



Outline Battery Safety Management Plan

E101 Hub 4 Ltd – Bedhampton Water Treatment Works: Battery Energy Storage System

SHF.3055.001.PL.R.001.02 - OBSMP



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Outline Battery Safety Management Plan for a Battery Energy Storage System at Land at Bedhampton Waterworks, Meyrick Road, Havant, PO9 3HB

Project:	Bedhampton Water Treatment Works: Battery Storage Facility
Document:	SHF.3055.001.P.L.R.001.02 – Outline Battery Safety Management Plan
For:	E101 Hub 4 Ltd
Status:	Final
Date:	March 2025
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1.0 Introduction

1.1 Introduction

- 1.1.1 This Outline Battery Safety Management Plan (OBSMP) has been prepared by Enzygo Ltd. to accompany a planning application for submission to Havant Borough Council for a proposed 150MW battery storage facility at Land at Portsmouth Water Bedhampton Water Treatment Works (WTWs), Meyrick Road, Havant, PO9 3HB (the development).
- 1.1.2 Enzygo Ltd. have worked closely with E101 Hub 4 Ltd (the Applicant) in collating the technical and safety information used for the detailed design of the Battery Energy Storage System (BESS).

1.2 Purpose of Document

- 1.2.1 The OBSMP details the regulatory guidance reviewed by Enzygo Ltd., to ensure that all safety concerns around the BESS element of the development are addressed in so far as is reasonably practicable.
- 1.2.2 This document provides an overview of the safety related information requirements which will be provided in advance of construction of the BESS. The purpose of this outline BSMP is to identify how the Applicant will incorporate best industry practice to reduce risk to life, property, and the environment from the BESS.
- 1.2.3 BESS technology is continuously evolving, as are the regulations and guidance on the safe operation of a BESS facility. Whilst the Proposed Development is based on the latest regulations and current best available technology, the OBSMP should be updated further to the pre-construction final design and procurement exercise to ensure a final BSMP reflects the most up to date requirements for best practice in the design and operation of a BESS facility. If required, an update to the OBSMP may be secured by planning condition.
- 1.2.4 As the energisation phase of the project is anticipated to commence no earlier than 2026, reference to current safety measures and guidelines are referred to. However, it is envisaged a detailed Battery Safety Management Plan shall be produced prior to energisation of the BESS to take account of prevailing guidance.

1.3 Document Structure

- 1.3.1 This Outline Battery Safety Management Plan includes the following sections:
- Introduction and purpose of the document
 - Description of proposed works
 - Current Legislation and Guidance
 - Battery Energy Storage System Detailed Design Stage
 - Conclusions and Summary of Outputs

2.0 Description of Works

2.1 Description of Works

2.1.1 The proposed development is a 150MW Battery Energy Storage System (BESS) which will comprise the following:

- Total capacity 150MW
- 132kV Switchyard
- 132/33kV Power Transformer
- DNO Protection / Control Room
- Private 33kV Switchroom
- Private Control Room
- Private 33/0.4kV Auxiliary Transformer
- Private Stores / Metering / Welfare Building [max 2.44m x 6.1m x max. height of 3m above ground]
- 2.4m Palisade Fence
- 3.5m Acoustic Fencing
- 30 units of BESS containers
- 15 units of PCS / Transformers
- Parking for maintenance vehicles
- CCTV Equipment
- Site Lighting

2.1.2 An extract of the Indicative Site Layout (drawing no: DACI-4402-E01-REV15), submitted in support of the planning application, is shown in Figure 1 below:

