 of Schedule 2 of the draft **Development Consent Order [EN010154/APP/3.1]**. The BSMP must be implemented as approved and maintained throughout construction, operation and decommissioning.

1.2.5 There are several battery storage technologies available to system designers. The generic system used for indicative planning purposes is a 480 MWh BESS system. The exact technology and system chemistry type is still to be determined, but for the purpose of this FBSMP it is assumed that the technology will be a lithium-ion battery cell type. The popular types of this chemistry within the lithium-ion family are Lithium Nickel Manganese Cobalt Oxide ($LiNiMnCoO_2$) known as "NMC" after the three key cathode materials or Lithium Iron Phosphate ($LiFePO_4$) known as "LFP". 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.

1.2.6 For the purposes of this document, a concept design has been considered that uses a BESS system based upon an LFP lithium-ion battery technology that is currently used on other sites being developed by the Applicant. This is considered to be a reasonable worst case for the purposes of the assessment in terms of BESS toxic gas emission potential (Hydrogen Fluoride production) and explosion risk (significant levels of hydrogen produced during thermal runaway).

1.2.7 As recommended in UK National Fire Chiefs Council (NFCC) revised guidelines (2024) (Ref 1), an Unplanned Emissions Assessment (presented in **Appendix 14-F** of the ES **[EN010154/APP/6.3]**) has been conducted using the concept design to assess the proposed BESS for smoke (Particulate matter PM_{10} and $PM_{2.5}$) and toxic gas hazards in the event of a thermal runaway incident. Consideration has been given to the potential magnitude of emissions, likely rates of dilution between potential emission location and sensitive receptors located outside of the DCO site and consideration of the likely consequences of emissions to air from the proposed BESS compound.

1.2.8 The BESS will be designed in accordance with the UK and internationally recognised good practice guidance available at the time.

1.2.9 BESS is continuing to evolve and advance, and as such there is a need for the Applicant to maintain commercial flexibility to meet the changing demands of the UK market prior to construction and to enable the Applicant to adopt the most up to date technology at the point of commencement of development. As such, the DCO application retains the flexibility that the BESS may be either AC-coupled or DC-coupled, which means it may be delivered in a single compound as a centralised BESS or distributed across the Principal Site co-located with the inverters, transformers and switchgear (referred to as Solar Stations).

1.2.10 It is currently anticipated that the Proposed Development would include approximately 328 BESS enclosures either distributed throughout the Principal Site and located alongside the Solar Stations (the ‘distributed BESS’ arrangement) or located at a single BESS Compound (the ‘centralised BESS’ arrangement). The final number of BESS enclosures would be determined during detailed design and will be dependent upon technology available at the time. Refer to **Figure 3-2A: Indicative Fixed South Facing Site Layout** and **Figure 3-2B: Indicative Single Axis Tracker Layout** of the ES **[EN010154/APP/6.2]**.

1.2.11 To ensure the BESS remains within manufacturer recommended operating parameters each of the individual BESS enclosures would have an integrated heating, ventilation and air conditioning (HVAC) system.

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

1.2.13 Once operational, the plant will be designed to operate unmanned with access required for maintenance only, and with an Operational Life of up to 10-15 years. Further details of the indicative design life of the key equipment of the Proposed Development is presented within **Chapter 3: The Proposed Development** of the ES **[EN010154/APP/6.1]**. The batteries are therefore expected to be replaced during the 60-year lifetime of the Proposed Development.

1.3 Potential BESS Failure

1.3.1 The unlikely event of a battery cell failure 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 event 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 and ultimately, if not controlled, a significant flaming or battery gas venting incident. As such, this FBSMP 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 Electrical systems within the BESS, aside from the batteries themselves, may also pose fire risks. However, due to the extensive historic long-term deployment of other technology such as transformers, inverters and switchgear, risks are well understood and regulated, through longstanding industry guidance and codes. Therefore, only the battery component of the BESS is addressed in this FBSMP.

1.4 Safety Objectives

1.4.1 The overall approach is to follow the Health and Safety Executive’s (HSE) hierarchy of controls, which are as follows:

a. Elimination;
b. Substitution;
c. Engineering Controls;
d. Administrative Controls; and
e. Personal Protective Equipment.

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

a. To minimise the likelihood of an event - his is an overriding priority;
b. To minimise the consequences should an event occur;
c. To restrict any event to the BESS site and minimise any impact on the surrounding areas;

d. To automatically detect and begin to fight a fire as soon as possible;

e. To ensure any personnel on Site are able to escape safely away from the DCO Site;

f. To ensure that firefighters can operate in reasonable safety where it is necessary for them to take operational action;

g. Final BESS design and site layout should minimise the requirement for direct 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 ideally be limited to boundary cooling of adjacent BESS and energy storage system (ESS) units to prevent the fire from spreading. This strategy will be derived from rigorous risk analysis studies and consequence modelling detailed in Section **5.1** in this FBSMP and will be agreed with LFR and be clearly communicated in the Emergency Response Plan (ERP), which is committed to within the **Framework Construction Environmental Management Plan**, Framework Operational Environmental Management Plan and Framework Decommissioning Environmental Management Plan which are submitted with the DCO application **[EN010154/APP/7.7], [EN010154/APP/7.8]** and **[EN010154/APP/7.9]** respectively. The ERP requires the detailed design post-consent to be fixed before it is developed because it is heavily predicated upon the selected BESS design and final BESS site layout;

h. 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;

i. To ensure that fire, smoke, and any release of toxic gases does not significantly impact site operatives, first responders, and the local community; and

j. To ensure that firewater run-off is contained and tested before removal by tanker and treated offsite.

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

a. The BESS will be designed, selected, and installed in accordance with international guidance, good practice, and related standards.

b. Risk assessments will be carried out for the entire system and elements across the lifecycle of the Proposed Development.

c. The location of the centralised and distributed BESS areas will be located to minimise impacts on offsite receptors (albeit this is inherent in the DCO application as it has been factored into the design process to date).

d. Separation distances between components will be selected to minimise the chance of fire spread.

e. 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.

f. 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).

g. All equipment will be monitored, maintained, and operated in accordance with manufacturer instructions and be compliant with requisite safety standards (UL, IEC, IEEE, NFPA).

h. 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) and / or 3rd party full scale destruction testing. 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.

i. 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.

j. Communication with the 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.

