

USKMOUTH ENERGY STORAGE PARK

BATTERY SAFETY MANAGEMENT PLAN

April 2025

Revision A

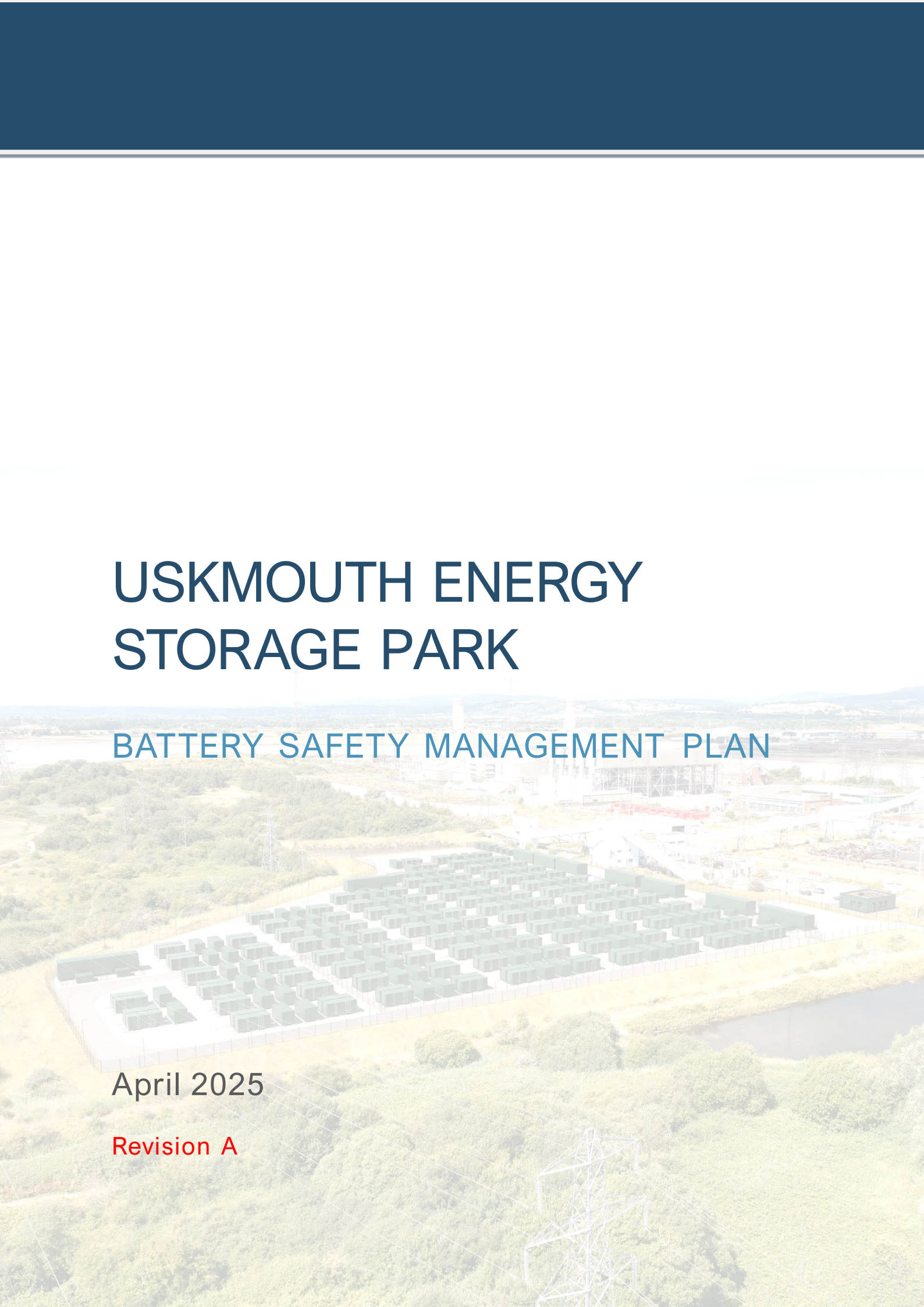


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1 INTRODUCTION

1. This Battery Safety Management Plan “BSMP” has been prepared by Uskmouth Energy Storage Limited (‘UESL’) to accompany the discharge of Requirement No. 7 of the approved planning permission granted permission on the 23rd of November 2023 in relation to the Battery Energy Storage System (BESS) application number 23/0835.
2. The measures and protocols prescribed in this BSMP shall be implemented to reduce the risks of a potential thermal runaway or fire occurring and to minimise the impact of a potential thermal runaway or fire event should it occur.

1.1 DOCUMENT STRUCTURE

3. This BSMP includes the following sections in accordance with the outline battery safety management plan approved under application 22/0823.
 - Introduction, including background, consultation, and document structure.
 - Statement of Compliance with Applicable Legislation.
 - Design Response to Risk.
 - Emergency Response Protocol (During Construction).
 - Standard Operation Procedures (Relevant to Safety).
 - Emergency Response Protocol (During Operation).
 - Battery Transportation Plan; and
 - Environmental Risk Assessment.

4. Table 4.1 of the Outline BSMP set out the pre-construction information requirements which are addressed in this BSMP. Table 1 provides a summary of where the information requirements are addressed.

Table 1 - Detailed Design Information Requirements

Requirement	Reason for Information Required	Location of Information in the BSMP
Statement of Compliance with Applicable Legislation	To demonstrate compliance with legislation, will cross reference to the other documents set out below.	Section 2, Statement of Compliance with Applicable Legislation
Detailed Design Drawing of BESS	To ensure available and safe access to the BESS for fire appliances. To enable SWFRS to evaluate the available access for fire appliances to all parts of the BESS. To show separation between components of BESS.	Appendix A
Statement of design responses to fire risk	To accompany the detailed design drawing and explain how the risk of fire spreading has been addressed through the Development Design.	Section 3, Design Responses to Risk
Battery Specification	To ensure that SWFRS are aware of the specific type of batteries installed. This would include the battery 'chemistry' as well as size and format of each cell.	Section 3.7, Battery Specification
Fire Detection System Specification	To demonstrate how the requirement for fire detection has been addressed.	Section 3.10, Fire Detection System Specification
Fire Suppression System Specification	To demonstrate how the requirement for fire suppression has been addressed.	Section 3.11, Fire Suppression System Specification
Standard Operating Procedures and Guidelines (Relevant to Safety)	To demonstrate an ongoing commitment to regular checks and maintenance during operation e.g., plans for swap-out of suspected modules. Include a list of competencies and/or certification requirements for competent Site Operating staff.	Section 5, Standard Operating Procedures
BESS Installation Contractor Emergency Protocol (during construction)	To demonstrate that protocols are in place to manage a fire during construction.	Section 4, Emergency Response Protocols (During Construction)
Site Operator Emergency Protocol (during operation, including decommissioning)	To demonstrate that protocols are in place to manage a fire during operation and decommissioning.	Section 6, Emergency Response Protocols (During Operation)
Other information requested by SWFRS to inform their Tactical Response Plan	To ensure that SWFRS has the information it requires to adequately address a fire at the BESS.	Appendix B, Record of Consultation with SWFRS.
Battery Transportation Plan	To ensure that the transportation of battery cells, including delivery of new, used, failed and replacement battery cells to and from the site is carried out in accordance with prevailing legislation.	Section 7, Battery Transportation Plan

