Outline Fire Risk Management Plan

Bishops Dal BESS

Ref	05389-8515225

Revision History

Issue	Date	Name	Latest changes
01	30/10/2024	Daniel Rose	First Created
02	12/12/2024	Daniel Rose	Included a wind rose. Included NFCC compliance assessment and best practice principles as Appendices.

Contents

1 Introduction

This document forms the Bishops Dal BESS outline fire risk management plan. The document indicates how the project has been developed to address fire risk in several ways. It contains key mitigation measures against the risk of fire ignition and propagation within the battery energy storage system (BESS) site.

Battery technology and associated understanding of fire risk is continually evolving within the industry. As such, this document sets out key principles and mitigation measures based on the current understanding of battery fire risk but does not constitute a detailed Fire Risk Management Plan. A detailed Fire Risk Management Plan would be developed during detailed design, following battery selection.

2 Project Description

2.1 General project information

Renewable Energy Systems Ltd (RES) is developing a 150MW BESS facility near Eccles Substation. The BESS will consist of battery storage enclosures (BSEs), power conversion systems (PCSs), transformers, electrical infrastructure, foundations, access track, crane hardstanding, and spares storage containers. The grid connection will be via an onsite 132kV substation.

2.2 Battery selection

The proposed battery technology for the development is anticipated to be lithium iron phosphate (LFP). LFP has better thermal stability and enters thermal runaway at higher temperatures compared to some other battery chemistries. This is demonstrated by the UL 9540A test results of RES' preferred battery system which show that, at a unit level following deliberate initiation of thermal runaway:

- No flaming outside the initiating battery rack was observed.
- Surface temperatures of modules within the target battery rack adjacent to the initiating battery rack do not exceed the temperature at which thermally initiated cell venting occurs.
- Wall surface temperature rise does not exceed 97°C above ambient.
- Explosion hazards were not observed during the test.

Data from UL9540A testing can also be used to inform detailed design of the site and safety systems.

Each BSE has an approximate capacity of 1.55MW / 3.12MWh and footprint of approximately 6.1 x 2.4m. The exact battery capacity and form factor will be determined during detail design phase and would be documented within the detailed Fire Risk Management Plan.

3 Design Factors

3.1 RES Internal BESS safety best practice principles

Based on available standards, construction and operation experience, RES has developed internal best practice to manage the safety of battery energy storage systems. A document summary of these principles can be found in Appendix A.

3.2 Fire response strategy

It is the intention that the site would be self-sufficient during a potential battery-based fire event and would not require fire service intervention to prevent fire spread or any other significant risks to people or property. Key principles of the NFCC Grid Scale Battery Energy Storage System planning – Guidance for FRS, 2023 ("the NFCC Guidance") are addressed through the mitigations identified within this report, as these pertain to the fire risk management strategy set out below. A summary of how the proposed project addresses the key principles of NFCC guidance is included in Section 3.3 and detailed assessment of NFCC recommendations against the proposed layout is provided in Appendix B.

The overarching fire risk management strategy would adopt the following controls:

1. Implement measures that result in a very low risk of fire ignition and any suitable environment for sustaining fire.
2. Implement measures that result in a very low risk of fire propagation and spread within a fire source (e.g. BSE).
3. Ensure fire spread between significant elements of the project is not expected, through application of design standards and use of calculations / modelling as necessary.
4. Include adequate provisions to allow the fire service to monitor a fire event, intervening only if there is a failure of the controls above.

Due to the risks associated with lithium-ion fires, transformer fires, and high-power equipment, there are significant safety benefits to minimising fire service intervention and consequential firefighter hazard exposure.

During detailed design, following battery product selection this Outline Fire Risk Management Plan will be developed, in liaison with the Fire Service and with due consideration of the NFCC Guidance. The detailed Fire Risk Management Plan will include:

- A fire risk appraisal that details how the fire response strategy above will be achieved, including the identification and design of any further mitigations required to achieve the strategy above.
- An emergency response plan.