1.5 Consultation with Lincolnshire Fire and Rescue Service

1.5.1 The local fire and rescue service, LFR has been consulted during pre-application discussions and as part of the Section 42 Statutory Consultation for the Proposed Development.

1.5.2 The Applicant held a MS Teams Meeting with LFR on 04 February 2025 to introduce the Proposed Development and to share preliminary site plans.

1.5.3 LFR emailed the Applicant on 20 March 2025 to advise that Draft National Fire Chiefs Council (NFCC) Grid Scale Energy Storage System Planning – Guidance for Fire and Rescue Services (July 2024 Draft Revision) (Ref 1) should be incorporated into site design and safety documentation.

1.5.4 The Applicant emailed a response on 20 March 2025 confirming that guidance will be followed, and that any deviations will be fully discussed and agreed with LFR.

1.5.5 The Applicant confirmed that they will share Proposed Development BESS safety and site design documentation with LFR when completed after DCO submission.

1.5.6 The Applicant has consulted NFCC guidelines and engaged with LFR throughout the pre-application phase and will ensure that the detailed BSMP will include any subsequent revisions made to NFCC guidelines. Close consultation will continue with LFR throughout the planning process.

1.6 Relevant Guidance

1.6.1 Guidance documents and standards considered by the Applicant have been used to inform the design of the Proposed Development.

1.6.2 There is currently limited UK specific guidance for BESS, however the Applicant has incorporated good practice from around the world.

1.6.3 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:

a. National Fire Chiefs Council (NFCC) Grid-Scale Battery Energy Storage System planning – Guidance for FRS (2023 and draft revision 2024) (Ref 1).

b. National Fire Protection Agency (NFPA) NFPA 855 (2023): Standard for the Installation of Stationary Energy Storage Systems (Ref 2)

c. NFPA 68 (2023): Standard on Explosion Protection by Deflagration Venting (Ref 3).

d. BS EN 14797 (2006): Explosion venting devices (Ref 4).

e. NFPA 69 (2024): Standard on Explosion Prevention Systems (Ref 5).

f. Underwriters Laboratories (UL) 9540A (2025) Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems (Ref 6).

g. UL 1642 (2020): Standards for Lithium Batteries (Ref 7).

h. UL 1973 (2022): Batteries for Use in Stationary and Motive Auxiliary Power Applications (Ref 8).

i. UL 9540 3rd Edition (2023): Standard for Energy Storage Systems and Equipment (Ref 9).

j. FM DS 5-33 (2023) FM Global Datasheet. Lithium-Ion Battery Energy Storage Systems (Ref 10).

k. UN 38.3: Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria – (Lithium Metal and Lithium-Ion Batteries) (Ref 11).

l. United Kingdom Power Networks (UKPN) Engineering Design Standard 07-0116: Fire Energy Storage Systems, 2016 (Ref 12).

m. DNV GL-Recommended Practice-0043: Safety, Operation and Performance of Grid-Connected Energy Storage Systems, 2017 (Ref 13).

n. Scottish and Southern Energy TG-PS-777: Limitation of Fire Risk in Substations, Technical Guide, 2019 (Ref 14).

o. BS 5839 Part 1 2017: Fire Detection and Fire Alarm Systems for Buildings (Ref 15).

p. BS 9990: 2015: Non-automatic firefighting systems in buildings - Code of practice (Ref 16).

q. The Regulatory Reform (Fire Safety) Order (RRO) 2005 (Ref 17).

r. The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) Assessment (Ref 18).

s. BS EN IEC 61936, Power installations exceeding 1 kV AC and 1,5 kV DC – AC (Ref 19).

t. 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 (Ref 20).

u. 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 (Ref 21).

v. Ministry of Housing, Communities and Local Government (published in 2015 and updated in 2023) Renewable and low carbon energy (Ref 23).

2. BESS Safety Requirements

2.1 Safe BESS Design

2.1.1 The BESS will be designed to address prevailing industry standards and good practice at the time of design and implementation. BESS system and components used to construct the facility will be certified to UL 9540 (2023) (Ref 9) and/or BS EN IEC 62933-5-2 (2020) (Ref 21) standards (or any future standards which supersede this).

2.1.2 As a minimum, the battery system will have completed unit or installation level UL 9540A (Ref 6) (5th Edition) testing, demonstrating that either thermal runaway propagation will not spread between modules or between battery racks or full-scale free burn (destruction) testing has validated that loss will be safely limited to one BESS enclosure and demonstrate that deflagrations do not occur or can be safely contained. UL 9540A heat flux test data can establish safe distances between BESS enclosures and ESS equipment i.e. transformers, inverters and switchgear, but will not be conclusive if full propagation of the battery system does not occur in the test.

2.1.3 NFPA 855 (2023) (Ref 2) currently 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) (Ref 5) and NFPA 68 (Explosion protection through deflagration venting) features (Ref 3).

2.1.4 If the BESS design integrates hybrid systems, sparker system or performance design explosion protection systems should be validated through BESS full-scale destruction testing, lean gas mixture testing and requisite pressure testing required by NFPA and EN standards.

2.1.5 If a BESS automatic fire suppression system or Thermal Runaway Propagation Prevention (TRPP) system (engineered to directly access cells within battery modules) is integrated within each BESS enclosure, this will conform to NFPA 855 standards and be tested to UL 9540A protocols 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. Fire suppression system performance should 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.

2.1.6 If the BESS design does not integrate automatic fire suppression systems and a dry pipe sprinkler or spray system is integrated, then NFCC (2025) revised guidance will be followed. Connections to any dry pipe systems that are required to be installed on the BESS compound should be installed in accordance with BS 9990 Non-automatic firefighting systems in buildings code of practice (Current Edition) (Ref 16) and should be identified in accordance with BS 3251 Indicator Plates for Fire Hydrants (Current Edition). If a dry pipe system is integrated for the Proposed Development, LFR instantaneous connection points will be located at a safe distance from enclosures and clearly signed for LFR response, in accordance with NFCC guidelines (Ref 1). Water supply for this type of system will be separate from the water supply designated for LFR boundary cooling firefighting requirements.

2.1.7 If the BESS enclosure is a walk-in design (this is a very low probability), 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.

2.1.8 If the BESS system is designed to safely burn out without internal fire suppression systems (to remove the risk of stranded energy in the battery systems), full-scale destruction performance testing will be conducted to demonstrate that loss will be safely limited to one BESS enclosure without the intervention of LFR. UL 9540A heat flux test data can also establish safe distances between enclosures and ESS equipment but will not be conclusive if full propagation of the battery system does not occur in the test.