Requirement	Reason for Information Required	Location of Information in the BSMP
Environmental Risk Assessment	To ensure that the potential for indirect risks (e.g., through leakage or other emissions) is understood and mitigated using methods consistent with Best Available Techniques (BAT) in relation to the specific battery chemistry selected.	Section 8, Environmental Risk Assessment
Air Quality Impact Assessment - Battery Fire	To ensure that in the unlikely event of a battery fire, the air quality impacts of a fire are understood and mitigated to demonstrate that relevant thresholds are not exceeded in relation to the specific battery chemistry selected.	Appendix C, Air Quality Battery Failure Plume Assessment

2 STATEMENT OF COMPLIANCE WITH APPLICABLE LEGISLATION

5. The development shall be constructed and operated in accordance with the following applicable legislation.
- a. The Health and Safety and Work Etc. Act 1974 (“HSWA”),
 - b. The Design risks and the Construction (Design and Management) Regulations 2015 (“CDM”),
 - c. The Regulatory Reform (Fire Safety) Order 2005 (“FSO”),
 - d. The Building Regulations 2010 (“BR”),
 - e. The Electricity Safety, Quality and Continuity Regulations 2002 (“ESQCR”),
 - f. The Electricity at Work Regulations 1989 (“EWR”),
 - g. The Dangerous Substances and Explosive Atmospheres Regulations 2002 (“DSEAR”),
 - h. The Control of Substances Hazardous to Health Regulations 2002 (“COSHH”),
 - i. The Health and Safety (Consultation with Employees) Regulations 1996 (“HSCER”),
 - j. The Lifting Operations and Lifting Equipment Regulations 1998 (“LOLER”),
 - k. The Management of Health and Safety at Work Regulations 1999 (“MHSWR”),
 - l. The Provision and Use of Work Equipment Regulations 1998 (“PUWER”),
 - m. The Work at Height Regulations 2005 (“WHR”),

3 DESIGN RESPONSE TO RISK

3.1 SUMMARY

6. Within this section of the BSMP, we outline UESL's approach to the identification, assessment, and management of risks in relation to the hazards associated with fires within standalone lithium-ion battery storage facilities and detail the Development's design outcomes to accompany the detailed design drawings to summarise the considerations and specifications of the site's layout and the selected battery manufacturers equipment.

3.2 APPROACH TO RISK

7. Prior to the commencement of the project's design phase, an assessment was completed to identify the key project stages at which risks associated with fires in standalone lithium-ion battery storage facilities are to be managed. Following the assessment, UESL identified the following critical steps across six key project stages as demonstrated within Table 2.

Table 2: Critical Steps and Project Stages

Step	Description	Project Stage	Summary
Step 1	Identification	Design	Detect, describe, and catalogue all potential risks to be assessed.
Step 2	Assessment	Design	Examination of safeguards and mitigations to reduce all potential risks identified.
Step 3	Implementation	Design	Implementing through design control measures for managing all potential risks identified.
Step 4	Review	Pre-Construction	Review the identified hazards, safeguards, and mitigations during the design phase, perform an in-depth analysis of each construction and operational process, update and identify any new hazards, safeguards and mitigation, document and implement management plans to ensure effective controls during construction.
Step 5	Monitor	Construction	Regular Inspection during the construction ensuring implementation control measures is being executed effectively.
Step 6	Verification	Commissioning	Through commissioning of the system process ensuring the implemented control measures are functioning effectively.
Step 7	Maintain	Operation	Preventative maintenance of the system during operation to ensure the implemented control measures performances are maintained.
Step 8	Manage	Operation	Change management in the event any new risks are identified post commissioning and during operation. Emergency management plans in the event of an abnormal event.
Step 9	Manage	End of Life Decommissioning	Repeat of Steps 1 – 5 specifics for the decommissioning construction works ensuring any new hazards identified during the operational phases are incorporated.

8. At each project phase the primary objectives were defined as follows.
- To ensure the safety of employees, contractors, and members of the public.

- b. To reduce the likelihood of a potential thermal runaway and fire event.
 - c. To minimise the consequences of a potential thermal runaway and fire event.
 - d. To ensure plans and procedures are in place to safety and effectively manage a potential thermal runaway and fire event.
- 9. As part of the assessment, key documents for the identification, assessment and management of hazards were identified to be utilised across the project, including.
 - a. A Hazard Identification Studies ("HAZID"),
 - b. A Hazard and Operability Analysis ("HAZOP").
- 10. The HAZID assessment set out to detect, describe, and catalogue potential risks, identify the potential sources, and causes of fires in stationary battery storage projects and provide assessment through examination safeguards and mitigations to be considered to reduce potential risks within the design phase.
- 11. Outcomes of the initial HAZID have been reflected within the projects design with key consideration made to.
 - a. The selection of the battery chemistry and battery vendor, ensuring.
 - i. Product reputation,
 - ii. ISO 9001 & 14001 management standards,
 - iii. Environmental & Social governance,
 - iv. Manufacturing traceability.
 - b. The quality of the battery equipment ensuring.
 - i. Certification and compliance of the relevant standards,
 - ii. Use of superior materials,
 - c. The layout of the site, ensuring,
 - i. Adequate spacing between equipment,
 - ii. Provision of dedicated Firewater facilities,
 - iii. Security & Fencing provisions,
 - iv. Local fire depart accessibility.
 - d. The Specification of the Fire Detection & Suppression Systems, ensuring.
 - i. Automatic operations,
 - ii. Multi-level detection equipment with all enclosures & buildings,
 - iii. Site wide fire monitoring systems,
 - iv. Automatic notification of fire alarm activations, and
 - v. system redundancy.
 - e. The Provision of Fire Fighting Equipment, ensuring.
 - i. Optionality to the Local Fire department,
 - ii. Provision onsite firewater,
- 12. At the end of each project phase and prior to the commencement of the next phase a Hazard and Operability Analysis (HAZOP) shall be performed to provide continued review of the Developments lifecycle to ensure risks are being correctly identified, safeguards and mitigation

are affectively implemented and ensure a process of change management is place between each project phases.

