EAST PARK ENERGY

East Park Energy

EN010141

Outline Battery Safety Management Plan

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EAST PARK ENERGY

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Outline Battery Safety Management Plan

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APPENDICES

1.0 INTRODUCTION

1.1 Purpose of Document

1.1.1 This outline Battery Safety Management Plan (oBSMP), produced on behalf of BSSL Cambsbed 1 Ltd (hereafter referred to as 'the Applicant'), outlines the key safety provisions in the event the Battery Energy Storage System (BESS) proposed to be installed as part of the East Park Energy project (hereafter referred to as 'the Scheme') fails, including measures to reduce system failure risk and failure outcome mitigation measures.

1.1.2 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 oBSMP is to identify how the Applicant will use good industry practice to reduce risk to life, property, and the environment from a BESS failure event.

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

1.1.4 While the operational phase is anticipated to commence no earlier than 2029, reference to current measures and guidelines are included here. However, this document will be updated prior to construction of the BESS to take account of prevailing standards, certifications, guidance, and testing requirements.

1.2 Project description

1.2.1 For the purposes of this document a concept design has been considered that uses a BESS system based upon lithium iron phosphate (LFP) lithium-ion battery technology. This is considered a reasonable worst case for the purposes of the assessment in terms of safety (toxic and explosive gas production risks). The BESS design and system chemistry type is still to be determined, and the final battery chemistry will be confirmed as part of the detailed design prior to the commencement of construction. The design of the BESS and its impact are controlled in several ways. Prior to commencement of construction of the BESS, a BSMP (in substantial accordance with the oBSMP) is required to be submitted to the relevant local planning authority and approved, in consultation with Cambridgeshire Fire and Rescue Service (CFRS). The Applicant must operate the BESS in accordance with the approved plan. As part of the BSMP, the Applicant will take into account the latest good practices for battery system failure prevention and detection, consequence modelling, risk analysis, and emergency response planning, as guidance continues to develop in the UK and around the world.

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

1.2.3 Once operational, the plant will be designed to operate unmanned with access required for maintenance only during the 40-year operating lifecycle of the Scheme.

1.3 Potential for BESS failure

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

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

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

1.3.4 As recommended in National Fire Chiefs Council (NFCC) revised guidelines (2024) (Ref 1) a Plume Analysis study has been conducted and is presented in the BESS Fire Emissions Modelling [Appendix A to this oBSMP] report. This study fully aligns with NFCC guidelines to assess the environmental impact of a BESS thermal runaway incident to sensitive receptors within a 1 km radius of the BESS Area (East Park Site D), to assess the potential to cause air quality impacts during a BESS fire. Concentrations of carbon monoxide (CO), formaldehyde, hydrogen chloride (HCl), hydrogen cyanide (HCN), hydrogen fluoride (HF), ammonia (NH_3), nitrogen dioxide (NO2) and particulates, were modelled using Atmospheric Dispersion Modelling Software (ADMS) to determine the effects of BESS fire emissions on human health. Furthermore, Iin line with NFCC recommendations, a high-level visibility assessment has also been undertaken using the modelled particulates results to determine the effect of BESS fire emissions on visibility to the local road network.

1.3.5 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 addressed through longstanding industry guidance and codes. Therefore, only the potential battery failure component of the BESS area is addressed in this report.

1.4 Safety objectives

1.4.1 The overall approach is to follow the Health and Safety Executive's (HSE) hierarchy of controls (REF 2):

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

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

- To minimise the likelihood of a failure event. This is an overriding priority;
- To minimise the consequences should an event occur;
- To restrict any event to the BESS 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 BESS Area;
- To ensure that firefighters can operate in reasonable safety where necessary;

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

- To ensure that fire, smoke, and any release of toxic gases does not significantly impact site operatives, first responders, and the local community; and
- To ensure that firewater run-off is contained and tested before release or, if necessary, removed by tanker and treated offsite.

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

- The BESS will be designed, selected, and installed in accordance with international guidance, good practice, and related standards;
- Risk assessments will be carried out for the entire system and elements across the lifecycle of the Scheme;
- The location of the BESS area will be located to minimise impacts on offsite receptors (albeit this is inherent in the DCO application as it has been factored into the design process to date);
- Separation distances between components will be defined through Large Scale Fire Testing (LSFT) and / or full scale destruction testing to minimise the chance of fire spread;
- Equipment will, where possible, be selected to be fire limiting, such as selection of transformer oils with low flammability and non-combustible BESS enclosures with high levels of thermal insulation (fire and heat resistance). The BESS facility will be designed with multiple layers of protection to mitigate and minimise the probability of a fire or thermal runaway incident;
- In the case of the selected BESS design, it will integrate multiple layers of prevention and mitigation features to minimise the chances of a BESS failure incident (equipment failure / burning or gas venting thermal runaway scenario);
- All equipment will be monitored, maintained, and operated in accordance with manufacturer instructions and be compliant with requisite safety standards (UL, IEC, IEEE, NFPA);
- The BESS design will include integrated fire and explosion prevention and protection systems. Following key industry safety standards (e.g. NFPA

855, UL 9540, BS EN IEC 62933-5-2) and based on comprehensive UL 9540A (2025, 5th Edition) and / or 3rd party LSFT / full scale destruction testing. This testing involves burning the full BESS system to validate minimum safe equipment spacing distances and performance test active and passive mitigation systems integrated into the BESS design. A BESS system and site-specific Emergency Response Plan (ERP) will be developed at the detailed design stage, based on national and international best practice measures;

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

1.5 Relevant guidance

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

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

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

- National Fire Chiefs Council (NFCC) Grid-Scale Battery Energy Storage System planning – Guidance for FRS (2023 and draft revision 2024). While the publication of the revised NFCC guidance is expected in 2025, the 2023 version of the BESS guidance remains current.

- National Fire Protection Agency (NFPA) NFPA 855 (2026): Standard for the Installation of Stationary Energy Storage Systems
- NFPA 68 (2023): Standard on Explosion Protection by Deflagration Venting.
- BS EN 14797 (2006): Explosion venting devices.
- NFPA 69 (2024): Standard on Explosion Prevention Systems.
- NFPA 70 (2023): National Electrical Code (NEC).
- Underwriters Laboratories, UL 9540A (2025): Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems;
- UL 1642 (2020): Standards for Lithium Batteries.
- UL 1973 (2022): Batteries for Use in Stationary and Motive Auxiliary Power Applications.
- UL 9540 3rd Edition (2023): Standard for Energy Storage Systems and Equipment.
- UL 2941 (2023): Outline of Investigation for Cybersecurity of Distributed Energy and Inverter-Based Resources.
- CSA / ANSI C800:25: Testing protocol for energy storage system reliability and quality assurance program.
- Clean Energy Associates (2025): BESS Quality Risks. A summary of the most common Battery Energy Storage System manufacturing defects of 2024.
- European Association for Storage of Energy (2025): EASE Guidelines on Safety Best Practices for Battery Energy Storage Systems.
- Department for Energy Security and Net Zero (2024): Health and Safety Guidance for Grid Scale Electrical Energy Storage Systems.
- IEEE 2686 (2025) standard: Recommended Practice for Battery Management Systems in Stationary Energy Storage Applications.
- FM DS 5-33 (2023) FM Global Datasheet. Lithium-Ion Battery Energy Storage Systems.
- UN 38.3: Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria – (Lithium Metal and Lithium-Ion Batteries).

- United Kingdom Power Networks (UKPN) Engineering Design Standard 07-0116: Fire Energy Storage Systems, 2016.
- DNV GL-Recommended Practice-0043: Safety, Operation and Performance of Grid-Connected Energy Storage Systems, 2017.
- Scottish and Southern Energy TG-PS-777: Limitation of Fire Risk in Substations, Technical Guide, 2019.
- BS 5839 Part 1 2017: Fire Detection and Fire Alarm Systems for Buildings.
- BS 9990: 2015: Non-automatic firefighting systems in buildings - Code of practice
- The Regulatory Reform (Fire Safety) Order (RRO) 2005.
- The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) Assessment.
- Fire Safety Journal (May 2025) Damilare Olugbemide / Noah Ryder: CFD analysis of performance-based explosion protection design for battery energy storage systems (BESS).
- BS EN IEC 61936, Power installations exceeding 1 kV AC and 1,5 kV DC – AC.
- BS EN IEC 62619 (2022): Secondary cells and batteries containing alkaline or other non-acid electrolytes. Safety requirements for secondary lithium cells and batteries, for use in industrial applications.
- BS EN IEC 62933-5-2 (2020): Electrical Energy Storage (EES) systems. Part 5-2: Safety requirements for grid integrated EES systems. Electrochemical-based systems.
- BS EN IEC 62281: 2019 + A2:2023: Safety of primary and secondary lithium cells and batteries during transport.
- BS EN IEC 62477-1 (2022): Safety requirements for power electronic converter systems and equipment. General.
- BS EN IEC 63056 (2020): Safety standard for lithium-ion battery systems.
- BS EN 16009 (2011): Flameless Explosion Venting Devices.
- BS EN 14373 (2021): Explosion Suppression Systems.
- BS EN IEC 61000-6-2 (2016): Electromagnetic compatibility (EMC). Generic standards. Immunity standard for industrial environments.

- BS EN IEC 61000-6-4 (2018): Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments.

1.6 Consultation with Cambridgeshire Fire and Rescue Service (CFRS)

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

1.6.2 On 15th October 2024, CFRS sent an official '*Cambridgeshire and Bedfordshire FRS Response to East Park Energy Consultation*' to the Applicant

1.6.3 The Applicant held a MS Teams Meeting with CFRS on 20th August 2025 to discuss the Scheme and to share preliminary site plans.

1.6.4 The Applicant confirmed that they will share all requisite BESS safety and design documentation for the Scheme with CFRS, once available.

1.6.5 The Applicant emailed a range of BESS safety materials for fire service training and education purposes, and a number of BESS destruction testing reports on 20th August 2025. The Applicant confirmed that NFCC guidance will be followed, and that any deviations will be discussed with CFRS.

Table 1

CFRS safety topics	CFRS safety or information requirements	Applicant's compliance and safety commitments
1.1	BESS enclosure design should be a cabinet type system to allow maintenance to be conducted without entering the BESS.	The Applicant can confirm a cabinet system is likely to be selected. Section 2.2.8 of this oBSMP stipulates safety features that must be integrated in the unlikely event that a walk in design is selected. BESS enclosure design will be fully communicated with CFRS at detailed design and factored into all

CFRS safety topics	CFRS safety or information requirements	Applicant's compliance and safety commitments
		risk assessments and Emergency Response Plans (ERP).
1.2	Spacing between BESS enclosures and validation of thermal insulation properties to ensure that fire will not propagate to another BESS.	The Applicant confirms that BESS will not be stacked. The Applicant will only select a BESS design where minimum equipment spacing has been validated through Large Scale Fire Testing (LSFT). This oBSMP stipulates these requirements in detail in Sections 1.4.3, 2.1.3, 2.2.2, 2.2.3, 2.4.2, 2.4.6, 2.6.11, 2.6.12, 2.7.1, 4.5.2, 5.1.1, 5.1.4, and 5.1.7.
1.3	Battery details must be shared with CFRS.	The Applicant clarifies in this oBSMP that the battery system will be lithium-ion, but full details will not be known until detailed design stage. Battery system details will be promptly shared with CFRS once known. LFP chemistry which currently dominates BESS battery systems has been used for the concept design, this is considered a reasonable worst case for the purposes of the assessment in terms of safety (toxic and explosive gas production risks).
1.4	BESS failure detection system requirements.	This oBSMP confirms in Section 2.6 (Detection and fire protection systems) that detection systems will meet all NFPA 855 and NFCC requirements and be approved by CFRS.
1.5	BESS suppression system requirements.	This oBSMP confirms in Section 2.6 how suppression system efficacy will be validated through UL 9540A or 3rd party testing. LSFT and consequence modelling commitments stipulated in the oBSMP (see above in table to Applicant's response to CFRS safety requirement 1.2) validate site-specific spacing distances to ensure minimal risk of fire propagation to adjacent equipment.

CFRS safety topics	CFRS safety or information requirements	Applicant's compliance and safety commitments
1.6	BESS explosion control requirements.	Section 2.7 of this oBSMP confirms that comprehensive explosion prevention and mitigation systems must be integrated into the BESS selected at the detailed design stage. The active and passive control systems will meet NFPA 855 and NFCC requirements and be approved by CFRS.
2.1	Site design to ensure safe access for emergency responders in and around the facility.	Section 4.2 of this oBSMP provides details of how the Applicant will comply with NFCC guidance and accommodate all CFRS operational requirements for safe emergency response.
3.1	Provision of water supplies for firefighting.	Sections 4.1, 4.3, 4.4 and 4.5 of this oBSMP details Fire Service incident response guidance, water supply commitments / options, firefighting water capture solutions, and comprehensive Emergency Planning commitments for the Scheme. The Applicant's commitments fully align with the latest NFPA 855 and NFCC guidance.
3.2	Water hydrant requirements.	Section 4.3 of this oBSMP details that if installed, the water hydrant specification will fully comply with CFRS BESS area requirements.
3.3	Water supply requirements.	Section 4.3 of this oBSMP confirms that the Applicant fully complies / exceeds NFCC guidance and CFRS minimum water supply requirements.
4.1	Vegetation management to minimise wildfire risks.	Section 2.4 of this oBSMP fully details how wildfire risks will be minimised in line with CFRS requirements through the Scheme's site layout commitments.
5.1	Provision of risk information for Emergency Response Planning (ERP).	Section 4.4.3 of this oBSMP stipulates the minimum information that must be included in an ERP drafted at detailed design stage with CFRS. The content requirements are based upon

CFRS safety topics	CFRS safety or information requirements	Applicant's compliance and safety commitments
		NFCC and NFPA 855 guidelines and encompass all CFRS key ERP subject areas.
5.2	Environmental impacts plans for containing and managing water runoff from the BESS area.	Sections 4.3 and 4.5.4 – 4.5.8 of this oBSMP confirms how water pollution risks can be minimised.
6.1	Emergency planning requirements for BESS fire impacts.	The Applicant commissioned a Plume Analysis Study (BESS Fire Emissions Modelling Report) which is included as Appendix A to this oBSMP, to assess fire impacts on all sensitive receptors within a 1km radius of the BESS area. The outline results are detailed in Sections 4.5.9 - 4.5.12 of this oBSMP and there are no significant impacts for any sensitive receptor location. Furthermore, Section 5.1.5 of this oBSMP stipulates that a BESS system and detailed-design specific Plume Analysis study will be conducted to assess the environmental impact of a site incident to sensitive receptors within a 1 km radius. This analysis will ensure that toxic gas emissions to sensitive receptors arising from the detailed design of the scheme remain below relevant public health exposure limit guidelines, when the battery system of a BESS enclosure is fully consumed (burnt out). Production of Particulate Matter (PM), and a visibility impact assessment on any transport links within a 1 km radius of the BESS compound, will also be included.
7.1	Key areas for consultation with CFRS.	Sections 1.6.1 – 1.6.5 of this oBSMP documents details of the Applicant's early engagement with CFRS. The Applicant will continue to engage with CFRS throughout the lifecycle of the scheme. Commitments made in this oBSMP and secured through the DCO will ensure that key safety areas identified by CFRS for consideration, are fully addressed

CFRS safety topics	CFRS safety or information requirements	Applicant's compliance and safety commitments
		at the detailed design stage and within the requisite BSMP, ERP, and Risk Assessment documentation.