2.1.9 As best practice, additional third party fire and explosion testing should be utilised by the BESS 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.

2.1.10 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.

2.1.11 Safety Certifications and mitigation features typically found within battery module design, which the Applicant will commit to for the Proposed Development, include:

a. Internal fuses;

b. Liquid cooling system

c. Active thermal management system (TMS)

d. Contactor at rack/string and bank level;

e. Overcharge safety device;

f. Internal passive protection products;

g. Venting systems and gas channels

h. Thermal or multi-sensor monitoring devices.

2.1.12 Battery cells will be certified to UL 1973 and/or BS EN 62619 and tested to UL 9540A unit or installation level for BESS designs.

2.1.13 Module design will be certified to UL 1973 and/or BS EN 62619 and tested to UL 9540A unit or installation level.

2.2 System Location

2.2.1 The Proposed Development will consist of the following components:

a. Solar PV panels (also known as ‘modules’);

b. PV panel mounting structures;

c. BESS;

d. Inverters;

e. Transformers;

f. Switchgear;

g. An Onsite Substation and control buildings;

h. Onsite cabling;

i. Ancillary infrastructure (e.g. combiner boxes, weather stations);

j. Electricity export and import via high-voltage Grid Connection Cable and connection to the National Electricity Transmission System;

k. Fencing and security;

l. Access tracks; and

m. Landscaping, permissive paths and biodiversity mitigation and enhancement areas.

2.2.2 The Proposed Development will connect to the proposed National Grid substation near Navenby (subject to a separate Planning Application to be submitted by National Grid).

2.2.3 Refer to **Chapter 3: The Proposed Development** of the ES **[EN010154/APP/6.1]** for a more detailed description of the components of the Proposed Development.

2.2.4 During the construction phase, one main construction compound and several secondary compounds will be created, as well as temporary roadways to facilitate access to all land within the Principal Site.

2.2.5 The Proposed Development will include BESS as associated development, which is primarily required for the operation of the solar PV panels. The BESS is designed to provide peak generation and grid balancing services to the electricity grid by allowing excess electricity generated either from the solar PV panels, or imported from the electricity grid, to be stored in batteries and dispatched, when required.

2.2.6 The illustrative design for the Proposed Development comprises of up to 84 Solar Station Compounds, spread across the Principal Site. However, the precise number of individual battery energy storage enclosures per Solar Station will depend upon the level of power capacity and duration of energy storage that the Proposed Development will require.

2.2.7 The exact locations of the BESS enclosures, transformers, and dedicated switchgear are yet to be determined. The BESS will be either DC-coupled (distributed) or AC-coupled (centralised). Under the distributed BESS option, electricity flows from solar panels and directly feeds into a battery system with no inversion of electricity from DC to AC and back to DC before storage in the batteries. As such, under this technology, BESS enclosures will be spread across the Principal Site and located alongside the Solar Stations (within Solar Station Compounds), given the Solar Stations need to co-locate near to solar PV. Alternatively, the BESS may also be AC-coupled (centralised), which would require greater consolidation as electricity from the solar panels would be required to be inverted from DC to AC through inverters and transformers before storage. However, due to the separation of the two components within the system, the centralised option can allow for more flexibility in how the plant is operated. **Figure 3-2A: Indicative Fixed South Facing Site Layout** and **Figure 3-2B: Indicative Single Axis Tracker Layout** of the ES **[EN010154/APP/6.2]** comprises an Indicative Principal Site Layout Plan and shows the potential number and distribution of Solar Station Compounds across the Proposed Development, it also details the location of the standalone BESS under the centralised BESS option. The final location of Solar Station Compounds and standalone BESS would be established within areas marked as Work No. 1 on the **Works Plans [EN010154/APP/2.2**] and in accordance with the ~~**Design Approach Document (Appendix A:**~~ **Design Commitments**~~**)**~~ **[EN010154/EXAMAPP/9.357.3].**

2.3 System Layout

2.3.1 Both the indicative site design and final detailed site design will provide separation between key system components or groups of key system components.

2.3.2 The BESS will be broken into discrete groups consisting of battery enclosures and inverters and transformers. Each group will be separated from the next. This separation will limit any fire that is not able to be contained to the affected group or part of the battery system and also allow emergency access in case of an intervention.

2.3.3 National Fire Protection Agency (NFPA) 855 (2023) (Ref 2) defines basic operation Health & Safety (H&S) protocols for all BESS site designs which should be incorporated into emergency response plans:

a. 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 25m to be maximum radius.

b. Automatic building evacuation area is defined as 200ft or 61m from the affected BESS enclosure.

2.3.4 NFPA 855 (2023) Ref 2) also defines five BESS hazard categories – hazards are assessed under both normal operating conditions and emergency / abnormal conditions:

a. Fire and explosion hazards;

b. Chemical hazards;

c. Electrical hazards;

d. Stored / stranded energy hazards; and

e. Physical hazards.

2.3.5 The minimum separation distance between the BESS enclosures and DCO Site boundary will be finalised at the detailed design stage. The draft NFCC guidance refers to a minimum 30m being required between BESS and offsite buildings, which will be achieved in all locations. The closest structure offsite is approximately 280m from the BESS enclosures in the centralised BESS. The closest BESS enclosures for the distributed BESS arrangement are approximately 200m from offsite structures. The centralised and distributed BESS will be sited a minimum of 200m from residential structures (building façade) offsite, in line with Design Commitment BA1 in the **Design ~~Approach Document~~Commitments [EN010154/EXAM~~APP~~/9.35~~7.3~~]**. It is also noted that the **Works Plans [EN010154/APP/2.2]**, which are secured under requirement 6 at Schedule 2 of the draft **Development Consent Order [EN010154/APP/3.1],** do not locate Solar Stations and the centralised BESS closer than 200m to residential structures offsite.

2.3.6 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.

