Fferm Solar Larnog

Environmental Statement

Volume IV, Appendix 5D: Outline Battery Fire Safety Management Plan

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Issue Sheet

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Document Title

Volume IV, Appendix 5D: Outline Battery Fire Safety Management Plan

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1. Introduction

1.1. Background

1.1.1. Trydan Gwyrdd Cymru (hereafter 'the Applicant') have employed WSP UK Limited (hereafter referred to as 'WSP') to develop an outline Battery Fire Safety Management Plan (BFSMP) for the proposed co-located Battery Energy Storage System (BESS) on the Larnog Solar Farm (hereafter 'the Proposed Development'). The Proposed Development would be located on land approximately 500 m south-west of Penarth and 550 m east of Sully (hereafter 'the Site').

1.1.2. As part of preparation of the detailed BFSMP, the Applicant will consider the latest guidance, policy and good practices for battery fire detection and prevention, along with the Emergency Response Plan (ERP) and Risk Management Plan (RMP), as guidance continues to develop in the UK and globally. This document provides a summary of the fire safety related information requirements which would be provided in advance of construction of the BESS. The purpose of this outline BFSMP is to identify how the Applicant would use good industry practice to reduce risk to life, property, and the environment from the BESS.

1.1.3. An indicative layout of the BESS and Substation compound has been developed and is illustrated in **Annex A**. The exact model of BESS container is yet to be finalised. Therefore, this BFSMP has been developed based on a representative lithium-ion battery energy storage system using lithium-ion battery chemistry. The final selection of BESS suppliers or integrators will be made as part of the detailed design stage.

1.2. Approach

1.2.1. The goal of the BFSMP is to prevent fire events from occurring and introducing mitigations to reduce the risk of propagation in the event of a fire to minimise damage to people and property. The BFSMP covers the following key areas:

- Organisation – overview of the organisation including roles and responsibilities;
- Fire Safety Arrangements – fire safety arrangements for the Site, including:
    - Risk Assessment - comprehensive risk assessment covering the most critical failure modes experienced by the BESS and Power Conversion System (PCS) / transformer skid from initial transportation to site and storage, to issues seen on other similar sized BESS. The risk assessment includes prevention measures and mitigations that must be implemented throughout the pre-construction, construction, and operational phases of the project; and
    - Recommendations List - the recommendations list contains technical guidance from international standards, independent insurers and known best practice

standards to enhance the design of the facility to mitigate fire risk as far as reasonably possible. The primary objective is to prevent any incident from occurring and secondarily introduce mitigation measures to prevent the spread of any event. It is recommended that the detailed plan includes any relevant feedback from the Local Fire and Rescue Service.

- Monitoring – evacuation drills, checks, maintenance and testing, record keeping; and
- Audit and Review – review schedule, audit trail requirements and response to changes.

1.2.2. As this document comprises an outline BFSMP, the following plans and information will be developed and incorporated within the detailed BFSMP, and therefore do not form part of this document:

- Specific Personal Emergency Evacuation Plans (PEEPs);
- Emergency Response Plan (ERP);
- Fire training syllabus;
- Design details; and
- Operating instructions for systems / equipment.

2. Organisation

2.1. Roles and Responsibilities

2.1.1. The table below sets out the recommended fire safety roles and responsibilities relevant to the management structure.

Table 2.1: Roles and Responsibilities

Role	Summary of Responsibilities
Board / Directors	• Ensure that the fire safety policies / codes of practice that complement this management plan are in place, properly implemented and reviewed; • Ensure that qualified people are appointed to oversee and implement fire safety arrangements and ensure that they are competent and appropriately trained to undertake their duties; • Ensure that arrangements are in place for the completion of Fire Risk Assessments and Fire Risk Assessment reviews, including, where appropriate, technical surveys in respect of fire protection; • Ensure that fire, security, and health and safety arrangements at the premises are complementary; and • Ensure that the applicant has adequate insurance coverage.
Fire Safety Manager	• Ensure that Fire Risk Assessments and reviews are carried out when required; • Ensure that fire safety systems and equipment are appropriately located and properly maintained; • Ensure that a robust and effective Emergency Response Plan is in place to safely evacuate all persons. This emergency plan must consider people with mobility, sensory and learning impairments, including those with temporary impairments; • Arrange for the Fire Emergency Plan to be issued to all relevant persons, so that they understand the actions to take in the event of a fire, particularly safe evacuation procedures; • Ensure that staff are appropriately trained in fire safety procedures to reflect the requirements of the Fire Risk Assessment; • Ensure that a copy of the current Fire Risk Assessment for the premises is readily accessible, and its contents are complied with; • Ensure that effective arrangements are in place for contacting the emergency services; and • Ensure that the Fire and Rescue Service are aware of any significant hazards associated with the premises e.g., ethanol and any other dangerous substances.
Site Personnel / Contractors	• Ensure familiarity with the Fire Emergency Plan for the premises and co–operate by participating in fire evacuation / drill procedures and by observing practical fire safety arrangements; • Be fully conversant with the Site strategy and steps to be taken during any events related to fire;

Role	Summary of Responsibilities
	• Know, and co-operate with, the fire safety manager for the premises; • Report to the fire safety manager regarding any concerns about fire safety; • Be familiar with all escape routes; • Take care to not wedge fire doors open, nor block or obstruct them; • Be aware of the action to be taken on discovering a fire, hearing a fire alarm, for raising the alarm (including the location of fire alarm call points) and for calling the Fire and Rescue Service; • Promptly evacuate the premises, in accordance with the Fire Emergency Plan, to a place of safety without putting themselves and others at risk, and not attempt to extinguish a fire unless they have been specifically trained; • Comply with the No Smoking policy in place.

2.2. Competency and Authority

2.2.1. All those who have designated roles and responsibilities in respect of the BFSMP shall be competent, with competence demonstrated through appropriate knowledge, training, and experience.

2.2.2. Individuals with designated responsibilities will be granted the necessary authority to make decisions and undertake actions commensurate with their roles.

2.3. Communications

2.3.1. Methods of communication would be put in place to ensure effective sharing and exchange of fire safety information.