2.0 BESS SAFETY REQUIREMENTS

2.1 Procurement

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

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

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

2.2 Safe BESS design

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

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

2.2.3 NFPA 855 (2026) (Ref 3) provides the most comprehensive guidelines for BESS design and site installation specifications. BESS design structural integrity will be demonstrated through full-scale destruction performance testing and / or by integrating rigorously tested NFPA 69 (Ref 17) (explosion prevention) and NFPA 68 (Ref 11) (Explosion protection through deflagration venting) features. NFPA 855 (2026) now mandates that LSFT of the BESS system is conducted to validate safe minimum equipment spacing distances. No fire propagation can occur during these full scale burn tests and the BESS selected at detailed design must as a minimum have completed this testing under the UL 9540A test program or an accredited 3rd Party LSFT test program i.e. CSA C800:25, DNV, TUV SUD (etc.). LSFT and / or full-scale destruction performance testing must demonstrate that equipment loss will be limited to one BESS enclosure without the intervention of fire fighters.

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

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

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

2.2.7 If the BESS design does not integrate automatic fire protection systems or TRPP systems and a dry pipe sprinkler or spray system is integrated, then NFCC (2024) (Ref 1) revised guidance will be followed. Connections to any dry pipe systems that are required to be installed on the BESS Area will be installed in accordance with BS 9990 Non-automatic firefighting systems in buildings code of practice (Current Edition) (Ref 7) and will be identified in accordance with BS 3251 Indicator Plates for Fire Hydrants (Current Edition) (Ref 8). If a dry pipe system is integrated for the scheme, CFRS instantaneous connection points will be located at a safe distance from enclosures and clearly signed for CFRS response, in accordance with NFCC guidelines. Water supply for this type of system will be separate from the water supply designated for CFRS boundary cooling firefighting requirements.

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

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

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

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

- Internal fuses;
- Liquid cooling system;
- Active thermal management system (TMS);
- Contactor at rack/string and bank level;
- Overcharge safety devices;
- Internal passive protection products;
- Venting systems and gas channels
- Thermal or multi-sensor monitoring devices.

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

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

2.3 System Location

2.3.1 The BESS is to be located within ‘East Park Site D’, in the area identified as ‘Work No. 2’ on the **Works Plan [EN010141/DR/2.3]**.

2.3.2 The BESS would be accessed from the main site access into East Park Site D from the B645 to the north. Road networks within the Order Limits will enable unobstructed access to all areas of the BESS site, two separate CFRS access points to the BESS area have been integrated to ensure firefighters do not have to drive through a smoke or gas plume to access the BESS.

2.3.3 The closest residential receptors to the BESS are located approximately 478m to the east, and approximately 495m to the west. The closest public right of way is approximately 123m to the south. The closest road is approximately 580m to the west.

2.4 System Layout

2.4.1 An illustrative layout for the BESS is shown on **ES Vol 3 Figure 2-1: Illustrative Environmental Masterplan [EN010141/DR/6.3]**.

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

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

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

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

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

2.4.5 The separation of the inverters and transformers will, depending on the design, be optimised at detailed design stage to minimise the likelihood of any spread of fire between adjacent components.

2.4.6 The layout of the Scheme provides adequate separation between enclosures, additional ESS (Energy Storage System) equipment, and other key site structures and infrastructure. The UK National Fire Chiefs Council (NFCC) 'Grid Scale Battery Energy Storage System planning – Guidance for FRS (2023 and 2024 draft revision)' (Ref 1) will be followed at an indicative design stage, which comprises:

- To protect BESS enclosures from exterior risks, they shall be provided with impact protection to prevent damage to battery enclosures by vehicles or construction equipment and use Damage Limiting Construction (DLC) techniques;
    - The indicative BESS layout conforms to NFPA 855 (2026) (Ref 3) standards allowing minimum separation distances to be established from LSFT. Layout of 1m minimum between battery storage units and 3m minimum to ESS equipment, and 2m minimum between adjacent and back-to-back BESS enclosures. This conformity to NFPA 855 (2026) testing requirements to establish minimum safe equipment spacing distances fully complies with revised NFCC guidelines;

- NFCC guidelines allow reduced separation distances if suitable design features can be introduced. The BESS system will have undertaken LSFT and utilised rigorous site specific consequence modelling reports to demonstrate that in the event of a BESS failure loss will be safely limited to one BESS enclosure without the intervention of CFRS;
- LSFT of the selected BESS design to establish minimum equipment spacing distances and site specific consequence modelling will provide a clear, evidence-based case for the final BESS area installation plans at the detailed design phase and will be agreed with CFRS. An independent Fire Protection Engineer specialising in BESS will validate all UL 9540A, LSFT and / or third party test and site specific consequence modelling data which has been provided;
- The separation of the inverters and transformers will, depending on the architecture, be optimised at detailed design stage to minimise the likelihood of any spread of fire between adjacent components;
- Areas within 10m of BESS enclosures do not contain combustible vegetation and would not be planted with any new combustible vegetation wherever possible. Where this is not feasible a full risk assessment would be conducted, and mitigation features applied if required by the CFRS. Any other vegetation on site would be kept in a condition such that they do not increase the risk of fire on site;
- The BESS enclosure would have an internal fire resistance rating of at least one hour (according to NFPA 855 (Ref 3), BR 187 (Ref 13) and FM Global Datasheet 5-33 (Ref 14));
    - The BESS area would be designed to integrate pressure fed (pump driven) fire hydrants and/or static water tanks for firefighting, dependent on available water supply. Water tanks will be located at least 10m from the nearest BESS enclosure. Water access points, whether hydrants or tank connections, would be located in consultation with the CFRS to provide redundancy and safe operating distances for firefighters; and

- Tanks and water outlets would be clearly labelled with appropriate signage and marked on site plans. Additionally, to avoid any mechanical damage, outlets and hard suction points would be safeguarded with bollards.

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

2.5 Battery System Enclosures

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

2.5.2 Each BESS enclosure will be installed by a certified and qualified installer. Each BESS enclosure will be UL 9540 (Ref 4) and / or BS EN IEC 62933-5-2 (Ref 5) certificated. Ingress protection (IP) testing of the enclosures is conducted under UL 9540 and / or BS EN IEC 62933-5-2 certification of any BESS system. IEC Factory Acceptance Testing (FAT) or an independent manufacturing audit will be carried out to ensure the supplied BESS enclosures comply with the requisite certified Ingress Protection (IP) levels.

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

2.5.4 Enclosure gas exhaust vents and deflagration panels must direct flaming or toxic gases away from site personnel or first responders in line with NFCC guidance (Ref 1) and NFPA 68 (Ref 11) and BS EN 14797 (Ref 12) standards; doors cannot be used as sole deflagration vents.

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

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

2.6 Detection and fire protection systems

2.6.1 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 liquid cooling systems with automated fail-safe operation (air cooling systems will not be considered for the Scheme); and
- Emergency Stop – both remote and local.

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

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

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

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

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

2.6.7 If a BESS enclosure design does not integrate automatic fire suppression systems and a dry pipe sprinkler or spray system is integrated, then NFCC (2024) (Ref 1) revised guidance will be followed. Connections to any dry pipe systems that are required to be installed on the BESS Area will be installed in accordance with BS 9990 Non-automatic firefighting systems in buildings code of practice (Current Edition) (Ref 7) and will be identified in accordance with BS 3251 Indicator Plates for Fire Hydrants (Current Edition) (Ref 8). If a dry pipe system is integrated for the scheme, CFRS instantaneous connection points will be located at a safe distance from enclosures and clearly signed for CFRS response, in accordance with NFCC guidelines. Water supply for this type of system will be separate from the water supply designated for CFRS boundary cooling requirements.

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

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

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

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

2.6.11 Draft NFCC (2024) (Ref 1) revised guidance acknowledges that it is increasingly common for BESS enclosures to be designed without integrated automatic fire suppression systems because high levels of thermal insulation are integrated which allows enclosures to be closely spaced whilst preventing propagation of fire to adjacent BESS. As mandated in NFPA 855 (2026), LSFT and / or full scale destruction testing to establish minimum equipment spacing distances coupled with rigorous site-specific consequence modelling will be conducted for the selected BESS design, to demonstrate that loss will be safely limited to one enclosure without the intervention of CFRS.

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

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

2.7 BESS Active and Passive Safety Systems

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

- As a minimum, a BESS active ventilation system will comply with NFPA 855 (2026) (Ref 3) / NFPA 69 (Ref 17) guidelines which require the prevention of a dangerous build-up of explosive gases (25% LEL). The gas exhaust / ventilation system must have redundancy and can be separate to any HVAC system providing climate control. Heating and cooling of the battery modules will be provided by an independent liquid cooling system which is separate to any HVAC system providing climate control for the BESS enclosure. Backup power for the gas detection system must have a 24-hour duration in standby and 2 hours in alarm, as demonstrated via NFPA 72 (Ref 21) compliant battery calculations and required by NFPA 855;
- When mechanical ventilation is required to maintain concentrations below the required limits, it shall be interlocked, so that the system shuts down upon failure of the ventilation system. Where emergency ventilation is used to mitigate an explosion hazard, the disconnect for the ventilation system will be clearly marked to notify personnel or first responders to not disconnect the power supply to the ventilation system during an evolving incident;
- The ventilation / gas extraction system shall also be designed to exhaust flames and gases safely outside the BESS enclosure, without compromising the safety of first responders. The ventilation system will be performance tested with lean gas mixture testing (gas mixture is defined by the specific BESS UL 9540A test data) to demonstrate that explosive gases do not exceed 25% LEL as required by NFPA 69 (Ref 17) standards, the system shall be provided with suitable ember protection to prevent embers from penetrating BESS enclosures (HVAC, gas exhaust, deflagration panels). An NFPA 69 compliance report will be provided to

demonstrate the compliance of the gas exhaust system with NFPA 855 (Ref 3) explosion prevention system requirements;

- Explosion protection systems not covered directly by NFPA 68 (Ref 11) and NFPA 69 (Ref 17) standards are commonly referred to as performance design explosion mitigation systems, these include automatic doors or vents which open to ventilate explosive gas mixtures and / or relieve pressure. If the BESS design integrates hybrid systems, sparker system, Active Ignition Mitigation System (AIMS), or performance design explosion protection systems it will be validated through BESS free burn testing, lean gas mixture testing and requisite pressure testing required by NFPA and EN standards. Further, the BESS enclosure will have completed UL 9540A (Ref 6) testing and / or large-scale Third-Party Fire and Explosion testing without pressure waves occurring or shrapnel being ejected. An independent Fire Protection Engineer specialising in BESS will review all UL 9540A test results and any additional fire and explosion test and modelling data which has been provided;
- The BESS enclosure will be designed to withstand overpressures generated by the battery system during thermal runaway. As a minimum, an explosion prevention system to NFPA 69 (Ref 17) standards will be integrated which should be complimented by an explosion protection system to NFPA 68 (Ref 11) and BS EN 14797 (Ref 12) standards. NFPA 68 design key performance requirements are:
    - The enclosure strength shall exceed the vent opening pressure by a safety factor of over two (including the doors)
    - The total vent size shall be selected such that the reduced deflagration pressure (Pred) is below two thirds (2/3) of the enclosure strength.
- Most LSFT test programs do not performance test BESS active protection system, therefore any BESS explosion prevention or control / protection system will be validated through additional full scale BESS destruction testing, lean gas mixture testing and requisite pressure testing required by NFPA and EN standards. An independent Fire Protection Engineer

specialising in BESS will review all UL 9540A (Ref 6) test results and any additional fire and explosion test and modelling data which has been provided.

3.0 BESS CONSTRUCTION AND OPERATION

3.1 Safe BESS Construction

3.1.1 The BESS would be constructed in 2 distinct phases. Firstly, the civil works and balance of non-BESS plant and equipment construction would be started. Then at a suitable point the BESS equipment would be delivered to be installed on the foundations and connected to the balance of plant.

