Glenburnie Wind Farm

AEI Technical Appendix 3.5

Outline Fire Risk Management Plan

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Contents

1 Introduction

1.1.1 This document forms the outline Fire Risk Management Plan (FRMP) for the revised proposed development. The document indicates how the revised proposed development 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) compound.

1.1.2 Fire safety of BESS is governed by regulation and international standards out with the planning system. While this document and its appendices do cover some of those standards, the focus of this document is on the location and design considerations as they are relevant for the planning application.

1.1.3 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 include a detailed FRMP. A detailed FRMP will be prepared prior to construction of the BESS compound.

2 BESS Description

2.1 General Information

2.1.1 The applicant is proposing to include a 50 MW BESS compound within the Glenburnie Wind Farm, the revised proposed development. The BESS will consist of battery storage enclosures (BSEs), power conversion systems (PCSs), transformers, electrical infrastructure, foundations, access track, crane hardstand, and spares storage containers. The grid connection will be via the 132 kV substation within the site, which services both the wind farm and the BESS.

2.2 Battery Selection

2.2.1 The proposed battery technology for the revised proposed 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 applicant's 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; and
- explosion hazards were not observed during the test.

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

2.2.3 Each BSE has an approximate footprint of 6.1 x 2.4 m. The exact battery form factor and capacity will be determined prior to the construction phase and would be documented within the detailed FRMP.

3 Design Factors

3.1 Internal BESS Safety Best Practice Principles

3.1.1 Based on available standards, construction and operation experience, the applicant has developed internal best practice to manage the safety of BESS. A document summary of these principles can be found in **Appendix A**.

3.2 Fire Response Strategy

3.2.1 It is the intention that the BESS compound 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's Grid Scale Battery Energy Storage System planning – Guidance for FRS1 ("the NFCC Guidance") are addressed through the mitigations identified within this document, as these pertain to the fire risk management strategy set out below.

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

i implement measures that result in a very low risk of fire ignition and any suitable environment for sustaining fire;

ii implement measures that result in a very low risk of fire propagation and spread within a fire source (e.g. BSE);

iii ensure fire spread between significant elements of the project is not expected, through application of design standards and use of calculations / modelling as necessary; and

iv include adequate provisions to allow the fire service to monitor a fire event, intervening only if there is a failure of the controls above.

3.2.3 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.

3.2.4 During detailed design, following battery product selection, this outline FRMP will be developed into a detailed FRMP, in liaison with the Fire Service and with due consideration of the NFCC Guidance. The detailed FRMP 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; and
- an emergency response plan.

3.3 Mitigation Measures

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

[1] National Fire Cheifs Council. 2023. Grid Scale Battery Energy Storage System planning – Guidance for FRS. Available at: https://nfcc.org.uk/wp-content/uploads/2023/10/Grid-Scale-Battery-Energy-Storage-System-planning-Guidance-for-FRS.pdf

Equipment Spacing

3.3.2 The layout of the BESS compound 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 aligns with applicable NFPA 8552 spacing criteria as well as the spacing recommendations outlined in FM Property Loss Prevention Datasheet 5-333. The layout allows minimum distance of 3 m between battery enclosures and any other infrastructure.

Protection Systems

3.3.3 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.

Access to BSE

3.3.4 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.

Location of BESS Compound

3.3.5 The location of the BESS compound has been selected considering the site constraints and the distances from existing nearby premises and proposed wind turbines. There are no premises nearby the BESS compound, with the nearest one (within the substation compound) to be more than 200 m in distance. The nearest residential premise to the BESS compound is the Howe, located approximately 2.8 km from the BESS compound. In addition, the nearest proposed and existing wind turbine will be approximate 600 m from the BESS compound. A distance of at least 6.1 m is achieved between BSEs and the edge of the BESS compound, in line with NFPA 855, and there are no existing or planned bushes or trees within 10 m of any BSE.

Access for Emergency Services

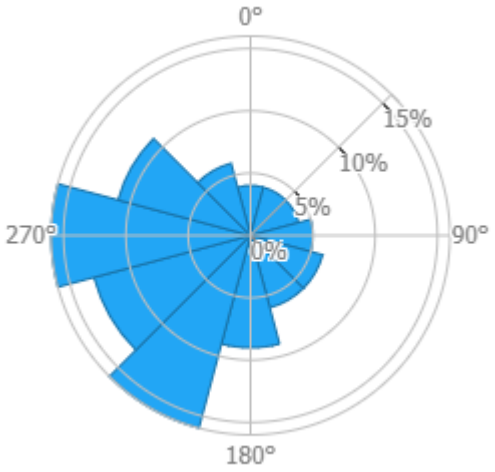
3.3.6 Should the fire service need to attend, the fenced BESS compound has a wide access route through north and south corridors and through centre, allowing the fire service to access the BESS compound during an incident. In addition, the current layout of the BESS compound allows for one access point from the proposed wind farm tracks.