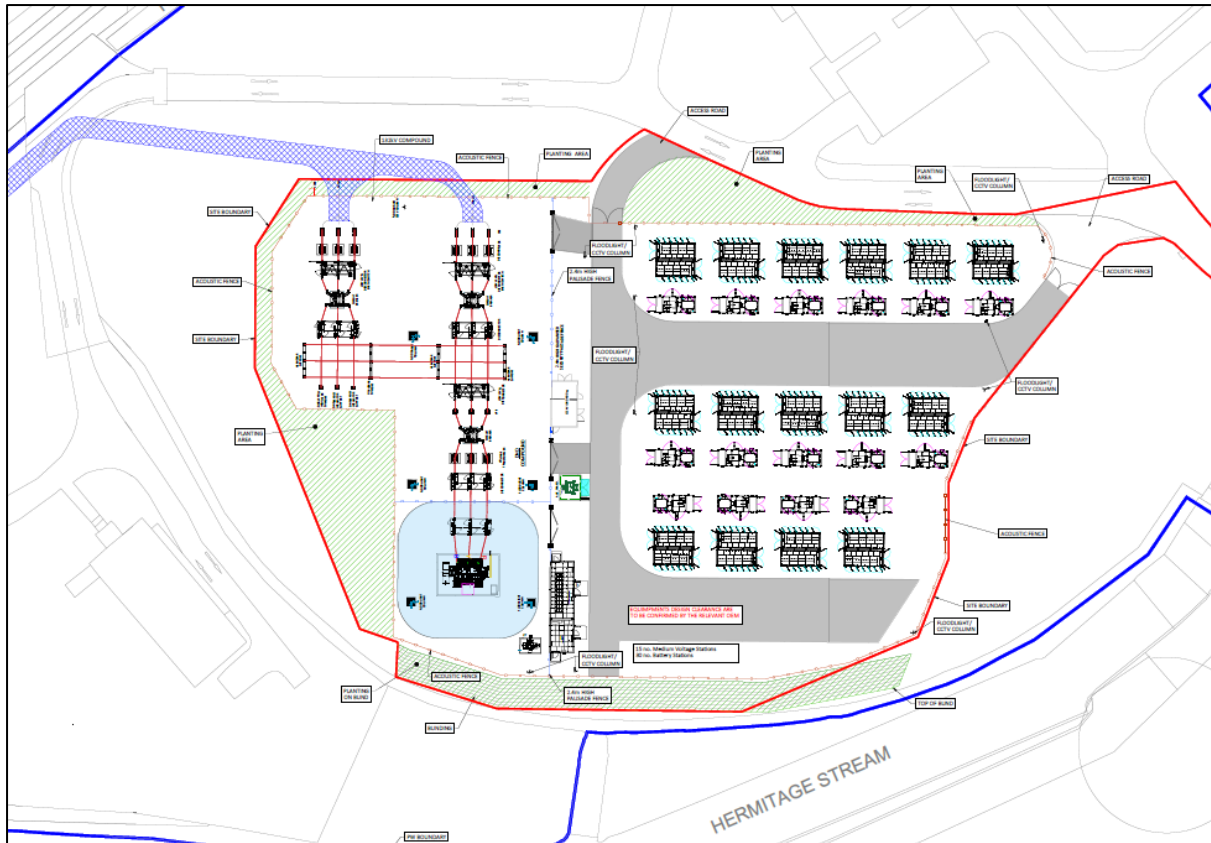


Figure 1: Indicative Site Layout

2.2 Overview of battery fire safety approach

- 2.2.1 The proposed BESS is based on a Sungrow PowerTitan 2.0 solution, with the battery cell / the batteries and the Power Conversion System in one container, based upon LFP lithium-ion battery technology that is currently used on other sites being developed by the Applicant.
- 2.2.2 Indicative specifications are provided below. This is considered to be a reasonable worst case for the purposes of the assessment in terms of safety and is the best information available at present.

PowerTitan 2.0:

Dimensions (H x W x D): 2896 x 6058 x 2438mm

Weight (kg): 4,200

Battery Configuration 416S12P

IP Rating IP55

Operation Ambient Temperature Range -30 °C to +50 °C (> 45 °C Derating)

Operation humidity range 0 % - 100 % (Non-condensing)

Temperature Control Method Intelligent Liquid Cooling

Safety Features FACP, FK5112, Flammable gas detector, Smoke detector, Heat detector, Sounder beacon, Alarm bell, Warning sign, Extinguishant abort button, Ventilation system, Pressure relief port, Manual automatic switching and emergency starting device (Default) Sprinkler, Vent panel, Aerosol (Optional)

- 2.2.3 The BESS will be designed in accordance with the UK and internationally recognised good practice guidance available at the time. Prior to energisation, the Applicant shall provide the final system design and construction information as detailed within the National Fire Chiefs Council's guidance.
- 2.2.4 The proposed battery units follow the principles for Battery Safety as follows:
- 1) Fire prevention – using battery technology proven to be at low risk of fire
 - 2) Equipment monitoring – in the event that temperatures increase to unsafe levels, systems will be automatically turned off
 - 3) Fire suppression – in the event that fire, smoke, or other gases are detected, then systems are in place to suppress any ignition to prevent a runaway event

Fire Prevention

- 2.2.5 It is proposed that the Battery Energy Storage System will use Lithium Iron Phosphate battery cells (LFP) as its chosen form of Lithium-Ion battery technology. LFP batteries are proven to have a lower temperature rise when compared to other types of lithium-ion batteries during thermal runaway events. Thermal runaway is a condition that occurs when the chemical reaction inside a battery cell exceeds its ability to disperse heat.
- 2.2.6 The BESS will be designed in accordance with the UK and internationally recognised good practice guidance available at the time. Prior to energisation, the Applicant shall provide the final system design and construction information as detailed within the National Fire Chiefs Council's guidance.
- 2.2.7 All battery units used will meet the relevant UL and IEC standards for safety which require rigorous testing and diligence. UL 9540A is the leading standard for prevention of thermal runaway propagation; battery modules must undergo destructive test methods for forced initiation of thermal runaway, to which the battery modules must show no sign of propagation between cells, modules, or enclosures. Batteries tested to this standard reduce both the likelihood of a cell failure and the impact should it occur.
- 2.2.8 As well as LFP batteries having stable characteristics, the prismatic cell has multi-layered protection and are housed in sealed Aluminium casing, offering a further level of protection and most importantly good thermal conductivity and cooling performance.

