Longfield Solar Farm

Other Documents [PINS Ref: EN010118]

Outline Battery Safety Management Plan

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Longfield Solar Energy Farm Ltd

APFP Regulation 5(2)(q)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Contents

Abbreviations and Acronyms

Term	Meaning
ADB	Approved Document B
ADR	European Agreement Concerning the International Carriage of Dangerous Goods by Road
BAT	Best Available Techniques
BESS	Battery Energy Storage System
BMS	Battery Management System
BSMP	Battery Safety Management Plan
CE	European Community Declaration of Conformity
COSHH	Control of Substances Hazardous to Health
DCO	Development Consent Order
DSEAR	Dangerous Substances and Explosive Atmospheres Regulations 2002
FAT	Factory Acceptance Testing
FMEA	Failure Mode and Effects Analysis
HAZOP/HAZID	Hazard and Operability Analysis and Hazard Identification
HGV	Heavy Goods Vehicle
HSE	Health and Safety Executive
LCRM	Land Contamination: Risk Management
LFP	Lithium Iron Phosphate (LiFePO4)
MSDS	Material Safety Data Sheets
NFPA	National Fire Protection Agency
NMC	Lithium Nickel Manganese Cobalt Oxide (LiNiMnCoO2)
R&D	Research and Development
SAT	Site Acceptance Testing
SIL	Safety Integrity Level
UKPN	United Kingdom Power Networks
UPS	Uninterruptible Power Supply
VESDA	Very Early Smoke Detection by Aspiration

1. Executive Summary

This report outlines the key fire safety provisions that are considered likely to be included in the design of the proposed Battery Energy Storage System (BESS) facilities which are to be installed in relation to the Longfield Solar Farm Scheme.

Prior to the commencement of construction of the BESS, Longfield Solar Energy Farm Ltd (the Applicant) will be required to prepare a Battery Safety Management Plan (BSMP) which must be in accordance with this outline BSMP. As part of preparation of the BSMP, the Applicant will take into account the latest good practices for battery fire detection and prevention, along with the emergency response plan, as guidance continues to develop in the UK and around the world.

There are several battery storage technologies available to system designers. The exact technology and system chemistry type is still to be determined, but it 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 (LiNiMnCoO2) known as “NMC” after the three key active materials or Lithium Iron Phosphate (LiFePO4) known as “LFP”. The final battery chemistry will be confirmed as part of the detailed design prior to the commencement of construction.

For the purposes of this document a Concept Design has been considered that uses a BESS system based upon LFP lithium ion battery technology that is currently used on other sites being developed by the group. This is considered to be a reasonable worst case for the purposes of the assessment in terms of safety.

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

The overall approach is to follow the HSE’s hierarchy of controls:

- Elimination
- Substitution
- Engineering Controls
- Administrative Controls
- Personal Protective Equipment

This document details the types of safety systems available on the market at present along with risk reduction barriers which are likely to be incorporated into the system to be installed at the site. It is possible that by the time of construction that all solid-state batteries, or other battery technology may be available. This will be reflected in the BSMP approved by the Local Planning Authorities in consultation with the Health and Safety Executive (HSE), Essex County Fire and Rescue Service and the Environment Agency.

A summary of the anticipated site-wide fire safety provisions are as follows:

- The BESS will be designed, selected and installed in accordance with international guidance, good practice, and related standards.
- Risk assessments will be carried out for the entire system and elements across the project lifecycle.
- The specific location of the BESS will be chosen to minimise impacts on receptors.
- Separation distances between components will be selected to minimise the chance of fire spread.

- Equipment will, where possible, be selected to be fire limiting, such as selection of transformer oils with low flammability and the fire resistance of the BESS enclosure.
- In the case of the BESS, it will be designed with multiple layers of protection to minimise the chances of a fire or thermal runaway.
- All equipment will be monitored, maintained and operated in accordance with manufacturer instructions.
- The BESS will include integrated fire detection with automated suppression systems.
- 24h monitoring of the system via a dedicated control room.
- The Applicant will have a dedicated emergency plan in place, with consideration of credible plant failure scenarios.
- Communication with the local fire services with engagement early in the project and continuing across design and construction phases. This will ensure a robust emergency plan and material is available in an emergency.