2.3.2. The essential areas for communication are outlined in **Table 2.2** below:

Table 2.2: Communication

Subject	Method/ Procedure
Dissemination of information about fire hazards	Safety briefings and meetings; and Exchange of documents.
Fire prevention arrangements	Included within staff training and refresher meetings.
Emergency fire response procedure	Included with staff training and refresher meetings.
Reporting system for concerns or deficiencies in fire safety matters	e.g., verbal, submit hard-copy form, e-form via app.
Liaison with local Fire & Rescue Service (FRS)	Familiarity visits.
Informing relevant parties on the stakeholder management plan	Communication via phone, email and meetings.

2.4. Project Development Cycle Guidance

2.4.1. Communication between the relevant parties during the construction phase is critical to ensure fire safety on-site.

2.4.2. **Table 2.3** below provides guidance on the principal coordination requirements between the Applicant, the BESS Supplier, the Engineering Procurement Construction (EPC) Contractor or Civil Contractor, the Independent Connection Provider (ICP) Contractor, and other Site Personnel.

2.4.3. The obligations of the Construction (Design and Management) (CDM) Regulations 2015 must be satisfied by the key duty holders (Client, Principal Designer and Principal Contractor) through the development cycle.

Table 2.3: Project Development Cycle Communication Requirements

Subject	Key Summary	Notes
Significant Fire Hazards	The Applicant will be responsible for ensuring the correct information flow between the relevant parties regarding significant fire hazards, their locations, quantities and any key precautions to be taken.	Precautions covered within **Section 3**.
Communications	Agree process for communicating: • Warning of fire; • Other fire-related alerts; • Changes in fire hazards; and • Reports of fire concerns affecting other party's area.	Other alerts may include investigating potential concerns (e.g. smell of smoke). Meetings (routine or *ad-hoc*) may be arranged.
Emergency Response	Agreements on: • Designated escape routes; • Shared escape routes; • Assembly points; • Meeting fire crews attending; • Step by step guide for evaluating any potential BESS facility fires; and • Post-incident de-brief / remediation.	
First Aid	Provide information on first aid provisions on-site, including the nearest hospitals and emergency contact details.	

3. Fire Prevention and Safety Arrangements

3.1. Prevention

3.1.1. Successfully operated BESS have a number of intrinsic safety features, from monitoring, protection and detection systems to fire suppression and containment systems. The following risk assessment covers the associated risk of a BESS and prevention / mitigation strategies to counter or reduce these risks.

3.1.2. A more detailed assessment of prevention and mitigation strategies can be developed during any further design stages. This will be informed by the final equipment selection following procurement and tendering activities, together with the integration of the chosen systems into the overall site design and operational strategy.

3.2. Risk Assessment

3.2.1. The EPC contractor retains control of fire safety until handover to the operator. The designer is liable for the fire safety design for a period up to 12 years post-completion. The EPC contractor will be responsible for integrating the Site wide fire protection and suppression strategy. The following risk matrix has been developed to consider the probability and impact of any identified failure modes, and the prevention / mitigation measures that could be included throughout the different phases of the Proposed Development.

Table 3.1: Risk Assessment Matrix

			Probability (P)				
		Severity Description	1	2	3	4	5
			(Remote)	(Unlikely)	(Possible)	(Probable)	(Almost Certain)
Severity (S)	5 – Catastrophic	Risk of death, explosion, complete loss of facility, catastrophic environmental damage	MEDIUM	HIGH	CRITICAL	CRITICAL	CRITICAL
	4 – Major	Life changing injury, extensive damage to facility, significant environmental damage	MEDIUM	HIGH	CRITICAL	CRITICAL	CRITICAL
	3 – Moderate	Significant non-life changing injury, significant damage to facility, minor environmental damage	LOW	MEDIUM	HIGH	CRITICAL	CRITICAL
	2 – Minor	Minor injury, minor damage to facility	LOW	LOW	MEDIUM	HIGH	HIGH
	1 – Inconvenience	No risk of injury, no damage to facility and no environmental damage	LOW	LOW	LOW	MEDIUM	MEDIUM

Table 3.2: Site Risk Assessment Matrix

No.	Component	Hazard	Cause of Hazard	Consequence	Initial Risk Assessment			Prevention/ Mitigation Strategy	Residual Risk Assessment			Further Comments
					S	P	Risk		S	P	Risk	
1	Battery	Battery fire / Explosion	Transportation	Personnel injury. Fatality. Physical damage to battery. Toxic chemicals leak. Explosion.	5	3	Critical	Lithium batteries are required to pass Section 38.3 of the UN Manual of Tests and Criteria[1] The provision of a UN 38.3 or UN transportation testing report is required for transportation. UN 38.3 requires several tests to prove the battery design is safe for transportation including thermal, vibration, shock, short circuit, and impact testing. The chosen technology has certification to UN 38.3 to prove the design is safe for transportation.	5	1	Medium	Certification of UN 38.3 to be requested from Original Equipment Manufacturer (OEM).
2	Battery	Battery fire / Explosion	Lifting equipment fails and drops BESS container	Personnel injury. Fatality. Physical damage to battery. Toxic chemicals leak. Explosion.	5	2	High	The EPC contractor should implement a formal lift study, crane pad design, ground-bearing assessment, Risk Assessment and Method Statement (RAMS), exclusion zones, wind monitoring, OEM lifting procedures, and compliance with the relevant industry standards before any battery container or transformer is lifted into position.	5	1	Medium	
3	Natural Hazard	Water damage	Flooding	Water damage to BESS equipment / submerged Site.	3	2	Medium	A Flood Consequence Assessment (FCA) has been completed for the Site **(Appendix 11E)**, the location of the BESS has been situated in a low flood risk area. Safe access and egress to the Site is likely to be available during extreme flood events. A drainage statement has been produced and has been incorporated into the FCA **(Appendix 11E)**. This provides specific information in relation to the management of surface water drainage on the Site. All major assets such as BESS containers, PCS, transformers and substations shall be installed on concrete slabs or plinths raised off the ground to further protect the facility.	3	1	Low	Flooding events more common due to climate change. Prevention strategy decreases the effects of this, but maintenance of drainage works throughout the year will decrease residual risk of water damage. Future climate change projections have been considered as part of the assessment presented in **Appendix 11E**.

