# CLEVE HILL SOLAR PARK

## OTHER DEADLINE 4 SUBMISSIONS
## OUTLINE BATTERY FIRE SAFETY MANAGEMENT PLAN

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SOLAR PARK

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# 1 INTRODUCTION

1. This Outline Battery Fire Safety Management Plan ('OBFSMP') has been prepared by Cleve Hill Solar Park Ltd ('CHSPL') to accompany the Development Consent Order ('DCO') application for Cleve Hill Solar Park ('the Development'). Requirement 2 of the draft DCO provides for approval of the detailed design of the Development prior to commencement of works. This includes, at Requirement 2(1)(j), details of safety management. This requirement covers all of the Development, including the Battery Energy Storage ('BESS') component and so this OBFSMP has been prepared to ensure that the risk of fire in the BESS is understood, accounted for and mitigated as far as practicable, in agreement with relevant consultees, and in supplement to the Outline Design Principles [REP3-010] document to form the basis for the decision of the relevant local planning authority ('LPA') to discharge Requirement 2.

2. Following the adoption of the measures set out in this OBFSMP, the risk of a fire occurring will be reduced, and if a fire did occur, the risk of it spreading to the point where it became a major incident will be reduced to an acceptable level. The assessment of fire risk carried out in the Environmental Statement at section 17.7.3.2 of Chapter 17 - Miscellaneous Issues [APP-047] therefore remains applicable.

## 1.1 Background

3. CHSPL is seeking to develop a solar photovoltaic array electricity generating facility and electrical storage facility at Cleve Hill, 2 km north east of Faversham and 5 km west of Whitstable on the north Kent coast.

4. Representations made by interested parties during the examination of the DCO application have raised concerns regarding the risk of fire in relation to BESS and specifically lithium-ion (Li-ion) batteries.

5. The specific detail of the energy storage component of the development has yet to be determined, and CHSPL has deliberately sought flexibility in the DCO application within the limits of the Rochdale Envelope assessed in the Environment Statement in order to ensure that the BESS can respond to the needs of this fast evolving sector at the time of construction of the Development. It is now known that a BESS consisting of containerised Li-ion batteries will be utilised at CHSPL and this document is specific to this solution.

6. A written representation on Electrical Safety [REP3-021] has also been produced and submitted to the examination, which sets out the legislation and regulations that apply to the Development. These regulations are not repeated here, but it is important to re-emphasise that the controls set out within that written representation on the safe deployment of energy storage technology apply alongside the planning process.

## 1.2 Document Structure

7. This OBFSMP includes the following sections:

- Introduction, including background, document structure, contributors and consultation requirements;
- Guidance;
- Cleve Hill Solar Park Battery Energy Storage Design Approach, including responses to recommendations;
- Battery Energy Storage Detailed Design Stage - Pre-Construction Information Requirements; and
- Conclusions.

### 1.3 Contributors

8. This document has been collated on behalf of CHSPL by Arcus Consultancy Services Ltd and reviewed by Pinsent Masons LLP with input provided by:

- Leclanché SA;
- Xero Energy; and
- Wirsol Energy.

9. This document has been reviewed by the Health and Safety Executive, with comments received incorporated in the document. A review by Kent Fire and Rescue Service (KFRS) is also underway, and expected to result in a subsequent iteration of this document.

#### *1.3.1 Leclanché SA*

10. Leclanché SA is a world leading provider and manufacturer with over a hundred years of history of high quality energy storage solutions, principally based on lithium-ion cell technologies.

#### *1.3.2 Xero Energy*

11. Xero Energy provides electrical engineering consultancy services with expertise covering technical, commercial and regulatory issues for renewable and low carbon electricity generation and storage. Xero Energy provided the indicative layout design for the DCO application.

#### *1.3.3 Wirsol Energy*

12. Wirsol Energy, a joint venture party in CHSPL, co-developed and co-owns the largest solar plus energy storage facility in Australia, a 25 MW / 50 MWh BESS facility at the 60 MW Gannawarra Solar Farm in Victoria.

#### *1.3.4 Kent Fire and Rescue Service*

13. KFRS is the statutory fire and rescue service for the administrative county of Kent and the unitary authority area of Medway.

#### *1.3.5 Health and Safety Executive*

14. The HSE has been closely studying battery safety for a number of years, using its bespoke battery testing facility to help customers understand how best to manage the risks faced by many industry sectors during battery manufacture, storage, transport and use.