2. Introduction

2.1. Scope of this Document

This outline BSMP document produced by the Applicant, outlines the key fire safety provisions for the BESS proposed to be installed at Longfield Solar Farm (the Scheme) including measures to reducing fire risk and fire protection measures.

This document provides a summary 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 use good industry practice to reduce risk to life, property, and the environment from the BESS.

Prior to the commencement of construction of the BESS, the Applicant will be required to prepare a BSMP which must be in accordance with this outline BSMP. As part of preparation of the BSMP, the Applicant will take into account the latest good practices for battery fire detection and prevention, along with the emergency response plan, as guidance continues to develop in the UK and around the world.

As the operational phase is anticipated to commence no earlier than 2026, references to current measures and guidelines are included here, however this document will be updated prior to construction of the BESS to take account of prevailing guidance.

2.2. Project Description

The Scheme includes a BESS within the BESS Compound either side of the Longfield Substation to the north of Toppinghoehall Wood as shown as Work Number 2 in the **Works Plans submitted with the Application [EN010118/APP/2.2].**

For the purposes of this document a Concept Design has been considered that uses a BESS based upon LFP lithium ion battery technology that is currently used on other sites being developed by the group. This is considered to be a reasonable worst case for the purposes of the assessment in terms of safety.

The design of the BESS and its impacts are controlled in several ways. Prior to commencement of construction of the BESS, a BSMP (in accordance with the Outline BSMP submitted with the Application) is required to be submitted to the relevant local planning authority and approved, in consultation with the HSE, the Essex County Fire and Rescue Service and the Environment Agency. The Applicant must operate the BESS in accordance with the approved plan.

Further, pursuant to a requirement of the Development Consent Order (DCO), the detailed design of the BESS must be in accordance with the Outline BSMP (which includes various safety requirements for the BESS design) and the **Outline Design Principles [EN010118/APP/7.3].** The Outline Design Principles contain controls over the BESS, which include: 1) that the chemistry of the BESS will be lithium ion, and 2) that an assessment will be undertaken, based on the detailed design for the BESS, to demonstrate that the risk of fire and impacts from such a fire will be no worse than as assessed in the plume assessment submitted with the Application. In this way, the Applicant can confirm that if the BESS constructed is different to that assessed in the plume assessment, its impacts in the event of a fire would be no worse than those assessed in the plume assessment, and therefore the risk to the local population would be very low.

The Concept Design consists of the BESS enclosures and the associated transformers, circuit breakers and inverters. The BESS, enclosures and auxiliary systems, such as cooling, uninterruptible power supply (UPS), fire detection and suppression systems, monitoring and control, will be designed in accordance with internationally recognised good practice guidance available at the time.

Once operational, the plant will be designed to operate unmanned with access required for maintenance only, and with a minimum Operational Life of 40 years.

2.3. Potential BESS failure

There are four main ways in which a lithium ion cell can fail: thermal, electrical, mechanical and chemical. The causes of failure could include issues such as: manufacturing defects, overcharging, over-discharging, mechanical damage, overheating or abuse and short circuits; whether internal or external.

Regardless of the type of failure or the cause, the main potential hazard is thermal runaway and ultimately, if not controlled, a fire, and therefore this report focusses on reducing fire risk associated with the BESS and managing the hazard in the unlikely event that it occurs.

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

2.4. Safety Objectives

The safety objectives for the design of the BESS are:

- To minimise the likelihood of an event. **This is the overriding priority.**
- To minimise the consequences should an event occur,
- To restrict any event to site and minimise any impact on the surrounding areas,
- To automatically detect and begin to fight a fire as soon as possible,
- To ensure any personnel on site are able to escape safely away from the site,
- To ensure that firefighters can to operate in reasonable safety where necessary,
- To ensure that fire, smoke, and the spread of gasses do not significantly affect occupants in surrounding buildings and areas.

The following sections set out the design responses incorporated into the Scheme in order to achieve these objectives.

2.5. Relevant Guidance

The Applicant owns and operates a number of lithium ion BESS with an exemplary safety track record. Guidance documents and standards considered by the Applicant in the design and selection of these systems have been used to inform the design of the Scheme.

There is currently limited UK specific guidance for BESS, however the Applicant operates globally and incorporates good practice from around the world.