[1] UN Manual of Tests and Criteria Rev.8 (2023) and Amendment 1 to Rev.8 (2025)

No.	Component	Hazard	Cause of Hazard	Consequence	Initial Risk Assessment			Prevention/ Mitigation Strategy	Residual Risk Assessment			Further Comments
					S	P	Risk		S	P	Risk	
4	Battery	Thermal Hazard	Battery Cell / Module Over / Under Temperature	Injuries to personnel (burns, smoke, and chemical inhalation). Damage to battery cell and BESS container.	5	3	Critical	The selected battery system should have a cooling system either via gaseous or liquid cooled utilising heat exchangers, expansion vessels, pumps and associated small bore pipe work to infer heat transfer from the battery cells. The battery cells will have a target temperature which is pre-programmed by the OEM in the Battery Management System (BMS) which communicates with the Industrial Personal Computer (IPC) or package controller within the control panel. This will then drive the cooling system to act to maintain an optimum ambient temperature to maintain the pre-programmed operating environment. Where the cooling system develops a fault, alarms will immediately be sent via the BESS Supervisory Control and Data Acquisition (SCADA) system to the operator's / control room. The BESS container will automatically be prevented from charging / discharging, to allow the operators time to rectify the fault. Continuous preventative maintenance as advised by the OEM.	5	1	Medium	
5	Battery	Thermal hazard	Fire Detection System Failure	Injuries to personnel (burns, smoke, and chemical inhalation). Damage to battery cell and surrounding BESS infrastructure.	5	3	Critical	The selected battery system should contain multiple smoke detectors, heat detectors and a flammable gas detector. The heat and smoke detectors will be evenly distributed in the BESS container, providing redundancy as they are not connected on the same line. Fire and smoke detection signals shall generate audible and visual alarm indications, activate the aerosol suppression system where applicable, and provide alarm reporting to the site fire alarm panels and SCADA system for operator notification and event management. In the rare event of a complete fire detection system failure, the initial communication loss or any continuous rise in temperature or electrical fault would be detected by the BMS and error messages communicated to the SCADA for operator rectification. Maintenance of the fire detection system is critical to ensure operation at regular intervals as dictated by the OEM. The operator will conduct checks on the full detection system using simulated smoke and heat to ensure correct operation of the fire detection panel and the automatic engagement of the fire suppression system.	5	2	High	BESS supplier to provide specification and datasheet to the Applicant evidencing the detection system and what occurs if it fails.
6	Battery	Thermal hazard	Fire Suppression System Failure	Injuries to personnel (burns, smoke, and chemical inhalation). Damage to battery cell and surrounding BESS infrastructure.	5	2	High	Where the fire suppression system fails to activate when required, the emergency response plan for the Site should be followed. Upon the initial activation of the fire suppression system, the SCADA system will notify the operators to enable the emergency response plan and contact the Local Fire Rescue Service (FRS) for assistance. Having multiple fire suppression systems in place will severely reduce the risk of system failure.	5	1	Medium	Please note that the Applicant determines the use of the optional fire suppression systems. In the event that water fire suppression system is incorporated into fire protection strategy; Contaminated firewater

No.	Component	Hazard	Cause of Hazard	Consequence	Initial Risk Assessment			Prevention/ Mitigation Strategy	Residual Risk Assessment			Further Comments
					S	P	Risk		S	P	Risk	
												will need to be safely contained and stored on Site, before being removed.
7	Battery	Thermal hazard	Battery Cell / Module Failure – Thermal Runaway	Injuries to personnel (burns, smoke, and chemical inhalation). Damage to battery cell and surrounding BESS infrastructure.	5	3	Critical	The fire suppression system in the BESS container will activate upon the detection of thermal runaway by the smoke and / or heat detectors. When activated, the suppression system will release a gaseous substance that will extract heat from the BESS and cool the system down in an attempt to extinguish the fire. Nearby water hydrants will be provided by the Applicant to cool down the exterior of the BESS enclosure, preventing propagation to BESS containers in close proximity. The battery modules and enclosures selected during the tender process will be proven to UL 9540A[2]. UL 9540A[2] standard subjects the battery modules and enclosure to large scale fire testing, where batteries are forced into thermal runaway, held for a period of time and then proven to not propagate from battery to battery and enclosure to enclosure respectively.	5	2	High	The EPC contractor / BESS integrator should provide a detailed methodology of the fire detection and suppression system, with particular emphasis on the disconnection of the BESS, interlocking of the container and liquid cooling systems. Local FRS to be engaged with the emergency plan in the event of thermal runaway. First responders to be advised of procedure to follow.
8	Battery	Explosion	Battery Cell / Module Failure – Thermal Runaway. Cascading failure / thermal effects from adjacent battery cells within pack.	Damage to battery components and surrounding BESS infrastructure. Release of toxic gases – pollution. Injury to Site personnel (burns, smoke and chemical inhalation. Release of flammable gasses due to overcharging.	5	2	High	The following parts of NFPA 855 (2026)[3] are considered. Section 9.7.6.7 of this states that: *"9.7.6.7.3 – All ESSs shall be provided with a reliable explosion control and prevention system designed, installed, operated, maintained, and tested in accordance with NFPA 69[4].* *9.7.6.7.3.1 – A partial volume deflagration evaluation shall be conducted in accordance with NFPA 68[5].* *9.7.6.7.3.3 – Where approved, ESSs designed to ensure that no hazardous pressure waves, debris, shrapnel or enclosure pieces are ejected, as validated by installation-level fire and explosion testing and an engineering evaluation performed by a registered design professional complying with Section 9.2 that includes the cabinet, shall be permitted in lieu of providing explosion control and prevention that complies with NFPA 69[4]. "* The BESS supplier should provide evidence that the BESS system meets both NFPA 68[4] and NFPA 69[5]. The EPC contractor should obtain UL 9540A[2] test reports and evaluate them, ensuring no module-to-module thermal runaway propagation occurred.	5	1	Medium	A flammable gas detector is triggered when the gas concentration reaches 10% of Lower Explosive Limit (LEL), activating the ventilation system. If a second level alarm (smoke and heat detector triggered simultaneously) is raised, the ventilation system will close in preparation for the gas fire extinguishing system. Explosion Vent panel systems for pressure relief can be included within the BESS container design.

