

Executive Summary

This Outline Battery Safety Management Plan (OBSMP) has been prepared to support a planning application for the:

“Construction of a battery energy storage system, comprising battery containers, transformers, high voltage electrical substation and ancillary infrastructure including underground cabling, fencing, CCTV, internal access tracks and water storage tanks for a temporary period of 40 years”.

This plan outlines key safety measures and design principles adopted for the battery energy storage (BESS) element of the proposed development, focusing on fire safety and prevention, and emergency response. Key features of the safety management approach which have been embedded into the site’s design include:

- Industry standards and best practices, including the National Fire Chiefs Council (NFCC) *Grid scale battery energy storage system planning guidance for FRS* (April 2023) and subsequent draft guidance;
- Implementation of appropriate setbacks within the BESS design between on-site infrastructure including electrical equipment and combustible materials;
- Safe access and egress arrangements to accommodate emergency vehicles;
- On-site water supply, if required, during a fire event; and
- Commitment to the development of a safety management strategy and an Emergency Response Plan in consultation with local fire and rescue service (KFRS).

Although the risk of a BESS safety incident in the UK is very low and within acceptable levels set by the Health and Safety Executive (HSE), this OBSMP has been created to address potential hazards such as thermal runaway, fire propagation, flammable gas buildup, and electrical risks.

Embedded mitigation measures within the project design include:

- Advanced monitoring and control systems, including isolation of battery units;
- Fire detection and suppression systems;
- Recommended spacing between the battery units and other infrastructure;
- Regular maintenance and testing procedures; and
- Comprehensive staff training and emergency response protocols.

The OBSMP ensures that fire safety is embedded into the overall design of the BESS from the outset, minimising both the risk of fire events and their potential impact. Through the implementation of these prevention, management, and emergency response measures, the OBSMP demonstrates that fire safety risk has been reduced to as low as reasonably practicable.

Introduction

This Outline Battery Safety Management Plan (OBSMP) has been prepared to support a planning application for the

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Purpose

The purpose of this document is to:

Identify the reasonably foreseeable risks associated with BESS technology; and

Describe the key measures that will be implemented in the design and operation of the BESS to reduce risks to life, property and the environment in line with industry guidance and best practice.

Prior to the commencement of construction of the BESS a safety management strategy and a Battery Safety Management Plan (BSMP) based on the key principles outlined in this OBSMP will be prepared in consultation with Kent Local Fire and Rescue Service (KFRS). The BSMP will consider the final selected technology and take into account the latest industry guidance and best practice in relation to battery safety management, fire detection prevention and response.

Proposed Development

Description

The proposed site for the BESS is on vacant land adjacent to the A226 Thames Way.

The specifications for the BESS will be subject to detailed design post-planning consent. The principal components of the BESS for the purpose of the planning application include:

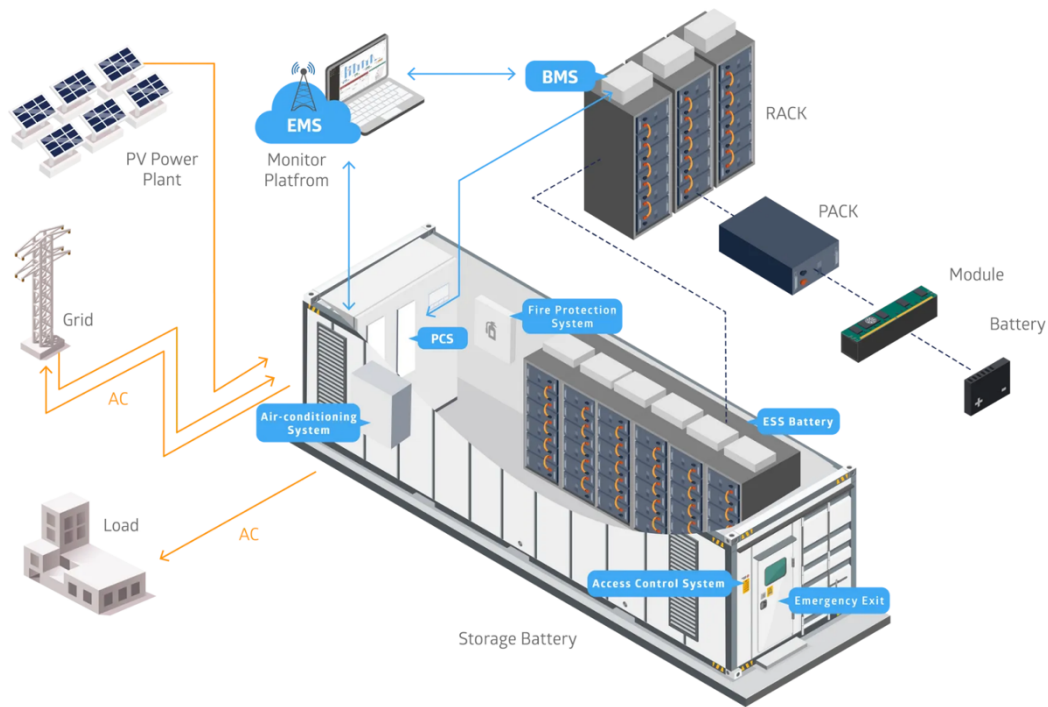
- Battery storage container units;
- Medium-voltage (MV) skids and ancillary low-voltage (LV) equipment;
- High-voltage (HV) grid transformers;
- Air insulated switchgear;
- A substation building housing a switch room and control room;
- Internal access tracks, gates and security fencing;
- Other supporting electrical infrastructure including cabling.