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

- National Fire Protection Agency (NFPA) 855 (United States of America)
- United Kingdom Power Networks (UKPN) Engineering Design Standard 07-0116: Fire Protection Standard for UK Power Networks Operational Sites, 2016
- DNV GL-Recommended Practice-0043: Safety, Operation and Performance of Grid-Connected Energy Storage Systems, 2017
- Scottish and Southern Energy TG-PS-777: Limitation of Fire Risk in Substations, Technical Guide, 2019
- BS 5839 Part 1 2017: Fire Detection and Fire Alarm Systems for Buildings
- The Regulatory Reform (Fire Safety) Order (RRO) 2005
- IEC 61936, Power installations exceeding 1 kV AC and 1,5 kV DC – AC

3. Consultation

3.1. Essex Fire and Rescue

As per all sites in which the Applicant plans to install battery systems, the local fire and rescue service, Essex Fire and Rescue (Essex F&R) has been consulted with three meetings held pre-submission. The Applicant has shared experience and knowledge with Essex F&R with regards to the Applicant's global experience of battery safety and fire management. This has included sharing the preliminary site design and earlier drafts of this report.

During this consultation Essex F&R has made a number of recommendations on the layout design which have been incorporated into the Concept Design, as set out in Table 1 below.

Table 1 – Essex F&R Design Recommendations

Topic	Essex F&R Recommendations	Scheme Response
Layout	Requested fire water be available on site to enable firefighting / cooling by means of monitor jet @ rate of 1800l/min for 1h.	As set out in Section 4.2 of this report and secured in the Outline Design Principles [EN010118/APP/7.3], the BESS layout includes four 110,000 litre tanks to ensure that a supply is immediately available for one hour and to have a minimum of four hours of firefighting water.
Layout	Requested rendezvous points be installed to ensure adequate space for firefighting appliances.	As set out in Section 4.2 of this report, and secured in the Outline Design Principles [EN010118/APP/7.3], the BESS layout includes two rendezvous points at the northeast and southwestern BESS entry points to ensure safe rendezvous in all wind conditions.
Layout	Requested clarity on access road suitability	As set out in Section 4.2 of this report and secured in the Outline Construction Traffic Management Plan [EN010118/APP/Appendix 13B], the site entrance from the public highway into the Site, and via internal access tracks to reach the BESS compound has been designed to be suitable for use by standard Heavy Goods Vehicles (HGV).
Site	Ensure adequate firefighting equipment provision onsite.	Plans include a site emergency store with spare hard suction hoses for fire water tanks and spare hoses and other safety equipment as necessary as the design develops. Spare hose provision to be discussed and agreed further with regards ownership and testing requirements. These measures are secured by Section 6 of this report.
General	Include adequate measures within an emergency plan.	A robust emergency plan will be created as secured by Section 6 of this report.

3.2. Other consultees

As set out in the Consultation Report submitted with the Application [EN010118/APP/5.1], the following consultees requested further information in relation to the BESS:

- Braintree District Council
- Chelmsford City Council
- Environment Agency
- Essex County Council
- Hatfield Peverel Parish Council
- Highways England
- Little Waltham Parish Council
- Terling and Fairstead Parish Council
- Members of the public

The matters raised by the above consultees included:

- General concern at the potential of a fire caused by the BESS;
- An Outline Battery Fire Safety Management Plan needs to be submitted with the DCO application;
- The BESS element should be located away from residential areas; and
- The Applicant will develop an emergency response plan in consultation with the local fire services.

The BSMP addresses the above matters raised during consultation.

4. BESS Safety Requirements

4.1. BESS Procurement and Testing

4.1.1. Procurement

The Applicant is a joint venture between EDF Renewables and Padero Solar. The EDF group has operated different battery technologies across a number of fields, including Nuclear Power. It operates with a stringent 3 stage prequalification process that leverages the global technological capabilities of EDF group in the selection of all components, with particular focus on the battery technology and inverter manufacturers. This limits the selection of manufacturers to only those which are approved by the EDF group.

EDF has a world class Research and Development (R&D) team and facilities that support this process. In 2020, EDF invested €685 million in R&D. EDF has undertaken a range of studies as part of the development of its global battery portfolio. As part of this work EDF Renewables New Technologies Team along with EDF R&D work with manufacturers and integrators to develop world leading battery systems.

EDF only considers and engages with suppliers and products that conform to ISO 9001, UN38.3, CE and local regulation, auditing both technical and financial aspects.