3.3 SITE LAYOUT – SEPARATION DISTANCES

13. The site layout has been concluded such that the distances between battery enclosures and power conversation system blocks are ≥ 3 metres.
14. The layout has also been concluded to reduce the potential risks of fire propagation in the event of fire event and simultaneous failure of the proposed fire suppressions system further by increasing the distance between adjacent power blocks to ≥ 6 metres.
15. A separation distance of ≥ 20 metres has also been maintained between batteries and equipment and buildings not associated directly to the battery storage facility.

3.4 SITE LAYOUT – ACCESS & SECURITY

16. The site layout includes the provision of a perimeter palisade security fence to prevent unauthorised access to the battery facility. A series of pedestrian and vehicle access gates allow for access to authorise person(s) whilst allowing for persons to exit the site in the event of an emergency evacuation.
17. A network of CCTV cameras has been included to protect the perimeter fencing and shall be always monitored via a dedicated certified monitoring centre.
18. Access roads and vehicular access gates have been sized to ensure the largest vehicle required to enter and exit the facility unrestricted post construction. The layout also ensures unrestricted access to the local fire department in a fire event. Additional measures have also been made to allow the local fire department to be able to approach a fire event without need to enter the site via the proposed flood gate.

3.5 SITE LAYOUT – FIRE WATER PROVISIONS

19. The site layout includes a dedicated onsite firewater provision via the means of a fire water tank sized to provide 1900 litres/minute for a minimum of two hours, two fire water pumps on a N+1 redundancy rated to provide 1900 litres/minutes at any one hydrant across the BESS area. A series of fire hydrants located to ensure a minimum of 90 metres distance to any part of the BESS area whilst ensuring the local fire department to always be able to approach a fire hydrant first from any entrance before approaching any potential fire across the BESS area.
20. Within each battery enclosure a dry pipe sprinkler system to NFPA 855 and NFPA 15 has also been developed to provide the local fire department with additional firefighting options for consideration in their Tactical Response plans.
21. The local fire department has also recently completed an onsite real-life scenario-based training exercise; during which the adjacent swales / ponds where also identified and used as an alternative water source.

3.6 BATTERY CHEMISTRY

22. The selected BESS chemistry is Lithium Ferro Phosphate ('LFP')

3.7 BATTERY SPECIFICATION

23. UESL has selected their preferred battery supplier for the proposed Development based on their global performance, reliability, and independent rankings. A summary of the selected supplier battery specification is provided in the below table.

Table 3 – Selected Manufacturers Battery Specification Summary Table

Item	Remark
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Manufacturer	CATL	
Cell Chemistry	Lithium Ferro Phosphate (LFP)	
Enclosure Dimensions (L x W x H)	6058mm (L) x 2438mm (W) x 2896mm (H)	
No. Modules / Block	40	
No. Racks / Block	5	
No. Modules / Rack	8	
Energy Capacity / Block	4.073 MWh +/-	
Voltage Range	1164.8~1497.6 VDC	
C-Rating	0.5	
Operational Ambient Temperature	-30°C up to +50°C	
Battery Management System	Included	
Auxiliary Power	Uo 230/400v	
Thermal Management System	Liquid Cooling	
Fire Detection System	Automatic (see	
Fire Suppression System	Automatic Aerosol Type	
Fire Fighting Equipment	Dry Pipe System	
IP Ratings	Battery Room	IP55
	Electrical Room	IP55
	TMS	IP67
	Module	IP67
Compliance Standards	Cell & Module	UN38.3
		UL1973
		IEC62619
		UL9540A
	Container	UL1973
		NFPA855
		UL9540A
		IEC 62477
		IEC 62619
		IEC 62933-5-2
		IEC 63056
		IEC 61000-4/

3.8 BATTERY MANAGEMENT SYSTEM

24. The selected preferred battery supplier's system includes a proprietary Battery Management System ("BMS") the BMS system is designed to monitor key electrical, mechanical, and environmental parameters to ensure the system operates within its designed thresholds. The BMS controls the battery systems, electrical systems and thermal management systems and is interlinked to the systems fire detections and fire suppression systems. The BMS provides early warning notification, fault notifications and disconnection of the battery system in the event of a parameter being exceeded. The BMS samples and records parameters every second and can provide a sub-second disconnection of the system in the event of a fault or parameter exceedance.
25. Key parameters considered for the importance of fire safety monitored by the BMS include but are not limited to.
- Overall system voltage
 - System State of Health ("SOH")
 - System Stage of Charge ("SOC")
 - Single cell temperatures

- e. Single cell voltage
 - f. Single cell temperature difference
 - g. Single cell voltage difference
 - h. Battery System Insulation Resistance
 - i. Enclosure ambient temperatures
 - j. Thermal Management System ("TMS") water temperatures
26. The BMS provides levels of early warning notifications when parameters are nearing their designed limits, these notifications are automatically generated and shall be monitored by a centralised system so that operational teams can investigate, analyse and provide reactive maintenance to repair or replace defective parts appropriately.
27. In the event of a parameter being exceeded the BMS automatically provides fault notification and immediate disconnection of the system from the high voltage AC supply, notifications are automatically generated and shall be monitored by a centralised system so that operational teams can investigate, analyse, and provide reactive maintenance to repair or replace defective parts appropriately.
28. Key parameters considered for the importance of fire safety which generate automatic disconnection of the system by the BMS include but are not limited to.
- a. A Communication fault,
 - b. SOC under/over limit,
 - c. System Current over limit,
 - d. Single cell voltage over/under limit,
 - e. Rack voltage difference over/under limit,
 - f. Single cell temperature over/under limit,
 - g. Rack temperature difference over/under limit,
 - h. Insulation fault under limit,
 - i. Auxiliary power fault,
 - j. Lightning protection device fault,
 - k. Fire system fault,
 - l. TMS water temperature over/under limit,
 - m. TMS fault,
 - n. Emergency stop button engaged,
 - o. Emergency stop button fault.

3.9 THERMAL MANAGEMENT SYSTEM

29. The selected preferred battery supplier's system includes a liquid cooled Thermal Management System ('TMS') to maintain the battery modules temperate within the designed parameters. The TMS is controlled by the battery systems BMS and uses measurements of cell temperatures and ambient temperature to determine the most optimum setting for the TMS to operate within.
30. The TMS includes a secondary heater which provides heat into the liquid loop in the event the loop temperatures go below the low parameter thresholds, this is to prevent the TMS from freezing in cold temperatures.