Introduction to Battery Energy Storage System Technology

Large-scale BESS are a relatively new and emerging technology in the UK.

BESS are now playing a crucial role in the UK in facilitating the integration of renewable energy into the electricity grid by efficiently storing excess electricity generated during peak periods and releasing it during times of high demand, thus helping to stabilise and balance the grid. Because of this BESS are considered a vital technology for the UK if it is to meet its "net zero" target.

The individual battery container units, which collectively comprise the BESS, are arranged in strings which connect to other electrical infrastructure including the power conversion units (PCS) and transformers. The PCS units convert the electricity supply between direct current (DC) from the battery and alternating current (AC) from the grid. The transformers decrease / 'step down' the voltage of the electricity from the grid when charging, or increase / 'step up' the voltage when discharging back to the grid. A high-level BESS system diagram is shown below.



Lithium-ion batteries

The battery container units contains the battery modules. These are most commonly lithium-ion batteries, a rechargeable battery which is used in a vast range of applications including mobile telephones and electric vehicles.

The lithium-ion cells are integrated into battery modules, which are stacked in a shelving unit to form a rack. A single rack or multiple racks are then housed in the battery container unit which is typically no larger than a shipping container. The battery containers are also fitted with electrical and safety management equipment.

Safety features

A critical aspect of BESS is safety.

The battery's function is to store chemical energy and a failure can result in the uncontrolled release of this energy. A cell failure usually begins with an initial cause, such as an electrical short circuit, which results in an increase of the cell temperature due to exothermic reaction(s) inside the cell. This increase in cell temperature may cause a thermal runaway event which can lead to gas formation, pressure build-up, cell venting and/or rupture, and possibly fire and/or explosion. If one battery cell experiences

thermal runaway, it can potentially rapidly spread to adjacent cells, potentially leading to a high heat release fire event.

Thermal runaway risks can be mitigated through incorporating safety features such as cooling, ventilation and heat detectors to ensure that any fault is quickly detected, isolated, and managed. Appropriate separation between cells, as well as liquid cooling, monitoring systems and smoke and heat detectors BESS Development to mitigate the potential for a thermal runaway event.

Quality assurance measures such as Factory Acceptance Testing (FAT) and Site Acceptance Testing (SAT) will also be carried out for the BESS, ensuring no mechanical damage is present with the equipment that could lead to faults. Once the BESS is operational, maintenance at regular intervals and continuous monitoring will ensure the BESS remains operating as expected.

It should be noted that along with rapid technological advancement, safety and regulation has become a crucial element in battery technology, with a focus on producing batteries with a higher threshold for thermal runaway and improved battery thermal management and monitoring systems.

Battery Management System

The Battery Management System (BMS) ensures the safe operation of the BESS by monitoring battery performance parameters and ensuring that the battery voltage, temperature, and current are kept within safe operating limits. The BMS gathers status data from cells, modules and racks, and exchanges information with other components. Some of the key functions of the BMS include controlling the charge and discharge of the battery system, monitoring the voltage, current and temperature and calculating the state of charge and state of health. The BMS will raise an alarm in the case of any abnormal conditions and, if required, will disconnect a battery cell from the system.

Other system infrastructure

Power Conversion System

The primary function of the PCS is to convert current from one form to another. Electricity networks tend to be Alternating Current (AC), whilst batteries charge or discharge energy in Direct Current (DC). The role of a PCS is to convert AC to DC for storage, and invert DC to AC for transmission. The PCS also provides safety functions to protect a battery from unsafe energy loads, promote long-term health of the battery and reduce the risk of equipment failure.

Transformers

The primary function of transformers is to step-up and step-down voltages. Electricity networks tend to operate at high voltage levels as this creates less electrical current in the power lines, which in turn reduces resistance and subsequent energy losses. Conversely, batteries are charged slowly at lower voltages to avoid damage and promote longevity. Transformers allow for AC voltage to be stepped up or down between the electricity network and BESS so that electrical power can be stored and transmitted effectively.