The manufacturing facilities are inspected and production lines are monitored. Production quality documentation is checked and on the production line, it is verified that the quality requirement is correctly respected and implemented. The following aspects are specifically checked:

- Material management,
- Procurement and supplier management,
- Manufacturing processes,
- Quality system,
- Reliability program,
- Training,
- Corrective action and non-confirming process and process improvements,
- Corporate social responsibility, environmental, health and safety,

Battery samples are also randomly selected from factories and tested in the EDF R&D laboratory in order to validate the reliability, safety and performance of products.

It is recognised within EDF that a robust quality process is a wise investment at the development and procurement stages that pays large dividends in terms of safe, continuous operation.

The system selected would also be tested in accordance with UL9450 A ('Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems') or its contemporary.

4.1.2. Testing

The system selected will be tested in accordance with UL9450A or its contemporary. This will determine the propensity of the system to suffer from thermal runaway at either cell, module or rack level. The electrochemistry of the BESS in the concept design for the Scheme is LiFePO4 or LFP.

The concept design BESS modules have been assessed to UL9450a and the system satisfied these criteria at Cell level.

The module tests showed that during thermal runaway of a cell there was no fire and the thermal runaway did not propagate to the adjacent cells.

4.2. Safe BESS Design

The BESS will be designed to address prevailing industry standards and good practice at the time of design and implementation.

The current industry standard is NFPA 855, Standard for the Installation of Stationary Energy Storage System and the Applicant also requires any system selected to comply with UL9540, which demonstrates the fire propagation for lithium ion batteries at cell, module unit level.

In addition to this, good practice guidance for electrical sites within the UK (see section 2.5) has been consulted with regards to site layout and separation distances for the transformers and inverters.

Fire safety provisions typically found within battery system design are as follows:

- Battery modules with safety features designed into the cell level such as:
    - Internal fuses
    - Contactor at rack/string and bank level
    - Overcharge safety device
    - Internal separating layers
    - Venting device
    - Thermal monitoring

4.2.1. System location

Within the Longfield site the selection of the location of the BESS has been based on a number of factors. The most pertinent factor being the selected site has tried to minimise the proximity to receptors of any nuisance with the distance to properties maximised where possible. This has the benefit of reducing the visual and noise impact but also minimises any potential impacts on the local population should an event occur. The location of the proposed BESS is more than 450m from any residential properties.

4.2.2. System layout

The layout of the system will provide separation between key components or groups of key components.

- The BESS will be broken onto 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 effected group or part of the battery system and also allow emergency access in case of an intervention.
- BESS enclosures will be separated from each other by a dedicated separation distance, which is currently a minimum of ~3m for the concept design. Noting that the cube system would consist of multiple small enclosures, but these groups would have a dedicated separation distance.

- The separation distance between the battery enclosures and Order limits boundary will be in accordance with NFPA 855 which is currently a minimum of 20m in the concept design. This far exceeds the current NFPA guidance of 3m.
- 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.
- Note that a skid mounted inverter & transformer could be utilised, in which case the separation of the group from the BESS would be considered.
- 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.

NFPA 855 recommends the following separation distances for BESS located outdoors:

- BESS should be separated by a minimum 3m (10 ft) from the following exposures:
    - **Site boundaries**
    - **Public ways**
    - Buildings
    - Stored combustible materials
    - Hazardous materials
    - High-piled stock
    - Other exposure hazards not associated with electrical grid infrastructure

      Noting that these limits may be reduced to 1m where testing to UL9450 has been undertaken.
- BRE BR187 External fire spread: building separation and boundary distances (BR 187 2nd edition)
    - Separation distances in England are generally calculated based on the recommendations of BR 187 External Fire Spread: Building Separation and Boundary Distances. Although the BESS enclosures are not classified as buildings the separation requirements of BR 187 is easily satisfied by the construction of the enclosures when they achieve 60 minutes fire resistance for integrity and insulation.

This means that in the unlikely event that all of the system design mitigations and preventative measures fail that should a fire occur, it should be limited to the part of the system that is on fire, i.e., the overall size of the battery system is inconsequential to the outcome; an event should be limited in size to only that equipment within a group, whether there are one or any number of groups.

4.2.3. Battery System Enclosures

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

The battery enclosures will be designed and constructed by the manufacturer in accordance with the good practice available at the time, such as the current guidance outlined in the NFPA 855, Standard for the Installation of Stationary Energy Storage Systems. This will ensure the enclosures will be of robust construction.