2.3.7 The layout of the Proposed Development 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 (2023 and 2024 draft revision)' (Ref 1) will be followed at this indicative design stage, which comprises:

a. The indicative BESS layout (refer to **Figure 3-2A: Indicative Fixed South Facing Site Layout** and **Figure 3-2B: Indicative Single Axis Tracker Layout** of the ES **[EN010154/APP/6.2]**) conforms to NFCC revised guidance and exceeds NFPA 855 (2023) standard. Spacing will be a minimum 3m and the current illustrative design allows for a separation distance of 6m spacing on distributed BESS and 3m spacing on the centralised BESS.

b. NFCC guidelines allow reduced separation distances if suitable design features can be introduced. If the BESS system is designed to safely burn out to remove the risk of stranded energy in the battery systems, then full scale free burn / destruction testing will have been conducted to demonstrate that loss will be safely limited to one BESS enclosure without the intervention of LFR.

c. If reducing distances, a clear, evidence-based case for the reduction will be shown in the detailed design phase and agreed with LFR i.e. UL 9540A unit or installation testing and / or third party full scale destruction testing heat flux data. An independent Fire Protection Engineer specialising in BESS will validate all UL 9540A and / or third party test and site specific consequence modelling data which will be provided.

d. 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.

e. 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 in close proximity to BESS areas would be kept in a condition such that it does not increase the risk of fire on site.

f. 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.

g. The BESS enclosure would have an internal fire resistance rating of at least one hour (according to NFPA 855 (Ref 2), BR 187 and FM Global Datasheet 5-33 (Ref 10)).

h. The BESS areas 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 and no further than 300m from the furthest 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 with 30 – 50m, which is considered an optimal safe distance.

i. 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.

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

2.4 Battery System Enclosures

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

2.4.2 Each BESS Enclosure will be installed by a certified and qualified installer. Each BESS Enclosure will be UL9540 and / or BS EN IEC 62933-5-2 certificated. Ingress protection testing of BESS enclosures is conducted under UL9540 and / or IEC62933-5-2 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 levels.

2.4.3 Ingress Protection (IP) ratings of BESS 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 HVAC systems and deflagration vents will be considered as part of an incident response strategy.

2.4.4 BESS 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 and NFPA 68 and BS EN 14797 standards, and doors cannot be used as sole deflagration vents.

2.4.5 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, BR 187 and FM Global Datasheet 5-33).

2.4.6 Where required, BESS enclosure walls will have a minimum one-hour fire resistance rating to BS EN 13501-2 (Ref 25) and BS EN 1364-1 standards (Ref 26).

2.5 Detection and Suppression Systems

2.5.1 In order to achieve the safety objectives, the Proposed Development 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:

a. Thermal monitoring of the battery enclosures and automated cut-out beyond safe parameters;

b. Battery liquid cooling systems with automated fail-safe operation (air cooling systems will not be considered for the Proposed Development); and

c. Emergency Stop – both remote and local.

2.5.2 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.

2.5.3 The fire and gas detection system for the Proposed Development will comply with NFPA 855 (2023) (Ref 2) and NFPA 69 (Ref 5) 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, BS EN 9999 (Ref 27), NFPA 855, NFPA 850 (Ref 28). 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.

2.5.4 If the BESS design does not integrate internal fire and gas detection equipment in alignment with NFPA 855 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.

2.5.5 NFPA 855 (2023) (Ref 2) 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.

2.5.6 If a BESS automatic fire suppression system or Thermal Runaway Propagation Prevention (TRPP) system (engineered to directly access cells within battery modules) is integrated within each BESS enclosure, this will conform to NFPA 855 standards and be tested to UL 9540A protocols 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. Fire suppression system performance should 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. System design and water supply requirements must be fully agreed with LFR.

2.5.7 If a BESS enclosure design does not integrate automatic fire suppression systems and a dry pipe sprinkler or spray system is integrated, then NFCC (2025) revised guidance will be followed. Connections to any dry pipe systems that are required to be installed within the 'BESS Area' (for either the distributed or centralised BESS option) should installed in accordance with BS 9990 Non-automatic firefighting systems in buildings code of practice (Current Edition) (Ref 16) and should be identified in accordance with BS 3251 Indicator Plates for Fire Hydrants (Current Edition). If a dry pipe system is integrated for the Proposed Development, 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.

2.5.8 The NFPA 855 (2026) working group is also proposing to prohibit the use of clean agent or aerosol fire suppression systems (FSS) within BESS enclosures unless fire and explosion testing 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.

2.5.9 Draft NFCC (2024) (Ref 1) revised 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. If the BESS system is designed to safely burn out to remove the risk of stranded energy in the battery systems, then full scale free burn / destruction testing will have been conducted to demonstrate that loss will be safely limited to one BESS enclosure without the intervention of LFR.

2.5.10 If the BESS system is designed to safely burn out without internal fire suppression systems, UL 9540A heat flux test data (if full propagation of battery system occurs) will establish safe distances between BESS enclosures and ESS equipment and additional 3rd Party fire and explosion testing will be required to also 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.

2.5.11 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.

2.6 BESS Active and Passive Safety Systems

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

a. As a minimum, a BESS active ventilation system will comply with NFPA 855 (2023) (Ref 2) / NFPA 69 (Ref 5) guidelines which require the prevention of a dangerous build-up of explosive gases (25% LEL). The gas exhaust / ventilation system must have redundancy and can be separate to any HVAC system providing climate control. 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 29) compliant battery calculations and required by NFPA 855.

b. When mechanical ventilation 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 should be clearly marked to notify personnel or first responders to not disconnect the power supply to the ventilation system during an evolving incident.

c. The ventilation / gas extraction system shall also be designed to exhaust flames and gases safely outside the BESS enclosure, without compromising the safety of first responders. The ventilation 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 should be provided to demonstrate the compliance of the gas exhaust system with NFPA 855 explosion prevention system requirements.

d. Explosion protection systems not covered directly by NFPA 68 and 69 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 or performance design explosion protection systems it should 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 should have completed full UL 9540A testing 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 should review all UL 9540A test results and any additional fire and explosion test and consequence modelling data which has been provided.

e. 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 standards will be integrated which should be complimented by an explosion protection system to NFPA 68 and BS EN 14797 standards (Ref 4). NFPA 68 design key performance requirements are:

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

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

f. Any BESS explosion prevention or control / protection system should be validated through 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 should review all UL 9540A test results and any additional fire and explosion test and consequence modelling data which has been provided.

3. BESS Construction and Operation

3.1 Safe BESS Construction

3.1.1 The BESS will be constructed in two distinct phases. Firstly, the civil works and balance of plant equipment 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 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 (Ref 11). Transportation will be managed in accordance with the European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR) 2019 (Ref 30) and the UK guidance on the transport of dangerous goods “Moving dangerous goods, Guidance” Government webpage (Ref 31).