A typical BESS will have an auxiliary transformers which steps down electricity from the high-voltage network to feed into the low-voltage system required for the powering of the on-site BESSb auxiliary systems; including the thermal management system, fire

suppression system, communications, security and welfare systems.

Energy Management System

The energy management system (EMS) is a control system that manages the charge and discharge of batteries by controlling the flow of energy between the electricity network and the BESS. The EMS interfaces with the electricity network and the BMS, logs the performance data, and monitors the state of charge and the state of health of the batteries. With this information the EMS optimises the BESS performance for safety, efficiency and longevity.

Thermal Management System

The thermal management system (TMS) monitors the temperature via sensors within the BESS and uses liquid or forced air cooling to ensure the BESS remains within the defined, safe operational range. It is important for the battery to be kept within a suitable operating temperature range to reduce degradation, malfunction and the risk of thermal runaway.

Fire Suppression System

The fire detection and suppression system consist of two main functions: firstly, detecting any fire hazard and secondly, suppressing that hazard if detected. Early off-gas detectors detect hazardous gases that are emitted under abuse conditions which may lead to thermal runaway. Aerosol-based suppression systems are triggered when a fire hazard is detected and seeks to suffocate the hazard.

Operational monitoring

Once operational, the BESS will be remotely monitored and controlled 24/7 by the Asset Manager and an Alarm Response Centre, with alarms raised upon detection of a hazardous condition or fault.

Onsite CCTV will be monitored by an accredited Alarm Receiving Centre (ARC) who will be able to contact the emergency services immediately in the event of an incident.

The remote monitoring and safety systems have two separate power supplies, one via the HV grid connection (used to charge the BESS) and one via a secondary LV auxiliary supply to the distribution network. The proposed development will also have an uninterruptible power supply (UPS) which would provide up to 72hr supply of electricity to the monitoring systems if required.

Fire Safety

Safety record of BESS in the UK

As of late 2024, the total capacity of operational BESS sites in the UK was estimated at 4.4 GW on 117 sites. This equates to 7GWh. of electricity.

To date, there have been only two reported UK BESS fires that required FRS attendance. The first occurred in 2020 at Carnegie Road in Liverpool and was contained with no 3rd party collateral damage or injury to firefighters or the public. The second occurred in February 2025 at a site in East Tilbury, Essex. The fire was contained and there was no 3rd party collateral damage. the site was handed back to site management a day later.

To date, nobody in the UK has been harmed or killed in a BESS incident, be this a first responder or a member of the public. No third-party property has been affected by a UK BESS incident.

Assessment against the National Fire Chiefs Council Guidance (NFCC)

The BESS has been designed in accordance with the Grid Scale Battery Energy Storage System Planning Guidance, 2023 developed by the NFCC to ensure that BESS developments allow for a safe and effective response from the fire service in the unlikely event of a fire incident.

In August 2024, the NFCC release a new draft of the Draft Grid Scale Energy Storage System Planning Guidance (NFCC, August. Whilst the draft guidance is not yet in effect, this guidance has been considered in the design of the BESS where it is considered practical to do so at this early stage of the design process.

Table One NFCC Guidance and BESS Design

NFCC	Requirement
Detection and monitoring	BESS units will include a battery management system (BMS) for monitoring of, and fault detection on, the system on a 24/7 basis to ensure the batteries are operating within safe operating limits. Once the site is fully tested and operational, maintenance will be undertaken on the BESS equipment at regular intervals recommended by the Original Equipment Manufacturer (OEM). This will encompass all BESS equipment supplied by the OEM including the fire detection and monitoring system.
Suppression systems	Fire suppression systems will be installed within battery units which will be compliant with all relevant fire safety standards. If a fire does occur, the battery unit system will employ an automatic fire detection and suppression process, typically in the form of internal aerosol-based fire suppression systems housed inside the battery units. As above, maintenance will be undertaken at regular intervals recommended by the OEM to ensure suppression systems are functioning correctly.
Deflagration prevention and venting	BESS equipment will be fitted with deflagration venting which conforms to the standard NFPA 68; this will activate to safely direct energy externally from the battery unit in the unlikely event that an explosive atmosphere is created inside a battery unit.