Equipment Monitoring

- 2.2.9 Active temperature monitoring is set up at the following scales in order to minimise the likelihood of propagation across cells, modules, and cubes:
- The temperature of every cell is monitored, and the temperature should be within the range of -30°C and 50°C. Each cell will be continually monitored to ensure that they stay within this range;
 - There is separate temperature monitoring of the battery modules (comprised of the cells); and

- At the top level there is active monitoring of the ambient temperature of each BESS cabinet.
- 2.2.10 The systems have sensors at the cell, module, unit and system level and the necessary software to warn or automatically shut down in the event of a problem.
- 2.2.11 Monitoring and control is not only done automatically by the control system, but also remotely by a dedicated 24/7 O&M team who will receive warnings and alarms if any operational parameters deviate from a defined normal range.

Fire Suppression

- 2.2.12 In addition to the temperature monitoring of the units, they are also actively monitored for smoke and other gases. The positive detection of two of the temperature, gas, or smoke monitors will automatically trigger the aerosol fire suppression systems that are sealed within each BESS cube.
- 2.2.13 As set out above, a fire event originating in a battery would be limited to a single cell and not require fire suppression in order to be managed; however, the system is in place should it be required.
- 2.2.14 In the event of fire originating outside of the battery, this would be extinguished by the fire suppression system, and therefore any fire event be contained within the Cube.
- 2.2.15 The Applicant has sought to ensure the BESS conforms to the fire safety guidance available at this present time, with acknowledgement of the fire event at a BESS at Carnegie Road, Liverpool, on 15th September 2020.
- 2.2.16 The Merseyside Fire and Rescue Service's Incident Investigation Team's Fire Investigation Report 132-20¹, noted that the BESS had smoke detectors fitted which crossed zones with linear heat sensors. The BESS was remotely monitored in Denmark, where the operator was based, however, the suppression system (which the sensors were connected to) was not set-up to be activated remotely.
- 2.2.17 Accordingly, subsequent delays in activating the suppression system contributed to the escalation of the fire. The proposed BESS at Bedhampton Water Treatment Works shall have both automatic monitoring and control to respond to any incident as well as 24/7 monitoring from an external control point, which gives a double level of control.
- 2.2.18 The Proposed Development reflects a design that follows manufacturer specifications that meet the current BESS safety guidelines. Along with following current or superseding standards for design, the Applicant can use this OBSMP, which includes a Health and Safety File, as a foundation for a final BSMP to help avoid or mitigate safety risks.

UL 9540A

- 2.2.19 UL 9540A is a standard for the safety of energy storage systems and equipment. It was developed by UL² as a test method for evaluating thermal runaway fire propagation in BESS.

¹

https://www.whatdotheyknow.com/request/876227/response/2075510/attach/4/IIT%20Report%20Final%20redacted.pdf?cookie_passthrough=1

² Underwriters Laboratories (UL) are most widely known for standards in electrical products.

It is widely recognised by the relevant authorities in the United States of America and the United Kingdom³.

- 2.2.20 UL first published UL 9540A in November 2017. It was designed to evaluate the fire characteristics of a BESS that undergoes forced thermal runaway. The data generated was intended to be used to determine the fire and explosion protection required for an installation of a BESS, including separation distances. As fire codes have evolved, UL 9540A has been updated several times since it was originally published, most recently in July 2022. It is an ANSI (American National Standards Institute) and SCC (Standards Council of Canada) accredited standard, and is referenced within UK NFCC guidance, the American and Canadian National Standard for Safety for Energy Storage Systems and Equipment, the International Code Council (ICC) International Fire Code (IFC), National Fire Protection Association NFPA 855, Standard for the Installation of Stationary Energy Storage Systems, as well as a wide variety of local and international building and fire codes.
- 2.2.21 UL 9540A test results help manufacturers and system integrators meet various codes and standards by evaluating the effects of a thermal event and the potential for fire propagation. It evaluates and determines the inherent safety of the specific battery chemistry, design, materials, and safety mitigation strategies.
- 2.2.22 UL 9540A Test Methodology comprises four levels of testing: Cell, Module, Unit, and Installation. Each level generates specific data used to evaluate thermal runaway characteristics and fire propagation.
- Cell Level Test is carried out on the smallest individual battery cell of the BESS
 - Module Level Test is carried out on the battery module under a smoke collection hood
 - Unit Level Test is conducted with BESS units installed as described in the manufacturer's instructions and the test configuration should correspond to the design of the BESS
 - Installation Level Test is used to assess the effectiveness of the fire and explosion mitigation methods for the BESS in its intended installation, including the effectiveness of sprinklers or fire protection plans
- 2.2.23 UL 9540A is a graduated test method, from the smallest cell unit to the complete BESS system in installation form. Once the present level of testing has been complied with, the next level of testing is not required.
- 2.2.24 The battery units the Applicant is proposing to utilise have undergone successful UL 9540A testing, with the resultant lack of thermal runaway propagation from the initiating module to adjacent modules in the Unit Level test indicating that, in the event one cell were to fail and enter thermal runaway, thermal runaway would be expected to be contained to that module, and end on its own without any Fire and Rescue Service intervention, significant additional damage, or propagation to neighbouring enclosures.
- 2.2.25 The BESS unit provider also offers comprehensive first responder guidance (tailored to each BESS site specifics) and offers full training, for incorporation into site emergency action plans. Systems are built with 24/7 remote monitoring and control capabilities.