3.3 Mitigation Measures

The following points define the key preliminary design mitigations against the risk of fire ignition and propagation within the BESS site. For a detailed assessment of how the layout meets the recommendations of current NFCC guidance, please refer to Appendix B.

3.3.1 Equipment spacing

The site has been developed to include adequate spacing between the battery storage enclosure (BSE) to mitigate against the risk of fire spread in the event of a fire within one BSE. The site layout aligns with applicable NFPA 855 spacing criteria as well as the spacing recommendations outlined in FM Global Property Loss Prevention Datasheet 5-33 (Interim revision January 2024). The layout allows minimum distance of 3m between batteries enclosures and any other infrastructure.

3.3.2 Protection systems

Each BSE will have a dedicated fire protection system, comprising flammable gas detection and venting, fire detection and alarm, and an automatic fire suppression system. Additionally, key battery health and environment parameters will be continuously monitored with alarms sent to a control centre. Automatic electrical disconnection will be enacted by the battery management system should operational temperature, current or voltage limits be breached. There will be levels of alarms prior to protection limits which warn the operator of proximity to safe operating limits. BSEs will be fitted with deflagration venting and explosion protection appropriate to the hazard.

3.3.3 Access to battery storage enclosure

All BSEs will be accessed via external doors only, i.e. no internal corridor to eliminate the risk of people being inside an enclosure during a fire or thermal runaway gas venting incident.

3.3.4 Location of BESS facility

The location of the facility has been selected considering the distances from existing nearby premises. There are no premises nearby site, with the nearest one to site to be more than 200m in distance. A distance of at least 6.1m is achieved between BSEs and the site boundary, in line with NFPA 855 (2023), and there is no existing or planned bushes or trees within 10m of any BSE.

3.3.5 Access for emergency services

Should the fire service need to attend the site, the fenced BESS compound has a wide access circular route with extra corridors through the centre, allowing the fire service to access the site during an incident. In addition, two site access points have been proposed to ensure that fire services would have an alternative option for approaching site if the combination of wind direction and smoke made one direction particularly onerous.

Turning locations for emergency response vehicles are available within the site hardstanding and at the main entrance gates as shown in Figure 1.

A mesoscale wind model conducted by RES (with reference Mesoscale Wind Climate for SCOdzqM9999) indicates that the prevailing wind direction for the area is from the southwest. Given the relative distances

between the proposed BESS compound and the site entrances, as well as the prevailing wind direction, it is assessed as unlikely that both site access points will simultaneously experience obscuration due to adverse conditions at the same time.

The layout infrastructure with the wind rose is shown in Figure 2.