3.10 FIRE DETECTION SYSTEM

31. The selected preferred battery supplier's system includes an automatic fire detection system within each battery enclosure and includes detection from the following equipment types.
 - a. Heat detectors,
 - b. Smoke detectors,
 - c. Hydrogen detectors,
 - d. Carbon Monoxide detectors.
32. Each battery enclosure also includes audible and visual notification devices in the event of a fault or alarm condition.
33. All fire detection systems shall all be installed and commissioned to BS EN 54, BS EN 9999, NFPA 885, NFPA 850.
34. Each battery enclosures fire detection system shall be integrated into a dedicated site wide fire monitoring system to allow notification from a centralized location onsite. The site wide monitoring system shall be securely monitored via a dedicated platform and provide automatic remote notification to a certified alarm receiving centre via a dual path signalling solution in the event of an emergency scenario, the system can also provide automatic signally to the local fire departed which shall be offered and provided at their discretion.
35. The site wide monitoring system shall also provide automatic controls to disconnect an affected battery enclosure from its designated Power Conversion System and nearby equipment from the High-Voltage network in the event of an alarm being triggered. Hardwired normally closed safety loops are also to be installed between each battery enclosure and its designated Power Conversion System to provide local disconnection from the High-Voltage network as a second layer of redundancy if a communications fault between the systems was to occur simultaneously.

3.11 FIRE SUPPRESSION SYSTEM

36. The selected preferred battery supplier's system includes an automatic fixed condensed aerosol fire suppression system triggered by the fire detection system.
37. Each suppression system shall be installed using LPCB approved products and installed and commissioned to BS EN 15276, NFPA 885, NFPA 850. As part of the battery systems enclosure compliance to NFPA 69 the system includes an explosion proof fan and inlet which operate to provide deflagration measures to the enclosure, before the fire suppression system is initiated the explosion proof fan and inlet are shutdown to allow an effective deployment of the suppression system aerosols. The fire alarm system shall be commissioned to ensure the gas exhaust system is not shut down during a thermal runaway situation.

3.12 CYBERSECURITY

38. The sites 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.
39. The development will reduce risk in accordance with the Health and Safety Executive (HSE) Operational Guidance document OG86. The International standards such as IEC 62443, UL 1741, IEEE 1815, IEEE 1547.3, and the recent published UL 2941 will be consulted and guidance from national sources such as National Cybersecurity Centre will be used to inform the implementation and protection measures.
40. The Development shall complete a verification of the system security measure by undertaking a third-party penetration test to prove the development compliance with the standards mentioned above.

4 EMERGENCY RESPONSE PROTOCOLS (DURING CONSTRUCTION)

4.1 SUMMARY

41. This section of the BSMP provides outlines the protocols and guidelines to be undertaken by the appointed construction contractors, suppliers, and UESL to ensure measures are in place to manage a potential fire during construction.
42. All construction works shall be undertaken ensuring compliance to UK Legislation as detailed Section 2 of this document.
43. UESL shall continue provide improvements to fire safety during the construction by:
 - a. Encouraging the use of new construction methods and safe working practices.
 - b. Maintain a continued review of the procedures and guidelines being implemented.
 - c. Monitor the construction to ensure the implementation of the procedures and guidelines are being adhered to.
 - d. Ensure the correct levels of management are in place to fulfil their duties.

4.2 EMERGENCY RESPONSE TEAM

44. A Construction Emergency Response Team ("CERT") with clear roles and responsibilities shall be appointed and be formed of key senior project team members from the following entities.
 - a. UESL
 - b. The Principal Designer
 - c. The Principal Contractor
 - d. Elected Contractors & Sub-Contractors
45. The CERT shall be responsible for.
 - a. Completing the developments construction Emergency Response Plan, including but not limited to
 - i. Review and further develop the responsibility matrix (RACI) for decision making and protocols for incident response – shared across the facility and response teams.
 - ii. Review and further detail the Standard Operating Procedures (SOPS) with specific emphasis on safe shutdown and isolation procedures, emergency response procedures and decommissioning procedures. Review and further detail the developments system monitoring data analytics for real time support in an emergency event.
 - b. Liaising with the local emergency services and making them aware of the detailed project programme, identify key milestones such as the battery delivery dates, installation commencement, commissioning commencement and any other periods of construction which may pose a higher risk of fire hazards being present.
 - c. Maintaining regular meetings and periodic reviews of the construction progress ensuring fire safety is maintained.
 - d. Provide continual updates to the local emergency services and notify them of any changes to key construction milestones, new hazards, or changes to the Emergency Response Plan.
 - e. Perform real life scenario-based testing to evaluate the effectiveness of the Emergency Response Plan.
 - f. Ensure the protocols, guidelines, and standards of this BSMP are followed.

4.3 FIRE DETECTION GUIDELINES

46. During construction a system for ensuring fire alarms can be effectively and successfully raised shall be implemented, the system shall be clearly documented within the construction emergency response plan and ensure alarms are loud, distinct and capable of alerting all personnel working within the proposed Development.
47. The Construction Emergency Response Plan shall include but not be limited to the following information as a minimum.
- a. A means of raising a manual fire alarm (e.g., emergency gas horns)
 - b. A clear plan showing the nearest escape route.
 - c. Details of the site appointed first aiders.
 - d. Details of the sites appointed fire marshals.
 - e. Details of the CERT's Incident Commander
 - f. Detail of Portable fire extinguishers with clear guidance of their type, use and locations.
48. Regular inspections of the implemented systems shall be conducted by the CERT to ensure the means of raising alarms are effective and notices are kept up to date and can be clearly read and understood.

4.4 HOT WORKS GUIDELINES

49. A permit system to regulate and minimise potentially hazardous operations like welding, cutting and grinding shall be implemented.
50. No hot works shall be permitted without a relevant permit being issued by the Site Safety Manager and a specific task risk assessment being undertaken.

4.5 UTILITIES & EQUIPMENT SHUTDOWNS

51. Following the delivery of the battery modules and during the commissioning of the sites, electrical systems the CERT shall ensure that the construction emergency response plan includes procedures for shutting down the BESS's High-Voltage AC supplies safely and effectively to isolate the battery system(s) in an emergency scenario. This shall include the disconnection of power sources during non-working hours where possible and ensuring a qualified Senior Authorised Person is always available.