³ UL 9540A is stated on page 4 of the UK National Fire Chiefs Council grid scale BESS planning guidance.

3.0 Guidance

3.1 Guidance

- 3.1.1 The main sources of guidance for BESS are from international sources, however, more detailed UK guidance is emerging, and it is expected that the regulatory environment will be more developed by the detailed design stage.
- 3.1.2 The following international guidance has been considered during the preparation of this OBSMP:
- Allianz Risk Consulting (ARC): *Battery Energy Storage Systems (BESS) Using Li-ion Batteries*, Tech Talk Volume 26 (2019)⁴
 - National Fire Protection Association (NFPA): NFPA 855, Standard for the Installation of Stationary Energy Storage Systems (2023)⁵
 - UL 9540A Test Method, Testing the fire safety hazards associated with propagating thermal runaway within battery systems⁶
 - Consolidated Edison and New York State Energy Research and Development Authority- *Considerations for ESS Fire Safety* (February 2017)⁷.
- 3.1.3 At the time of writing, the NFPA and UL United States of America standards are not explicitly relevant to the United Kingdom, which currently has limited specific guidance for BESS, but notwithstanding this provide valuable guidance and are referred to in the Allianz Risk Consulting technical note.
- 3.1.4 The Applicant has developed the BESS incorporating the prevailing legislation, industry guidance, and good practice from around the world.
- 3.1.5 Examples of existing UK guidance include:
- The Energy Operations Forum: *Good Practice Guide* (December 2014)⁸
 - Institute of Engineering and Technology - *Code of Practice for Electrical Energy Storage Systems* (August 2017)⁹
 - The Energy Institute: Battery Storage Guidance Note 1- Battery Storage Planning (August 2019)¹⁰
 - National Fire Chiefs Council: Grid Scale Battery Energy Storage System planning – Guidance for FRS (April 2023)¹¹
- 3.1.6 The National Fire Chiefs Council's guidance makes particular reference to the NFPA 855 document and other international publications on BESS.

⁴ <https://www.agcs.allianz.com/content/dam/onemarketing/agcs/agcs/pdfs-risk-advisory/tech-talks/ARC-Tech-Talk-Vol-26-BESS.pdf>

⁵ <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=855>

⁶ <https://www.ul.com/services/ul-9540a-test-method>

⁷ www.nyserda.ny.gov

⁸ <https://www.eatechnology.com/engineering-projects/electrical-energy-storage/>

⁹ <https://shop.theiet.org/code-of-practice-for-electrical-energy-storage-systems>

¹⁰ <https://bit.ly/3LiJ2YP>

¹¹ <https://ukfrs.com/sites/default/files/2023-04/Grid%20Scale%20Battery%20Energy%20Storage%20System%20planning%20Guidance%20for%20FRS.pdf>

- 3.1.7 The UK Government's Planning Practice Guidance (PPG9), which advises local Councils in developing policies for renewable and low carbon energy and identifies the planning considerations, was updated on 14th August 2023, with Paragraphs 032 – 036 specific to BESS.
- 3.1.8 The updated guidance encourages Applicants to engage with the relevant local fire and rescue service before submitting an application to the local planning authority, and to consider the NFCC guidance. Both of which the Applicant has done in this regard – see Table 2 'Fire Department' section for further.

3.2 Li-Ion Battery Transportation Guidance

- 3.2.1 International guidance for testing and certification for the transportation of Li-Ion batteries exists in the form of UN38.3¹², published by the United Nations as recommendations.
- 3.2.2 European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR) 2019 ¹³ includes mandatory rules for signatory states based on UN38.3 recommendations. In the ADR UN 38.3 is mentioned as obligatory. The United Kingdom is a signatory to these rules, so must apply them.
- 3.2.3 UK guidance on the transport of dangerous goods is available online on the Government's "*Moving dangerous goods, Guidance*" website¹⁴.