[2] UL 9540A – Battery Energy Storage System (ESS) Test Method.
[3] NFPA 855 (2026) – Standard for the Installation of Stationary Energy Storage Systems, 2026.
[4] NFPA 69 – Standard on Explosion Prevention Systems.
[5] NFPA 68 – Standard on Explosion Protection by Deflagration Venting.

No.	Component	Hazard	Cause of Hazard	Consequence	Initial Risk Assessment			Prevention/ Mitigation Strategy	Residual Risk Assessment			Further Comments
					S	P	Risk		S	P	Risk	
9	Battery	Thermal hazard	Battery Cell / Module Over / Under Voltage / No Voltage	Irreversible Battery damage. Efficiency reduction. Thermal Runaway.	3	2	Medium	Batteries should be continuously monitored by the BMS, where the BMS detects a cell in under voltage, Under Voltage Protection (UVP), an alarm would be sent to the SCADA to inform the operator and the BMS should take corrective action to increase the cells voltage. Where the battery cell is detected to have an overvoltage, Over Voltage Protection (OVP) will be activated. The BMS will force shut the battery rack contractors, bringing the rack offline and isolating it from the remainder of the unit. Further investigations will be required, but it is likely that the battery module will be replaced by the OEM. In the case of no voltage, the watchdog system for BMS indicates a fault and shuts down the relevant system, this will be integrated with EMS and reflected on SCADA. A fault alarm will be triggered to identify specific rack or bank that has failed.	3	1	Low	BESS supplier to provide documentation evidencing this.
10	All BESS equipment	Damage to equipment and Arc Flash	Ground fault or Earth leakage	Damaged to equipment Injury to site personnel (burns, electrocuted)	4	2	Medium	BMS monitors insulate faults and will isolate the system in the event of a fault being detected, as well as opening the disconnector. Surge protection device and fuses installed in line with safety by design and earthing standards.	4	1	Medium	
11	All BESS equipment	Electrical hazard	Communications Failure	Damage to battery cell and BESS container.	2	2	Low	Where a rare communications failure occurs within the BESS containers, the system will lock in, and all Direct Current (DC) contactors should close to isolate the effected BESS enclosure. The auxiliary power will be maintained to provide power to monitoring systems of the BESS. For a Site-wide power outage, there is a large Uninterruptible Power Supply (UPS) which is used to power the auxiliary circuits until the power can be returned. The UPS will undergo continuous maintenance as part of the Operation and Maintenance (O&M) regime.	2	1	Low	The communications logic from each BESS supplier will vary, the communications logic is usually CANbus between each rack and the system BMS, then MODbus RS484 or TCP/ IP to the EMS and onwards to the SCADA. The SCADA then provides access to the operators through a local or remote Human Machine Interface (HMI), then finally on to the integration with the grid where applicable. BESS supplier to provide documentation evidencing this.

No.	Component	Hazard	Cause of Hazard	Consequence	Initial Risk Assessment			Prevention/ Mitigation Strategy	Residual Risk Assessment			Further Comments
					S	P	Risk		S	P	Risk	
12	Battery	Thermal hazard	Cooling System Failure	Injuries to personnel (burns, smoke, and chemical inhalation). Electrical and fire damage to battery cell.	3	2	Medium	Entering standby mode allows the affected BESS enclosure to prevent any unintended temperature increases due to charging / discharging. The temperature will gradually increase/ decrease to the local ambient temperature over time. The operators will be alerted through the SCADA and can immediately proceed with corrective actions using the on-site spares contingent. Maintenance of the cooling system is critical to ensure reliable operation. At regular intervals as dictated by the OEM, the operator will conduct preventative maintenance including coolant checks / top-ups and related activities to ensure reliable operation.	3	1	Low	The cooling system is normally powered from the auxiliary circuit for the Site, which is fed from the main grid voltage via a step-down transformer and in-line UPS. Where the system fails through mechanical, electrical or software means, the operators will be notified via the EMS / SCADA system that an error has occurred. The affected BESS enclosure will automatically enter standby mode by not importing / exporting from the batteries.
13	All BESS equipment	Electronical Failure and Thermal Hazard	Energy Storage Plant Controller Failure Lightning Strike	Electrical and fire damage to battery cell and other Site equipment.	5	2	High	Where a very unlikely error occurs with the energy storage plant controller and too much power is imported from the grid or too much power is exported from the BESS, there are multiple lines of protection. The transformers on each BESS block are likely to be protected via voltage transformers and current transformers' measurements. These protective devices would trip the Site and each BESS block would shut off as required. The PCS also has voltage protection and would trip when outside of the expected voltage range.	5	1	Medium	
14	Transformer / Power Conversion System	Thermal and Environmental hazard	Transformer / Power Conversion System Failure	Fire spreading to surrounding BESS containers and / or surrounding environment.	4	2	Medium	It is advised that the transformers and PCS are packaged together in a skid configuration. The skid is positioned according to the manufacturer's guidance, and the components will be spaced in accordance with NFPA 855 (2026)[3] and BS EN/ IEC 61936[6].	4	1	Medium	
15	Transformer / Power Conversion System	Electrical Hazard	Incorrect separation distances between equipment	Equipment failure. Reduced efficiency and/ or increased wear of equipment. Injury to humans.	3	3	High	The transformer skids and BESS containers are to be subject to NFPA 855 (2026)[3] requirements and shall be separated from other enclosures with minimum separation distances according to BS EN/ IEC 61936-1[6] standard. Complying with the separation distance requirements reduces heat transfer between equipment which contributes to keeping equipment in the operating temperature range provided by the	3	1	Medium	

[6] BS EN/ IEC 61936 – Secondary cells and batteries containing alkaline or other non-acid electrolytes & Safety requirements for secondary lithium cells and batteries, for use in industrial applications.