The BESS enclosures will be locked to prevent unauthorised access and, where required, will have a fire rating of 1 hour (the length of time that the enclosure can withstand a standard fire resistance test) the concept design is rated EI60 as per ISO 13501-2.

4.2.4. Fire Detection and Suppression

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

- **Thermal monitoring** of the battery enclosures and automated cut-out beyond safe parameters.
- Battery cooling systems with automated fail safe operation.
- **Emergency Stop** – both remote and local.
- **Fire detection** suitable to the architecture such as:
    - Very early smoke detection by aspiration (VESDA) system.
    - Gas detection such as H2 and C0; as early indication of cell failure.
    - Standard heat and smoke detection system.
- **Fire suppression** equipment such as
    - NOVEC 1230, StatX powder fire suppression, or other contemporary system.
    - Some system technology have integrated water spray nozzles for direct injection of firefighting water, sometimes referred to as dry riser.

4.3. Safe BESS Construction

The BESS would be constructed in 2 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 up to the balance of plant.

The installation would be subject to pre-requisites such as a contractor emergency protocol detailing the actions to be taken in an emergency, including a construction emergency response plan 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.

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. Transportation and will be managed in accordance with the European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR) 2019 and the UK guidance on the transport of dangerous goods “Moving dangerous goods, Guidance” webpage.

The concept design includes BESS equipment prepopulated with batteries and will have undergone Factory Acceptance Testing (FAT). By definition the FAT testing will be undertaken away from site reducing the risks during on site construction with visual inspections and functional testing undertaken before any Site Acceptance Testing (SAT). The Site installation will be supervised by the Original Equipment Manufacturer and done in a hierarchical way to ensure that all necessary systems are available before the next step is required. The outline sequence which is laid out in the manual is as follows:

- Inspect the items in the protective covers
- Unpack and inspect the items
- Install on the foundations
- Once stable inspect the internal components*
- Mechanically anchor the unit to the foundations
- Connect any dry riser pipes and or the fire suppression system & strobe and siren
- Install the grounding
- Electrically interconnect the equipment DC, AC and comms.
- Cold commission the equipment.
- Hot commission the equipment.
- Test the equipment.

* Procedures will be in place with appropriate equipment to deal with any damaged equipment firstly to secure it, then quarantine it before returning for return or replacement.

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 all mitigations against issues in place before the next step occurs.

4.4. Safe BESS Operation

4.4.1. Control Room

The BESS will be monitored by the onsite control systems as well as 24/7 monitoring by a remote control room.

- The control room will also monitor a number of other sites across the UK, staff will be fully trained and familiar with the technology.
- The control room will also be responsible for the security of the site with state of the art detection and monitoring systems. These can be repurposed in an emergency to support first responders.
- The control room will have the ability and authority to immediately shut the system down should the need arise.
- The control room will be responsible for the implementation of the emergency plan acting as a point of contact to emergency services.
- The BESS Compound will have signage in accordance with the relevant Electrical Regulations but will also have the control room emergency telephone number should a member of the public or Emergency Services need to make contact.

4.4.2. Control architecture

Different battery systems have different topologies of control and safety systems that extends all the way to, in some measures, cell level however it is likely that the selected system will have:

- A module monitoring system.
- Each rack or string will typically have a rack / string monitoring system, receiving information from each module

- Each bank will have a monitoring system, receiving information from each rack/ string.
- A **Battery Management System** (BMS) with built in fail-safe automated algorithms.

The battery system components communicate with a master controller(s) that reads and records this information and uses algorithms to enable the safe operation of the system within these parameters.

These control systems will be failsafe by design with automatic shutdown of parts, or of the whole system, depending on circumstance.

The BMS will identify any failed cells and disconnect them, reducing the risk of a minor cell failure escalating to a failure of cell electrolyte containment. Individual cells will also be enclosed in battery banks, providing secondary containment, with the battery banks then enclosed in 'cubes' or shipping container, providing tertiary containment against pollution.

4.4.3. Security

The site security profile will be assessed by the Applicant's dedicated security team and the output form this assessment will inform the level of security measures used.

As a minimum the BESS will have security fencing clearly signed identifying the dangers within the site and the Control Room freephone telephone number for use in case of an emergency.