3.3 Battery Energy Storage System Design Approach

- 3.3.1 The NFCC (2023) Guidance for FRS are acknowledged as a starting point and cannot cover every eventuality or type of design of BESS proposals, however, it is considered good practice to supply information as early as possible in the scheme from the applicant / developer / designer / manufacturer etc., to allow an initial appraisal of the BESS to be made.
- 3.3.2 As such, Table 1 addresses the system design and construction details as much as can be considered reasonably practicable at this stage of the application.
- 3.3.3 The proposed development will minimise fire risk by:
- Procuring components that comply with all relevant legislation and best practice guidance at the time of design and implementation
 - Employment of construction techniques that comply with all relevant legislation and best practice guidance at the time of design and implementation
 - Including automatic fire detection systems in the facility design
 - Including automatic fire suppression systems in the facility design
 - Including automatic monitoring and control system
 - Connection to manned 24/7 remote monitoring and control of system, including automatic warnings and alarms when a non-normal parameter is detected
 - Including redundancy in the system design to provide multiple layers of protection

¹² https://www.unece.org/fileadmin/DAM/trans/danger/ST_SG_AC.10_11_Rev6_E_WEB_-_With_corrections_from_Corr.1.pdf

¹³ https://www.unece.org/fileadmin/DAM/trans/danger/ST_SG_AC.10_11_Rev6_E_WEB_-_With_corrections_from_Corr.1.pdf

¹⁴ <https://www.gov.uk/guidance/moving-dangerous-goods>

- Designing the BESS facility to contain and restrict the spread of fire through the use of fire-resistant materials, and adequate separation between elements of the BESS - The separation distance between the battery containers and site boundary shall be in accordance NFPA 855 (2023), which has a guidance of 3m. (NB: These limits may be reduced to 1m where testing to UL9450 has been undertaken)
- Working with the FRS to develop a tactical response that will minimise risk in the event of fire and mitigate impact, with engagement early in the project and continuing across design and construction phases
- Production of a dedicated emergency response plan, showing full understanding of hazards, risks, and consequences
- Ensuring that firewater run-off is contained and treated, with measures in place which will be detailed within the Emergency Response Plan.

Table 1: System design and construction

NFCC information requirement	Bedhampton WTWs BESS
1. The battery chemistries being proposed (e.g. Lithium-ion Phosphate (LFP), Lithium Nickel Manganese Cobalt Oxide (NMC)). Because: a. Battery chemistries will directly affect the heat released when a cell goes into thermal runaway b. Battery chemistries will influence vapour cloud formation. c. An understanding of the battery chemistry is useful when requesting scientific advice during an incident.	See paragraph 2.2.4
2. The battery form factor (e.g. cylindrical, pouch, prismatic)	See para. 2.2.7
3. Type of BESS e.g. container or cabinet	The BESS shall be a cabinet design
4. Number of BESS containers/cabinets	See layout plan (Figure 1)
5. Size/capacity of each BESS unit	The BESS is proposed to have a total capacity is 150MW
6. How the BESS units will be laid out relative to one another	See layout plan (Figure 1)
7. A diagram / plan of the site.	See layout plan (Figure 1)
8. Evidence that site geography has been taken into account	The predominantly flat site constitutes made ground and is part of the wider Portsmouth Water Bedhampton WTW. Buildings associated with the water treatment works are located to the immediate north, alongside ground mounted solar panels. The northern boundary is adjacent to an internal road and features an intermittent

	hedgerow. The Bedhampton railway line lies beyond the site to the north
9. Access to, and within, the site for FRS assets	See layout plan (Figure 1) and section 4.3
10. Details of any fire-resisting design features	The battery units incorporate the latest safety features and storage components, such as a fast stop, fire detection and suppression system, gas detection (carbon monoxide), deflagration panels, lockable disconnect switch, open door sensor, gas spring damper, and a sliding door lock
11. Details of any: a. Fire suppression systems b. On site water supplies (e.g. hydrants, EWS etc) c. Smoke or fire detection systems (including how these are communicated) d. Gas and/or specific electrolyte vapour detection systems e. Temperature management systems f. Ventilation systems g. Exhaust systems h. Deflagration venting systems	See Table 2, Project Response
12. Identification of any surrounding communities, sites, and infrastructure that may be impacted as a result of an incident.	The nearest residential property lies c.40m to the north of the site, which is in full compliance with the minimum distance of 25m as set out within the NFCC guidance to occupied buildings.

3.4 Allianz Risk Consulting Battery Energy Storage System Design Recommendations

- 3.4.1 The recommendations set out in the ARC publication are set out in the table below, alongside a demonstration of compliance with the guidance and response from Energy 101 Limited as appropriate.