3.1.4 The appointed contractor will ensure the transported BESS equipment will be prepopulated with batteries and will have undergone FAT to IEC 62933-5-2 standards. Site Acceptance Tests (SAT) will follow IEC 62933-5-2 and IEEE 2962 (in development) 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 without risk and with all mitigations against issues in place before the next step occurs.

3.2 Safe BESS Operation

Control Room

3.2.1 The BESS will be monitored by the on-site control room as well as 24/7 monitoring by a remote-control facility provided by the BESS manufacturer or operator. Of note:

a. The control room (when operational) will be responsible for the security of the DCO Site with state-of-the-art detection and monitoring systems. These can be repurposed in an emergency to support first responders.

b. The control room will have the ability and authority to immediately shut the system down should the need arise.

c. The control room (when operational) will be responsible for the implementation of the emergency plan acting as a point of contact to emergency services.

d. 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).

e. The 24/7 remote control facility will monitor the security of the BESS site, and monitoring and detection systems will be repurposed in an emergency to support first responders. NFPA 855 (2023) (Ref 2) defines the minimum monitoring and control standards.

f. 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.

g. In some circumstances it will be necessary to discharge 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 once the detailed design of the BESS is known. This will be prepared in conjunction with LFR and is secured through this document.

3.2.2 Signage will 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 and will also include details of:

a. Relevant hazards posed i.e., the presence of High Voltage DC Electrical Systems is a risk, therefore their location should be identified;

b. The type of technology associated with the BESS;

c. Any suppression system fitted;

d. 24/7 Emergency Contact Information; and

e. 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 DCO Site boundary, whichever is closer.

Control Architecture

3.2.3 NFPA 855 (2023) (Ref 2) stipulates that a Battery Management System (BMS) should at a minimum provide the following safety functions, which the Proposed Development with adhere with:

a. High cell temperature trip to isolate the module or rack when detecting cell temperatures that exceed limits;

b. Thermal runaway trip to isolate the battery system when a cell is detected to have entered a thermal runaway condition;

c. 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

d. 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) / Battery Management Systems (BMS) controls should as a minimum incorporate NFPA 855 (2023) (Ref 2) monitoring and control features and conform to the new IEEE 2686 (2025) standard: Recommended Practice for Battery Management Systems in Stationary Energy Storage Applications (Ref 32). Additional IEEE standards in development (IEEE P2688 and IEEE P2962) 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, UL 1741 (Ref 33), IEEE 1815 (Ref 34), and IEEE 1547.3 (Ref 35) will be consulted and guidance from national sources such as National Cybersecurity Centre inform the implementation and protection measures. Reference should be made to the Health and Safety Executive (HSE) Operational Guidance document OG86 (Ref 36).

3.2.7 UL published 'UL 2941 (2023) Outline of Investigation for Cybersecurity of Distributed Energy and Inverter-Based Resources' (Ref 24). 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 BESS system supplier at the detailed design stage will conform to these requirements.

Security

3.2.8 The DCO Site security profile will be assessed and managed by the Principal Contractor during construction and by the operatives undertaking maintenance during operation, 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 areas 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 The Principal Site will also have 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 every 6-12 months depending on the risk profile of equipment. This typically consists of a major maintenance period and a minor maintenance period. This will encompass all BESS and supporting equipment supplied by the 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 **Framework Operational Environmental Management Plan (OEMP) [EN010154/APP/7.8]** submitted as part of the DCO application. Furthermore, penstocks will be inspected and operated as per proprietary manufacturer requirements and specifications; either at least once every six months or as per the specification, whichever is the shorter time period prescribed, to ensure they are not seized and are clear of debris and obstructions to free flow.

3.2.13 During operation all works on the DCO 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.

3.2.14 The operation of the BESS will be managed in accordance with the final OEMP.

End of Life Disposal

3.2.15 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 the party placing the battery components on the UK market pursuant to the Waste Batteries and Accumulators Regulations 2009 (or such equivalent regulations in force at the time of decommissioning) it has certain obligations in respect of battery disposal.

3.2.16 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. Once a defective module is safely 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 offsite for inspection by an authorised manufacturer's representative. Full details of the proposed arrangement will be provided in the detailed Battery Safety Management Plan.

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

3.2.18 The Applicant will follow the hierarchy of waste management through the life of the Proposed Development as follows:

a. 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.

b. 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.

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

d. 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.

3.2.19 Measures relating to the management of waste and materials are set out in the **Framework OEMP [EN010154/APP/7.8].**

4. Firefighting

4.1 Safe BESS Construction

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 22).

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 should 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 Personal Protective Equipment (PPE) should be worn, and operations should 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 on the BESS Areas should installed in accordance with BS 9990 (Non-automatic firefighting systems in buildings - Code of Practice) (current edition) (Ref 16) and should be identified in accordance with BS 3251 Indicator Plates for Fire Hydrants (current edition).

4.1.5 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 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.

4.1.6 The Applicant has consulted NFCC guidelines and engaged with LFR throughout the pre-application phase and will ensure that the detailed BSMP will include any subsequent revisions made to NFCC guidelines. Close consultation will continue with LFR throughout the planning process and is a requirement for approval of the final BSMP in accordance with requirement 7 of the draft **Development Consent Order [EN010154/APP/3.1]**.

4.2 Fire Service Access

4.2.1 UK National Fire Chiefs Council BESS planning guidance document published in April 2023, stipulates that suitable facilities for safely accessing and egressing BESS-Solar Station Compounds should be provided. Designs should be developed in close liaison with the local Fire and Rescue Service (FRS) as specific requirements may apply due to variations in vehicles and equipment.

4.2.2 This should include:

a. At least two separate access points to each Solar Station Compound to account for opposite wind conditions/direction.

b. Roads/hard standing capable of accommodating fire service vehicles in all weather conditions. As such there should be no extremes of grade.

c. A perimeter road or roads with passing places suitable for fire service vehicles.

d. Road networks on sites must enable unobstructed access to all areas of the facility.

e. Turning circles, passing places etc size to be advised by LFR depending on fleet.

f. Emergency access route plans for first responders will be included in the ERP and hard copies will be available on site. Route sign requirements will be agreed with LFR.

4.2.3 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 22). 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 should 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.

4.2.4 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 emergency plan.

4.2.5 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. Signage will include details of:

a. Relevant hazards posed;

b. The type of technology associated with the BESS;

c. Any suppression system fitted; and

d. 24/7 Emergency contact information.

4.2.6 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 DCO Site, whichever is closer.