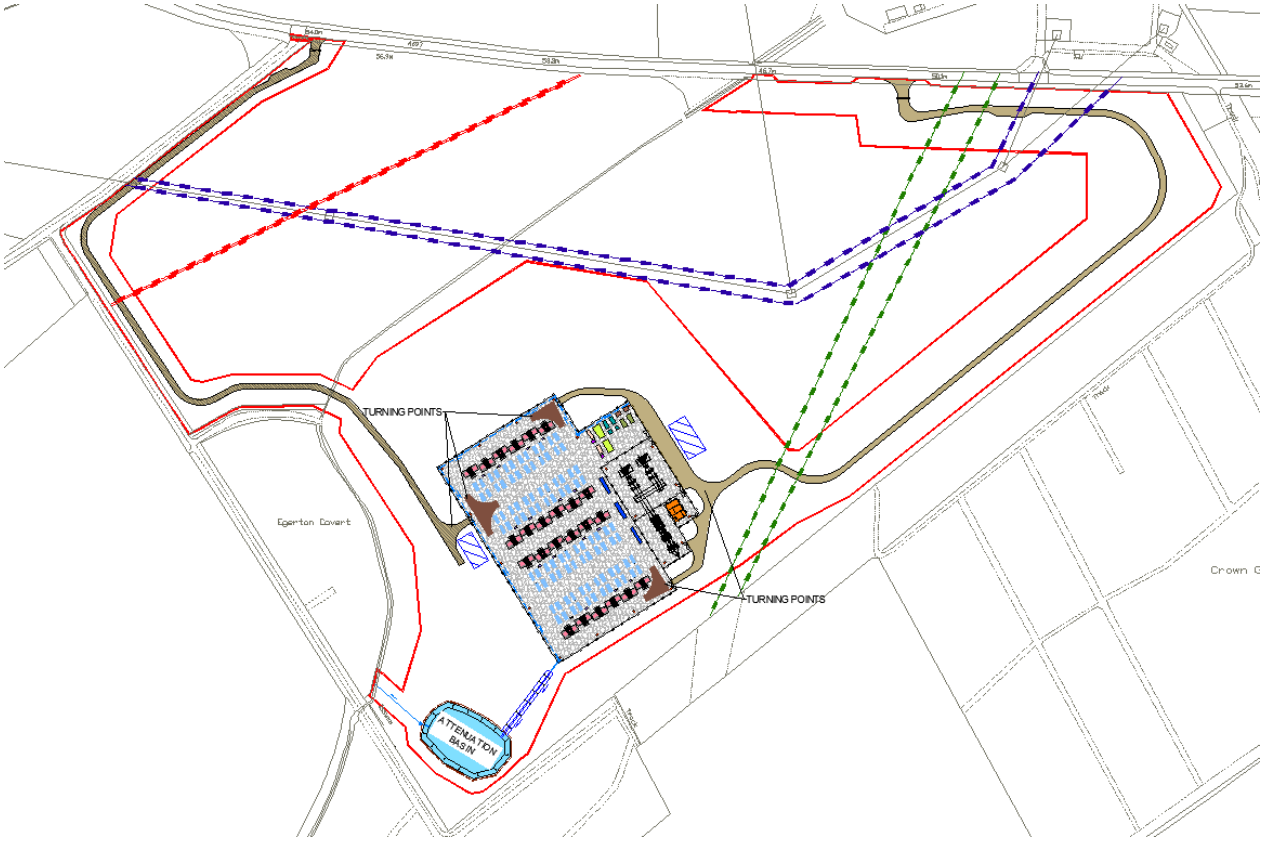

Figure 1: Turning locations & internal site corridors

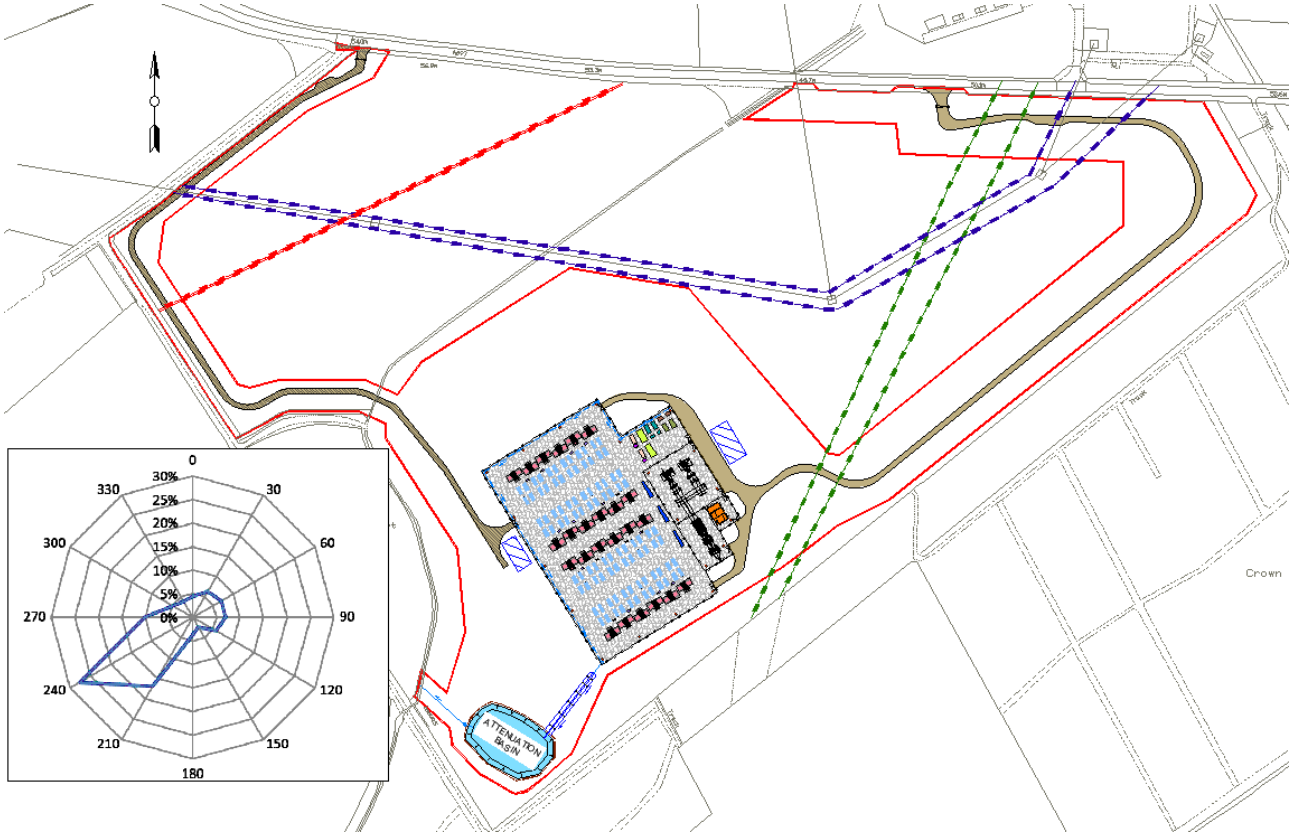

Figure 2: Infrastructure Layout with wind rose and north direction

Vehicular access to allow the emergency services to safely reach the development during design flood conditions has been considered and achieved.

3.3.6 Water Supply

Existing and potential water supplies are identified in Figure 3. A water main has been identified within the A697, approximately 270m to the northwest of the site.

It is intended that an onsite water supply would not be required to achieve the fire response strategy outlined in 3.1. However, if agreed as necessary in development of the Fire Risk Management Plan, a supply of 1,900 litres per minute for at least 2 hours in line with the NFCC Guidance could potentially be achieved through provision of a piped hydrant or provision of space allocation for water tanks. While a piped hydrant solution is considered a suitable option, further assessment would be needed to confirm if the required water supply could be achieved through this approach. Should the assessment determine that a piped hydrant solution would not be viable, as described above, provision has been made for potential water tank locations, as indicated in Figure 3.