No.	Component	Hazard	Cause of Hazard	Consequence	Initial Risk Assessment			Prevention/ Mitigation Strategy	Residual Risk Assessment			Further Comments
					S	P	Risk		S	P	Risk	
								OEM. Separation distance requirements also establish adequate maintenance and access for personnel to service equipment safely.				
16	Transformer / Power Conversion System BESS	Electrical hazard	Arcing or short circuit Overcharging due to BMS failure	Electrocution resulting in injury or fatality. Ignition to start fire.	5	3	Critical	The BESS supplier will include arc flash protection on the module and string level. The relevant contractors will conduct arc flash / fault level studies for the HV switchgear according to IEEE 1584[7] or equivalent and provide arc-flash personal protective equipment (PPE) requirements for relevant equipment on-site. All equipment on Site will be subject to an intensive maintenance regime in accordance with the relevant OEM.	5	1	Medium	BESS supplier to provide documentation evidencing arc flash protection. Arc flash studies provider to be confirmed in scope / responsibility. OEM to provide maintenance regimes.
17	All BESS equipment	Electrical hazard	Failure to follow maintenance regime	Reduced BESS lifetime. Battery efficiency and capacity decrease.	1	2	Low	The BESS OEM will provide a minimum recommended operations and maintenance regime that must be followed throughout the lifetime of the facility. The BESS operator and OEM are both incentivised to fully implement the maintenance regime, as the financial performance from both parties may be significantly impacted from premature degradation, unexpected downtime or loss of systems. The operator should carry out periodic inspections and Site meetings to ensure that the O&M provider is adhering to the recommended guidance.	1	1	Low	Annex E of NFPA 855[3] includes a sample inspection / audit checklist that provides guidance for what is expected to be inspected. Site specific requirements and UK specific requirements will need to be taken into consideration.
18	All BESS equipment	Environmental hazard	Failure to follow vegetation management / debris management	Injuries to Site personnel. Damage to BESS infrastructure. Damage to surrounding environment and wildlife. Wildfire.	1	2	Low	The operator is to sign an agreement with an O&M provider to ensure that the BESS site is well maintained. Site maintenance including vegetation management is to be delegated to the O&M provider. The O&M provider shall ensure that there is no over-hanging vegetation across the Substation and BESS compound, all BESS containers including transformer / PCS must be completely free of over-hanging tree branches and a minimum of 3 m from the closest vegetation in accordance with NFPA 855[3].	1	1	Low	NFCC[8] guidance recommends that areas within 10m of BESS units are kept clear of combustible vegetation and that any other vegetation in the compound should be kept in a condition such that they do not increase the risk of fire on Site. This is a more conservative approach than required to comply with NFPA 855 (2026)[3], however it would reduce the risk of fire spreading.
19	Natural Hazard	Environmental Pollution	Exposure of contaminated fire water to environment	Soil pollution. Local ecosystem impacts. Injury to humans.	4	3	Critical	Site specific fire water containment strategy to be developed by a technical expert. This should be developed following guidance from FM Global[9] to prevent contaminated water leakage. Health and safety in grid scale electrical energy storage systems published by DESNZ[10] recommends that management of potential chemical release through water and drainage	4	1	Medium	NFCC[8] Guidance recommends that water run-off and potential impact on the environment, along with mitigation measures,

[7] IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations.
[8] National Fire Chiefs Council (NFCC) – Grid-Scale Battery Energy Storage System planning, Guidance for FRS, Version 2.0 October 2025.
[9] FM Global – Property Loss Prevention Datasheets, 5-33 Lithium-Ion Battery Energy Storage Systems, Interim Revision April 2026.
[10] Department for Energy Security and Net Zero (DESNZ) – Health and Safety Guidance for Grid Scale Electrical Energy Storage Systems, March 2024.

No.	Component	Hazard	Cause of Hazard	Consequence	Initial Risk Assessment			Prevention/ Mitigation Strategy	Residual Risk Assessment			Further Comments
					S	P	Risk		S	P	Risk	
								management (including for contaminated run off) should be included in the Site Emergency Response Plan. Containment strategy may include bunding of the Substation and BESS compound, use of appropriately sized water tank to store contaminated water and / or a Site drainage network that can be isolated to ensure containment.				should be considered and detailed in the Emergency Response Plan (EPR). It is the role of the Principal Contractor to create the EPR, before handing over to the Site owner.
20	Natural Hazard	Release of toxic gases.	Battery fire Vented toxic gas due to battery overcharging or exposure to fault conditions	Respiratory issues, eye and skin irritation, long-term health problems to humans. Environmental damage to local wildlife, ecosystems, and water sources. Air quality degradation.	4	3	Critical	The DESNZ[10] guidance recommends that the Site Emergency Response Plan should include the management of potential chemical release. A Computational Fluid Dynamics (CFD) plume assessment can be utilised post-planning, to analyse the behaviour of fumes released by the BESS in the event of a fire or the release of toxic gases due to battery overcharging or fault conditions. This is critical as it identifies likely receptors that would be impacted in the event of a fire. This is used to influence changes that can be made to the Site to eliminate impacts. In cases where impacts cannot be eliminated, the Health & Safety Executive hierarchy of controls should be followed. This involves substituting hazardous materials where possible, implementing engineering controls, utilising administrative controls, and, as a last resort, relying on PPE to mitigate the effects of chemical toxins released during a fire.	4	2	High	

No.	Component	Hazard	Cause of Hazard	Consequence	Initial Risk Assessment			Prevention/ Mitigation Strategy	Residual Risk Assessment			Further Comments
					S	P	Risk		S	P	Risk	
21	All BESS Equipment	Fire	Emergency services unable to respond effectively due to lack of knowledge of battery chemistry, system size and procedure.	Unwarranted damage to BESS equipment and surrounding infrastructure. Financial cost to replace and repair damage. Injury to first responders / SFRS.	5	2	High	FM Global Datasheet 10-1[9], Pre-Incident and Emergency Response Planning provides recommendations that the Applicant should follow to develop a pre-incident and emergency response plan in the event of a fire or explosion. The aim is to develop a plan in partnership with the local FRS to improve their ability to respond effectively and improve their safety. FM Global Datasheet 10-1[9] lists clear steps for creating a plan in conjunction with FRS. It is recommended that the local FRS is consulted in the creation and assessment of the pre-incident and emergency response plans, and that they should be updated regularly. Site personnel should be training in emergency plan priorities and actions to follow in the event of an incident.	5	1	Medium	The DESNZ[10] guidance identifies the inability of emergency services to respond effectively as an initiating event of a fire. It may not be an initiating event, but it can contribute to the severity of a fire incident and the consequences. Owners and developers directly benefit from developing an effective emergency plan as it can mitigate the overall scope of property damage and increases the likelihood of the facility to maintain continuity of operations.
22	All BESS Equipment	Electrocution	Leaving the rack doors opened while system operating, after routine maintenance activities.	Injuries to Site personnel. Fatality.	5	2	High	Making sure that the High voltage terminals covered and not exposed. O&M procedures implemented for accessing asset and putting the asset out of service, with training provided to all staff that will be in the BESS compound at any time. The cabinets and keys are only to be held by authorised personnel. Incorporating a proximity alarm on the doors during operation but does not shut the system down. Staff to always wear PPE when performing O&M on the site.	5	1	Medium	

3.3. Recommendations

3.3.1. The recommended guidance found in the referenced standards, guidance and data sheets covers technical guidance and key loss prevention recommendations as advised by NFPA[3], NFCC[8], FM Global[9] and DESNEZ[10]. This covers the design, operation, protection, inspection, maintenance, and testing of BESS' that utilise Lithium-Ion batteries in order to reduce the likelihood and impact of BESS related fires.