### 1.4 Consultation Requirements

15. Prior to the submission of the final version of this document to the LPA in respect of discharge of requirement 2 of the DCO, KFRS and HSE will be consulted on the content of this plan, which shall include the final detail as required by this OBFSMP.

## 2 GUIDANCE

16. The following international guidance has been considered during the preparation of this OBFSMP:

- Allianz Risk Consulting (ARC), Tech Talk Volume 26 (2019). Battery Energy Storage Systems (BESS) using Li-ion batteries[1];

[1] https://www.agcs.allianz.com/news-and-insights/risk-advisory/tech-talk-volume-26-bess-english.html

- National Fire Protection Association (NFPA) 855, Standard for the Installation of Stationary Energy Storage Systems, (2020 edition currently under development and not yet available)[2];
- UL 9540, Standard for Energy Storage Systems and Equipment[3]; and
- Consolidated Edison and New York State Energy Research and Development Authority - Considerations for ESS Fire Safety (February 2017)[4].

17. At the time of writing, the NFPA and UL United States of America standards are not specifically relevant to the United Kingdom but notwithstanding this provide valuable guidance, and are referred to in the ARC technical note which is addressed in section 3.1 of this document.

18. More detailed UK guidance is emerging, and it is expected that the regulatory environment will be more developed by the detailed design stage. Examples of existing UK guidance include:

- The Energy Operators Forum "Good Practice Guide" (December 2014)[5];
- Institute of Engineering and Technology - Code of Practice for Electrical Energy Storage Systems (August 2017)[6]; and
- The Energy Institute: Battery Storage Guidance Note 1 - Battery Storage Planning (August 2019)[7].

# 3 CLEVE HILL SOLAR PARK BATTERY ENERGY STORAGE SYSTEM DESIGN APPROACH

19. The Development will minimise fire risk by:

- Procuring components and using construction techniques which comply with all relevant legislation;
- Including automatic fire detection systems in the development design;
- Including automatic fire suppression systems in the development design;
- Including redundancy in the design to provide multiple layers of protection;
- Designing the Development to contain and restrict the spread of fire through the use of fire-resistant materials, and adequate separation between elements of the BESS; and
- Ensuring that KFRS recommendations and requirements are addressed to enable an adequate emergency response to a fire.
- Work with KFRS to develop their Tactical Response Plan in case of an incident (see Table 4.1).

## 3.1 Allianz Risk Consulting Battery Energy Storage System Design Recommendations

20. The recommendations set out in the ARC publication are set out in Table 3.1 with the project response.

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[2] https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=855
[3] https://standardscatalog.ul.com/standards/en/standard_9540_1
[4] https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Energy-Storage/20170118-ConEd-NYSERDA-Battery-Testing-Report.pdf
[5] https://www.eatechnology.com/engineering-projects/electrical-energy-storage/
[6] https://shop.theiet.org/code-of-practice-for-electrical-energy-storage-systems
[7] https://eur03.safelinks.protection.outlook.com/?url=https%3A%2F%2Fpublishing.energyinst.org%2Ftopics%2Fpower-generation%2Fbattery-storage%2Fbattery-storage-guidance-note-1-battery-storage-planning&data=01%7C01%7C%7Cfbce9f4783304951211308d72af01893%7C6b5953be6b1d4980b26b56ed8b0bf3dc%7C0&sdata=%2FgEjqDC2nzzxcKTWFaKkUEiiTiiOzTamrAsxsMz9Y4M%3D&reserved=0