4.6 SAFE STORAGE AND HANDLING OF FLAMMABLE MATERIALS

52. Any flammable material used during construction shall be stored under the following guidelines.
- a. Flammable materials shall be stored in approved containers designed specifically for their safety storage, labelled appropriately, and free from any damage that may compromise their integrity.
 - b. Flammable materials will be stored in designated areas that are well-ventilated, away from sources of ignition, and separated from incompatible substances. Additional consideration shall be made of its distance from the proposed BESS facility and be managed by the CERT in coordination with the overall construction programme.
 - c. Storage areas for flammable materials shall be equipped with appropriate firefighting equipment, such as fire extinguishers which shall be regularly inspected and maintained.
 - d. All storage areas must have clear signage indicating the presence of flammable materials and outlining the necessary safety precautions.
 - e. Flammable materials must be stored at a safe distance from emergency exits, walkways and evacuation routes.

- f. Storage areas should be kept clean, free of clutter, and easily accessible to facilitate safe handling and emergency response.
 - g. Smoking, open flames, and any activities that may generate sparks are strictly prohibited in flammable material storage areas.
- 53. Flammable materials used during construction shall be handled under the following guidelines.
 - a. Only trained and authorized personnel should handle flammable materials.
 - b. Proper personal protective equipment (PPE), such as safety goggles, gloves, and flame-resistant clothing, must be worn when handling flammable materials.
 - c. Ensure that the work area is well-ventilated during any activities involving flammable materials.
 - d. Always use appropriate tools and equipment for the safe handling and transfer of flammable materials.

4.7 SMOKING POLICY

- 54. Smoking including the use of electronic vapes shall be strictly prohibited within the demise of the battery facilities construction zone and areas where flammable materials are present and/or stored.
- 55. The Main Contractor shall provide a designated smoking area at a location to be agreed with the CERT ensuring the designated area is equipped with appropriate means to extinguish smoking articles safely and provide firefighting equipment, such as fire extinguishers which shall be regularly inspected and maintained.

5 STANDARD OPERATION PROCEDURES (RELEVANT TO SAFETY)

5.1 SUMMARY

56. This section of the BSMP provides a summary of the operating procedures and guidelines relevant to battery fire safety and forms part of a series of standard operating procedures and guidelines for the wider facility.

5.2 OPERATIONAL TEAM MANAGEMENT PROCEDURE

57. Prior to commercial operation UESL shall appoint an Operational Team to manage, service, maintain and operate the battery facility. The Operational Team shall consist of key UESL employees and specialist sub-contractors who are yet to be appointed.
58. The Team shall be structured to ensure the procedures and guidelines of this BSMP can be effectively and safely delivered and shall ensure key safety roles are fulfilled including but not limited to.
- Site Operational Manager
 - Site Safety Officer
 - Site Fire Safety Officer

5.3 ROUTINE MAINTENANCE PROCEDURE

59. During operation routine maintenance shall be undertaken of the battery facility. Maintenance shall be conducted in accordance with the manufacturer's guidelines, current relevant standards, and industry best practices and as a minimum shall include the tasks as detailed within Table 4 below.

Table 4 – Standard Routine Maintenance

Task Description	Occurrence	Reason
Measure the ambient temperature & humidity.	Daily / System Automation	To ensure the system has been maintained within the manufacturers safe thresholds.
Measure the modules internal cell temperatures.	Daily / System Automation	To ensure the system has been maintained within the manufacturers safe operational thresholds.
Measure the modules internal voltages.	Daily / System Automation	To ensure the system has been maintained within the manufacturers safe operational thresholds.
Measure the systems State of Charge and State of Health.	Daily / System Automation	To ensure the system has been maintained within the manufacturers safe operational thresholds.
Check the Battery Management Systems logs for abnormalities, errors, or faults.	Daily / System Automation	To ensure the system has been maintained within the manufacturers safe operational thresholds.
Check the Fire Alarm and Fire Suppression Systems logs for abnormalities, errors, or faults.	Daily / System Automation	To ensure the system has been maintained within the manufacturers safe operational thresholds.
Perform a local fire alarm test.	Weekly	To ensure the fire alarm system is correctly functioning as intended to its specification.
Perform a visual inspection of the Battery Enclosures.	Weekly / Following any	To ensure the integrity of the enclosures.

Task Description	Occurrence	Reason
	adverse weather conditions.	
Perform a visual inspection of the Thermal Management Systems.	Weekly	To ensure Thermal Management System is operating as originally intended and there are no visual and audible signs of damage to the equipment.
Perform a visual inspection of the fire alarm and fire suppression systems	Weekly	To ensure the Fire Alarm and Fire Suppression Systems are free from damage, faults and have not been accidentally discharged.
Perform a visual inspection of the enclosures deflagration systems	Weekly	To ensure the deflagration venting are free from damage, faults and no debris is present within the fan outlets or actuators which would impede their effective operation.
Perform a visual inspection of the battery systems cabling.	Monthly	To ensure the three no signs of damage or distortion.
Check and test the battery systems Uninterrupted Power Supplies (UPS)	Monthly	To ensure the battery systems UPSs are functional and free of damage or fault.
Replace the UPS batteries within each Fire Alarm Panel	6 Months	To ensure the UPS health of the Fire Alarm Panels are maintained in accordance with the designed standards.
Clean and or replace any filters associated to the Thermal Management System	6 Months	To ensure the thermal management system performance is maintained to the designed intent.
Perform an intrusive inspection of all battery enclosures and associated systems.	6 Months	To ensure the integrity of the system, ensuring the enclosures and systems are free from damage and fault.
Perform in-depth electrical measurements of the battery systems.	12 Months	To ensure all electrical system within the battery enclosure are maintained within the manufacturers and designed safe thresholds.

5.3.1.1 *System data analytics will be integrated into EMS / BMS systems and controls which reduces Thermal Runaway risks. Data Analytics can also be used to predict accurate End-of-Life timeframes and provide operator maintenance alerts.*

5.4 DEFECTIVE MODULE PROCEDURE

60. In the event of a defective 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.
61. Once a defective module is safely removed in accordance with the specific risk assessment, it shall be placed in an approved protective container prior to being transported from the detective unit to a dedicated safe location for inspection by an authorised manufacturer's representative.
62. Following the outcome of the authorised manufacturers inspection, a further specific risk assessment shall be conducted appropriately to ensure the safety of employees, contractors, and members of the public prior to the defective module being removed and transported from the

Development. Defective modules shall be either transported to the battery manufacturers approved repair facility or processed to be recycled in accordance with The Waste Accumulators Regulations 2009. All transportation to and from the development shall be done so in accordance with the Battery Transport Plan.