3.3.2. The recommendations will need to be reviewed and adapted as the Proposed Development proceeds throughout its lifecycle. It is also recommended to arrange a Site visit and consultation with the Local Fire Authority to incorporate their recommendations into site safety. This would need to be agreed with the Local Fire Authority and undertaken post-consent following approval of the BESS compound construction.

3.4. Protection Measures

3.4.1. Passive and active fire protection measures should be maintained in good working order to ensure their effectiveness. Active fire protection measures have been introduced throughout the Site design, covering fire detection and suppression especially on the BESS containers as these are flagged as the highest risk assets. Passive fire protection has been included by following NFPA 855 (2026) guidance for the Site layout design and firefighting equipment on-site.

3.4.2. They will be subjected to checks, tests and maintenance as detailed in **Table 3.3** below. (Different frequencies may be appropriate – manufacturers or supplier's recommendations should be followed).

Table 3.3: Recommended Maintenance Schedule

System	Frequency	Comment
Fire Panel Alarms	Monthly	User operation test.
	Quarterly	Check / service by specialist contractor.
BESS Smoke Detectors	As agreed with BESS Supplier	All sensors checked in accordance with interval specified by OEM including link to SCADA / HMI.
BESS Gas Detectors	As agreed with BESS Supplier	All sensors checked to confirm correct operation when sensing H2 LEL and also testing link to Fire Panel.
BESS Purge Ventilation	As agreed with BESS Supplier	Ventilation functionality and backup supply tested to ensure correct operation regularly as a critical safety system
BESS Heat Detectors	As agreed with BESS Supplier	All sensors checked in accordance with interval specified by OEM including link to SCADA / HMI.

System	Frequency	Comment
BESS Fire Suppression	As agreed with BESS Supplier	All fire suppression devices checked in accordance with interval specified by OEM including link to SCADA / HMI.
BESS Audible Alarm	As agreed with BESS Supplier	All fire alarms checked in accordance with interval specified by OEM including link to SCADA / HMI.
BESS Visual Alarm	As agreed with BESS Supplier	All fire alarms checked in accordance with interval specified by OEM including link to SCADA / HMI.
Emergency Lighting	Monthly	User operation test.
	Annually	Check / service by specialist contractor.
Sprinkler System	Weekly	Check by user.
	Quarterly	Check / service by specialist contractor.
Fire Hydrants	Weekly	Check by user for obstructions.
	Annually	Check / service by specialist contractor.
Fire Doors	6-monthly	Inspection by user.
Fire Exits	Monthly	User check for ease of opening.
Fire Extinguishers	Monthly	Inspection by user.
	Annually	Check / service by specialist contractor.
Fire door / shutter release mechanisms	Weekly	Operation check by user.
	Annually	Check / service by specialist contractor.

3.4.3. Passive fire precautions are concerned with the physical conditions in the premises which are designed to facilitate containment of fire by design, construction and layout, effective communication and safe evacuation. Active fire precautions are those features of the fire safety management system that detect and operate in the event of a fire, including fire alarm systems, emergency lighting systems, firefighting equipment and fire shutters / curtains.

3.5. Training and Firefighting Facilities

3.5.1. All staff will receive appropriate fire safety training. The main features of the training will be as shown in **Table 3.4**.

Table 3.4: Training Schedule

Training	Content	Frequency
General Fire Safety Induction – All Staff	Site layout familiarisation. Identification of escape routes and assembly point. Fire detection, suppression, and warning arrangements. Emergency procedures.	On commencement
Routine Staff Training – All Staff	Emergency plan and procedures. Roll call procedures. Fire prevention (including BESS).	Initial Annual refresher

Training	Content	Frequency
	Roles and responsibilities. Key points from fire risk assessment. False alarms – review and prevention measures. Fire events (and near-misses). Special instruction relevant to particular role (e.g. calling fire service, assisting person as part of PEEP).	
Evacuation Practice	Full evacuation drill testing all procedures. Review and communication of feedback to all.	6 monthly (for each shift group)
Portable Fire Extinguisher Training (Designated Staff only)	Practical firefighting using portable equipment of types as installed in the premises.	Initial Periodic refresher
Nominated Person Training/ Fire Warden	Role and responsibilities detail. Routine fire checks. Understanding fire-related systems and equipment. Assisting evacuation process. Checking premises/ areas safely. Liaison with Fire Service. Reporting procedures for faults, near-misses.	Initial Annual refresher

3.5.2. Training should be provided at the intervals stated in the schedule; however, it may be appropriate to update training in circumstances such as changes to the Substation and BESS compound layout, introduction of new fire risks, or changes to the emergency procedures. Such issues should be highlighted through the ongoing fire risk assessment process.

3.5.3. Detailed records should be kept of all fire safety training, including the dates, subjects covered and names of those receiving the training.

3.5.4. There will be certain facilities on the Site to assist with Fire Service operations. These are likely to comprise of:

- Fire hydrants;
- Water storage tanks where connection to water mains is not available; and
- Fire vehicle access route.

3.5.5. The local Fire Service should be invited to Site to attend training and familiarise themselves with the Site, BESS equipment and the firefighting facilities. Ongoing liaison will be maintained.

3.5.6. Only staff who have been nominated and who have received appropriate training may use the fire extinguishers provided on Site.

3.5.7. Personal safety is paramount and, if in any doubt about safety, no first-aid firefighting will be carried out. The judgement as to safety must only be made by the trained operator.