Table 2: ARC Recommendations

ARC Recommendation	Project Response
Fire department • Invite the fire department to your property to discuss BESS hazards. An adequate emergency response is the key to avoiding an uncontrolled fire. Keep in mind that some fire fighters will not fully understand the hazards and may assume that lithium-ion batteries are the same as lithium batteries. • Key questions to discuss with the fire department include: - What is the main difference between extinguishing and cooling? - How to handle a damaged battery? - How to manage the flammable and toxic gases? • Plan training exercises with the fire department when the system is commissioned. • Standard Operating Procedures (SOP) & Standard Operating Guidelines (SOG) are of major importance and should be updated and tested on a regular basis.	The Hampshire Fire and Rescue Service (FRS) is a consultee and shall be asked to comment on the planning application. The Applicant has engaged with the Hampshire FRS, and following consent, shall continue to discuss a site-specific response plan in the form of a Tactical Information Record for the Bedhampton BESS.
Construction and Location • Install BESS outdoors a minimum of 20 m (65 ft.) from important buildings or equipment. Maintain a minimum of 3 m (10 ft.) separation from lot lines, public ways and other exposures. • Within the module, maintain a minimum of 1 m (3 ft.) separation distance between enclosures for all units up to 50 kWh when not listed, or up to 250 kWh when listed.	The design of the BESS will reflect prevailing legislative requirements and UK industry recommendations. Separation between components within BESS containers/modules will comply with identified applicable UK regulations and legislation identified at the time of detailed design. Thermal barriers will be utilised where the minimum space separation

• Install a thermal barrier where the minimum space separation cannot be provided. • If the BESS must be located indoors, install in a 2-hour fire rated cut-off room, which is accessible directly outdoors for manual firefighting. • Restrict the access to competent employees or sub-contractors. • Ensure enclosures are non-combustible.	cannot be provided, also in accordance with applicable regulations. Separation distances in England are generally calculated based on the recommendations of BR 187 External Fire Spread: Building Separation and Boundary Distances (Ref 1-3). Whilst BESS infrastructure is not classified as buildings, the separation requirements of the BR 187 is easily satisfied by the construction of the containers when they achieve 60 minutes fire resistance for integrity and insulation. The BESS containers will be located outdoors. The areas between and around equipment will be finished with gravel and kept free of vegetation or other material that could act to spread a fire. Access to the BESS containers will only be available to competent operational staff who have received appropriate training and certification where required by legislation, or under the supervision of competent operational staff. All enclosures will be non-combustible to relevant standard (e.g. EI120).
Material, equipment, and design • BESS will be tested in accordance with UL 9540A, <i>Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems</i>. This standard evaluates thermal runaway, gas composition, flaming, fire spread, reignition and the effectiveness of fire protection systems. Data generated can be used to determine the fire and explosion protection requirements for a BESS. • Place capacitor, transformer, and switch gear in separate rooms according to best engineering practices.	The BESS utilised will hold the relevant test certificates and meet the electrical safety regulation applicable under UK regulations and legislation. The detailed design identifies the location of capacitors transformers and switch gear which are located in line with fire safety best practice.

Ventilation and temperature control • Maintaining temperature control is vital to these batteries' longevity and proper operation as they degrade exponentially at elevated temperatures. • Ensure ventilation is provided in accordance with the manufacturer's recommendations. • Install and maintain the ventilation during all stages of a fire. Ventilation is important since batteries will continue to generate flammable gas as long as they are hot. Also, carbon monoxide will be generated until the batteries are completely cooled through their core.	All enclosures will include adequate Heating Ventilation and Air Conditioning (HVAC) installations incorporating redundancy. The behaviour of HVAC and air circulation in the event of a pre-alarm and main alarm will be defined by the manufacturer (and, if applicable, the certifier) with due regard to the extinguishing agent used.
Gas detection and smoke detection • Install a very early warning fire detection system, such as aspirating smoke detection. • Install carbon monoxide (CO) detection within the container or BESS room.	A minimum of two types of fire detection system will be deployed, (e.g., optical, heat, chemical etc.). The fire detection system will be installed with fire resistant wires and components. Carbon monoxide detectors will be installed as required.
Fire protection • Install Liquid cooled gas suppression system. • This includes: - Smoke detection - Water dry pipe - Fused sprinkler heads - Thermal detection - Flammable gas detection - Vent - Aerosol - Arc Flash: $\leq 12 \text{ cal/cm}^2$	The fire protection concept will be based on the prevention of propagation with high construction standards, suppression systems and distances to adjacent installations. The BESS will include an aerosol-based extinguishing fire suppression system, as a first barrier of security against fire propagation within a unit. Separation between adjacent installations is a security redundancy measure to limit fire propagation in case of a suppression system failure or a non-typical failure event.

	It is anticipated the BESS shall have access to a hydrant, to provide a minimum of 1,900 litres per minute for two hours.
Maintenance • Follow original equipment manufacturer recommendations for the inspection, testing and maintenance of BESS. In addition, ensure that the following are completed: - Measure the internal resistance of the cells. Replace cells when a dramatic drop is detected. Keep in mind that the internal resistance is mainly independent of the state of charge but increases as the battery ages. Therefore, it is a good gauge of predictable life. - Perform infrared scanning at least once per year. - Check for fluid leakage. - Implement electric terminal torquing procedures to maintain connection integrity.	Internal resistance is measured as part of the State of Health (SOH) control system, with maintenance and replacement carried out regularly to respond to the results. Constant insulation monitoring of each battery bank detects potential leakage. Prepare an operating procedure for the swap-out of faulty cells/modules. This will include plans for suitable storage locations for the modules prior to removal from site. Torque tests are part of the operation and maintenance process. Infrared scanning will take place annually.