*Table 3.1 - ARC Recommendations*

| **ARC Recommendation** | **Project Response** |
|---|---|
| **1. Fire department**<br><br>• Invite the fire department to your property to discuss BESS hazards. An adequate emergency response is the key to avoiding an uncontrolled fire. Keep in mind that some fire fighters will not fully understand the hazards and may assume that lithium-ion batteries are the same as lithium batteries.<br>• Key questions to discuss with the fire department include:<br>− What is the main difference between extinguishing and cooling?<br>− How to handle a damaged battery?<br>− How to manage the flammable and toxic gases?<br>• Plan training exercises with the fire department when the system is commissioned.<br>• Standard Operating Procedures (SOP) & Standard Operating Guidelines (SOG) are of major importance and should be updated and tested on a regular basis. | CHSPL will address all of these recommendations through consultation with KFRS. This consultation is currently underway and is expected to be ongoing.<br><br>KFRS will hold a Tactical Information Record for Cleve Hill Solar Park. CHSPL will engage with KFRS as required to provide the necessary information for this document prior to the commencement of construction of the BESS and will update the information during operation as required by KFRS. |
| **2. Construction and location**<br><br>• Install BESS outdoors a minimum of 20 m (65 ft.) from important buildings or equipment. Maintain a minimum of 3 m (10 ft.) separation from lot lines, public ways and other exposures.<br>• Within the module, maintain a minimum of 1 m (3 ft.) separation distance between enclosures for all units up to 50 kWh when not listed, or up to 250 kWh when listed.<br>• Install a thermal barrier where the minimum space separation cannot be provided.<br>• If the BESS must be located indoors, install in a 2 hour fire rated cut-off room, which is accessible directly outdoors for manual firefighting.<br>• Restrict the access to competent employees or sub-contractors.<br>• Ensure enclosures are non-combustible. | The design of the BESS will reflect prevailing legislative requirements and UK industry recommendations.<br><br>A minimum of 3 m separation or the minimum separation specified in applicable UK legislation will be utilised between individual battery containers.<br><br>Separation between components within BESS containers/modules will comply with identified applicable UK regulations and legislation identified at the time of detailed design (see Table 4.1). Thermal barriers will be utilised where the minimum space separation cannot be provided, also in accordance with applicable regulations.<br><br>The BESS containers will be located outdoors.<br><br>Access to the BESS containers will only be available to competent operational staff who have received appropriate training and certification where required by legislation, or under the supervision of competent operational staff.<br><br>All enclosures will be non-combustible with EI120 standard. |

| ARC Recommendation | Project Response |
| --- | --- |
| **3. Material, equipment and design**<br><br>• BESS should be tested in accordance with UL 9540A, Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems. This standard evaluates thermal runaway, gas composition, flaming, fire spread, re-ignition and the effectiveness of fire protection systems. Data generated can be used to determine the fire and explosion protection requirements for a BESS.<br>• Place capacitor, transformer, and switch gear in separate rooms according to best engineering practices. | The BESS utilised will hold the relevant test certificates and meet the electrical safety regulation applicable under UK regulations and legislation.<br>The detailed design will identify the location of capacitors transformers and switch gear. The design responses to fire risk requirement set out in Table 4.1 will specifically address the placement of these items. |
| **4. Ventilation and temperature control**<br><br>• Install adequate ventilation or an air conditioning system to control the temperature. Maintaining temperature control is vital to these batteries longevity and proper operation as they degrade exponentially at elevated temperatures.<br>• Ensure ventilation is provided in accordance with the manufacturer's recommendations.<br>• Install and maintain the ventilation during all stages of a fire. Ventilation is important since batteries will continue to generate flammable gas as long as they are hot. Also, carbon monoxide will be generated until the batteries are completely cooled through to their core. | All enclosures will include adequate Heating Ventilation and Air Conditioning (HVAC) installations incorporating redundancy.<br><br>The behaviour of HVAC and air circulation in the event of a pre-alarm and main alarm will be defined by the manufacturer (and, if applicable, the certifier) with due regard to the extinguishing agent used. |
| **5. Gas detection and smoke detection**<br><br>• Install a very early warning fire detection system, such as aspirating smoke detection.<br>• Install carbon monoxide (CO) detection within the container or BESS room. | A minimum of two types of fire detection system will be deployed, (e.g., optical, heat, chemical etc.).<br>The fire detection system will be installed with fire resistant wires and components. |
| **6. Fire protection and water supply**<br><br>• Install sprinkler protection within BESS rooms and ideally within BESS containers. The sprinkler system should be designed to provide 12.2 l/min/m² over 232 m² (0.30 gpm/ft2 over 2500 ft²). Water has been proven to be the best agent to fight a fire involving lithium-Ion batteries. It is important to note that other extinguishing agents, such as aerosols or gaseous extinguishing systems, will extinguish the fire, but they do not provide cooling like water. Insufficient cooling allows a hot and deep-seated core to remain. The heat will rapidly spread back through the battery and reignite remaining active sections. This is the primary reason ARC recommends the use of water for | The fire protection concept will be based on the prevention of propagation with high construction standards, suppression systems and distances to adjacent installations.<br><br>THE BESS will include a gas-based extinguishing fire suppression system, (e.g., Novec 1230), as a first barrier of security against fire propagation within a container.<br><br>Separation between adjacent installations is a security redundancy measure to limit |