5.5 PERSONAL PROTECTIVE EQUIPMENT GUIDELINES

63. All tasks and works undertaken on the battery system or its associated equipment has requirements for the use of Personal Protective Equipment (PPE), planned and unplanned tasks shall have a task specific risk assessment completed prior to commencing any works with each task specific PPE requirements detailed and adhered to at all times.
64. As a minimum, all employees, contractors, and visitors attending the battery facility both during construction and operation shall ensure the following PPE requirements are always worn:
- a. Protective Headgear
 - b. High Visibility Clothing
 - c. Protective Eyewear
 - d. Protective Gloves
 - e. Protective Footwear
 - f. Arc Flash Clothing
 - g. Flame Resistance Clothing

5.6 TRAINING GUIDELINES

65. Key employees and contractors who manage, operate, and maintain the facility shall be provided with site and product specific training to ensure competencies of the site are achieved.
66. Regular tool-box talks are to be performed by UESL employees and contractors who manage, operate, and maintain the facility to provide knowledge refreshment on key safety and operational principals throughout the facility's operational lifespan.

5.7 COMPETENCIES GUIDELINES

67. All employees and contractors shall be vetted by the site's appointed site safety manager to validate they have the correct level of qualification and competency specific to the task or tasks to be undertaken prior to any works being commenced.
68. Only electrically qualified employees and contractors who have completed the battery specific product training and site-specific inductions shall be permitted to work on the proposed battery systems.
69. Employees or Contractors who have not completed the battery systems product specific training shall be permitted to do only under the supervision of a senior person or person(s) who has completed the product specific training.

6 EMERGENCY RESPONSE PROTOCOLS (DURING OPERATION)

6.1 SUMMARY

70. This section of the BSMP outlines the protocols and guidelines to be undertaken by the appointed Operational Teams to ensure measures are in place to manage potential thermal runaway and fire scenarios during operation.
71. All construction works shall be undertaken ensuring compliance to UK Legislation as detailed Section 2 of this document.
72. UESL is yet to formally appoint the project's operational teams, and the following protocols provide the minimum requirements the project teams shall follow based on safeguards and measures identified during the design process.
73. UESL shall continue provide improvements to fire safety during the construction by:
- a. Encouraging the use of new methods and safe working practices.
 - b. Maintain a continued review of the procedures and guidelines being implemented.
 - c. Monitor the operation to ensure the implementation of the procedures and guidelines are being adhered to.
 - d. Ensure the correct levels of management are in place to fulfil their duties.

6.2 EMERGENCY RESPONSE TEAM

74. An Operational Emergency Response Team ("OERT") with clear roles and responsibilities shall be appointed and be formed of key senior project team members from the following entities.
- a. UESL
 - b. Operation and Maintenance Contractor
75. The OERT shall be responsible for.
- a. Liaising with the CERT prior to operation being commenced and perform an in-depth handover of the Emergency Response Plan in place during the construction period.
 - b. Review and update the Emergency Response Plan in place during construction to align with the protocols and procedures required for operation.
 - c. Liaising with the local emergency services to make them aware of when the updated emergency response plan shall be implemented ensuring there no delay in the plans between the end of the construction period and the commencement of the operational period.
 - d. Maintaining regular meetings and periodic reviews ensuring fire safety is maintained.
 - e. Provide continual updates to the local emergency services and notify them of any changes to the operational facility, new hazards, or changes to the Emergency Response Plan.
 - f. Perform real life scenario-based testing to evaluate the effectiveness of the Emergency Response Plan.
 - g. Ensure the recommendation of the air quality assessment as summarised in section 8.3 and 8.4 of these documents are enforced.
 - h. Ensure the protocols and guidelines of this BSMP are followed.

6.3 PROVISION OF FIREWATER

76. To ensure additional redundancy during operation temporary diesel generators shall be implemented to ensure a permanent power supply to the firewater systems pumps are available.

The temporary generators shall have an adequate fuel supply sized to maintain both pumps at 100% power for 24 hours and include an auto changeover system to exchange between the Developments permanent power supply and the generators in the event of a local power outage. The temporary generators shall be tested weekly to ensure their operation with regular maintenance conducted in accordance with the manufacturer's guidelines. The temporary diesel tanks are to be replaced every six months to ensure the quality of the fuel is maintained to a good standard.

6.4 FIRE DETECTION GUIDELINES

77. The site wide fire alarm systems are to be maintained through the operational period in accordance with the operational procedures identified with this BMSP.

6.5 HOT WORKS GUIDELINES

78. A permit system to regulate and minimise potentially hazardous operations like welding, cutting, and grinding shall be implemented.
79. No hot works shall be permitted without a relevant permit being issued by the Site Safety Manager and a specific task risk assessment being undertaken.

6.6 UTILITIES & EQUIPMENT SHUTDOWNS

80. The automatic disconnection system triggered by the fire alarm system are to be maintained and tested regularly as identified with this BSMP.

6.7 SAFE STORAGE AND HANDLING OF FLAMMABLE MATERIALS

81. Any flammable material shall be stored under the following guidelines.
- a. Flammable materials shall be stored in approved containers designed specifically for their safety storage, labelled appropriately, and free from any damage that may compromise their integrity.
 - b. Flammable materials will be stored in designated areas that are well-ventilated, away from sources of ignition, and separated from incompatible substances.
 - c. Storage areas for flammable materials shall be equipped with appropriate firefighting equipment, such as fire extinguishers which shall be regularly inspected and maintained.
 - d. All storage areas must have clear signage indicating the presence of flammable materials and outlining the necessary safety precautions.
 - e. Flammable materials must be stored at a safe distance from emergency exits, walkways and evacuation routes.
 - f. Storage areas should be kept clean, free of clutter, and easily accessible to facilitate safe handling and emergency response.
 - g. Smoking, open flames, and any activities that may generate sparks are strictly prohibited in flammable material storage areas.
82. Flammable materials used during construction shall be handled under the following guidelines.
- a. Only trained and authorised personnel should handle flammable materials.
 - b. Proper personal protective equipment (PPE), such as safety goggles, gloves, and flame-resistant clothing, must be worn when handling flammable materials.
 - c. Ensure that the work area is well-ventilated during any activities involving flammable materials.

- d. Always use appropriate tools and equipment for the safe handling and transfer of flammable materials.

6.8 SMOKING POLICY

- 83. Smoking including the use of electronic vapes shall be strictly prohibited within the demise of the battery facilities and areas where flammable materials are present and/or stored.
- 84. A designated smoking area at a location to be agreed with the OERT shall be provided ensuring the designated area is equipped with appropriate means to extinguish smoking articles safely and provide firefighting equipment, such as fire extinguishers which shall be regularly inspected and maintained.