4.2.7 A full site swept path analysis for emergency vehicles will be undertaken at the detailed design stage and the roads will be confirmed as suitable for emergency vehicle access.

4.2.8 In accordance with latest NFCC revised guidance (2024) (Ref 1) the detailed BSMP will include a site plan that shows all sensitive receptors within a 1km radius of the DCO Site that could be affected by a fire. The plan will have a compass rose showing north and the prevailing wind direction.

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

a. The layout of buildings;
b. 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);
c. All permanent ignition sources within the DCO Site and show they are a minimum of 6m away from combustible and flammable waste;
d. Any areas where combustible waste is being treated or stored including non-waste material;
e. All separation distances;
f. Any areas where combustible liquid wastes are being stored;
g. Any area where depollution of end of life vehicles (ELVs) takes place;
h. Any area where crushing, shredding, baling of metals or ELVs takes place;
i. Main access routes for fire engines and any alternative access;
j. Access points around the perimeter of the DCO Site to assist firefighting;
k. Hydrants and water supplies;
l. Areas of natural and unmade ground;
m. 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);
n. Storage areas with pile dimensions and fire walls (where applicable) – this includes wastes stored in a building, bunker, or enclosures – include indicative pile layouts and ensure it is geographically representative;
o. The location of fixed plant or storage location of mobile plants when not in use;
p. The location of spill kits;
q. The quarantine area; and
r. Anything site specific considered needing to be added.

4.3 Fire Water Supply

4.3.1 The Solar Station Compounds will be designed to integrate pressure fed (pump driven) fire hydrants and/or static water tanks (tanks can be integrated above or below ground) 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 LFR to provide redundancy and safe operating distances for firefighters with 30 – 50m, which is considered an optimal safe distance. 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 at the detailed design stage based upon BESS fire and explosion test data by an independent Fire Protection Engineer and water storage volumes will be agreed with LFR during detailed design.

4.3.3 Each indicative BESS area design will contain a minimum of two firefighting water storage units of no less than 230,000 litres in capacity, capable of delivering 1900 litres per minute for 2 hours (in line with NFCC guidance). The Applicant will align with the minimum requirements in the NFCC guidance at the time of detailed design, which may include greater onsite storage for example should this be required by the revised guidance or LFRS.

4.3.4 Water storage will either be in sectional steel panel tanks, or cylindrical steel tanks, above or below ground.

4.3.5 Where above ground, tanks will be supported on structural concrete slab foundations to a maximum depth of 1m.

4.3.6 The design commitments for the Proposed Development (presented within ~~Appendix A of~~ the **Design ~~Approach Document~~Commitments [EN010154/EXAM~~APP~~/9.35~~7.3~~]**) 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 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 will integrate an external firefighting water capture drainage system. In the event of a fire, and prior to applying the fire water, the outfalls from the BESS areas will be closed via automatic penstock valves or similar systems, isolating the BESS areas drainage from the wider environment. The automatic close trigger of the penstock will be linked with fire detection, spill detection or abnormal conditions. The penstock will also have a manual option of closing should the automatic system fail. The entire BESS compound and swale will also include an impermeable lining to ensure no polluted runoff will infiltrate to ground. Fire water runoff may contain particles from a fire. The runoff must 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 Fire hydrants and connections to any dry pipe systems that are 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 16) and should be identified in accordance with BS 3251 Indicator Plates for Fire Hydrants (Current Edition).

4.3.9 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.

4.4 Emergency Planning

4.4.1 The BESS will have a robust and validated emergency plan, developed in consultation with LFR.

4.4.2 Some example BESS and site design information which is anticipated to be shared with LFR to establish a risk profile for first responders, are listed below:

a. Battery chemistry integrated into BESS – can provide fire and explosive risk profile.

b. Battery form factor (cylindrical, pouch, prismatic).

c. Battery energy Wh / kWh – confirmation of new battery cell (second life cells will not be accepted).

d. 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.

e. Battery module vent or gas exhaust specifications.

f. 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).

g. Direct suppression system details – direct module TRPP or rack level FSS integration.

h. Rack design – number of modules and kWh energy, spacing between modules, passive protection features, gas exhaust features, electrical isolation functions, heat or thermal runaway sensor integration, etc.

i. Rack configuration – spacing to adjacent racks, number of racks in BESS, spacing to walls, doors, gas vents and roof.

j. Type of BESS enclosure design e.g., enclosure 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.

k. EMS / BMS data monitoring capabilities and incident response integration capacity.

l. Number of BESS enclosures on site.

m. Size and MWh capacity of each BESS enclosure.

n. BESS and ESS equipment spacing; spacing to other equipment, boundaries, vegetation, roads or access routes, fire hydrants / water tanks, site building structures, etc.

o. Access routes, observation points, turning areas, FRS equipment and assets, water supply locations and capacity, drainage, and water capture design.

p. Definition and frequency of BESS equipment testing and maintenance requirements.

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

a. Digital emergency response plans;

b. Remote emergency shutoff procedures;

c. SDS / Hazardous material documentation;

d. Maps or design drawings;

e. Gas detection capabilities; could include multi-sensor data metrics e.g., Carbon Dioxide (CO_2), Carbon Monoxide (CO), Hydrogen (H_2), VOC off gas + overpressure + local temperatures;

f. 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;

g. ERP training drills for site operatives + FRS engagement (site familiarisation + training drills) + SME engagement (fire protection experts or battery experts); and

h. Other documentation as required by specific BESS project i.e., local response stipulations, contact information for nominated response personnel, community contacts, etc.

4.4.4 An ERP will be developed at the detailed design stage to facilitate effective and safe emergency response. It will follow UK NFCC and NFPA 855 guidelines and will include as a minimum:

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

b. Facility description, including infrastructure details, operations, number of personnel, and operating hours;

c. Site plan depicting key infrastructure:

   i. Site access points, internal roads, agreed access routes, observation points, turning areas, etc.

   ii. Firefighting facilities (water tanks, pumps, booster systems, fire hydrants, fire hose reels etc).

   iii. Water supply locations and capacity.

   iv. Drainage and water capture design and locations;

d. Up-to-date contact details of the emergency response co-ordinator including the subject matter expert (SME) for the DCO Site;

e. Safe access to and within the facility for emergency vehicles and responders, including to key site infrastructure and fire protection systems;

f. Details and explanation of warning systems and alarms on site and locations of alarm annunciators with alarm details (smoke, gas, temperature);

g. Hazards and potential risks at the facility and details of their proposed management;

h. The role of the FRS at incidents involving a fire, thermal event or fire spreading to the DCO Site;

i. Emergency shutoff or isolator locations;

j. A list of dangerous goods stored on site;

k. Site evacuation procedures;

l. Site operation Emergency Management protocols - 4 phases: discovery, initial response / notification, incident actions, resolution and post incident actions / responses;

m. Emergency procedures for all credible hazards and risks, including building, infrastructure and vehicle fire, wildfires, impacts on local respondents, impacts on transport infrastructure; and

n. 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.