The site will also have high quality CCTV with video analytics to identify and prevent unauthorised access to enable the correct security response to be undertaken by the control room.

4.4.3.1. Cybersecurity

Cybersecurity will form a fundamental part of the system design and architecture. Standards such IEC 62443 and guidance from sources such as National Cybersecurity Centre will inform the implementation and protection measures, reference shall be made to the HSE Operational Guidance document OG86.

4.4.4. Maintenance

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

Maintenance is likely to be undertaken on the BESS equipment twice a year. This typically consists of a major maintenance period and a minor maintenance period. The major is relatively non-intrusive and involves checking connections and inspections from the transformer down to the module level. This will encompass all BESS equipment supplied by the original Equipment Manufacturer including the fire system. The minor maintenance is typically a visual inspection and rectification of any accumulated non critical defects.

All maintenance will be undertaken in a carefully controlled manner following the site safety rules and in accordance with the Operational Environmental Management Plan (OEMP) [EN010118/APP/7.11].

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

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

4.4.5. Battery Phasing or Augmentation

The BESS may be constructed in two phases, Work Numbers 2A and 2B in the DCO, with the first phase, 2A taking approximately 12-18 months during construction of the Solar Farm Site and in parallel with the Longfield Substation and the Grid Connection Route, and the second phase, 2B taking approximately 12-18 months an estimated five years later.

During the operational phase, from time to time there may be a requirement to replace or augment the battery system due to equipment failure or degradation of the system capacity. Note the planned design life may require replacement or augmentation of the battery systems on more than one occasion depending on use case.

The risks associated with any wholesale replacement with similar or any new technological developments will also be considered before any works commence. It is also possible that any replacement or augmentation of the system may use a contemporary equivalent of the original BESS system. Any modifications would be subject to EDF Renewables Management of Change process applying the same or similar principles to those laid out in this document.

4.5. End of life / disposal

With regards 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 (as amended) and 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.

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

The Applicant will follow the hierarchy of waste management throughout the life of the Scheme as follows:

- Reduce – lithium ion batteries have a 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.
- Reuse – If the batteries are no longer suitable for use by the Applicant there may still be opportunities to use the batteries for second life applications, such as domestic or windfarm storage.
- Recycle – The supplying manufacturer will have obligations under the Waste Batteries and Accumulators Regulations 2009 (as amended) (or such equivalent regulations in force at the time of decommissioning) and will be contractually obliged to offer a recycling service.
- Recovery – The recycling should allow any useful materials to be recovered and re-enter the supply chain.
- Disposal – Any disposal of batteries shall be undertaken in compliance with all applicable Laws and all regulatory requirements, product stewardship, registration disposal and recycling or take back requirement.

5. Firefighting

5.1. Fire Service Guidance

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

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.

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 container. However, the batteries within the enclosures will still hold charge in the event of a fire, even after the electrical system is isolated. It will not be possible to confirm that there is no residual risk from the energised batteries within the container, and this will inform the strategy for firefighting in the emergency plan.

The Applicant has engaged with Essex F&R throughout the pre-application phase, which has led to a number of design improvements as set out in Section 3.1 of this report.

5.2. Fire Service Access

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

Firefighting access will be designed in accordance with guidance of Approved Document B (ADB). Although ADB is not applicable as this site is not covered under the building regulations it provides useful access road specifications which are outlined in the table below. It should be noted that vehicles differ across the UK for different fire and rescue services and access route specifications should be considered on a site by site basis.

Turning facilities will be provided in any dead-end access route that is longer than 20m.

Appliance type	Minimum width of road between kerbs (m)	Minimum width of gateways (m)	Minimum turning circle between kerbs (m)	Minimum turning circle between walls (m)	Minimum clearance height (m)	Minimum carrying capacity (tonnes)
Pump	3.7	3.1	16.8	19.2	3.7	14.0
High reach	3.7	3.1	26.0	29.0	4.0	23.0

Typical Fire and Rescue Service Vehicle Access Route Specification

The minimum proposed access-road width to reach the BESS will be 4m.

A swept path analysis for emergency vehicles has been undertaken and the roads have been confirmed as suitable for emergency vehicle access.

Following feedback from Essex F&R two rendezvous points have been created at the BESS area to allow coordination of firefighting activities.