6.9 DECOMMISSIONING

- 85. During decommissioning the same protocols and procedures set out during construction and operation are to be maintained.
- 86. A specific Decommissioning Emergency Response Team “DERT” shall be appointed to ensure any change and/or new hazards identified during operation are considered in a new hazard assessment prior to any decommissioning activities taking place, a standalone Decommissioning Emergency Response Plan shall be finalised with continued consultation with the local emergency services.

7 BATTERY TRANSPORTATION PLAN

7.1 SUMMARY

87. This section of the BSMP provides information for how battery modules are to be managed including how the delivery of new, used, defective and replacement battery modules to and from the site is to be carried out.
88. At the time of writing this BSMP the UK Legislations on the transportation of lithium-ion batteries adopt the following European and international standards.
- a. for road — the European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR)
 - b. for rail — the International Carriage of Dangerous Goods by Rail (RID)
 - c. for air — the International Civil Aviation Organization (ICAO) Technical Instructions (TI) for the Safe Transport of Dangerous Goods by Air and the International Air Transport Association (IATA) Dangerous Goods Regulations
 - d. for sea — the International Maritime Dangerous Goods Code (IMDG Code)

7.2 DELIVERY OF NEW & REPLACEMENT BATTERY CELLS/MODULES

89. The selected battery manufacturer shall ensure all new and replacement battery modules transported to the site adhere to the above standards or any new standards which may supersede the above applicable to UK legislation.
90. Transportation of battery modules to the site are to be co-ordinated in a just in time basis to avoid additional storage and handling modules. In the event this cannot be achieved UESL shall ensure a suitable temporary storage unit shall be available for use both during construction and operation, the storage unit is to be of a similar nature and construction to that of the proposed battery enclosures provided by the manufacturer and have its own independent ambient temperature control system, fire detection alarm system and suppression system linked into the site wide fire alarm monitoring system.
91. Prior to any new or replacement battery modules being dispatched to the site the selected battery manufacturer shall.
- a. Ensure that the modules are dispatched with the minimum stored energy capacity possible without impacting the integrity of the battery modules.
 - b. Ensure the transported BESS equipment will be prepopulated with batteries and will have undergone Factory Acceptance Testing (FAT) to BS EN IEC 62933-5-2 standards or equivalent.
 - c. Ensure all modules have the correct UN 38.3 certification.
 - d. Ensure all modules are suitably packaged and protected for the planned mode of transport to be used, all units shall be clearly labelled to the international standards including but not limited to.
 - i. The proper shipping name “Lithium-ion batteries.”
 - ii. The correct UN assignment number in accordance with the batteries type.
 - iii. The correct specific hazard class.
 - iv. Specific handling labels and instructions.
 - v. Contact information.
 - e. The selected battery manufacturer and UESL shall ensure that the selected transportation agent/handler has the correct level of competency, certification and qualified personal for

the handling of the proposed battery modules. Material Handling Data sheets are to be provided to the selected transportation agent/handler prior to the dispatch of the modules to ensure all hazards are understood correctly.

- f. Pre-test the new or replacement battery module to ensure it is free of any defects, test results shall be provided to UESL prior to being dispatched for validation.
 - g. Each battery module shall be fitted with a shock sensor to provide clear visible indication if the battery module has been exposed to any extreme impacts during the transportation period and include a multi-sensor data loggers capable of logging temperature & humidity, where possible the use of airconditioned containers shall be used to maintain the ambient temperature during transport..
 - h. Where battery modules are to be delivered in multiple quantities (e.g., the initial delivery of the modules to site) each container in which the modules are housed shall have installed at least four multi-sensor data loggers capable of logging temperature & humidity where possible the use of airconditioned containers shall be used to maintain the ambient temperature during transport.
- 92. Prior to acceptance of the new/replacement battery module, UESL shall ensure that Site Acceptance Tests (SAT) will follow BS EN IEC 62933-5-2 standards and protocols, or equivalent including the following checks are performed before the module/cell is accepted for use.
 - a. Check each shock sensor and validate each module has not been exposed to any adverse impacts during the transportation period.
 - b. Visually inspect each module to ensure there are no physical defects to both the packaging and the modules.
 - c. Re-test each module and validate the result against the pre-delivery test performed by the manufacturer to ensure there have been no adverse effects to the module during the transportation period.
 - d. Check the ambient temperature data loggers and ensure the modules have not been exposed to conditions exceeding the modules allowable design parameters.
- 93. Any defects or recorded abnormalities shall be raised with the manufacturer immediately, and any rejected or defective modules are to be processed in accordance with the Defective Module Procedures and in accordance with the section 7.3 (Transportation of Defective Module from the Site).

7.3 TRANSPORTATION OF DEFECTIVE MODULES FROM THE SITE

- 94. Defective modules are to be transported from the site adhering to the above European and international standards or any new standards which may supersede the above applicable to UK legislation.
- 95. Prior to the defective battery module being transport from the site UESL shall ensure.
 - a. The defective module has the minimum stored energy capacity possible without impacting the integrity of the battery modules.
 - b. The defective module is placed into an approved container designed specifically for their safety storage and transport and free from any damage that may compromise their integrity. The transportation container shall be clearly labelled to the international standards including but not limited it.
 - i. The proper shipping name "Lithium-ion batteries."
 - ii. The correct UN assignment number in accordance with the batteries type.
 - iii. The correct specific hazard class.

- iv. Specific handling labels and instructions.
 - v. Contact information.
- c. The transportation container shall be fitted with a shock sensor to provide clear visible indication if the battery module has been exposed to any extreme impacts during the transportation period to its end destination and include a multi-sensor data loggers capable of logging temperature & humidity where possible the use of airconditioned containers shall be used to maintain the ambient temperature during transport
- d. UESL shall ensure that the selected transportation agent/handler has the correct level of competency, certification and qualified personal for the handling of the proposed battery modules. Material Handling Data sheets are to be provided to the selected transportation agent/handler prior to the dispatch of the modules to ensure all hazards are understood correctly.