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

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

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

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

3.2 Safe BESS Operation

Control Room

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

- The control room (when operational) will be responsible for the security of the BESS 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 (when operational) will be responsible for the implementation of the Emergency Response Plan (ERP), acting as a point of contact to emergency services.
- Staff will be fully trained and familiar with the BESS technologies and will be responsible for alerting CFRS and, if required, for connecting CFRS with BESS incident Subject Matter Experts (SMEs).
- The 24/7 remote control facility will monitor the security of the BESS site, and monitoring and detection systems will be repurposed in an emergency to support first responders. NFPA 855 (2026) (Ref 2) defines the minimum monitoring and control standards.
- The 24/7 remote control facility will have the capability to immediately shut the system down should an incident occur, and the need arise. It can also implement the ERP, acting as a point of contact to the emergency services.
- In some circumstances it will be necessary to discharge stored electricity from the batteries to enable the first / second responders to deal with the incident. This capability could potentially be achieved through the 24/7 remote control facility. The precise methodology in this regard will be agreed in the ERP and also documented in the BSMP once the detailed

design of the BESS is known. This will be prepared in conjunction with CFRS.

3.2.2 Signage should be installed in a suitable and visible location on the outside of the BESS units, identifying the presence of a BESS system. Signage would be as per NFCC guidelines (Ref 1) and will also include details of:

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

Control Room

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

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

on an appropriate signal, or if communication is disrupted between the inverter/charger and the supervisor control.

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

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

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

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

Security

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

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

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

Maintenance

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

3.2.12 Routine maintenance will be undertaken on the BESS equipment depending on the risk profile of the equipment to be selected. This typically consists of a major maintenance period and a minor maintenance period. This will encompass all BESS and supporting equipment supplied by the Original Equipment Manufacturer (OEM) including the fire protection and explosion prevention system. Minor maintenance is typically a visual inspection and rectification of any accumulated noncritical defects. All maintenance will be undertaken in a carefully controlled manner, following the site safety rules and in accordance with the **outline Operational Environmental Management Plan (oOEMP) [EN010141/DR/7.5]** approved pursuant to DCO Requirements.

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

3.2.14 Upon any large-scale replacement / augmentation of BESS enclosures, the safety measures associated with the BESS will be reviewed for their appropriateness considering the prevailing guidance at that time and the technology installed, in consultation with the CFRS and the outcomes of that review shall be shared with Huntingdonshire District Council and Cambridgeshire County Council.

End of life disposal

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

3.2.16 In the event of a defective battery module or cell being identified, the defective module shall be immediately placed out of service and be electrically disconnected from the system. A specific risk assessment shall be conducted prior to the removal of the defective module to ensure the safety of employees and contractors.

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

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

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

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

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

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

4.0 FIREFIGHTING

4.1 Fire Service Guidance

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

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

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

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

4.1.5 If a dedicated automatic water-based suppression system or TRPP system (engineered to directly access cells within battery modules) is provided within each BESS enclosure, this will be tested at UL 9540A (Ref 6) unit / installation level or through significant scale third-party fire and explosion testing. The suppression or TRPP system will be capable of operating effectively in conjunction with a gas exhaust / ventilation system to minimise deflagration risks. The system design must be capable to control or fully suppress a fire, without the direct intervention of CFRS.

4.1.6 The Applicant has consulted NFCC guidelines (Ref 1) and engaged with CFRS throughout the pre-application phase and will ensure that the detailed BSMP will include any subsequent revisions made to NFCC guidelines. Close consultation will continue with CFRS throughout the planning process.

4.2 Fire Service Access

4.2.1 UK National Fire Chiefs Council BESS planning guidance document (Ref 1), stipulates that suitable facilities for safely accessing and egressing the BESS compound should be provided. Designs would be developed in close liaison with CFRS, as specific requirements may apply due to variations in vehicles and equipment.

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

4.2.3 The proposed access-route width around the BESS area will be 6m and there are no dead-end access routes or extremes of grade (accessible in all weather conditions). Turning circles, passing places etc size to be advised by CFRS depending on fleet.

4.2.4 Road networks within the Order Limits will enable unobstructed access to all areas of the BESS sites, two separate CFRS access points to the BESS sites have been integrated to ensure firefighters do not have to drive through a smoke or gas plume to access the BESS.

4.2.5 Emergency access route plans for first responders will be included in the Emergency Response Plans and hard copies will be available on site. Route sign requirements will be agreed with CFRS.

4.2.6 Signage will be installed in a suitable and visible location on the outside of BESS enclosures identifying the presence of a BESS system. Safety signage will be installed in accordance with Health and Safety (Safety Signs and Signals) Regulations 1996 (Ref 36). Signage will include details of:

- Relevant hazards posed;
- The type of technology associated with the BESS;
- Any suppression system fitted; and
- 24/7 Emergency contact information.

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

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

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

- The layout of buildings.
- Any areas where hazardous and flammable materials are stored on site (location of gas cylinders, process areas, chemicals, piles of combustible wastes, oil and fuel tanks).
- All permanent ignition sources within the Order Limits and show they are a minimum of 6 m away from combustible and flammable waste.
- Any areas where combustible waste is being treated or stored including non-waste material.
- All separation distances.
- Any areas where combustible liquid wastes are being stored.
- Any area where depollution of end of life vehicles (ELVs) takes place.
- Any area where crushing, shredding, baling of metals or ELVs takes place.
- Main access routes for fire engines and any alternative access.

- Access points around the perimeter of the Order Limits to assist firefighting.
- Hydrants and water supplies.
- Areas of natural and unmade ground.
- Drainage runs, pollution control features such as drain closure valves, and fire water containment systems such as bunded or kerbed areas (this may be easier to show on a separate drainage plan).
- Storage areas with pile dimensions and fire walls (where applicable) – this includes wastes stored in a building, bunker, or containers – include indicative pile layouts and ensure it is geographically representative.
- The location of fixed plant or storage location of mobile plants when not in use.
- The location of spill kits.
- The quarantine area.
- Anything site specific considered needing to be added.

4.3 Firefighting Water Supply

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

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

4.3.3 The BESS area design will contain a minimum of two firefighting water storage units of no less than 228,000 litres in capacity, capable of delivering 1900 litres per minute for 4 hours (exceeding NFCC guidance).

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

4.3.5 Fire hydrants and connections to any dry pipe systems that are installed on the BESS compound will be installed in accordance with BS 9990 Non-automatic Firefighting Systems in Buildings Code of Practice (Current Edition) (Ref 7) and should be identified in accordance with BS 3251 Indicator Plates for Fire Hydrants (Current Edition) (Ref 8).

4.3.6 Site and BESS design principles and ERP content will ensure that the CFRS are expected to employ a defensive strategy i.e. only boundary cooling should be employed for cooling of adjacent BESS or associated supporting equipment, this ensures that environmental pollution risks are minimised. Boundary cooling typically involves firefighters directing water fog or spray pattern discharge to ensure the incident does not spread to adjacent BESS enclosures. NFCC guidance (Ref 1) states: "*If it can be confirmed that the recommended firefighting tactic for the BESS is to defensively fire fight and boundary cool whilst allowing the BESS to consume itself, this will reduce the water requirements, and thus the drainage/environmental protection requirements significantly.*" A BESS design which may require direct CFRS firefighting engagement tactics will not be selected for this facility.

4.3.7 The BESS scheme will integrate an external firefighting water capture drainage system. In the event of a fire a system of automatically self-actuating valves at the outfalls from the BESS areas will be closed, isolating the BESS areas drainage from the wider environment. Fire water runoff may contain particles from a fire; the runoff must be contained and tested before being allowed to discharge to the local watercourses. The water contained by the valves will be tested and released or, if necessary, removed by tanker and treated offsite (in consultation with the relevant consultees at the time). Pollution analysis will always be conducted before removing from site (if polluted) or releasing into drainage systems, if safe to do so.

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

4.3.9 The provision for water storage tanks to be incorporated into the BESS area is included in the **Design Parameters and Principles Document [EN010141/DR/7.1]**.

4.4 Emergency planning

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

- Battery chemistry integrated into BESS – can provide fire and explosive risk profile.
- Battery form factor (cylindrical, pouch, prismatic).
- Battery energy Wh / kWh – confirmation of new battery cell (second life cells will not be accepted).

- Battery module cooling system details (e.g., liquid cooling design, air cooling design) – cooling system capability assessment to stop or reduce battery cell thermal runaway propagation. Air cooled designs will not be accepted for the Scheme.
- Battery module vent or gas exhaust specifications.
- Battery module kWh energy + number of cells contained in the module + battery circuitry details (number of cells in series vs number of cells in parallel).
- Direct suppression system details – direct module TRPP system, Fire protection direct injection system, or rack level FSS integration.
- Rack design – number of modules and kWh / MWh energy, spacing between modules, passive protection features, gas exhaust features, electrical isolation functions, heat or thermal runaway sensor integration, etc.
- Rack configuration – spacing to adjacent racks, number of racks in BESS, spacing to walls, doors, gas vents and roof.
- Type of BESS enclosure design e.g., container or cabinet, gas exhaust / ventilation features, deflagration vent design features, BESS enclosure level fire protection and suppression system details (proof of testing with BESS design and test data), additional fire or explosion protection features i.e., thermal barriers.
- EMS / BMS data monitoring capabilities and incident response integration capacity.
- Number of BESS enclosures on site.
- Size and MWh capacity of each BESS enclosure.
- BESS and ESS equipment spacing; spacing to other equipment, boundaries, vegetation, roads or access routes, fire hydrants / water tanks, site building structures, etc.
- Access routes, observation points, turning areas, FRS equipment and assets, water supply locations and capacity, drainage, and water capture design.

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

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

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

4.4.3 An ERP will be developed post planning consent to facilitate effective and safe emergency response. It will follow UK National Fire Chiefs Council (NFCC) (Ref 1) and NFPA 855 (Ref 3) guidelines and will include as a minimum:

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

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

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

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

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

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

4.5 Firefighting consequences

Firefighting techniques

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

4.5.2 The fire and rescue service (CFRS) in foreseeable and credible emergency response scenarios, would most likely adopt a defensive firefighting strategy by using water on neighbouring areas such as battery enclosures and structures to cool down and prevent further fire spread. As mandated by NFPA 855 (2026) (Ref 3), the Scheme will select a BESS design that has undertaken LSFT to demonstrate thermal insulation protection capabilities of the BESS enclosure design, validate minimum equipment spacing distances, and demonstrate that deflagrations do not occur and / or can be safely constrained. In accordance with NFCC guidance (Ref 1), the Scheme will be managed in such a way so as to prevent a fire spreading to the BESS or inadvertently fire loading, by providing a 'bridge' or path between BESS enclosures to transmit flaming or radiant heat.

4.5.3 As recommended in NFCC revised guidance (2024) (Ref 1), it is not anticipated that firefighting techniques will require direct hose streams or spray directly on battery systems, and techniques will be limited to boundary cooling of adjacent BESS enclosures and supporting equipment to prevent the fire from spreading. Ingress Protection (IP) ratings of BESS enclosures will be shared with CFRS so that risks associated with boundary cooling can be understood. This strategy will be finalised with the CFRS at the detailed design stage and be clearly communicated in the Emergency Response Plan (ERP).

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

Surface-water runoff

4.5.5 A fire affecting the BESS has the potential to mobilise pollutants in surface water runoff. As set out in the **outline Surface Water Management Plan [EN010141/DR/7.13]**, the BESS drainage system will be designed to isolate and contain such flows to prevent pollution of the surrounding environment. This will be achieved using an impermeable surface finish within the BESS compound leading to an attenuation basin. Outfalls from the BESS drainage system will be fitted with automatically actuated valves, which are connected to the BESS fire alarm system. In the event of a fire, these self-actuating valves will close, isolating the BESS drainage system and containing firewater runoff locally.

4.5.6 The surface water drainage system will be designed to attenuate runoff from the 1 in 100 year storm event plus a 40% climate change allowance. This capacity is expected to accommodate a reasonable worst-case scenario involving firewater runoff combined with a 1 in 10 year storm event. The BESS area design will contain a minimum of two firefighting water storage units of no less than 228,000 litres in capacity, capable of delivering 1900 litres per minute for 4 hours (exceeding NFCC guidance). This equates to a total volume of 360 cubic metres for the BESS area. Accordingly, the drainage design will provide sufficient capacity to contain either the full firefighting volume in combination with the 1 in 10 year storm event, or the 1 in 100 year plus climate change event on its own, whichever scenario is more onerous. Separate attenuation features dedicated to the BESS units may be required where certain suppression systems are installed, and final storage requirements will be agreed with the Fire and Rescue Service.

4.5.7 Following a fire event, retained water will be sampled and analysed to confirm whether pollution has occurred. If contaminated (polluted), the water will be removed from site by tanker for treatment at an appropriate offsite facility. If testing confirms that the water is suitable for discharge, it will be released to the local drainage network under controlled conditions, in consultation with the relevant regulators. This approach ensures that environmental protection is maintained under both normal and emergency conditions.

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

Smoke plume impacts

4.5.9 The BESS Fire Emissions Modelling Report (Plume Study) at Appendix A of this oBSMP assesses the battery fire emission impact in the five worst case fire locations (using the concept BESS design) on sensitive receptors within a 1 km radius of the BESS area. Typically, a BESS fire would be a relatively short-term incident, the plume study therefore compared predicted concentrations against Acute Exposure Guidance Levels (AEGLs), which have higher threshold concentrations than the national air quality objectives and are relevant to short term releases. AEGLs are expressed as concentrations of a substance above which it is predicted that the general population could experience, including susceptible individuals:

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

4.5.10 Based on the factors of distance to the nearest property, public rights of way (PROW), and road networks and the anticipated short-term nature of a fire incident, the assessment concludes that there will not be adverse effects at the closest receptor locations because of a BESS fire incident. Notwithstanding, at the detailed design stage a BESS system and site specific plume analysis study will be conducted to assess the environmental impact of a site incident to sensitive receptors within a 1 km radius. Toxic gas emissions to sensitive receptors must be below relevant public health exposure limit guidelines when the battery system of a BESS is fully consumed (burnt out), production of Particulate Matter (PM) and a visibility impact assessment on any transport links within a 1 km radius of the BESS area will also be included. The emergency response plan (ERP) produced at the detailed design stage (template outlined in section 4.4.3) will incorporate all necessary emergency response procedures and actions based upon thermal runaway test data supplied by the BESS system provider.