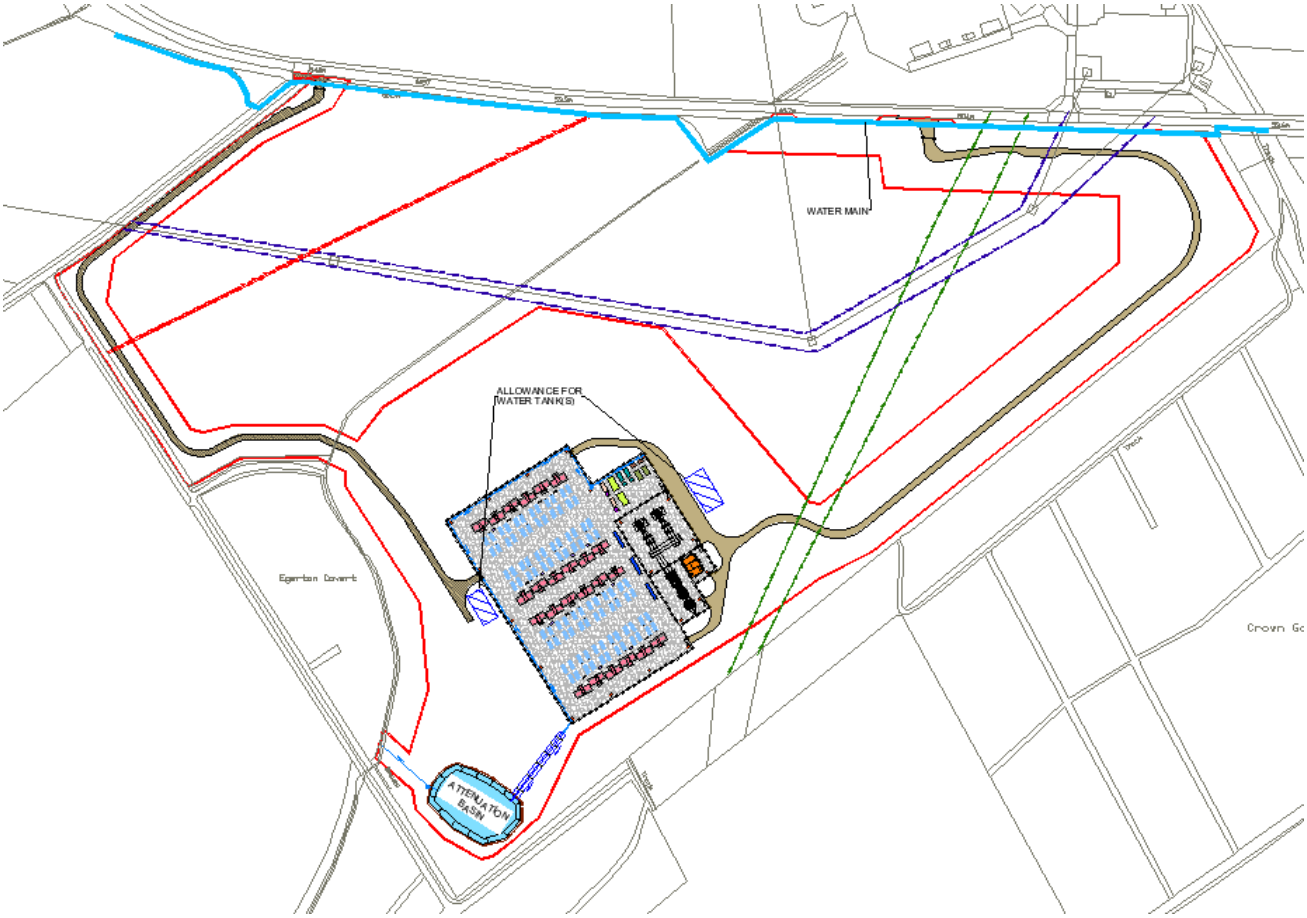

Figure 3: Potential water supplies

4 Operational Factors

As well as mitigations to make the site inherently safer by design and the inclusion of active and passive controls, operational mitigations will be implemented to manage fire risk. This section states the operational factors which will be considered in the detailed Fire Risk Management Plan.

4.1 Hazard Identification and Mitigation Analysis

During detailed design, project and equipment specific hazards will be identified. Actions taken to mitigate those hazards will also be identified and residual risks will be communicated as part of the emergency response plan.

4.2 Hazardous Material

Any hazardous materials stored at the BESS facility will be fully justified and detailed in the emergency response plan. This will detail the location, description, quantity and appropriate precautions.

4.3 Emergency Response Plan

The Emergency Response Plan will be developed iteratively in line with the project specific Fire Risk Management Plan. It will outline how the operator will respond to incident and accident scenarios on site including clear guidance for first responder organisations.

4.4 Safety Management Structure

The BESS safety management structure is yet to be fully defined but will include a formal top-down management structure that has the authority and responsibility to make decisions in design, procurement, construction and operation that places safety and environmental risk at forefront.

4.5 Staff Competence

The Fire Risk Management Plan will ensure that all personnel who have responsibility for safety or activities which could impact the surrounding environment are competent to discharge those responsibilities.

5 Conclusion

During the preliminary design, efforts have been made to mitigate, minimise, and prevent any fire hazard on site by incorporating specific design factors and considering operational factors as described in this document. During detailed design and following battery product selection, a detailed Fire Risk Management Plan will be created including a project specific fire risk appraisal to verify the strategy presented in this document and an emergency response plan will be developed through liaison with the local fire service.