Site access	The site includes two separate vehicular access points to the BESS compound to account for varying wind conditions / direction. This ensures that the KFRS will always have access to the site if required. Roads and hardstanding areas have been designed to accommodate fire service vehicles, including the avoidance of any extremes of grade. All access tracks have been designed to ensure adequate spacing is provided for emergency vehicles to access all areas of the site if required, including a minimum width of 4 m. Copies of site layout plans including access arrangements will be shared with the KFRS as soon as practicable to ensure they are familiar with access requirements for the site.
Spacing between battery units	The NFCC 2023 Guidance prescribes a standard minimum spacing between units of 6 metres. The preliminary BESS design has a minimum separation of 6 metres between battery enclosures.
Distance from occupied buildings	The NFCC 2023 Guidance notes that battery units should be at least 25 m away from occupied buildings. The HV compound switchroom is > 25 metres distance from the nearest battery container unit. The nearest off-site occupied buildings include residential dwellings are over 25 metres from the nearest proposed battery unit.
Site conditions	The proposed development has been designed to ensure that no combustible materials are stored adjacent to the BESS and access can be kept clear and maintained at all time. The areas between and around the equipment will be finished with gravel and kept free of vegetation or other combustible material.
Water supplies	The NFCC 2023 Guidance advises that sites should be capable of delivering no less than 1,900 litres per minute for at least 2 hours. The intended firefighting strategy for the BESS is a 'controlled burn' strategy rather than firefighting with water. Water tanks of 180m³ capable of delivering up to 1,900 litres per minute for 2 hours are included in the preliminary site design.
Signage	Signage will be provided throughout the BESS and will be designed and sized in accordance with relevant industry standards. This will include signage relating to hazards, 24/7 emergency contact information and other relevant information, as required. The locations of signage will be determined at the detailed design stage.
Emergency Plans	Emergency plans will be developed in close consultation with the KFRS, including a Risk Management Plan and Emergency Response

	Plan. The Risk Management Plan will provide advice in relation to emergency response, including the identification of hazards and risks and how these are to be mitigated. The Emergency Response Plan will outline the procedures to be followed in the event of an emergency, comprising relevant site information including an up-to-date site layout, relevant on-site emergency resources, how the fire services will be alerted, evacuation procedures and emergency contact information. Lessons learned from other fires involving battery storage has highlighted the need to ensure the attending emergency services are aware of the exact location of the fire without entering the battery container units. Liaison with the KFRS in fire safety planning will take place at the post-consent stage (once the specific battery technology has been confirmed), including regular site familiarisation visits at appropriate intervals.
Recovery	The development of an Emergency Response Plan will consider post-incident recovery procedures to ensure damaged equipment is removed and disposed of safely, and the site is de-energised / re-energised in a controlled and safe manner.

Fire safety and firefighting strategy

In addition to the design features, the following measures will be implemented for the BESS in order to ensure a safe approach in the unlikely event of a fire:

If a fire is detected, the battery system will be automatically electrically isolated.

The access has been designed so that emergency services will be able to access the site safely and efficiently. All internal access tracks are at least 4 m wide, ensuring the route is wide enough to allow emergency service access. The site includes two separate vehicular access points.

Thermal runaway may occur under certain circumstances, resulting in the release of hazardous and flammable gases. A 25 m exclusion zone is typically considered for a major incident on BESS sites, ensuring that the concentration of harmful gases outside of the exclusion zone is within acceptable limits. An access control system will be implemented to ensure that it is always clear who, if anyone, is inside the BESS compound and whether there is a need to evacuate someone from the site in case of an incident occurring. The BESS will not have emergency responders physically enter the battery container units hence there is unlikely to be any immediate threat to life to the responders.

An emergency response plan will be developed using guidance from the HSE, consultation from the KFRS. The firefighting strategy is expected to be apply a "controlled burn" approach to a battery fire. This means that in the unlikely event of a fire, the primary strategy will be to not apply water directly to the battery container units

and instead allow the battery to burn out naturally

The use of perimeter cooling may be used to avoid fire propagation in a limited set of circumstances, for example, if the KFRS considers there to be a life at risk inside the BESS compound. Such an event shall be discussed with the KFRS.

Based on the distance of the BESS from the nearest properties, it is not anticipated that there will be adverse effects at the closest receptor locations in the unlikely event of a fire event. Whilst there is a low risk of adverse effects at the closest receptors, the emergency response plan will incorporate mitigation to reduce the magnitude of risk associated with any incident.

A post event action plan will be drawn up that will determine any immediate and follow up actions required to an event.

Emergency Response Plan

An Emergency Response Plan will be developed in collaboration with the KFRS and following guidance from the HSE. The plan will be maintained and regularly reviewed throughout the operation of the BESS.

The Emergency Response Plan will be readily available for operations and maintenance personnel. In the case of an emergency, critical alarms will likely be raised from the contracted 24/7 control room and emergency services contacted. The Emergency Response Plan will be followed and the site will be isolated. An Emergency Response Plan would include, but not necessarily be limited to the following:

Alarm information;

Contact information: subject matter expert, system owner, first responders etc;