4.5.11 The plume study identifies the closest residential receptor is 478 metres from the BESS area, the closest PROW is 123 metres, and the closest road section is 557 metres. No significant off-site impacts were recorded with all toxic emission levels at sensitive receptor locations below AEGL 1 level, and smoke plume impacts on the road network are expected to be negligible i.e. no impact on stopping distances. From the plume study, it can be concluded that there is no impact due to toxic gas or visibility impairment on any sensitive receptor in the proximity of the proposed BESS area, arising from a reasonable worst-case (BESS Unit) fire. The effects of the fire are restricted to the proximity of the BESS, and the applicant selected the BESS site to incorporate conservative buffer zones to ensure minimal off-site impacts in credible BESS failure scenarios.

4.5.12 Notwithstanding, whilst there is very low risk of adverse air quality effects at the closest receptors, the Emergency Response Plan (ERP) produced at the detailed design stage will incorporate all necessary emergency response procedures and actions based upon thermal runaway test data supplied by the BESS system provider. The ERP could contain the following measures or protocols relating to air quality for sensitive receptors located downwind from a fire plume:

- Notification of potentially affected residents including advice on the health effects of smoke and ways to reduce exposure (e.g. close windows and stay indoors);
- Notification of potentially affected members of the public to move to a cleaner air location;

- Due to the BESS not having personnel access into the battery enclosures, there is unlikely to be any immediate threat to life arising from a BESS failure event.
- Cancellation of outdoor events and potentially moving affected residents to a cleaner air location; and
- Should there be a BESS fire in the closest proximity to the road, the site operator to determine wind direction and seek to close the road if deemed necessary i.e. any significant fire plume impact on traffic visibility.
- First responders are expected to wear full Personal Protection Equipment (PPE) for incident response, this is especially critical within the immediate area of the BESS enclosure that is on fire due to toxic gases potentially exceeding IDLH values at these distances. The residential areas and road sensitive receptors are sufficiently far away from the BESS compound to not be impaired by any of the simulated fires, in terms of visibility or toxicity.

5.0 PRE-CONSTRUCTION REQUIREMENTS

5.1 Summary

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

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

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

5.1.4 Comprehensive Hazard Mitigation Analysis (HMA) will be conducted by a BESS specialist independent Fire Protection Engineer following NFPA 855

(2026) (Ref 3) guidelines and recommendations to cover BESS system and site-specific safety issues. Typically, the main components of an HMA are:

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

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

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

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

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

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

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

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

- The detailed design, including drawings of the BESS;
- A statement on the battery system specifications, including fire detection and suppression systems;
- A statement on operational procedures and training requirements, including emergency operations;
- A statement on the overall compliance of the system with applicable legislation;

- An environmental risk assessment to ensure that the potential for indirect risks (e.g., through leakage or other emissions) is understood and mitigated; and
- Emergency Response Plan(s) covering construction, operation and decommissioning phases will be developed once a construction team, and an operator have been appointed. These plans will be developed in consultation with CFRS and other local emergency services to include the adequate provision of firefighting equipment onsite and ensure that fire, smoke, and any release of toxic gases from a thermal runaway incident does not significantly affect site operatives, first responders, and the local community.

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

5.1.11 Safe decommissioning of the BESS will be addressed prior to decommissioning of the scheme in a final Decommissioning Environmental Management Plan.

6.0 CONCLUSION

6.1 Summary

6.1.1 This outline Battery Safety Management Plan (oBSMP) has demonstrated in a systematic way the mitigation of the safety risks posed by the BESS that forms part of the Scheme.

6.1.2 The Applicant is committed to developing a BESS project incorporating equipment which provides optimal levels of performance and safety during its lifecycle.

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

6.1.4 The implementation of this oBSMP is secured through a Requirement in Schedule 2 of the DCO. This stipulates that a final Battery Safety Management Plan (BSMP) will be submitted to and approved by Huntingdon District Council and Cambridgeshire County Council, in consultation with CFRS, prior to commencement of the construction of the BESS. That plan will be substantially in accordance with this oBSMP.

7.0 REFERENCES

Ref 1 National Fire Chiefs Council (NFCC) 2024, Grid Scale Battery Energy Storage System planning – Guidance for FRS. Available at: https://nfcc.org.uk/consultation/draft-grid-scale-energy-storage-system-planning-guidance/ (accessed 31/09/2025).

Ref 2 The Health and Safety Executive 2024, Using personal protective equipment (PPE) to control risks at work. Available at: https://www.hse.gov.uk/ppe/managing-risk-using-ppe.htm (accessed 31/09/2025)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

EAST PARK ENERGY

East Park Energy

EN010141

Appendix A: BESS Fire Emissions Modelling

Document Reference: EN010141/DR/7.10

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009: Regulation 5(2)(q)

September 2025

Version P01

EAST PARK ENERGY

Planning Act 2008

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

BESS Fire Emissions Modelling

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Application Document Number:	EN010141/DR/7.10
Author:	Arcadis Consulting (UK) Ltd

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CONTENTS

EXECUTIVE SUMMARY

The Battery Energy Storage System (BESS) has the potential to cause air quality impacts in the rare result of a fire incident. Concentrations of carbon monoxide (CO), formaldehyde, hydrogen chloride (HCl), hydrogen cyanide (HCN), hydrogen fluoride (HF), ammonia (NH_3), nitrogen dioxide (NO_2) and particulates from a potential BESS fire have been modelled using an air quality dispersion model to determine the likely effects on human health.

A high-level visibility assessment has also been undertaken using the modelled particulates results to determine the effect of BESS fire emissions on visibility on the local road network to inform the **outline Battery Safety Management Plan (oBSMP) [EN010141/DR/7.10]**.

The predicted maximum particulate matter greater than 10 microns in diameter (PM_{10}) concentrations were all well below the 8-hour Health and Safety Executive (HSE) Workplace Exposure Limit (WEL) and the predicted maximum CO concentrations were well below the relevant World Health Organisation (WHO) guideline values for all exposure periods. All other pollutant maximum concentrations were below their respective level 1 Acute Exposure Guidance Levels (AEGLs) for all exposure periods.

The lowest visibility predicted on the road closest to the BESS Area (the B645) was approximately 3.8km, which is considerably further than vehicle stopping distance at the national speed limit for this road.

Based on the factors of distance to the nearest locations of human exposure and the anticipated short-term nature of a fire incident, the assessment concludes that there would be no significant air quality or visibility effects as a result of a BESS fire incident.

1.0 INTRODUCTION

1.1.1 The Battery Energy Storage System (BESS) has the potential to cause air quality impacts in the rare result of a fire incident. Concentrations of carbon monoxide (CO), formaldehyde, hydrogen chloride (HCl), hydrogen cyanide (HCN), hydrogen fluoride (HF), ammonia (NH_3), nitrogen dioxide (NO_2) and particulates from a potential BESS fire have been modelled using an air quality dispersion model to determine the likely effects on human health.

1.1.2 A high-level visibility assessment has also been undertaken using the modelled particulates results to determine the effect of BESS fire emissions on visibility on the local road network to inform the **outline Battery Safety Management Plan (oBSMP) [EN010141/DR/7.10]**.

1.1.3 The following sections outline the methodology used in the assessment and the modelling results.

2.0 ASSESSMENT METHODOLOGY

2.1 Relevant Guidance and Standards

2.1.1 **ES Volume 1 Chapter 11: Air Quality [EN010141/DR/6.1]** provides an overview of the legislation and planning policy against which the Scheme has been considered for air quality.

2.1.2 The assessment has been undertaken with due consideration of the Environment Agency's (EAs) 'Air emissions risk assessment for your Environmental Permit' guidance (Ref 1), which provides advice on assessing releases to air. Whilst this guidance is used for dispersion modelling for environmental permitting purposes, it includes useful general guidance on undertaking detailed modelling of emissions to air.

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

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

2.1.4 The occurrence of adverse health effects is not likely to occur in the general public at concentrations below the AEGLs. AEGLs have a range of exposure periods ranging from 10 minutes to 8 hours, and public exposure over every AEGL averaging period has been considered in this assessment. The AEGLs are presented in Table 1 and are expressed in units of parts per million (ppm) but have been converted into units of microgram per cubic meter ($\mu g/m^3$) to allow direct comparison against predicted concentrations (as background concentrations and model outputs are provided in $\mu g/m^3$).

Table 1: AEGLs for the Modelled Pollutants (Ref 2)

Pollutant	10 Minutes (ppm)			30 Minutes (ppm)			1 Hour (ppm)			4 Hour (ppm)			8 Hour (ppm)		
	AEGL 1	AEGL 2	AEGL 3	AEGL 1	AEGL 2	AEGL 3	AEGL 1	AEGL 2	AEGL 3	AEGL 1	AEGL 2	AEGL 3	AEGL 1	AEGL 2	AEGL 3
CO	NR*	420	1700	NR	150	600	NR	83	330	NR	33	150	NR	27	130
Formaldehyde	0.9	14	100	0.9	14	70	0.9	14	56	0.9	14	35	0.9	14	35
HCl	1.8	100	620	1.8	43	210	1.8	22	100	1.8	11	26	1.8	11	26
HCN	2.5	17	27	2.5	10	21	2	7.1	15	1.3	3.5	8.6	1	2.5	6.6
HF	1	95	170	1	34	62	1	24	44	1	12	22	1	12	22
NH_3	30	220	2700	30	220	1600	30	160	1100	30	110	550	30	110	390
NO_2	0.5	20	34	0.5	15	25	0.5	12	20	0.5	8.2	14	0.5	6.7	11
Pollutant	**10 Minutes (µg/m^3)**			**30 Minutes (µg/m^3)**			**1 Hour (µg/m^3)**			**4 Hour (µg/m^3)**			**8 Hour (µg/m^3)**		
	AEGL 1	**AEGL 2**	**AEGL 3**	**AEGL 1**	**AEGL 2**	**AEGL 3**	**AEGL 1**	**AEGL 2**	**AEGL 3**	**AEGL 1**	**AEGL 2**	**AEGL 3**	**AEGL 1**	**AEGL 2**	**AEGL 3**
CO	NR	48,1153	19,47526	NR	171,840	687,362	NR	95,085	378,049	NR	37,805	171,840	NR	30,931	148,928
Formaldehyde	1105	17,195	122,822	1105	17,195	85,975	1105	17,195	68,780	1105	17,195	42,988	1105	17,195	42,988
HCl	2684	149,121	924,548	2684	64,122	313,153	2684	32,807	149,121	2684	16,403	38,771	2684	16,403	38,771
HCN	2764	18,794	29,849	2764	11,055	23,216	2211	7849	16,583	1437	3869	9507	1106	2764	7296
HF	818	77,748	139,129	818	27,826	50,741	818	19,642	36,010	818	9821	18,005	818	9821	18,005
NH_3	20,896	153,235	1,880,613	20,896	153,235	1,114,438	20,896	111,444	766,176	20,896	76,618	383,088	20,896	76,618	271,644
NO_2	941	37,636	63,981	941	28,227	47,045	941	22,582	37,636	941	15,431	26,345	941	12,608	20,700

**NR = Not recommended due to insufficient data*

2.1.5 There is no AEGL for particulates. As such, the Health and Safety Executive (HSE) Workplace Exposure Limit (WEL) (Ref 3) has been used, which is $4mg/m^3$ for respirable dust. Whilst this is over an 8-hour reference period, it is considered appropriate for use in the assessment in lieu of any other limits.

2.1.6 In the absence of an AEGL 1 threshold for CO, CO concentrations have been compared against the World Health Organisation (WHO) CO guideline values of $100mg/m^3$ for 15-minute average, $35mg/m^3$ for 1-hour average and $10mg/m^3$ for 8-hour average (Ref 4), which is a lower threshold concentration than AEGL 2 and 3. The WHO air quality guidelines are a set of evidence-based recommendations of limit values for specific air pollutants developed to help countries achieve air quality that protects public health.

2.1.7 The impact of the smoke plume on visibility has been calculated based on the mass concentration of particulate matter, using the following equation developed in the Principles of Smoke Management (Ref 5):

S = K / αm mp

Where:

S = visibility through smoke (m).

K = proportionality constant; a value of 3 has been used in the assessment which is applicable to the observation of a non-light emitting object in smoke.

αm = specific extinction coefficient (m^2/g); a value of $7.6m^2/g$ has been used in the assessment based on flaming combustion of wood and plastics (as opposed to smouldering which has lower αm value).

mp= mass concentration of particulate matter (g/m^3); a value has been calculated using the modelled PM_{10} concentration associated with the BESS fire.

2.1.8 It should be noted that the visibility through smoke equation outlined above is based on certain assumptions and therefore has inherent limitations, for example the extinction coefficient will depend on the particle size distribution and optical properties of the particulates. The output of the visibility calculations should therefore be treated with caution and used as a guide only.

2.2 Study Area

2.2.1 There is no guidance that exists on the assessment of emissions from BESS fires. For the purposes of this assessment, a study area of 1km from the BESS Area has been used, based on professional experience of assessing emissions from similar schemes, and based on air quality assessments undertaken for fires at similar BESS sites such as Green Hill Solar Farm (Ref 6). The BESS fire emissions assessment study area is presented below in Figure 1.