5.3. Fire water

The Scheme will include 4 large water tanks, each with approximately 108,000 litres (l) of water. This is approximately 10 times the minimum requirement identified for a site without access to a hydrant.

Based upon numbers provided by Essex F&R this will provide defensive firefighting water for in excess of 4 hours. Essex F&R has indicated that in a BESS fire event they would consume water at a rate of approximately 1,800lt/min. This is equal to 108,000lt/hr, therefore the provision of 4 large water tanks will enable firefighting for approximately 4 hours in total.

5.4. Fire equipment

Additional firefighting equipment will also be provided on the site to assist with emergency operations.

Weather stations will be installed to identify the weather conditions in an emergency situation. This will allow the fire service to approach from a safe direction.

Other firefighting or emergency equipment such as additional fire hose to be stored onsite will be agreed with Essex F&R prior to the commencement of construction.

5.5. Emergency Planning

The BESS will have a robust and validated emergency plan, developed in consultation with Essex F&R. This emergency plan will include:

- Details of the BESS
    - Overall site drawings identifying all of the relevant features required in an emergency such as layout, muster points, e-stop locations and firefighting equipment.
    - Design drawings and schematics of the system for reference.
    - Procedures for the isolation of enclosures in the case of failure.
    - Battery data
        - MSDS (Material Safety Data Sheets)
        - COSHH (Control of Substances Hazardous to Health) Assessment
        - Number of cells
    - Fire detection system details.
    - Fire-fighting strategy.
        - Conservative plume and explosion impact assessments.
        - Review of local risk points e.g. adjacent trees or infrastructure requiring possible protection from fire propagation;
        - Review of fire water provisions
        - Actions to be undertaken in an emergency.

5.6. Firefighting consequences

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

Following liaison with Essex F&R 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.

The Applicant has also advised that unless in the very early stages of a fire that this approach should be taken to a BESS fire.

Therefore, it is not anticipated that firefighting techniques will involve direct jets of water onto equipment and will be limited to containment and cooling of adjacent units to prevent the fire from spreading. This strategy will be finalised with the local fire authority and be clear in the emergency plan.

As set out in the SuDS Strategy for the Solar Site [EN010118/APP/Appendix 9C], the Longfield Solar drainage strategy includes a separate system around the BESS with a combination of positive drainage and swales or ditches around the perimeter of the battery system to act as a natural barrier to runoff or collecting runoff into an attenuation / storage pond. This will have automatic and manual isolation systems to ensure that any firewater runoff is captured for analysis prior to disposal. This trapped water may then be reused as a potential source of firefighting water. This follows the management plan process as detailed in "Protocol for the disposal of contaminated water and associated wastes at incidents 2018" jointly issued by the Environment Agency, Northern Ireland Environment Agency, Water UK and Chief Fire Officers Association.

A post event action plan will be drawn up that will determine any immediate and follow up actions required to an event including an assessment in general accordance with LCRM (Land Contamination: Risk Management) and BS 10175:2011+A2:2017 (Investigation of potentially contaminated sites – Code of practice).

There are many factors which would inform the design of an investigation following an incident which ultimately account for the volume and concentration of the loss. In the case of a fire to a BESS unit, variables to be considered include;

- Extent of the fire: including duration, number of BESS units impacted, number of adjacent assets impacted;
- Firefighting method: whilst defensive techniques are anticipated, larger volumes of water may be required to dampen and cool adjacent assets, alternative techniques to fight any adjacent fires;
- Location of the fire: adjacent to drainage or close to soft ground;
- Existing site conditions: recent weather and precipitation levels.

6. Pre-Construction Information Requirements

The detailed design phase will consider the lifecycle of the battery from cradle to grave. A large number of studies will be undertaken, with a focus on fire risk including, but not limited to, studies in line with risk analysis and management tools such as Hazard and Operability Analysis and Hazard Identification (HAZOP/HAZID), failure Mode and Effects Analysis (FMEA), Bowtie risk assessments and Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) to inform the overall design solution. An agile method is applied during the engineering design phase for fire safety analysis. The analyses are updated based on any changes of the project context and during the design process from the selected contractors in case of any deviation from the initial set of technical requirements. These will be finalised before construction commences.