Appendix A – RES BESS safety best practice principles

Appendix B - NFCC Recommendations Cross-Referenced to the BESS Layout and Design

Criterion	NFCC Recommendation	Status	Design Compliance with NFCC 2022	Design Compliance with Draft NFCC 2024
1	Access – Minimum of two separate access points to the site	Compliant	The site benefits from two distinct access points connected to the A697 road. The primary site access is located approximately 350 meters north of the proposed BESS compound, while the secondary access is situated approximately 330 meters northwest of the compound. A mesoscale wind model conducted by RES (with reference Mesoscale Wind Climate for SCOdzqM9999) indicates that the prevailing wind direction for the area is from the southwest. Given the relative distances between the proposed BESS compound and the site entrances, as well as the prevailing wind direction, it is assessed as unlikely that both site access points will simultaneously experience obscuration due to adverse conditions at the same time. For further details, refer to Figure 2, which illustrates the wind rose for the area, providing a graphical representation of the prevailing wind patterns.	No change – layout remains compliant
2	Roads/hard standing capable of accommodating fire service vehicles in all weather conditions. As	Compliant	The proposed access tracks connecting the site entrances to the public road have been designed with a typical width of approximately 4.5 meters, incorporating wider sections at bends to facilitate safe vehicle manoeuvring.	No change – layout remains compliant

	such there should be not extreme grades.		The secondary access track includes a 25-metre section with an existing gradient of approximately 16%, sloping downward when approaching the site. The proposed access track will be designed and constructed in line with appropriate industry guidance and in agreement with the fire and risk services to ensure an appropriate surface and gradient for the intended use. All site access tracks, and BESS internal compound corridors have been designed to accommodate emergency response vehicles, including high-reach fire tenders and fire tender pump vehicles. The tracks feature a 14m radii, ensuring full compatibility with the turning requirements of these vehicles.	
3	A perimeter road with passing place suitable for service vehicles	Compliant	The BESS compound layout allows circular routes that run around the compound and between electrical equipment allowing access to all BESS units as indicated in Figure 1.	No change – layout remains compliant
4	Access tracks and BESS internal compound corridors must enable unobstructed access to all areas of the facility	Compliant	The BESS internal compound corridors run around the BESS units, thus allowing access to all BESS units. The site meets requirements of Approved Document B5 Vol 2 allowing all points on site to be within 45m of a fire appliance when required.	No change – layout remains compliant
5	Turning circles, passing places etc. size to be advised by FRS depending on fleet	Compliant	The BESS internal compound corridors allow access to all BESS units (see Figure 1) in two different direction and allow for FRS vehicles to drive in and drive out without need to reverse. In case that FRS need to manoeuvre the layout has allowed several turning points.	No change – layout remains compliant

6	Distances from BESS units to occupied buildings and site boundaries.	Compliant	There are no premises within 25m of BESS units, the nearest residential dwelling is more than 500m. The site boundary is minimum 35m distance from BESS units.	Initial min distance to boundary increased to 30m – layout remains compliant
7	Access between BESS units – minimum of 6.0m suggested.	Compliant	The suggested 6.0m separation is based on a 2017 Issue of the FM Global Loss and Prevention Datasheet 5-33 (footnote 9 in the NFCC Guidance). This Datasheet has been revised in July 2023 and again in Jan 2024 and it now details the following items: • For containerized LIB-ESS comprised of Lithium iron phosphate (LFP) cells, provide aisle separation of at least 5ft (1.5m) on sides that contain access panels, doors, or deflagration vents. The current site layout has been developed to include adequate spacing between the battery storage enclosure (BSE) to mitigate against the risk of fire spread in the event of a fire within one BSE. The layout allows minimum distance of 3m between batteries enclosures and any other infrastructure.	1. Spacing distance of 6.0m removed. New spacing requirement is reduced to approx. 1m assuming that the BESS will be fire certified to UL9540A or equivalent. 2. BESS units are not to be vertically stacked. The current site layout does not allow for vertical stacked BESS. Layout remains compliant.
8	Areas within 10m of BESS units to be cleared of combustible vegetation	Compliant	There is no existing vegetation or proposed in the design within 10m of BESS units.	No change – layout remains compliant
9	Water supply	Compliant	It is intended that an onsite water supply would not be required to achieve the fire response strategy outlined in 3.1. However, if agreed as necessary in development of the Fire Risk Management Plan, a supply of 1,900 litres per minute for at least 2 hours in line with the	The current requirement is 1,900 l/min for 2 hours. The draft NFCC 2024 has a reduced requirement of 25/ l/s (1500 l/m). layout remains compliant.