3.5.8. In the event of a fire or thermal runaway, water will be utilised to negate the spread in an attempt to reduce the damage to the BESS equipment within the compound and further prevent any consequent damages to the local environment.

3.5.9. This will result in contaminated runoff water which needs to be safely contained within the Site and safely removed. Allowance will need to be made as part of the detailed drainage strategy for the containment of potentially contaminated fire-fighting water in the event of a fire within the BESS.

3.5.10. This could comprise of an underground storage tank through which runoff from the BESS is passed. During normal conditions this tank is allowed to drain via the infiltration process outlined above, however in the event of a fire, a control valve on the outlet of the tank is closed prior to the deployment of firefighting water.

3.5.11. The full firewater runoff strategy will be developed during the detailed design stage of the Proposed Development.

3.6. Evacuation and Emergency Procedure

3.6.1. All staff should be trained in necessary actions in the event of fire.

3.6.2. The emergency evacuation procedures are in **Table 3.5**. Evacuation procedure notices are displayed at key locations around the compound as a reminder to staff.

Table 3.5: Fire Emergency Response Procedure

Task	Action
What People / Staff Should Do If They Discover a Fire	Raise the alarm by operating the nearest fire alarm call point.
What People / Staff Should Do If They Hear the Fire Alarm	Leave the Site by the nearest exit. Evacuate to the designated assembly point. Do not stop or return to collect personal belongings. Close any doors en-route without delaying your escape. Remain at the assembly place. Return to the Site only when authorised to do so by authorised personnel or attending Fire Officer. A person who discovered the fire should immediately pass any information to the supervising manager at the assembly point. For those with specific designated duties: • Call the FRS by dialling 999; • Tackle the fire only if trained and where appropriate; • Those with responsibilities for assisting persons with Personal Emergency Evacuation Plans should

Task	Action
	respond as required following the actions as identified in the Plan; • Ensure any visitors are escorted from the Site to the assembly point; and • During joint occupation (Contractor still present), notify the Contractor following the agreed protocol.
What Designated Staff Should Do if a False Activation has Occurred	Reset the Fire Alarm. Advise staff that it is safe to return to the Site. Record the event in the Logbook.
Arrival of Visitors	All Visitors are logged in and out of the Site by use of the Visitors Book. All Visitors are made aware of the Fire Evacuation Procedures on arrival. The designated person will take the Visitors Book to the Assembly Point in the event of an evacuation and perform a roll call. The FRS will be made aware of any suspected missing person.
Contacting the FRS	Information on escape routes, fire alarms and procedures will need to be detailed verbally at reception area when signing in as standard printed information will not be adequate.
FRS Liaison Procedure	On the arrival of the FRS the following should be done: • The designated staff member will make themselves known to the Officer in Charge of the attending crew on their arrival (meeting them at the designated location; • The designated staff member will provide all known details to the FRS on arrival; and • The designated staff member will continue to act as liaison / point of contact at the direction of the Fire Incident Commander.
Specific Information for the FRS	The designated staff member will give the FRS specific information such as: • Location of the fire / incident; • Location of fire panel; • Missing persons; • Flammable material stores; • Location of high risk areas; and • Any unusual activities such as Site works or temporary structures. Contractor to include procedure to follow if they have a fire emergency on their Site with regards to notification of responsible persons / tenants.

3.6.3. The process of shutting down and isolating the BESS system will be developed and shared with the operator in the detailed design stage of the Proposed Development.

4. Operations and Monitoring

4.1. Operational Strategy

4.1.1. During the operational phase, the BESS will be managed through a combination of monitoring, control and maintenance measures designed to maintain system performance and minimise safety risks. A central SCADA system is expected to provide continuous oversight of the BESS, enabling real-time monitoring of key operating parameters such as cell temperature, state of charge, voltage and system status. Automated alarms and fault detection functions are anticipated to support the early identification of abnormal operating conditions, allowing operators to investigate and respond to potential issues before they escalate. An in-depth view of these measures will be provided during the detailed design phase of the Proposed Development.

4.2. Evacuation Drills

4.2.1. An evacuation drill should be carried out at the frequency stated in **Table 3.4**. Routine drills should be organised and monitored by the Fire Safety Manager. Records will be kept of each evacuation drill.

4.2.2. The below **Table 4.1** and **Table 4.2** detail two Standard Personal Emergency Evacuation Plans (PEEPs). Standards PEEPs are for use when a person who requires assistance in an emergency comes to the premises as a visitor. In other circumstances it will be appropriate to have a specific PEEP for anyone requiring one.

Table 4.1: Plan 1 - Person with Sight Impairment

Key Points	Key Summary
Requirement	Person is partially sighted or blind making it difficult to locate and negotiate escape routes.
Escape Procedure	The person's host will take them to a safe position outside the Site. (It is not anticipated that visitors with sight impairments will be allowed unaccompanied access around the Site).
Specialist Equipment	None specified for this plan.
Fire Warden Assistance	None specified for this plan.
Communications	Information on escape routes, fire alarms and procedures will need to be detailed verbally at reception area when signing in as standard printed information will not be adequate.

Table 4.2: Plan 2 - Person with Hearing Impairment

Key Points	Key Summary
Requirement	Person has hearing impairment making it difficult to hear the fire alarm clearly, or the person is totally deaf making it impossible to hear the fire alarm.
Escape Procedure	The person will be alerted by their host, or by a companion/ colleague who is visiting with them. Or the person will be alerted by seeing a fire alarm visual warning device. It is anticipated that independent escape can then be made following the signed escape routes.
Specialist Equipment	Some visual warning devices are in place where visitors may be unaccompanied, e.g. toilets.
Fire Warden Assistance	None specified for this plan.
Communications	Availability of visual information in reception area to inform visitors of escape routes and procedures.

4.3. Checks, Maintenance and Testing

4.3.1. To maintain system integrity throughout the asset lifecycle, routine inspection and maintenance activities will be required in accordance with the recommendations of the OEM, the Site Operator, British Standards and general fire safety guidelines. The testing and maintenance schedule is included in **Table 3.3**.