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 detailed BSMP prior to the commencement of construction. The detailed BSMP must include:

- The detailed design, including drawings of the BESS.
- A statement on the battery system specifications, including fire detection and suppression systems.
- A statement on operational procedures and training requirements, including emergency operations.
- A statement on the overall compliance of the system with applicable legislation.
- An environmental risk assessment to ensure that the potential for indirect risks (e.g., through leakage or other emissions) is understood and mitigated using methods consistent with Best Available Techniques (BAT) in relation to the specific battery chemistry selected.
- An emergency plan covering construction, operation and decommissioning phases developed in consultation with Essex F&R, to include the adequate provision of firefighting equipment onsite.

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

Safe decommissioning of the BESS will be addressed prior to decommissioning of the Scheme in the final version of the Outline Decommissioning Environmental Management Plan (DEMP) submitted as part of the Application [EN010118/APP/7.12].

7. Conclusion

The Applicant is committed to developing a safe BESS that will provide long dependable operation. It is in everyone's interest that the selected BESS technology is robust, in particular with regards to safe operation.

This report demonstrates that as well as the Applicant having significant internal expertise and robust processes in BESS development, the relevant stakeholders have been consulted and their responses have informed the design of the Scheme, and therefore safety will be inherent in the overall design, minimising the risk of a fire event occurring, and reducing the impact of such an event should it occur.

This report provides a clear list of pre-construction information requirements (Section 6) to enable the Applicant to demonstrate prior to construction that the Scheme will be implemented and operated safely.

8. References

Ref 1-1 United Kingdom Power Networks (UKPN) (2016) Engineering Design Standard 07-0116: Fire Protection Standard for UK Power Networks Operational Sites.

Ref 1-2 DNV (2017) GL-Recommended Practice-0043: Safety, Operation and Performance of Grid-Connected Energy Storage Systems.

Ref 1-3 Scottish and Southern Energy (2019) TG-PS-777: Limitation of Fire Risk in Substations, Technical Guide.

Ref 1-4 British Standard (2017) BS 5839-1:2017 Fire Detection and Fire Alarm Systems for Buildings.

Ref 1-5 Regulatory Reform (2005) The Regulatory Reform (Fire Safety) Order 2005.

Ref 1-6 BSI Standards Publication (2021) BS EN IEC 61936, Power installations exceeding 1 kV AC and 1,5 kV DC – AC.

Ref 1-7 ULP94.

Ref 1-8 UL Standard (2020) UL9540A Energy Storage Systems and Equipment.

Ref 1-9 NFPA (2020) NFPA 855, Standard for the Installation of Stationary Energy Storage Systems.

Ref 1-10 International Standards Organisation (2015) ISO9001:2015 Quality Management Systems – Requirements.

Ref 1-11 United Nations (2015), Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria (UN 38.3).

Ref 1-12 Fire and Emergency Planning Directorate (1998) Fire Service Manual Volume 2: Fire Service Operations, Electricity.

Ref 1-13 HM Government (2019) The Building Regulations 2010, Fire Safety - Approved Document Volume 2: Buildings other than dwellings. (Incorporating 2020 amendments).

Ref 1-14 Water UK (2018) Protocol for the disposal of contaminated water and associated wastes at incidents (Jointly issued by Water UK, Environment Agency, NIEA, Natural Resources Wales, DWI, Fera, Defra's CBRN Recovery Team, NFCC National Resilience).

Ref 1-15 United Nations (2021) Agreement Concerning the International Carriage of Dangerous Goods by Road.

Ref 1-16 Richard Chitty (2014) External fire spread: building separation and boundary distances (BR 187 2nd edition).

Ref 1-17 HSE (2002) The Dangerous Substances and Explosive Atmospheres Regulations 2002.

Ref 1-18 NFPA (2020) NFPA855 Standard for the Installation of Stationary Energy Storage Systems.

Ref 1-19 Environment Agency (2021) Land contamination risk management (LCRM) Stage 1-3.

Ref 1-20 BSO British Standard (2017) BS 10175:2011+A2:2017 Investigation of potentially contaminated sites. Code of practice.

Ref 1-21 UK Statutory Instruments (2009) The Waste Batteries and Accumulators Regulations 2009.

Ref 1-22 HSE (2017) Operation Guidance document OG86 Cyber Security for Industrial Automation and Control Systems (IACS).

Ref 1-23 International Society of Automation (2018) ISA62443 Security of Industrial Automation and Control Systems.