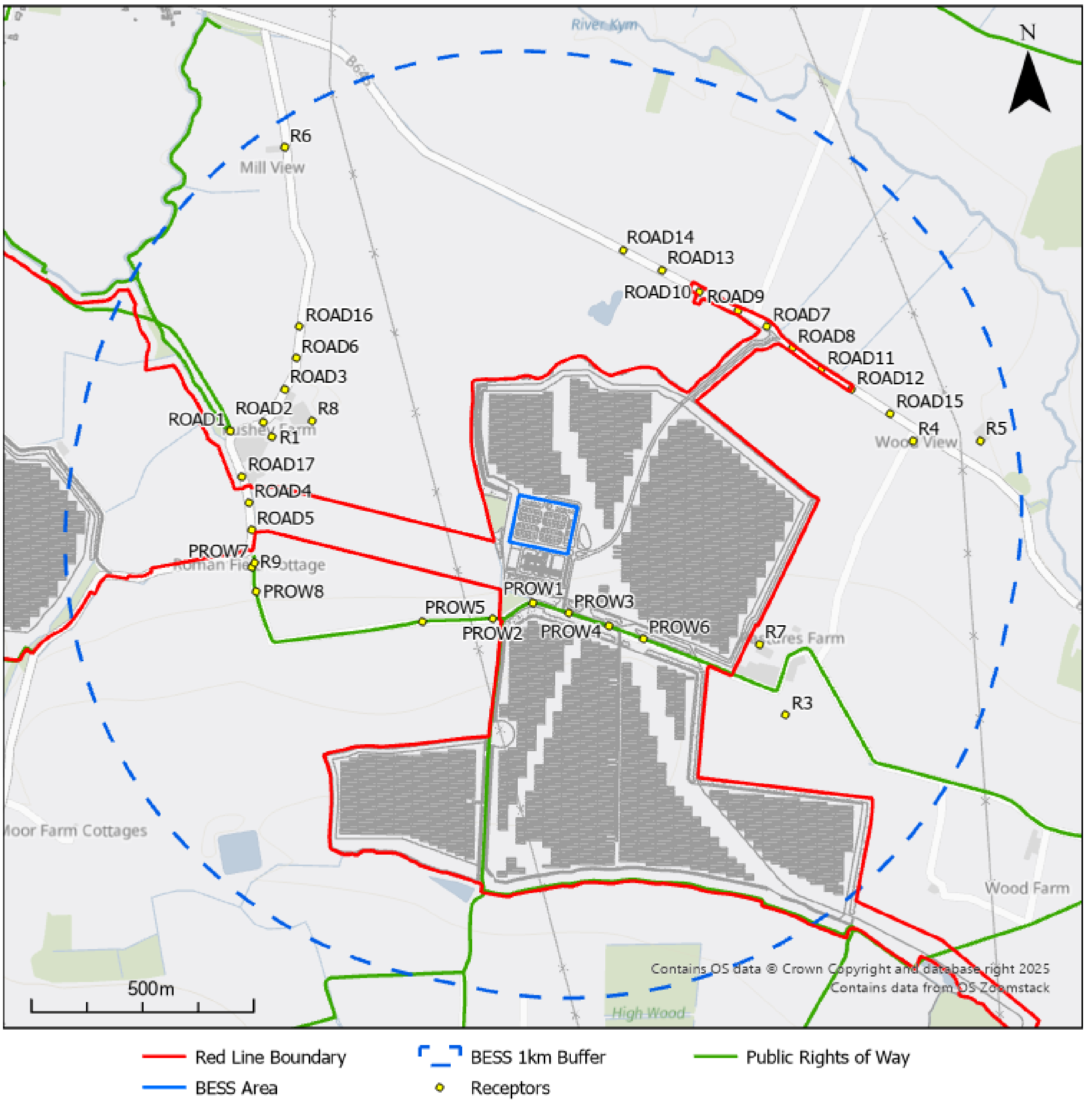

Figure 1: BESS Fire Emissions Assessment Study Area and Receptor Locations

2.3 Modelling Parameters

Input Data

2.3.1 ses hourly meteorological data to define conditions for plume rise, transport and diffusion of pollutants. It estimates the concentration for each source and receptor combination for each hour of input meteorology and calculates user-selected long-term and short-term averages.

2.3.2 The BESS Area would be situated within East Park Site D as illustrated on **ES Vol 3 Figure 2-1: Illustrative Environmental Masterplan**

[EN010141/DR/6.3]. The battery storage units would be located within the area identified as Work No. 2 on the **Works Plan [EN010141/DR/2.3]**. The precise number of BESS enclosures will depend upon the level of power capacity of energy storage that the Scheme will require.

2.3.3 The final layout of the BESS Area will be determined during detailed design. For the purpose of this assessment, five worst case BESS fire locations (i.e. locations within the BESS Area closest to sensitive receptors) have been modelled as depicted in Figure 2. The arrangement of the BESS has not been finalised, therefore the maximum extent of the BESS Area has been used as a worst case.

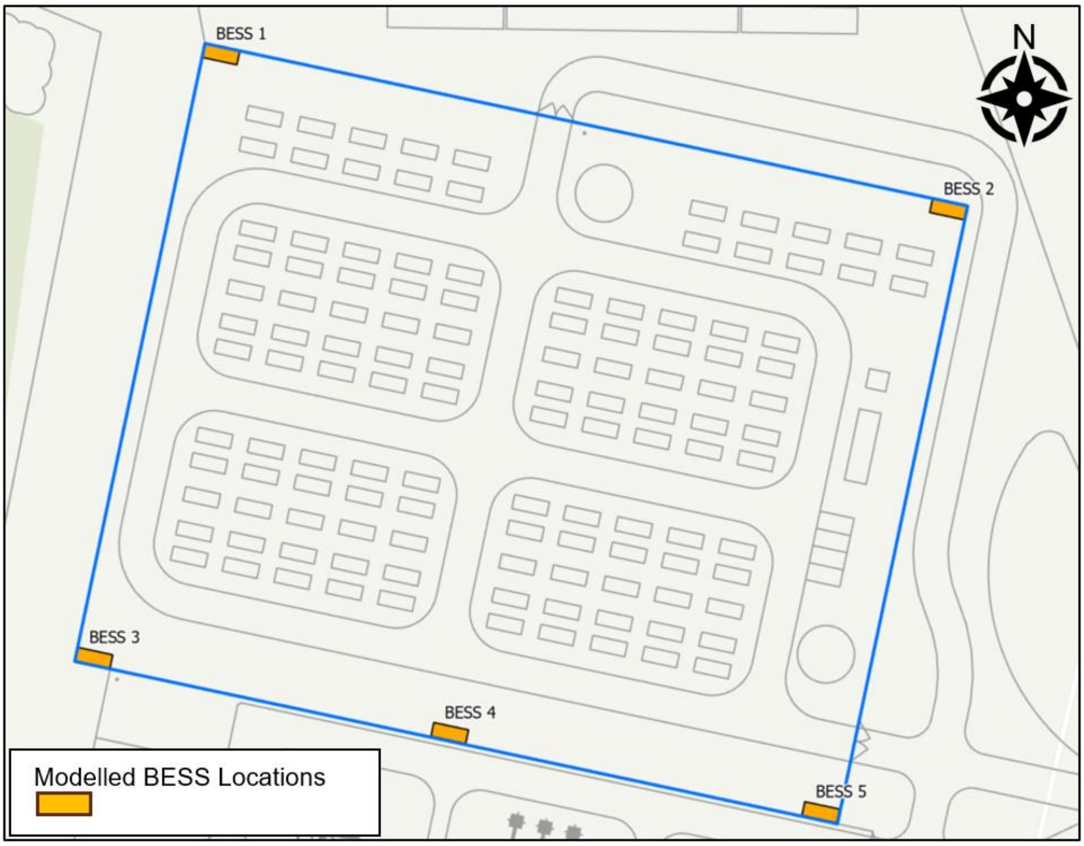

Figure 2: Modelled BESS Fire Locations

2.3.4 Each of the five BESS fire locations have been modelled as an area source so that plume rise was factored into the model (the model does not allow for plume rise for volume sources). The area source dimensions have been based on the dimensions of one BESS enclosure (6.1m long and 2.4m wide).

2.3.5 Emissions data for BESS fires are limited. At the recommendation of the Applicant's Battery Safety and Testing Consultant, emissions data have been derived from the GridSolv Quantum Cube Bespoke Unit Testing Summary Report, prepared by Fire & Risk Alliance LLC for Wartsila North America, Inc. (Ref 7). The test fire was conducted using Large Format Prismatic (LFP) lithium iron phosphate battery modules; each module comprised 52 cells and each rack comprised eight modules. Emissions from a test fire were measured using a probe approximately 3.35m above ground level. The maximum recorded concentrations are presented in Table 2. It should be noted that the report presents concentrations for other gases (such as carbon dioxide and methane), however, only gases considered the most harmful to human health have been considered in this assessment.

Table 2: Maximum Gas Concentrations Measured above the Initiating Unit (Ref 7)

Pollutant	Maximum Concentration (ppm)
CO	330
Formaldehyde	56
HCl	100
HCN	15
HF	44
NH_3	1,100
Nitric Oxide (NO)	20

2.3.6 Emissions data were not available in the report for particulates. As such, at the recommendation of the Applicant's Battery Safety and Testing Consultant, particulate emissions data were taken from the Axminster Energy Hub Plume Assessment Study prepared by DNV for Clearstone Energy (Ref 8). The assessment assumed that a battery unit fire is equivalent to a diesel fire for production of Particulate Matter and used a concentration of 0.25g/m^3. The height at which the concentration was measured was not reported, therefore the same height as that reported in the Quantum Cube Bespoke Unit Testing Summary Report (Ref 7) has been assumed (3.35m).

2.3.7 The Quantum Cube Bespoke Unit Testing Summary Report (Ref 7) did not report a maximum temperature at the sampling point. As such, the maximum recorded temperature from the roof of another test fire was utilised, at the recommendation of the Scheme's Battery Safety and Testing Consultant. The Sungrow BESS PowerTitan 2.0 Large Scale Burn Test Report prepared by DNV for Sungrow Power Supply Co., Ltd. (Ref 9) reported a maximum roof temperature of 914°C. In lieu of any other suitable data, this was used for the temperature. Roof temperatures can reach 1300°C during a fire; it is therefore considered that using a temperature of 914°C is a conservative estimate as a higher temperature would be expected to increase the buoyancy and aid dispersion.

2.3.8 When modelling a fire in ADMS, the height of the release should be the height of the flames. Maximum flame heights of around 4m were reported in the Sungrow BESS PowerTitan 2.0 Large Scale Burn Test Report (Ref 9). However, this exceeds the height of the sampling point, therefore the height of the release was assumed to be 3.35m (height of the sampling point). This is considered a conservative estimate as a higher release height would generally result in increased dispersion.

2.3.9 The plume rise is primarily buoyancy-driven rather than being mechanically expelled like a stack, as such a nominal value of 1m/s has been used for the velocity to activate the plume rise module (which would not activate if the velocity was 0m/s).

Meteorological Data and Surface Characteristics

2.3.10 Meteorological data recorded at Bedford meteorological station was used for the air quality modelling as this was the closest, most appropriate station with good data capture for the desired time period. Bedford meteorological station is located approximately 10km south-west of the BESS Area, at Bedford Aerodrome and is predominantly surrounded by open agricultural land. In accordance with the EA guidance (Ref 1), models have been run using five years of meteorological data, from 2020 to 2024 inclusive. The meteorological data was obtained from Air Pollution Services which provided hourly meteorological data for each year.

2.3.11 Wind roses for each of the years are presented in Figure 3 to Figure 7. These show that the prevailing wind is from the south-west.