			NFCC Guidance could be achieved through the potential provision of a piped hydrant or through provision of space allocation for water tanks. While a piped hydrant solution is considered a suitable option, further assessment would be needed to confirm if the required water supply could be achieved using the existing water main indicated in Figure 3. Should the assessment determine that a piped hydrant solution would not be viable, as described above, provision has been made for potential water tank locations, as indicated in Figure 3.	
10	Signage	Compliant	Signage will be positioned at the entrance to the Site, including a site layout plan and details of the key personnel.	Adherence to the dangerous substances (Notification and marking of Sites) Regulations 1990 (NAMOS) should be considered where the total quantity of dangerous substances exceeds 25 tonnes. It is anticipated that there will not be the need to store dangerous substance on site. Should any hazardous materials stored at the BESS facility, they will be fully justified and detailed in the emergency response plan detailing the location, description, appropriate precautions and quantity. Layout remains compliant.
11	Emergency Plan	Compliant	An ERP will be developed for the Site prior construction that will be adopted during construction and operation phases.	1. Identification of sensitive receptors within 1km to allow appropriate emergency planning – This has been completed as part of the Noise Baseline Assessment, the table below details the outcome

<table>
<tr>
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<tr><th>Receptor</th><th>Distance (m)</th><th>Direction</th></tr>
<tr><td>Whitrig A</td><td>450</td><td>Northwest</td></tr>
<tr><td>Whitrig B</td><td>400</td><td>Northwest</td></tr>
<tr><td>Woodside</td><td>600</td><td>Northeast</td></tr>
<tr><td>Rossander</td><td>700</td><td>Northeast</td></tr>
<tr><td>Fernyrig New Cottage</td><td>850</td><td>Southeast</td></tr>
<tr><td>Fernyrig Farm</td><td>520</td><td>South</td></tr>
<tr><td>Todrig Farm</td><td>800</td><td>North</td></tr>
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2. Wind rose to be included showing north and prevailing wind direction – A wind rose is shown with the site layout and north direction at Figure 2.

Layout remains compliant.
</td>
</tr>
<tr>
<td>12</td>
<td>Environmental Impacts</td>
<td>Complaint</td>
<td>The Applicant has undertaken a comprehensive environmental assessment for the site and will be submitted with the planning application.</td>
<td>1. Suitable environmental protection measures should be provided. This should include systems for containing and managing water runoff – A Flood Risk Screening and Drainage Management Plan will be submitted as part of the planning application.

2. Sites located in flood zones should have details of flood protection or</td>
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</table>

				mitigation measures. A Flood Risk Screening and Drainage Management Plan has been submitted as part of the planning application. The BESS compound does not sit within flood risk areas. Although a small area of flooding has been identified along the secondary access track, if flooding were to occur, access / egress from the site could still be achieved via the primary access and the likelihood of requiring use of the secondary access at the same time as a flood event is considered very low. Layout remains compliant.
13	System design, construction, testing and decommissioning	Compliant	Testing and decommissioning information will only be available at detailed design stage. The layout is considered compliant with this item currently.	No change – layout remains compliant.
14	Deflagration Prevention and venting	Compliant	Details will be available at detailed design stage, but equipment will be in line with NFPA855 which includes requirements for explosion prevention and venting. The layout is considered compliant with this item currently.	No change – layout remains compliant.