4.3.2. Fire safety records should be kept up to date and available for inspection on Site. The summary of fire safety records to be kept is as follows:

- Staff fire safety training;
- Equipment and systems testing and checks;
- Equipment and systems routine maintenance and servicing;
- Fire alarm activations;
- Fire events;
- Fire risk assessment and associated action plans;
- Fire safety officer visits and associated correspondence; and
- Evacuations planned and unplanned.

4.4. Record Keeping

4.4.1. Fire safety records should be kept up to date and be available for inspection on Site. The summary of fire safety records to be kept is as follows:

- Staff fire safety training;
- Equipment and systems testing and checks;

- Equipment and systems routine maintenance and servicing;
- Fire alarm activations;
- Fire events;
- Fire risk assessment and associated action plans;
- Fire safety officer visits and associated correspondence; and
- Evacuations, planned and unplanned.

5. Audit and Review

5.1. Fire Risk Assessment Review

5.1.1. The fire risk assessment should be reviewed at least annually.

5.1.2. A review will also take place in the event of significant changes, such as:

- Increase in number of people likely to be in the Site;
- Proposed alterations in the layout of the Site;
- Increase in fire loading in the Site; and
- Proposed changes to this fire safety management plan or the arrangements specified within it.

5.1.3. The fire risk assessment and procedures should also be reviewed following any occurrence of fire (no matter how minor) or any reported fire-related near-miss.

5.2. Response to Changes

5.2.1. Whenever changes are made which;

- Necessitate review of fire risk assessment (as specified in **Section 5.1** above); or
- Affect the management structure or arrangements of the premises.

5.2.2. The impact of those changes on the BFSMP should be assessed and amendments made as necessary.

5.3. Records Audit

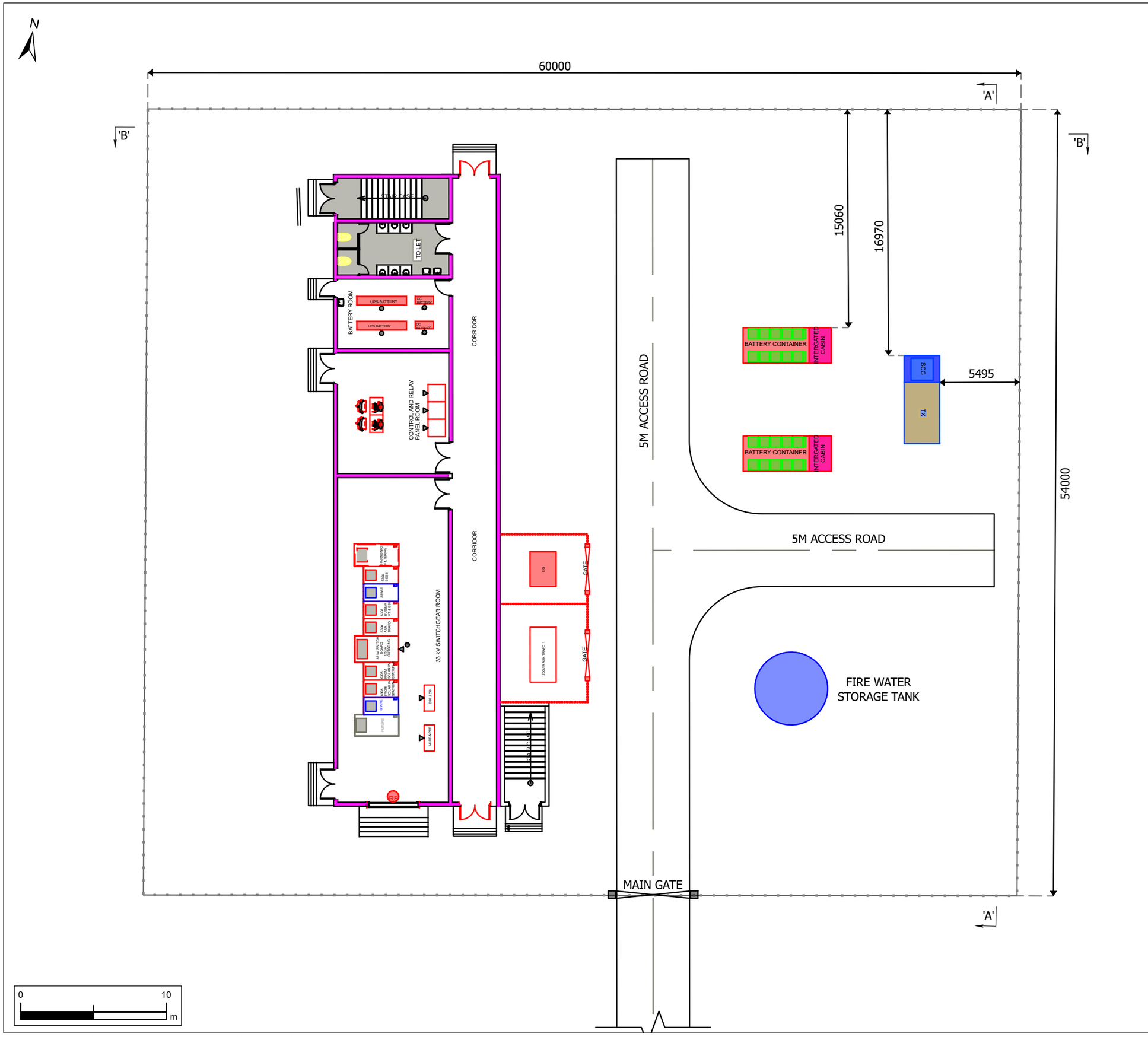
5.3.1. The fire safety records detailed in **Section 4** should be audited annually by personnel with designated responsibility.

5.4. BFSMP Formal Review

5.4.1. The BFSMP should be the subject of an annual review. The results of the review should be recorded, and any necessary changes will be made and implemented.

5.4.2. The review will be undertaken by a competent person nominated by personnel with designated responsibility.

Annex A – BESS and Substation Concept Layout



Legend

- Substation Fencing
- Battery and PCS Enclosure
- PCS Transformer Enclosure
- Fire Water Storage Tank

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Rev.	Date	Revision Description	Drawn	Check	Rev.	App.
0	05/11/2026	Initial Issue	AR	RJ	DP	SM

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Project: Fferm Solar Larnog

Drawing Title: Substation and Battery Energy Storage Systems (BESS) Layout

Trydan Gwyrdd Cymru

Drawing No.: Figure 1