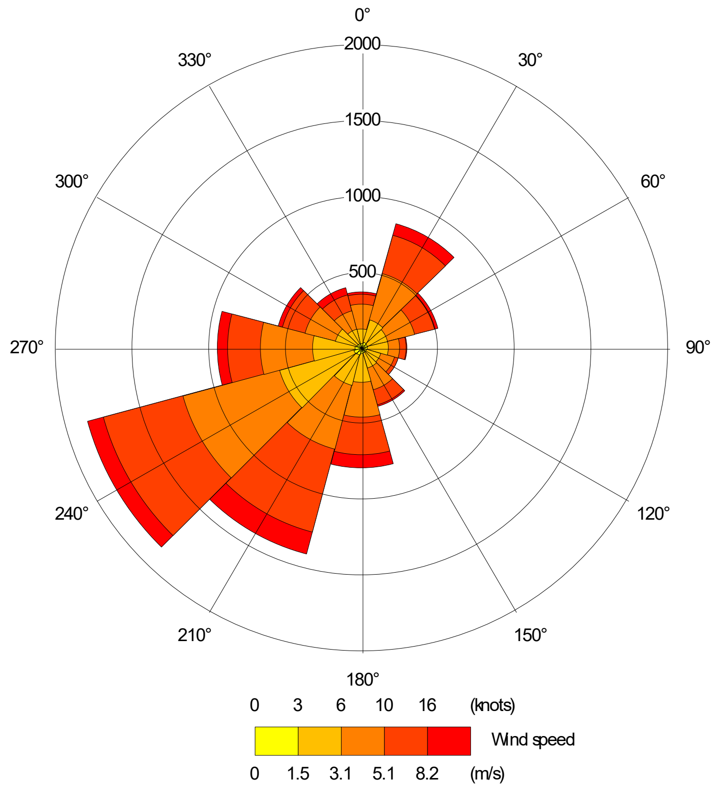

Figure 3 2020 Wind Rose for Bedford Meteorological Station

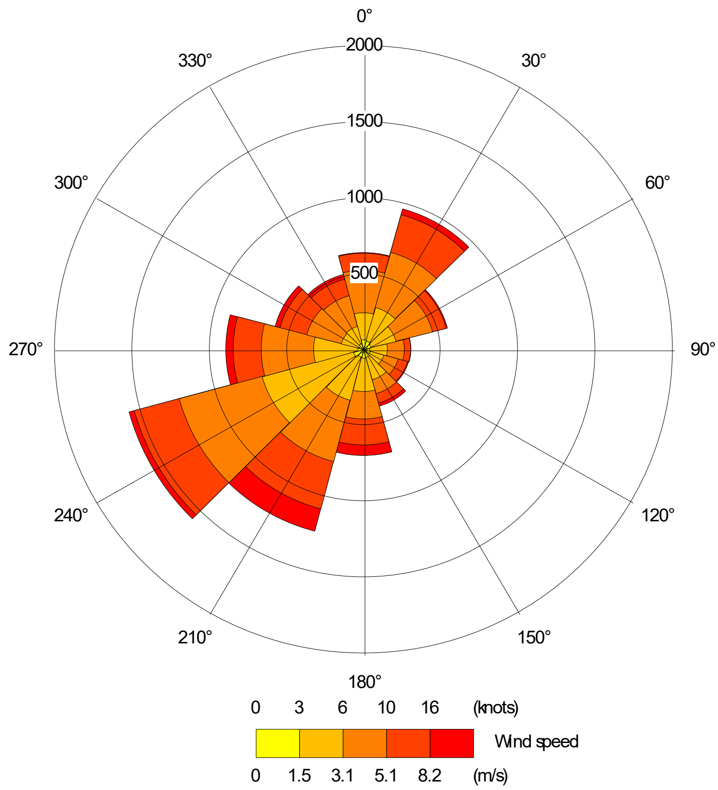

Figure 4 2021 Wind Rose for Bedford Meteorological Station

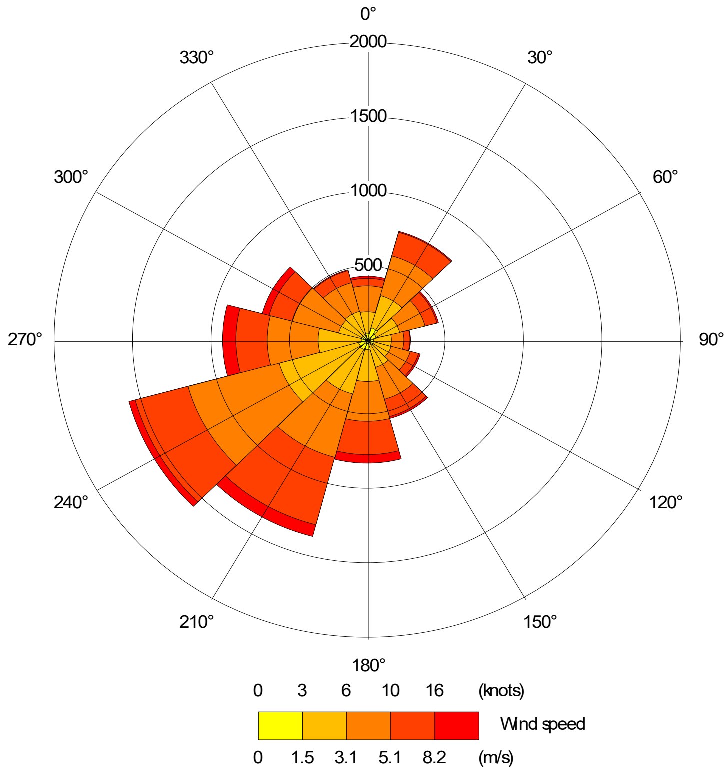

Figure 5 2022 Wind Rose for Bedford Meteorological Station

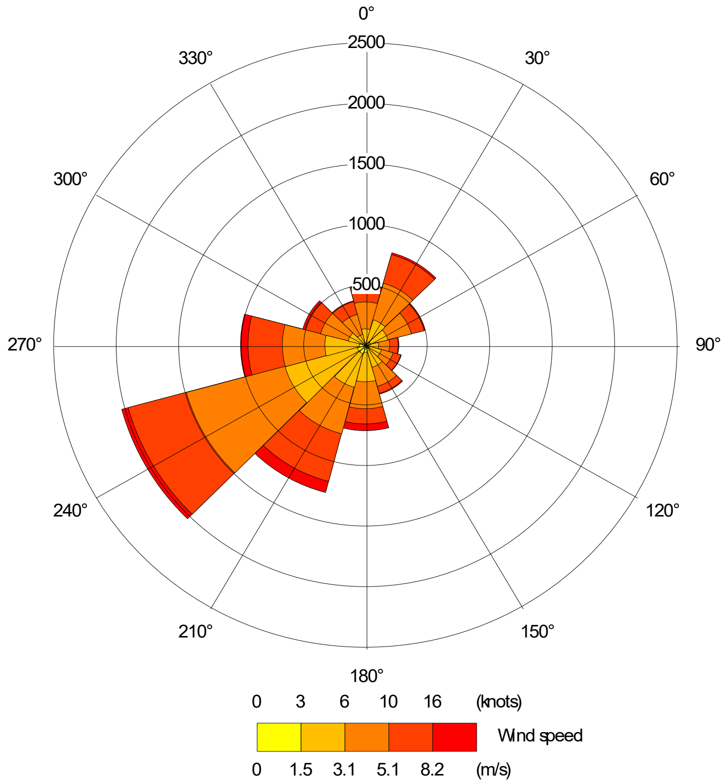

Figure 6 2023 Wind Rose for Bedford Meteorological Station

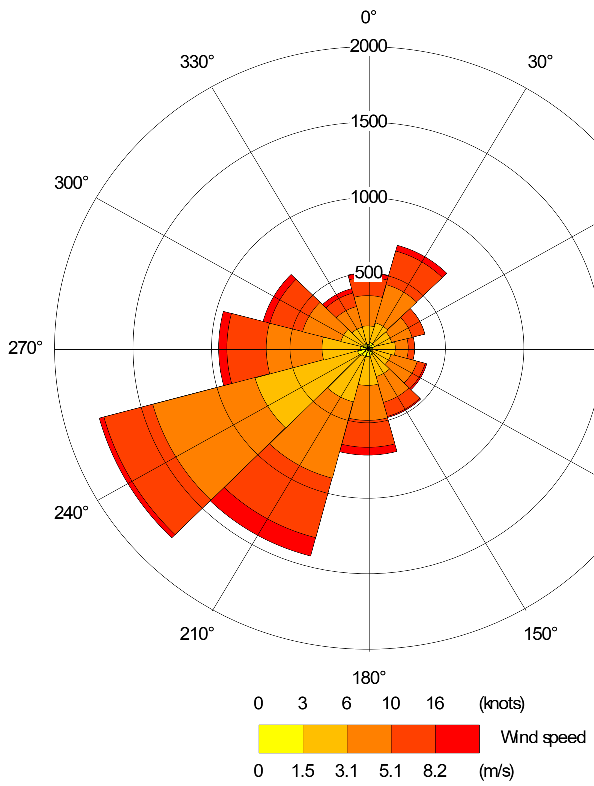

Figure 7 2024 Wind Rose for Bedford Meteorological Station

2.3.12 A surface roughness of 0.3m and minimum Monin-Obukhov length of 10m was used to represent the predominantly agricultural/rural surroundings of the Scheme. These parameters, which are determined by land use, influence wind patterns and atmospheric turbulence affect pollution dispersion. These values were selected as they were judged to be most representative of the predominant land use dispersion characteristics across the Study Area.

2.3.13 Terrain data has been incorporated into the model using 50m x 50m resolution terrain data from the Ordnance Survey (OS) OS Terrain 50 dataset. The terrain file covers the Scheme and its surroundings.

Emission Rates

2.3.14 The data presented in Table 2 are measured concentrations at a point 3.35m above ground level. Emission rates of $1g/m^2/s$ were initially used in the model, together with the parameters discussed above (summarised in Table 3).

Table 3: Parameters used to Derive Emission Rates for use in the Assessment

<table>
<tr><th colspan="2">Parameter</th><th>Model Inputs</th></tr>
<tr><td colspan="2">Area source geometry</td><td>6.1m long and 2.6m wide</td></tr>
<tr><td colspan="2">Release height</td><td>3.35m</td></tr>
<tr><td colspan="2">Velocity</td><td>1m/s</td></tr>
<tr><td colspan="2">Temperature</td><td>914°C</td></tr>
<tr><td rowspan="8">Emission Rate</td><td>CO</td><td rowspan="8">1 g/m²/s</td></tr>
<tr><td>Formaldehyde</td></tr>
<tr><td>HCl</td></tr>
<tr><td>HCN</td></tr>
<tr><td>HF</td></tr>
<tr><td>NH3</td></tr>
<tr><td>NO</td></tr>
<tr><td>PM10</td></tr>
</table>

2.3.15 The resulting concentrations were then compared with the measured concentrations to derive pollutant specific ratios. These ratios were applied to the preliminary emission rates (1g/m^2/s) to derive the emission rates that were used in the assessment. A test model was then set up using the derived emission rates to ensure that the predicted concentrations at the sampling point matched the measured concentrations. The emission rates were then adjusted to scale based on the BESS unit area for the East Park Energy Scheme (6.1m long and 2.4m wide). The derived emission rates used in the model are presented in Table 4.

Table 4: Derived Emission Rates used in the Assessment

Pollutant	Emission Rate (g/m^2/s)
CO	6.80
Formaldehyde	0.19

Pollutant	Emission Rate ($g/m^2/s$)
HCl	0.33
HCN	0.12
HF	0.91
NH_3	0.03
NO	0.14
PM_{10}	0.48

Receptors

2.3.16 Human receptors have been identified in the vicinity of the Scheme using Google Earth imagery and OS mapping. Worst case receptors have been selected at locations closest to the BESS Area where the public could be exposed to emissions from a potential BESS fire. These include residential properties and public rights of way (PROW). The receptor locations are presented in Table 5 and in Figure 1.

Table 5: Receptor Locations

Receptor	X (m)	Y (m)	Z (m)	Distance to BESS Area (m)
R1	513678	263541	1.5	573
R2	514855	263112	1.5	536
R3	514837	262915	1.5	611
R4	515121	263533	1.5	769
R5	515274	263534	1.5	919
R6	513707	264193	1.5	944
R7	514777	263075	1.5	478
R8	513770	263578	1.5	495
R9	513635	263248	1.5	581
PROW1	514268	263168	1.5	123

Receptor	X (m)	Y (m)	Z (m)	Distance to BESS Area (m)
PROW2	514176	263132	1.5	177
PROW3	514347	263145	1.5	132
PROW4	514438	263115	1.5	187
PROW5	514017	263127	1.5	266
PROW6	514516	263086	1.5	256
PROW7	513639	263257	1.5	577
PROW8	513642	263194	1.5	582

2.3.17 Worst case locations on roads in the vicinity of the BESS Area were selected for the visibility assessment, as detailed in Table 6 below.

Table 6: Visibility Assessment Locations

Receptor	X (m)	Y (m)	Z (m)	Distance to BESS Area (m)
ROAD1	513586	263555	1.5	666
ROAD2	513661	263573	1.5	598
ROAD3	513707	263650	1.5	581
ROAD4	513626	263393	1.5	594
ROAD5	513633	263332	1.5	582
ROAD6	513734	263718	1.5	589
ROAD7	514795	263790	1.5	591
ROAD8	514852	263742	1.5	603
ROAD9	514728	263825	1.5	571
ROAD10	514641	263868	1.5	557
ROAD11	514917	263692	1.5	631
ROAD12	514984	263647	1.5	671
ROAD13	514558	263918	1.5	568

Receptor	X (m)	Y (m)	Z (m)	Distance to BESS Area (m)
ROAD14	514471	263961	1.5	587
ROAD15	515072	263594	1.5	736
ROAD16	513742	263790	1.5	623
ROAD17	513612	263452	1.5	619

Model Outputs

2.3.18 The model has been used to predict the maximum 10-minute, 30-minute, 1-hour, 4-hour and 8-hour mean pollutant concentrations that would occur at each receptor, based on five years of meteorological data. These maximum concentrations have been compared against the AEGLs shown in Table 1. This approach is considered to be worst-case, as it assumes that a potential fire incident occurs at the same time that the meteorological conditions are poorest for pollution dispersion.

Background Concentrations

NO_2 and PM_{10}

2.3.19 Defra predicted annual mean background maps provided in 1km x 1km grid squares (Ref 10) have been used to determine background pollutant concentrations for NO_2 and PM_{10} for each receptor location. Base year concentrations (2025) have been used as a worst case as concentrations are predicted to reduce in future years.

CO

2.3.20 Defra Pollution Climate Mapping predicted annual mean background maps provided in 1km x 1km grid squares (Ref 10) have been used to determine background pollutant concentrations for CO for each receptor location. The latest year available from the maps is 2010, and maximum 8-hour mean background concentrations were used rather than annual mean concentrations, which is a worst-case assumption.

NH_3

2.3.21 The Air Pollution Information System (APIS) annual mean background maps provided in 1km x 1km grid squares (Ref 11) have been used to determine background pollutant concentrations for NH_3 for each receptor location. The concentrations represent a three-year average for the period 2020 to 2022.

Formaldehyde

2.3.22 As described by the UK Health Security Agency (Ref 12), concentrations of formaldehyde in ambient air are generally below 10µg/m^3; but may reach 20µg/m^3 in urban or industrial areas. Given the rural land use surrounding the Scheme, an annual mean background concentration of 10µg/m^3 has been used at all receptors in the assessment.

HF

2.3.23 Very little data exists on concentrations of HF in UK ambient air, but concentrations are expected to be extremely low. An annual mean HF concentration of between 0.06 and 0.23µg/m^3 was monitored at a UK HF production site between 1991 and 1994 (Ref 13). In the absence of any other data, a background HF concentration of 0.23µg/m^3 has been used for all receptors in the assessment, which is expected to be worst-case given the nature of the measurements.