8 ENVIRONMENTAL RISK ASSESSMENT

8.1 SUMMARY

96. Within this section of the BSMP, we outline UESL approach to the identification, assessment, and management of environmental risks in relation to the hazards associated with standalone lithium-ion battery storage facilities.
97. As identified in Section 3 of this document, a HAZID and HAZOP processes was completed as part of the design phase assessments. During these processes, the following environmental impacts for assessment and mitigation relevant to battery safety were identified.
1. Impacts from potential pollutants entering a watercourse from leakage of defective battery modules.
 2. Impact from potential airborne pollutants during a thermal runaway event.
 3. Impacts from potential airborne pollutants during a fire scenario.
 4. Impacts from potential pollutants entering a watercourse from the use of fire water following a thermal runaway event.
98. To understand the impacts of items 2-4 an additional assessment was conducted during the design process to understand the worst credible scenarios of any such occurrence, Section 8.2 below provides further information of the approached taken by the Development.

8.2 THERMAL RUNAWAY & FIRE METHODOLOGY

99. Multiple methods of mitigations and safeguards have been identified and implemented within the Development's design and management protocols as demonstrated within this BSMP to reduce the likelihood of thermal runaway events and fire scenarios, minimise the consequences and provide protocols and guidelines to manage the impact of any such event. The likelihood of a major accident or disaster is considered to be extremely unlikely; however, the Development has taken a conservative approach in its assessments to inform the emergency response protocols.
100. The most likely credible scenario considered if safeguards were to fail is a thermal runaway occurrence of a single module and left untreated could affect all 40 modules within a single enclosure, therefore, the most credible worst-case thermal runaway scenario has been considered to be a single enclosure simultaneously entering into thermal runaway. To provide additional levels of safety factors to inform the emergency response protocols a conservative approach has been undertaken within the assessments performed and such assessments consider two enclosures simultaneously entering thermal runaway.
101. Thermal runaway events left untreated could result in a battery gas venting or burning scenarios, although considered to be extremely unlikely the most credible worst-case scenario considered has be on the basis of an entire enclosure entering into thermal runaway simultaneously and therefore resulting in a single enclosure subsequently entering into a fire scenario. Due to the physical distances between enclosures, it is considered that a fire will not propagate from one container to another, however like with the considerations above and to provide additional safety factors to inform the emergency response protocols a conservative approach has been undertaken within the assessments performed and such the assessments consider two enclosures simultaneously entering a fire scenario.

8.3 THERMAL RUNAWAY AIRBORNE POLLUTION

102. UESL commissioned specialist consultant Hoare Lee to perform a detailed assessment of the impacts of airborne pollution from a thermal runaway event occurrence to provide understanding of the potential impacts to human health based on the above scenarios to inform the emergency response protocols.

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103. The final report has been provided as part of this BSMP and can be found within Appendix C of this document.
104. The scenarios analysed of the selected chemistry demonstrates that there is no exceedance of harmful gases to Acute Exposure Level Guidelines (AELG) Levels 2 and 3, however they do predict exceedances of Hydrogen Fluoride at AELG Level 1, AELG Level 1 are Notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.
105. The maximum area of exceedance of Acute Exposure Level Guidelines (AELG) during a thermal runaway event is 190 metres in the initial 10 minutes after event from any affected enclosure reducing down to 109 meters. These distances are based on a person being stood directly within a potential smoke plume without personal protection equipment. During an incident, unprotected persons would be required to be excluded from this area. The CERT and OERT shall ensure a system are in place to enforce this in any such event and shall.
- a. consult with the emergency services to ensure that they are aware and equipped with the correct levels of PPE as recommended by Public Health England and training to enable their ability to approach a thermal runaway scenario safely and effectively,
 - b. ensure that employees, and contractors who are appointed to provide any first response to any such event are provided with the correct level of training and PPE to enable their ability to approach a thermal runaway event scenario safely and effectively.
 - c. Ensure measures for protecting the public are in place taking into account for:
 - i. Persons working or occupying the adjacent power stations.
 - ii. Persons walking along the public foot path located to the south of the site.

8.4 FIRE SCENARIO AIRBORNE POLLUTION

106. UESL commissioned specialist consultant Hoare Lee to perform a detailed assessment of the impacts of airborne pollution from fire event occurrence to provide understanding of the potential impacts to human health based on the above scenarios to inform the emergency response protocols.
107. The final report has been provided as part of this BSMP and can be found within Appendix C of this document.
108. The scenarios analysed of the selected chemistry shows that there would be no impact to public human health and have demonstrated that AELG-1 limits would not be exceeded at the nearest residential receptors.
109. An exclusion zone of >30 metres in accordance with NFPA recommendations from any affected enclosures during a fire event has been recommended for the protection and safety of unprotected persons. The CERT and OERT shall ensure a system are in place to enforce this exclusion zone in any such event and shall.
- a. consult with the emergency services to ensure that they are aware and equipped with the correct levels of PPE as recommended by Public Health England and training to enable their ability to approach a fire scenario safely and effectively,
 - b. and ensure that employees, and contractors who are appointed to provide any first response to any such event are provided with the correct level of training and PPE to enable their ability to approach a fire event scenario safely and effectively.
110. The recommended exclusion zone does not extend beyond the DCO order limits boundary.

8.5 FIREWATER POLLUTION

- 111. The impact of pollution entering the local watercourse has been mitigated by the site's drainage design.
- 112. The electrical compound comprises of an impermeable bunded area as detailed in the original submissions, the battery area is split into zones with each zone separated from one another. Within each zones runoff water is directed into individual penstock outlets which can allow each zone to be isolated in sections from the main carrier drainage.
- 113. In the event of a fire scenario, initially the fire alarm system would stop the onsite pumped runoff system to allow for the penstock outlets of the affective area to be isolated.
- 114. Fire water can then be monitored and tested at each penstock outlet during and after the management of a fire event and based on its results shall either be.
 - a. Treated onsite or.
 - b. Suitably pumped into tankers to be disposed of offsite.

8.6 LEAKAGE OF DEFECTIVE MODULES

- 115. Leakage from defective modules into the local water course is unlikely to occur due to.
 - a. The modules housing design to IP67,
 - b. The modules being enclosed within a separate compartment of the container housing.
- 116. As identified within the operational procedures, modules and containers are to be regularly inspected for damage or defect and in the event that a module was found to be leaking, initially the affect area shall be isolated from the main drainage via the penstock outlets as described in section 8.5, the defective module would be processed in accordance with the defective module procedure. Once the defective module is removed and the area decontaminated any water collected within the penstock outlet is to be tested, and based on its results the collected water shall either be.
 - a. Treated onsite prior to being discharged back into the sites main drainage system or suitably pumped into tankers to be disposed of offsite.

APPENDIX A – SITE LAYOUT DRAWING

APPENDIX B - SWFRS RECORD OF CONSULTATION

APPENDIX C – AIRBORNE POLLUTION EVENT ASSESSMENT