| ARC Recommendation | Project Response |
|---|---|
| fighting the fire and cooling the batteries.<br>• Implement a procedure for battery submersion in the pre-emergency plan performed by the fire department. Submerging batteries in water (preferably outdoors) after they burn has proven to be effective at cooling the batteries and neutralizing the thermal threat. They will continue to release gases, mostly carbon monoxide, but also flammable gas such as hydrogen. Therefore, never submerge several batteries in a confined space without adequate ventilation.<br>• Ensure that sufficient water is available for manual firefighting. The ability of the fire department to control a fire involving a BESS depends on the presence of an adequate water supply and their knowledge of the hazards. The following should be considered:<br>− An external fire hydrant should be located within 100 m (330 ft.) of the BESS room or containers.<br>− The water supply should be able to provide a minimum of 1,900 l/min (500 gpm) for at least 2 hours. | fire propagation in case of a suppression system failure or a non-typical failure event.<br><br>A system for water-based cooling will be implemented to ensure that adequate cooling can be delivered to batteries. This may take the form of an automated system (such as a sprinkler system) or a manually deployed solution. The justification for the system chosen to be implemented including its compliance with legislation will be provided in the pre-construction BESSFSMP.<br><br>CHSPL will liaise with KFRS to ensure that at least one permanently accessible water supply point is provided. This should be easily accessible and readily identifiable in the event of a fire and should ensure the supply of a minimum of 1,900 litres/minute of water to within 100 m of any part of the BESS area, and must be available prior to installation of the BESS. The water supply information must be provided in the design responses to fire risk information (see Table 4.1). |
| **7. Maintenance**<br>• Follow original equipment manufacturer recommendations for the inspection, testing and maintenance of BESS. In addition, ensure that the following are completed:<br>− Measure the internal resistance of the cells. Replace the cells when a dramatic drop is detected. Keep in mind that the internal resistance is mainly independent of the state of charge, but increases as the battery ages. Therefore, it is a good gauge of predictable life.<br>− Perform infrared scanning at least once per year.<br>− Check for fluid leakage.<br>− Implement electric terminal torqueing procedures to maintain connection integrity. | Internal resistance is measured as part of the State of Health (SOH) control system, with maintenance and replacement carried out regularly to respond to the results.<br>Constant insulation monitoring of each battery bank detects potential leakage.<br><br>Prepare an operating procedure (within the Standard Operation Procedures and Guidelines referred to in Table 4.1) for the swap-out of faulty cells/modules. This will include plans for suitable storage locations for the modules prior to removal from site.<br><br>Torque tests are part of the operation and maintenance (O&M) processes. |

# 4 BATTERY ENERGY STORAGE SYSTEM DETAILED DESIGN STAGE - PRE-CONSTRUCTION INFORMATION REQUIREMENTS

21. Table 4.1 sets out the minimum information to be included with the final version of this OBFSMP:

***Table 4.1 - Detailed Design Information Requirements***

| **Requirement** | **Reason for Information Required** |
|---|---|
| **Statement of Compliance with Applicable Legislation** | To demonstrate compliance with legislation, will cross reference to the other documents set out below. |
| **Detailed Design Drawing of BESS** | To ensure available and safe access to the BESS for fire appliances.<br><br>To enable KFRS to evaluate the available access for fire appliances to all parts of the BESS.<br><br>To show separation between components of BESS. |
| **Statement of design responses to fire risk** | To accompany the detailed design drawing and explain how the risk of fire spreading has been addressed through the Development Design. |
| **Battery Specification** | To ensure that KFRS are aware of the specific type of batteries installed. This would include the battery 'chemistry' as well as size and format of each cell. |
| **Fire Detection System Specification** | To demonstrate how the requirement for fire detection has been addressed. |
| **Fire Suppression System Specification** | To demonstrate how the requirement for fire suppression has been addressed. |
| **Standard Operating Procedures and Guidelines (Relevant to Safety)** | To demonstrate an ongoing commitment to regular checks and maintenance during operation e.g., plans for swap-out of suspected modules.<br><br>Include a list of competencies and/or certification requirements for competent Site Operating staff. |
| **BESS Installation Contractor Emergency Protocol (during construction)** | To demonstrate that protocols are in place to manage a fire during construction. |
| **Site Operator Emergency Protocol (during operation, including decommissioning)** | To demonstrate that protocols are in place to manage a fire during operation and decommissioning. |
| **Other information requested by KFRS to inform their Tactical Response Plan** | To ensure that KFRS has the information it requires to adequately address a fire at the BESS. |

# 5 CONCLUSION

22. This document sets out the design approach to be taken, and the information which is required to be provided in advance of construction of the BESS at Cleve Hill Solar Park to demonstrate that the BESS will be constructed and operated safely.