HCl

2.3.24 The latest annual mean background HCl concentration measured from Rothamsted has been used, which corresponds with the year 2015 (Ref 10). Rothamsted is part of the UKEAP: Acid Gas and Aerosol Network and is the nearest site with data to the Scheme. An annual mean HCl concentration of 0.28µg/m^3 was measured at this site in 2015 which has been used at all receptors.

HCN

2.3.25 No information is available on background concentrations of HCN, but the concentrations are expected to be negligible and have been assumed to be zero in the assessment.

Short Term Background Concentrations

2.3.26 In accordance with the EA guidance (Ref 1), it has been assumed that the short-term background concentration of a substance is twice its long-term concentration. As such, all the background concentrations described above were doubled to approximate the short-term background concentrations corresponding with the AEGL exposure periods shown in Table 1. The background concentrations used in the assessment are presented in Table 7. These background concentrations were added to the model outputs to calculate the total concentration for comparison against the AEGLs.

Table 7: Estimated Short Term Background Concentrations

Receptor	Short Term Background Concentration (µg/m³)							
	CO	Formaldehyde	HCl	HCN	HF	NH_3	NO_2	PM_{10}
R1	2864.2	20.0	0.6	0.0	0.5	3.2	10.9	26.4
R2	2867.1	20.0	0.6	0.0	0.5	3.2	11.1	25.1
R3	2867.7	20.0	0.6	0.0	0.5	3.2	11.1	24.5
R4	2872.0	20.0	0.6	0.0	0.5	3.2	11.1	25.5
R5	2872.0	20.0	0.6	0.0	0.5	3.2	11.1	25.5
R6	2874.1	20.0	0.6	0.0	0.5	3.2	11.1	24.1
R7	2867.1	20.0	0.6	0.0	0.5	3.2	11.1	25.1
R8	2864.2	20.0	0.6	0.0	0.5	3.2	10.9	26.4
R9	2864.2	20.0	0.6	0.0	0.5	3.2	10.9	26.4

Receptor	Short Term Background Concentration (µg/m^3)							
	CO	Formaldehyde	HCl	HCN	HF	NH_3	NO_2	PM_{10}
PROW1	2867.1	20.0	0.6	0.0	0.5	3.2	11.1	25.1
PROW2	2867.1	20.0	0.6	0.0	0.5	3.2	11.1	25.1
PROW3	2867.1	20.0	0.6	0.0	0.5	3.2	11.1	25.1
PROW4	2867.1	20.0	0.6	0.0	0.5	3.2	11.1	25.1
PROW5	2867.1	20.0	0.6	0.0	0.5	3.2	11.1	25.1
PROW6	2867.1	20.0	0.6	0.0	0.5	3.2	11.1	25.1
PROW7	2864.2	20.0	0.6	0.0	0.5	3.2	10.9	26.4
PROW 8	2864.2	20.0	0.6	0.0	0.5	3.2	10.9	26.4
ROAD1*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	26.4
ROAD2*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	26.4
ROAD3*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	26.4
ROAD4*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	26.4
ROAD5*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	26.4
ROAD6*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	26.4
ROAD7*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	25.1
ROAD8*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	25.1
ROAD9*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	25.1
ROAD10*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	25.1
ROAD11*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	25.1
ROAD12*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	25.1
ROAD13*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	25.1
ROAD14*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	25.1
ROAD15*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	25.5
ROAD16*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	26.4

Receptor	Short Term Background Concentration (µg/m³)							
	CO	Formaldehyde	HCl	HCN	HF	NH_3	NO_2	PM_{10}
ROAD17*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	26.4

Background concentrations have been rounded to one decimal place. *Receptors only considered in visibility assessment, therefore only PM_{10} background required.

Unit Conversion

2.3.27 AEGL concentrations are expressed in units of ppm, whereas ADMS-6 outputs are provided in units of µg/m³ and background concentrations are also typically provided in µg/m³. To convert the AEGLs into µg/m³ for comparison against the modelled concentrations, the following equation was used:

AEGL (µg/m³) = molecular weight x AEGL (ppb) ÷ 24.45

2.3.28 The molecular weights for each pollutant used in the assessment are as follows:

- CO - 28.01;
- Formaldehyde - 30.03;
- HCL - 36.46;
- HCN - 27.03;
- HF - 20.01;
- NH_3 - 17.03; and
- NO - 30.01.

3.0 RESULTS

3.1 Human Health

3.1.1 The concentrations presented in Table 8 to Table 12 are the maximum total concentrations predicted at receptors for 10-minute, 30-minute, 1-hour, 4-hour and 8-hour AEGL averaging periods, respectively. These results represent the highest concentrations predicted across five years of meteorological data. The final column of the table indicates which BESS fire location resulted in the maximum pollutant concentrations at each receptor. The results indicate that the highest concentrations for all pollutants were predicted at receptor PROW1 and resulted from a fire at the BESS 4 location. PROW1 is a receptor point corresponding with a public right of way, 123m to the south of BESS 4.

3.1.2 The predicted maximum PM_{10} concentrations were all well below the 8-hour HSE WEL and the predicted maximum CO concentrations were well below the relevant WHO guideline values for all exposure periods. All other pollutant maximum concentrations were below AEGL level 1 (notable discomfort, irritation, or certain asymptomatic non-sensory effects) for all exposure periods.

3.1.3 It should be noted that emissions data was available for NO rather than NO_2. However, there are no AEGLs available for NO and the AEGL guidelines state that “AEGL values for nitrogen dioxide should be used for emergency planning” rather than NO (Ref 2). As such, for the purposes of this assessment, it has been assumed that 100% of the modelled NO concentrations are NO_2, which is a worst-case assumption given that not all NO would be oxidised to NO_2, particularly over shorter averaging periods.

Table 8: Maximum Modelled 10-Minute Mean Concentrations including Backgrounds

Receptor	Maximum 10-Minute Mean Concentration including Background (µg/m³)								Corresponding BESS Location
	CO	Formaldehyde	HCl	HCN	HF	NH_3	NO_2	PM_{10}	
R1	3839.3	46.6	48.0	16.8	131.5	7.8	31.2	95.9	BESS 1
R2	3953.7	49.6	53.5	18.7	146.4	8.3	33.7	102.6	BESS 2
R3	3825.7	46.1	47.2	16.5	129.2	7.7	31.0	92.8	BESS 5
R4	3805.3	45.4	46.0	16.0	125.8	7.6	30.5	92.0	BESS 4
R5	3829.4	46.1	47.2	16.4	129.1	7.7	31.0	93.8	BESS 1
R6	3798.2	45.2	45.6	15.9	124.6	7.6	30.3	90.0	BESS 3
R7	4055.0	52.4	58.4	20.4	160.0	8.8	35.8	109.8	BESS 5
R8	3960.7	49.9	53.9	18.8	147.8	8.4	33.7	104.6	BESS 1
R9	3798.2	45.4	46.0	16.0	125.9	7.6	30.3	93.0	BESS 4
PROW1	8580.3	175.7	278.5	98.1	767.8	30.1	129.9	432.4	BESS 4
PROW2	6580.8	121.2	181.3	63.8	499.3	20.7	88.3	289.9	BESS 3
PROW3	8329.4	168.8	266.3	93.8	734.1	28.9	124.6	414.5	BESS 5
PROW4	6325.2	114.2	168.8	59.4	464.9	19.5	83.0	271.6	BESS 5
PROW5	5013.5	78.5	105.0	36.9	288.8	13.3	55.7	178.1	BESS 3
PROW6	6002.9	105.4	153.1	53.9	421.7	18.0	76.3	248.7	BESS 5
PROW7	3796.0	45.4	45.9	16.0	125.7	7.6	30.3	92.8	BESS 4
PROW8	3780.9	45.0	45.2	15.7	123.6	7.5	30.0	91.8	BESS 3
Maximum	**8580.3**	**175.7**	**278.5**	**98.1**	**767.8**	**30.1**	**129.9**	**432.4**	**BESS 4**
AEGL 1 (µg/m³)	***100,000**	**1105**	**2684**	**2764**	**818**	**20,986**	**941**	****4000**	**-**
Maximum as % AEGL 1	***8.6%**	**15.9%**	**10.4%**	**3.5%**	**93.9%**	**0.1%**	**13.8%**	****10.8%**	**-**

*No AEGL 1 for CO so WHO 15-minute guideline used. **No AEGL for PM_{10} so 8-hour HSE WEL used.

Table 9: Maximum Modelled 30-Minute Mean Concentration including Backgrounds

Receptor	Maximum 30-Minute Mean Concentration including Background (µg/m^3)								Corresponding BESS Location
	CO	Formaldehyde	HCl	HCN	HF	NH_3	NO_2	PM_{10}	
R1	3746.6	44.0	43.5	15.2	119.0	7.4	29.2	89.3	BESS 1
R2	3859.4	47.0	48.9	17.0	133.8	7.9	31.7	95.8	BESS 5
R3	3722.9	43.3	42.2	14.7	115.4	7.2	28.9	85.5	BESS 5
R4	3609.8	40.1	36.5	12.7	99.6	6.7	26.4	78.1	BESS 4
R5	3624.3	40.5	37.2	12.9	101.5	6.7	26.7	79.1	BESS 5
R6	3569.3	38.9	34.4	11.9	93.9	6.5	25.6	73.7	BESS 3
R7	3968.1	50.0	54.2	18.9	148.4	8.4	34.0	103.6	BESS 5
R8	3873.9	47.5	49.7	17.3	136.1	8.0	31.9	98.4	BESS 1
R9	3715.7	43.2	42.0	14.6	114.9	7.2	28.6	87.1	BESS 3
PROW1	8510.6	173.8	275.1	96.9	758.5	29.8	128.4	427.4	BESS 4
PROW2	6517.0	119.4	178.2	62.7	490.7	20.4	87.0	285.3	BESS 3
PROW3	8251.0	166.7	262.5	92.5	723.6	28.5	123.0	408.9	BESS 5
PROW4	6257.5	112.4	165.5	58.2	455.9	19.2	81.6	266.8	BESS 5
PROW5	4960.6	77.0	102.4	36.0	281.7	13.1	54.6	174.4	BESS 3
PROW6	5752.8	98.6	141.0	49.6	388.1	16.8	71.1	230.8	BESS 5
PROW7	3708.1	43.0	41.7	14.5	113.8	7.2	28.4	86.6	BESS 3
PROW8	3707.1	43.0	41.6	14.5	113.7	7.2	28.4	86.5	BESS 3
Maximum	**8510.6**	**173.8**	**275.1**	**96.9**	**758.5**	**29.8**	**128.4**	**427.4**	**BESS 4**
AEGL 1	***35,000**	**1105**	**2684**	**2764**	**818**	**20,896**	**941**	****4000**	**-**
Maximum as % AEGL 1	***24.3%**	**15.7%**	**10.2%**	**3.5%**	**92.7%**	**0.1%**	**13.6%**	****10.7%**	**-**

*No AEGL 1 for CO so WHO 1-hour guideline used. **No AEGL for PM_{10} so 8-hour HSE WEL used.

Table 10: Maximum Modelled 1-Hour Mean Concentration including Backgrounds

Receptor	Maximum 1-Hour Mean Concentration including Background (µg/m^3)								Corresponding BESS Location
	CO	Formaldehyde	HCl	HCN	HF	NH_3	NO_2	PM_{10}	
R1	3659.1	41.7	39.3	13.7	107.3	6.9	27.4	83.1	BESS 1
R2	3761.3	44.4	44.1	15.4	120.6	7.4	29.7	88.8	BESS 5
R3	3633.3	40.9	37.8	13.2	103.3	6.8	27.0	79.1	BESS 5
R4	3484.4	36.7	30.4	10.5	82.8	6.1	23.8	69.2	BESS 2
R5	3472.8	36.4	29.8	10.3	81.2	6.0	23.6	68.3	BESS 5
R6	3434.7	35.3	27.9	9.6	75.8	5.8	22.8	64.1	BESS 3
R7	3877.6	47.5	49.8	17.4	136.2	8.0	32.1	97.1	BESS 5
R8	3794.2	45.3	45.8	16.0	125.4	7.6	30.2	92.7	BESS 1
R9	3634.4	41.0	38.1	13.2	103.9	6.8	26.9	81.3	BESS 3
PROW1	8410.8	171.0	270.3	95.2	745.1	29.3	126.3	420.3	BESS 4
PROW2	6427.1	117.0	173.8	61.2	478.6	20.0	85.1	278.9	BESS 3
PROW3	8139.4	163.6	257.1	90.6	708.6	28.0	120.7	401.0	BESS 5
PROW4	6163.0	109.8	160.9	56.6	443.2	18.7	79.6	260.1	BESS 5
PROW5	4902.8	75.5	99.6	35.0	273.9	12.8	53.4	170.2	BESS 3
PROW6	5469.4	90.9	127.2	44.7	350.0	15.5	65.2	210.6	BESS 5
PROW7	3630.3	40.9	37.9	13.2	103.4	6.8	26.8	81.0	BESS 3
PROW8	3630.8	40.9	37.9	13.2	103.5	6.8	26.8	81.1	BESS 3
Maximum	**8410.8**	**171.0**	**270.3**	**95.2**	**745.1**	**29.3**	**126.3**	**420.3**	**BESS 4**
AEGL 1	***35,000**	**1105**	**2684**	**2211**	**818**	**20,896**	**941**	****4000**	**-**
Maximum as % AEGL 1	***24.0%**	**15.5%**	**10.1%**	**4.3%**	**91.1%**	**0.1%**	**13.4%**	****10.5%**	**-**

*No AEGL 1 for CO so WHO 1-hour guideline used. **No AEGL for PM_{10} so 8-hour HSE WEL used.