4.0 Battery Energy Storage System Detailed Design Stage- Pre-construction Information

4.1 Battery and Rack Safety Standards

4.1.1 The batteries that will be installed in the BESS will be Lithium Iron Phosphate (ferrophosphate) type LFP battery cells. The cells and modules will be compliant with the following standards or their successors:

- UN38.3¹⁵ - International guidance for the transportation of Li-Ion batteries
- UL1973¹⁶ - Batteries for Use in Stationary and Motive Auxiliary Power Applications
- UL9540A¹⁷ revision 3 - Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems.
- IEC62619¹⁸ - Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications
- GB/T 36276-2018¹⁹ – Lithium ion battery for electrical energy storage

4.1.2 The racks are integrated into outdoor intelligent liquid-cooled units compliant with the following standards or their successors:

- UL9540A (see above)
- UL1973 (see above)
- IEC62619 (see above)
- IEC62477-1²⁰ - Safety requirements for power electronic converter systems and equipment - Part 1: General
- IEC61000-6-2²¹/²² - Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments; Part 6-4: Generic standards - Emission standard for industrial environments
- IEC61508²³ - the international standard for functional safety for electrical, electronic and programmable electronic safety related systems.
- NFPA 855²⁴ - Standard for the Installation of Stationary Energy Storage Systems

4.1.3 UL9540A is the leading industry standard for prevention of thermal runaway propagation. The standard describes destructive test methods for forced initiation of thermal runaway and

¹⁵ [1520832 E ST SG AC.10 11 Rev6.pdf \(unece.org\)](https://standardscatalog.ul.com/ProductDetail.aspx?productId=UL1973)

¹⁶ <https://standardscatalog.ul.com/ProductDetail.aspx?productId=UL1973>

¹⁷ <https://www.ul.com/services/ul-9540a-test-method>

¹⁸ <https://webstore.iec.ch/publication/28895>

¹⁹ <https://www.chinesestandard.net/PDF.aspx/GBT36276-2018>

²⁰ <https://webstore.iec.ch/publication/7080>

²¹ <https://webstore.iec.ch/publication/25630>

²² <https://webstore.iec.ch/publication/26622>

²³ <https://www.61508.org/knowledge/what-is-iec-61508.php>

²⁴ <https://catalog.nfpa.org/NFPA-855-Standard-for-the-Installation-of-Stationary-Energy-Storage-Systems-P20704.aspx>

seeks to identify if and how quickly thermal runaway propagates between cells, modules, and cabinets.

- 4.1.4 All cells, racks, and modules to be installed at the proposed battery storage site will have passed the UL9540A evaluations for thermal runaway fire propagation wherein cells are forced into thermal runaway to determine the thermal runaway characteristics and the released gas composition. At the module level the approach determines propagation behaviour within the module and thermal energy release outside of the module. Both open and closed room scenarios are considered for unit-to-unit fire spread with heat release rate and gas analysis to determine the potential for explosion.
- 4.1.5 Results from the UL 9540A Test Method addresses the following key issues identified by building codes and the fire service:
- BESS installation instructions
 - Installation ventilation requirements
 - Effectiveness of fire protection (integral or external)
 - Fire service strategy and tactics

4.2 Fire Detection and Suppression

- 4.2.1 The battery units have an integrated aerosol fire extinguishing system that consists of:
- Smoke detector
 - Temperature detector
 - Aerosol fire extinguishing device
- 4.2.2 The Sungrow Operating System alarms panel includes a hierarchy of warnings and alarms and enables acknowledgement, action logging, and search and sort functions. Alarm classification settings require the operator to acknowledge critical alarms regardless of where they are in BESS. The visibility of alarms is present throughout fleet view, plant view, and control view, enabling the operator to quickly navigate and respond to warnings and alarms as needed.
- 4.2.3 When either the smoke or temperature detectors are triggered, it is classified as a first level fire alarm. When this happens the alarm cabinet quits the state of operating and sends a signal to the Environmental Management System (EMS).
- 4.2.4 When both the detectors are triggered, it is classified as a second level fire alarm. When this happens the aerosol of the alarm cabinet is released, with all of the electrical cabinets in the system out of operation and signal reported to the EMS.
- 4.2.5 In the event of the detectors both being triggered a specified concentration of fire extinguishing agent is sprayed to fill the entire protection area, and which will result in total flooding of the area that will extinguish any open flame. This method is effective in combating electrical fires, electrolyte fires and other combustibles fires (A/B/C fires).