4.4.5 The DCO 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 Emergency Response Plan.

4.4.6 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.

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

a. The hazards and risks to the facility and their proposed management;

b. Any safety issues for firefighters responding to emergencies at the BESS facility;

c. 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;

d. The adequacy of proposed fire detection and suppression systems e.g., water supply on-site; and

e. 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

4.5.1 As the BESS will not have personnel access into the battery enclosures, there is unlikely to be any immediate threat to life, only equipment which forms part of the Proposed Development.

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. The Proposed Development will select a BESS design that has undertaken full scale free burn testing to demonstrate thermal insulation protection capabilities of the BESS enclosure design, validate equipment spacing distances, and demonstrate that deflagrations do not occur and/or can be safely constrained. In accordance with NFCC guidance, the DCO Site will be maintained 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 (2024) (Ref 1) it is not anticipated that firefighting techniques will require direct hose streams or spray directly on battery systems and 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 The emergency services would most likely commit to fighting fire by using water on neighbouring areas such as battery enclosures, trees, and structures to cool down and prevent further fire spread.

4.5.5 A BESS fire could result in the mobilisation of pollution within surface water run-off. As set out in **Chapter 9: Water Environment** of the ES **[EN010154/APP/6.1]** and **Appendix 9-D: Framework Surface Water Drainage Strategy** of the ES **[EN010154/APP/6.3]**, at detailed design stage it is proposed that runoff from the battery storage area will be contained by local bunding and attenuated within the lined impermeable sustainable drainage system and attenuation swale (SuDS) features prior to being passed forward to the local land drainage network. In the event of a fire, and prior to applying the fire water, the outfalls from the BESS areas will be closed via automatically self-actuating penstock valves (with manual backup) or similar systems at the outfalls from the BESS attenuation swales will be closed, isolating the BESS areas drainage from the wider environment. The entire BESS compound and swale will also include an impermeable lining to ensure no polluted runoff will infiltrate to ground. Fire water runoff may contain particles from a fire; 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 =. Further details of the contaminant testing will be outlined in the final BSMP including details of the analytical suite and sampling frequency.

4.5.6 **Chapter 14: Other Environmental Topics** (Section 14.2 Air Quality) of the ES **[EN010154/APP/6.1]** and **Appendix 14-F: Unplanned Emissions Assessment** of the ES **[EN010154/APP/6.3]** presents a review of potential emissions to air from out-gassing and from fire; considers the potential magnitude of emissions and likely rates of dilution between potential emission locations and sensitive receptors located outside the DCO Site and considers the likely consequences of emissions to air from the proposed BESS. Given that enclosures will be sited a minimum of 200m from residential receptors, concentrations will be below Acute Exposure Guidance Level 1 (AEGL-1) at any existing residential receptor location.

4.5.7 Typically, a BESS fire would be a relatively short-term incident. The plume study therefore compared predicted concentrations against 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:

a. 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

b. Level 2 - Irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape

c. Level 3 - Life-threatening health effects or death

4.5.8 Based on the factors of distance to residential properties (there will be no residential properties located within 200m of a BESS enclosure) and the anticipated short-term nature of a fire incident, the assessment concludes that there will not be exceedances of safe levels at receptor locations because of a BESS fire incident. The ERP produced at the detailed design stage will incorporate all necessary emergency response procedures and actions based upon thermal runaway test data supplied by the BESS system provider.

5. Pre-construction Requirements

5.1 Summary

5.1.1 The detailed design phase of the Proposed Development will consider the lifecycle of the battery system from installation to decommissioning. At the detailed design stage, risk assessment tools 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 stage. Mitigation measures will be discussed and coordinated with LFR.

5.1.3 As stipulated in NFPA 855 (2023) (Ref 2), a Failure Modes and Effects Analysis (FMEA) of the BESS (BS EN IEC 60812) or Layer of Protection Analysis (LOPA) of the BESS will be conducted to lay the foundation for predictive maintenance requirements and 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 (2023) (Ref 2) guidelines and recommendations to cover BESS system and site-specific safety issues. Typically, the main components of an HMA are:

a. BESS Information (design and site layout)

b. Code Analysis (BESS safety and fire standards)

c. UL 9540A testing, 3rd party fire and explosion test results, consequence modelling (heat flux analysis, NFPA 68 deflagration analysis, etc.) reports

d. Failure Modes and Effects Analysis (FMEA)

5.1.5 A BESS system and site specific Plume Analysis study based on the detailed design will be conducted to assess the environmental impact of a site incident to sensitive receptors within a 1km radius. An unplanned emissions assessment is presented within **Appendix 14-G: Unplanned Emissions Assessment** of the ES **[EN010154/APP/6.3]**. 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.

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:

a. Hazard and Operability Analysis (HAZOP);

b. Hazard Identification (HAZID);

c. Fire Risk Analysis (FRA);

d. Explosion Risk Analysis (ERA); and

e. Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) (Ref 18).

5.1.7 Additional BESS system risk analysis reports frequently provided by Tier 1 BESS manufacturers or BESS integrators, 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. A non-exhaustive list of reports are listed below:

a. NFPA 69 Explosion Prevention Compliance report;

b. Deflagration analysis report;

c. FDS gas ventilation analysis report;

d. Heat Flux and flame tilt analysis report;

e. Full scale fire test report;

f. Firefighting water analysis report;

g. UL 9540A test interpretation reports;

h. Emergency Response Plan (ERP) templates; and

i. 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 the local planning authority as a final BSMP prior to the commencement of construction, in consultation with LFR and the EA. The BSMP must include:

a. The detailed design, including drawings of the BESS;

b. A statement on the battery system specifications, including fire detection and suppression systems;

c. A statement on operational procedures and training requirements, including emergency operations;

d. A statement on the overall compliance of the system with applicable legislation;

e. An environmental risk assessment to ensure that the potential for indirect risks (e.g., through leakage or other emissions) is understood and mitigated; and

5.1.10 ERPs 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 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.

5.1.11 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.