Table 11: Maximum Modelled 4-Hour Mean Concentration including Backgrounds

Receptor	Maximum 4-Hour Mean Concentration including Background (µg/m^3)								Corresponding BESS Location
	CO	Formaldehyde	HCl	HCN	HF	NH_3	NO_2	PM_{10}	
R1	3575.7	39.4	35.2	12.2	96.1	6.5	25.7	77.1	BESS 3
R2	3703.4	42.8	41.3	14.4	112.8	7.1	28.5	84.7	BESS 5
R3	3601.3	40.0	36.3	12.6	99.0	6.7	26.3	76.8	BESS 5
R4	3453.2	35.8	28.9	10.0	78.6	5.9	23.2	66.9	BESS 2
R5	3407.8	34.6	26.7	9.2	72.5	5.7	22.2	63.7	BESS 2
R6	3390.8	34.1	25.7	8.9	69.9	5.6	21.8	60.9	BESS 2
R7	3779.9	44.9	45.0	15.7	123.1	7.5	30.1	90.2	BESS 5
R8	3735.3	43.7	43.0	15.0	117.5	7.3	29.0	88.5	BESS 1
R9	3597.3	40.0	36.3	12.6	99.0	6.7	26.1	78.7	BESS 3
PROW1	8248.4	166.6	262.4	92.4	723.3	28.5	123.0	408.7	BESS 4
PROW2	6299.1	113.5	167.6	59.0	461.5	19.4	82.4	269.8	BESS 3
PROW3	7937.0	158.1	247.2	87.1	681.4	27.1	116.5	386.5	BESS 5
PROW4	6126.7	108.8	159.2	56.0	438.3	18.5	78.9	257.5	BESS 5
PROW5	4846.9	73.9	96.9	34.0	266.4	12.5	52.3	166.2	BESS 3
PROW6	5064.4	79.9	107.5	37.7	295.6	13.5	56.8	181.8	BESS 5
PROW7	3590.5	39.8	35.9	12.5	98.0	6.6	26.0	78.2	BESS 3
PROW8	3574.6	39.4	35.2	12.2	95.9	6.5	25.7	77.0	BESS 3
Maximum	**8248.4**	**166.6**	**262.4**	**92.4**	**723.3**	**28.5**	**123.0**	**408.7**	**BESS 4**
AEGL 1	***10,000**	**1105**	**2684**	**1437**	**818**	**20,896**	**941**	****4000**	**-**
Maximum as % AEGL 1	**82.5%**	**15.1%**	**9.8%**	**6.4%**	**88.4%**	**0.1%**	**13.1%**	**10.2%**	**-**

*No AEGL 1 for CO so WHO 8-hour guideline used. **No AEGL for PM_{10} so 8-hour HSE WEL used.

Table 12: Maximum Modelled 8-Hour Mean Concentration including Backgrounds

Receptor	Maximum 8-Hour Mean Concentration including Background ($\mu g/m^3$)								Corresponding BESS Location
	CO	Formaldehyde	HCl	HCN	HF	NH_3	NO_2	PM_{10}	
R1	3484.8	36.9	30.8	10.7	83.8	6.1	23.8	70.6	BESS 3
R2	3568.8	39.1	34.7	12.1	94.7	6.5	25.7	75.1	BESS 2
R3	3551.5	38.6	33.9	11.7	92.3	6.4	25.3	73.3	BESS 5
R4	3415.0	34.8	27.0	9.3	73.4	5.8	22.4	64.2	BESS 2
R5	3383.8	33.9	25.5	8.8	69.2	5.6	21.7	62.0	BESS 2
R6	3352.6	33.0	23.9	8.2	64.8	5.5	21.0	58.2	BESS 2
R7	3731.2	43.5	42.6	14.8	116.6	7.3	29.1	86.7	BESS 5
R8	3657.9	41.6	39.2	13.6	107.1	6.9	27.4	83.0	BESS 1
R9	3519.3	37.8	32.5	11.3	88.5	6.3	24.5	73.1	BESS 1
PROW1	8105.6	162.7	255.4	90.0	704.1	27.9	120.0	398.6	BESS 4
PROW2	6200.9	110.8	162.8	57.3	448.3	18.9	80.4	262.8	BESS 3
PROW3	7674.1	151.0	234.4	82.6	646.1	25.8	111.0	367.8	BESS 5
PROW4	6097.9	108.0	157.8	55.5	434.4	18.4	78.3	255.4	BESS 5
PROW5	4754.9	71.4	92.4	32.4	254.0	12.1	50.3	159.7	BESS 3
PROW6	4954.8	76.9	102.2	35.9	280.9	13.0	54.5	173.9	BESS 5
PROW7	3523.4	38.0	32.7	11.3	89.0	6.3	24.6	73.4	BESS 1
PROW8	3540.7	38.4	33.5	11.6	91.4	6.4	25.0	74.6	BESS 3
Maximum	**8105.6**	**162.7**	**255.4**	**90.0**	**704.1**	**27.9**	**120.0**	**398.6**	**BESS 4**
AEGL 1	***10,000**	**1105**	**2684**	**1106**	**818**	**20,896**	**941**	****4000**	**-**
Maximum as % AEGL 1	***81.1%**	**14.7%**	**9.5%**	**8.1%**	**86.1%**	**0.1%**	**12.8%**	****10.0%**	**-**

*No AEGL 1 for CO so WHO 8-hour guideline used. **No AEGL for PM_{10} so 8-hour HSE WEL used.

3.2 Visibility

3.2.1 Table 13 presents the modelled PM_{10} concentrations and corresponding predicted visibility at the modelled points corresponding with the closest sections of road network to the BESS Area.

Table 13: Maximum Modelled 10-Minute Mean PM_{10} Concentrations including Backgrounds

Receptor	Road Name	Maximum 10-Minute PM_{10} Concentration (including Background)	BESS Location where Maximum Concentration was Modelled	Predicted Approximate Visibility (m)	Predicted Approximate Visibility (km)
ROAD1	Moor Rd	94.3	BESS 5	4184.2	4.2
ROAD2	Moor Rd	91.0	BESS 3	4338.0	4.3
ROAD3	Moor Rd	93.7	BESS 1	4211.6	4.2
ROAD4	Moor Rd	92.7	BESS 4	4256.8	4.3
ROAD5	Moor Rd	93.2	BESS 3	4234.9	4.2
ROAD6	Moor Rd	92.1	BESS 3	4284.7	4.3
ROAD7	B645	93.3	BESS 2	4228.6	4.2
ROAD8	B645	91.4	BESS 2	4317.0	4.3
ROAD9	B645	96.9	BESS 2	4073.5	4.1
ROAD10	B645	103.8	BESS 2	3804.4	3.8
ROAD11	B645	88.7	BESS 2	4450.4	4.5
ROAD12	B645	87.7	BESS 1	4500.1	4.5
ROAD13	B645	99.6	BESS 2	3962.5	4.0
ROAD14	B645	94.0	BESS 1	4198.1	4.2
ROAD15	B645	91.5	BESS 2	4312.1	4.3
ROAD16	Moor Rd	92.3	BESS 1	4276.0	4.3
ROAD17	Moor Rd	90.2	BESS 3	4377.9	4.4

3.2.2 As indicated in Table 13, the lowest visibility predicted on local roads occurs at ROAD10, which represents the closest point of the B645 to the BESS Area. The worst-case visibility distance predicted at this location because of smoke from a BESS fire is approximately 3.8km, which is considerably further than vehicle stopping distance at the national speed limit for this road (the typical braking distance is 73m for a car travelling at 60mph (Ref 14)). It should be reiterated that these visibility calculations assume that a fire occurs at the closest BESS enclosure to the road and that this happens to coincide with the worst possible meteorological conditions for pollution dispersion at that road location (worst hour for dispersion across five years of meteorological data). Furthermore, the equation used to determine visibility is based on certain assumptions and therefore has inherent limitations.

4.0 UNCERTAINTY AND SENSITIVITY

4.1.1 Uncertainty in dispersion modelling predictions can be associated with a number of different factors, including:

- Model uncertainty-due to model limitations;
- Data uncertainty-due to errors in input data, including emissions estimates, background estimates and meteorology; and
- Variability-randomness of measurements used.

4.1.2 Potential uncertainties in model results have been minimised as practicable and worst-case inputs used in the absence of definitive information. This encompassed the following:

- Choice of model – ADMS-6 is a commonly used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- Meteorological data – Modelling was undertaken using five years of meteorological datasets from the closest observation site to the Scheme. The highest concentrations predicted by the model over these five years were reported at the worst-case human and visibility receptors;

- Receptor locations – The closest human and visibility receptors to the BESS Area were selected as these are expected to experience the greatest impacts from the fire; and
- Variability - All model inputs are as accurate as possible and worst-case conditions have been considered where necessary in order to ensure a robust assessment of potential pollutant concentrations.

4.1.3 It is considered that the use of the stated measures to reduce uncertainty and the use of worst-case assumptions when necessary has resulted in model accuracy of an acceptable level.

5.0 ASSESSMENT AND LIMITATIONS

5.1.1 The following assumptions have been made within this assessment:

- Modelling accounts for a steady burn as recorded during Large Scale Fire Testing (LSFT) as a result of a multiple cell thermal runaway occurring within a single battery module in one BESS enclosure. The BESS facility will be designed with multiple layers of protection to mitigate and minimise the probability of a fire or thermal runaway incident as outlined in the **outline BSMP [EN010141/DR/7.10]**. It is therefore assumed that the fire would be limited to one BESS enclosure;
- It is assumed that one BESS enclosure is 2.9m in height, 6.1m long and 2.4m wide;
- It is assumed that Prismatic LFP batteries would be used. This is considered to be a reasonable worst case for the purposes of the assessment in terms of BESS toxic gas emission potential;
- Batteries are sealed by design so do not vent when in normal use and have no free electrolyte;
- The batteries will be controlled by charging management systems that will detect if a cell or battery is not operating correctly;
- There is no AEGL for particulates. As such, the Health and Safety Executive (HSE) Workplace Exposure Limit (WEL) (Ref 3) has been used which is 4mg/m^3 for respirable dust. Whilst this is over an 8-hour reference

period, it is considered appropriate for use in the assessment in lieu of any other limits;

- There is no AEGL 1 for CO. As such, CO concentrations have been compared against the World Health Organisation (WHO) CO guideline values of 100mg/m^3 for 15-minute average, 35mg/m^3 for 1-hour average and 10mg/m^3 for 8-hour average (Ref 4);
- Visibility is affected not only by particulate concentrations, but by a range of factors including smoke composition, particulate size distribution, humidity levels, light conditions etc, therefore the visibility assessment is considered to be high level, as such detailed conclusions should not be drawn from the results;
- Emissions data for BESS fires are limited and have come from a range of sources. Worst case parameters have been used where possible;
- There is limited real world data collated on fires associated with solar schemes. No suitable emissions data was found for particulates. As such, the assessment assumed that a battery unit fire in the BESS is equivalent to a diesel fire for production of PM as recommended by the Applicant's Battery Safety and Testing Consultant and as done for previous assessments such as the Axminster Energy Hub Plume Assessment Study prepared by DNV for Clearstone Energy (Ref 8);
- A nominal value of 1m/s has been used for the velocity to activate the plume rise module;
- Due to the limited availability of data on fires associated with solar schemes, emissions data was available for NO rather than NO_2. For the purposes of this assessment, it has been assumed that modelled NO concentrations are NO_2, as a worst case (NO converts to NO_2 in the atmosphere, and NO_2 is considered more harmful in terms of its health effects);
- There were no background concentrations available for HCN. However, it is considered that background concentrations for this pollutant would be negligible;

- In accordance with the EA guidance (Ref 1), it has been assumed that the short-term background concentration of a substance is twice its long-term concentration. As such, the background concentrations obtained for the assessment were doubled to approximate short term background concentrations; and
- The building effects option in ADMS 6 is not applicable to area sources. The dispersion of pollutants released from elevated sources can be influenced by the presence of buildings close to the emission point. The only building located in the vicinity of the BESS Area would be a two-storey building within the substation compound containing electrical equipment, meeting rooms and welfare facilities. This building is expected to be a maximum of 6m in height and located approximately 12m south of the BESS Area. As the BESS fire emissions have been modelled as an area source and not a point source, building dispersion effects have not been incorporated into the modelling. The closest receptors to this building are associated with a public right of way (located more than 80m from the building at its closest point) and residential receptors are located more than 500m away and so are unlikely to be impacted by any localised building effects.

6.0 MITIGATION

6.1.1 Prior to the commencement of construction of the BESS, BSSL Cambsbed 1 Ltd. (the ‘Applicant’) will be required to prepare a BSMP. This will build upon the mitigation secured in the **outline BSMP [EN010141/DR/7.10]** submitted as part of this application. As part of preparation of the BSMP, the Applicant will incorporate the latest good practices for battery storage safety, failure detection and prevention, along with the emergency response planning, as guidance continues to develop in the UK and internationally. The following measures relating to air quality have been included:

- Notification of potentially affected residents including advice on the health effects of smoke and ways to reduce exposure (e.g. close windows and stay indoors);
- Notification of potentially affected members of the public to move to a cleaner air location; and
- Cancellation of outdoor events and potentially moving affected residents to a cleaner air location.

7.0 CONCLUSION

7.1.1 Based on the factors of distance to the nearest locations of human exposure and the anticipated short-term nature of a fire incident, the assessment concludes that there would be no significant air quality effects as a result of a BESS fire incident. It is also worth noting that an **outline BSMP [EN010141/DR/7.10]** has been produced as part of this application and identifies how the Applicant will use good industry practice to reduce risk to life, property, and the environment in the rare event of a BESS fire.

7.1.2 Notwithstanding, whilst there is low risk of adverse air quality effects at the closest receptors, the Emergency Response Plan produced at the detailed design stage will incorporate all necessary emergency response procedures and actions based upon thermal runaway test data supplied by the BESS system provider.

8.0 REFERENCES

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Ref 5 Klote, J. H. and Milke, J.A. (2002), Principles of Smoke Management.

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Ref 7 Wartsila North America, Inc (2023), Quantum Cube Bespoke Unit Testing Summary Report

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