4.3 Access to facility by fire appliances and other emergency vehicles

- 4.3.1 Site access and internal service roads leading into the site compound are already established on the Portsmouth Water site.

- 4.3.2 The proposed site access strategy, incorporating two access points, has been designed to accommodate up to 16.5m long articulated vehicles for construction, which represent the largest vehicle size required to transport components and materials to the site. However, the majority of these vehicles are likely to be up to 10m rigid HGVs, which are capable of transporting all construction materials and components associated with the BESS. Only the substation components would require transportation by larger articulated vehicles of up to 16.5m in length. This has been considered as part of the construction routing analysis.

4.4 Safety Information

- 4.4.1 The table below, Table 3, sets out a guide for the information that will be maintained as a 'Health and Safety File' by the operator so best practice is followed to minimise fire risk. E101 Hub 4 Ltd is committed to producing and maintaining this document as part of a best practice approach.
- 4.4.2 The information in the Health and Safety File will help to inform the Tactical Information Record developed with the FRS.

Table 3: Detailed Design Information for Health and Safety File

Specification	Reason for Inclusion
Statement of Compliance with Applicable Legislation	To demonstrate compliance with legislation.
Detailed Design Drawing of Battery Energy Storage System	To ensure available and safe access for fire appliances To enable FRS to evaluate the available access for fire appliances to all parts of the BESS. To show separation between components of the BESS.
Statement of design responses to fire risk	To accompany the detailed design drawing and explain how the risk of fire spreading has been addressed through the Development Design.
Battery Specification	To ensure that FRS are aware of the specific type of batteries installed. This would include the battery chemistry as well as size and format of each cell.
Fire Detection System Specification	To demonstrate how the requirement for fire suppression has been addressed.
Fire Suppression System Specification	To demonstrate how the requirement for fire suppression has been addressed.
Standard Operating Procedures and Guidelines (Relevant to Safety)	To demonstrate an ongoing commitment to regular checks and maintenance during operation e.g., plans for swap-out of suspected modules. Include a list of competencies and/or certification requirements for competent Site Operating Staff.
BESS Installation Contractor Emergency Protocol (during construction)	To demonstrate that protocols are in place to manage a fire during construction.

Site Operator Emergency Protocol (during operation, including decommissioning)	To demonstrate that protocols are in place to manage a fire during the operation and decommissioning.
Battery Transportation Plan	To ensure that the transportation of battery cells, including delivery of new, used failed and replacement battery cells to and from the site is carried out in accordance with prevailing legislation.

5.0 Conclusion

5.1 Summary

- 5.1.1 This OBSMP outlines the technical details of the proposed 150MW battery storage facility, and how the facility will be managed from a fire safety risk mitigation perspective.
- 5.1.2 The document collates the technical and safety information used for the detailed design of the BESS to ensure that all safety concerns around the facility are addressed in so far as is reasonably practicable.
- 5.1.3 The OBSMP may be updated once the proposed phasing of development is known and in line with any new regulations and / or guidelines that are introduced.
- 5.1.4 This document is provided to demonstrate the Applicant is committed to developing a safe BESS and is willing to consult / has consulted with relevant stakeholders to design and implement a scheme that minimises the risk of an event occurring.
- 5.1.5 The Applicant shall provide a detailed battery safety management plan via an agreed pre-energisation planning condition, which shall confirm the technology to be utilised, the design of the facility, and provide the relevant up-to-date safety certification.

5.2 Outputs

- 5.2.1 E101 Hub 4 Ltd are committed to working towards the following Fire Safety outputs:

Tactical Information Record

- 5.2.2 E101 Hub 4 Ltd invite the FRS to develop a Tactical Information Record for the Bedhampton WTW BESS; which will facilitate FRS responders to the site with technical and tactical information about the site and best approaches in the event of a fire event.

Health and Safety File

- 5.2.3 E101 Hub 4 Ltd (or their successor) will produce a 'Health and Safety File' which will be maintained and updated by the operator as part of a best practice approach. A guide to the information to be included in the Health and Safety File is set out above.
- 5.2.4 The Health and Safety File will be made available to the FRS and could be used as the basis for the Tactical Information Record set out above.

Glossary

- ADR - Agreement Concerning the International Carriage of Dangerous Goods by Road
- ARC - Allianz Risk Consulting
- BESS – Battery Energy Storage System
- CO - Carbon Monoxide
- DNO – Distribution Network Operator
- EMS – Environmental Management System
- ESS – Energy Storage System
- FRS – Fire and Rescue Service
- HVAC - Heating Ventilation and Air Conditioning
- LFP - Lithium Iron Phosphate battery cells
- Li-ion - Lithium-ion
- LPA - Local Planning Authority
- MW – Megawatt
- NFPA - National Fire Protection Association
- OBSMP - Outline Battery Safety Management Plan
- HFRS – Hampshire Fire & Rescue Service
- SOG - Standard Operating Guidelines
- SOH - State of Health
- SOP - Standard Operating Procedures



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