5.1.12 Safe decommissioning of the BESS will be addressed prior to decommissioning of the Proposed Development in a Decommissioning Environmental Management Plan (DEMP), substantially in accordance with the **Framework DEMP [EN010154/APP/7.9]** submitted as part of the DCO application.

6. Conclusion

6.1.1 This Framework BSMP has demonstrated in a systematic way the mitigation of the safety risks posed by the BESS in the Proposed Development.

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 Framework BSMP 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 Framework BSMP is secured through Requirement 7 in Schedule 2 of the draft **Development Consent Order [EN010154/APP/3.1]**. This provides that a detailed Battery Safety Management Plan (BSMP) will be submitted to and approved in consultation with LFR and the EA by the relevant planning authorities prior to the commencement of the works for the BESS. The final BSMP plan will be substantially in accordance with this Framework BSMP.

7. References

Ref 1 National Fire Chiefs Council (NFCC) Grid-Scale Battery Energy Storage System planning – Guidance for FRS (2023 and draft revision 2024).

Ref 2 National Fire Protection Agency (NFPA) NFPA 855 (2023): Standard for the Installation of Stationary Energy Storage Systems

Ref 3 NFPA 68 (2023): Standard on Explosion Protection by Deflagration Venting.

Ref 4 BS EN 14797 (2006): Explosion venting devices.

Ref 5 NFPA 69 (2024): Standard on Explosion Prevention Systems.

Ref 6 Underwriters Laboratories (UL) 9540A (2025) Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems;

Ref 7 UL 1642 (2020): Standards for Lithium Batteries.

Ref 8 UL 1973 (2022): Batteries for Use in Stationary and Motive Auxiliary Power Applications.

Ref 9 UL 9540 3rd Edition (2023): Standard for Energy Storage Systems and Equipment.

Ref 10 FM DS 5-33 (2023) FM Global Datasheet. Lithium-Ion Battery Energy Storage Systems.

Ref 11 UN 38.3: Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria – (Lithium Metal and Lithium-Ion Batteries).

Ref 12 United Kingdom Power Networks (UKPN) Engineering Design Standard 07-0116: Fire Energy Storage Systems, 2016.

Ref 13 DNV GL-Recommended Practice-0043: Safety, Operation and Performance of Grid-Connected Energy Storage Systems, 2017.

Ref 14 Scottish and Southern Energy TG-PS-777: Limitation of Fire Risk in Substations, Technical Guide, 2019.

Ref 15 BS 5839 Part 1 2017: Fire Detection and Fire Alarm Systems for Buildings.

Ref 16 BS 9990: 2015: Non-automatic firefighting systems in buildings - Code of practice

Ref 17 The Regulatory Reform (Fire Safety) Order (RRO) 2005.

Ref 18 The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) Assessment

Ref 19 BS EN IEC 61936, Power installations exceeding 1 kV AC and 1,5 kV DC – AC.

Ref 20 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.

Ref 21 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.

Ref 22 Fire Service Manual Volume 2 Fire Services Operations – Electricity

Ref 23 Ministry of Housing, Communities and Local Government (2015) Renewable and low carbon energy. Available at: https://www.gov.uk/guidance/renewable-and-low-carbon-energy

Ref 24 UL 2941 (2023) The Outline of Investigation (OOI) for Cybersecurity of Distributed Energy and Inverter-Based Resources.

Ref 25 BS EN 13501-2:2023 – TC: Fire classification of construction products and building elements - Classification using data from fire resistance and/or smoke control tests, excluding ventilation services.

Ref 26 BS EN 1364- 1: Fire resistance tests for non-loadbearing elements (walls).

Ref 27 BS EN 9999:2017 – TC: Fire safety in the design, management and use of buildings.

Ref 28 NFPA 850 (2020): Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations.

Ref 29 NFPA 72 (2025): National Fire Alarm and Signaling Code®.

Ref 30 United Nations Economic Commission for Europe (UNECE). European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR 2019).

Ref 31 Department for Transport (2012). Moving Dangerous Goods Guidance. Available at: https://www.gov.uk/guidance/moving-dangerous-goods

Ref 32 IEEE 2686 (2025) standard: Recommended Practice for Battery Management Systems in Stationary Energy Storage Applications.

Ref 33 UL 1741 (2021): Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources

Ref 34 IEEE 1815 (2012): IEEE Standard for Electric Power Systems Communications-Distributed Network Protocol (DNP3)

Ref 35 IEEE 1547.3 (2023): IEEE Guide for Cybersecurity of Distributed Energy Resources Interconnected with Electric Power Systems.

Ref 36 Health and Safety Executive (HSE) (2017) Operational Guidance document OG86

Abbreviations

Table 1-1: Abbreviations

Abbreviation	Definition
AEGLs	Acute Exposure Guidance Levels
BESS	Battery Energy Storage System
BMS	Battery Management Systems
BSMP	Battery Management Safety Plan
CO	Carbon Monoxide
CO_2	Carbon Dioxide
DCO	Development Consent Order
DLC	Damage Limiting Construction
EA	Environment Agency
EES	Electrical Energy Storage
EMS	Energy Management Systems
ERP	Emergency Response Plan
ESS	Energy Storage System
FAT	Factory Acceptance Testing
FBSMP	Framework Battery Safety Management Plan
FMEA	Failure Modes and Effect Analysis
H_2	Hydrogen
H&S	Health and Safety
HMA	Comprehensive Hazard Mitigation Analysis
HSE	Health and Safety Executive
HVAC	Heating, Ventilation and Air Cooling
IP	Ingress Protection
LFP	Lithium Iron Phosphate ($LiFePO_4$)

LFR	Lincolnshire Fire and Rescue Service
MWh	Megawatt hours
NFCC	National Fire Chiefs Council
NFPA	National Fire Protection Agency
NMC	Lithium Nickel Manganese Cobalt Oxide ($LiMnCoO_2$)
OEM	Original Equipment Manufacturer
OEMP	Operational Environmental Management Plan
PM	Particulate Matter
SAT	Site Acceptance Test
SCADA	Supervisory Control and Data Acquisition
SIL	Safety Integrity Level
SMEs	Subject Matter Experts
SuDS	Sustainable Drainage System
TMS	Thermal Management System
TRPP	Thermal Runaway Propagation Prevention
UPS	Uninterruptible Power Supply
Wh/kWh	Watt hour/Kilowatt hours