3.3.7 A wind rose created using project specific historical metrological data indicates that the prevailing wind direction for the area is from the south-west. Given the location of the site entrance, as well as the prevailing wind direction, it is assessed as unlikely that the site entrance will experience obscuration due to adverse conditions. The wind rose is also shown in **Diagram 1** below.

[2] National Fire Protection Association, 2023, NFPA 855 Standard for the Installation of Stationary Energy Storage Systems, Available at: https://www.nfpa.org/codes-and-standards/nfpa-855-standard-development/855

[3] FM, 2024, FM Property Loss Prevention Data Sheets 5-33, Available at: https://www.fm.com/resources/fm-data-sheets#rbdatasheetssearch_q=5-33&rbdatasheetssearch_e=0

Diagram 1 – Wind Frequency Rose for Glenburnie Wind Farm



3.3.8 Should it be deemed necessary, a secondary access point can be formed opposite the main access point to the BESS compound to provide an alternative route for emergency services. This would ensure continued access in the event that wind direction and smoke make access from one direction particularly challenging. The land surrounding the BESS compound is under the applicant's control, and it is considered feasible to accommodate such an arrangement if required.

3.3.9 Turning locations for emergency response vehicles are available within the BESS compound, adjacent to and opposite the main access point.

3.3.10 The proposed access tracks geometry from the nearest public road D124) has been designed to facilitate wind farm traffic and fire response vehicle access, with a minimum width of 4.5 m, incorporating wider sections at bends. The access tracks will be designed and constructed to provide a minimum carrying capacity of 12.5 t per axle.

3.3.11 SEPA flood mapping indicates a short section with a 10% chance of surface water and river flooding. This flooding is caused by two undersized culverts near the site. As part of the detailed design, these culverts will be replaced with appropriately sized structures to resolve the issue. The detailed design will ensure that flood risk is eliminated or reduced to a negligible level, guaranteeing that emergency service access to the BESS compound remains unobstructed at all times.

3.4 Water Supply

3.4.1 Potential water supplies are identified in Error! Reference source not found..

3.4.2 The proposed fire response strategy, as outlined in Section 3.2, is designed to be implemented without the need for an onsite water supply. However, should the detailed FRMP determine that a dedicated water supply is required, provisions will be made to ensure a flow rate of 1,900 litres per minute for a minimum duration of two hours, in accordance with NFCC Guidance.

3.4.3 The substation compound is expected to include water supply facilities. Potential water provisions for the BESS compound will be accommodated either through a piped hydrant connected to the same source as the substation or via a dedicated water storage tank, as identified in Error! Reference source not found..

4 Operational Factors

4.1.1 As well as mitigations to make the BESS compound 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 addressed in the detailed FRMP.

4.2 Emergency Response Plan

4.2.1 The emergency response plan will be developed in line with the detailed FRMP. It will outline how the operator will respond to incident and accident scenarios on the BESS compound including clear guidance for first responder organisations.

4.3 Hazard Identification and Mitigation Analysis

4.3.1 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.

4.4 Hazardous Material

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

4.5 Safety Management Structure

4.5.1 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.

4.6 Staff Competence

4.6.1 The detailed FRMP 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

5.1.1 During the preliminary design, efforts have been made to mitigate fire hazards on the BESS compound by incorporating specific design factors as described in this outline FRMP.

5.1.2 During detailed design and following battery product selection, a detailed FRMP will be developed. This will include a project specific fire risk appraisal, which will be used to verify and finalise the strategy presented in this document, and an emergency response plan, which 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

Item	NFCC 2022 BESS Guidance Recommendation	Design factors / mitigations	Impact of Draft 2024 NFCC BESS Guidance
1	Access – Minimum of two separate access points to the BESS compound	The current BESS compound layout allows for one access point from the proposed wind farm tracks. A mesoscale wind model conducted by RES (with reference Mesoscale Wind Climate for SCOlcfM9999) that is presented in Diagram 1, indicates that the prevailing wind direction for the area is from the south-west. Given the location of the site entrance, as well as the prevailing wind direction, it is assessed as unlikely that the site entrance will simultaneously experience obscuration due to adverse conditions. Should it be deemed necessary, a secondary access point can be formed opposite the main access to provide an alternative route for emergency services. This would ensure continued accessibility in the event that wind direction and smoke make access from one direction particularly challenging. The land surrounding the BESS compound is under the applicant's control, and it is considered feasible to accommodate such an arrangement if required.	No change
2	Tracks/hardstand capable of accommodating fire service vehicles in all weather	The proposed access tracks geometry from the nearest public road (D124) has been designed to facilitate wind farm traffic and fire response vehicle access, with a minimum width of 4.5 m, incorporating wider sections at bends. The tracks will be designed and constructed to provide a minimum carrying capacity of 12.5 t per axle. The proposed access track includes an 800 m section with an approximate existing gradient between 14% and 24%, sloping upwards when approaching the BESS	No change

Item	NFCC 2022 BESS Guidance Recommendation	Design factors / mitigations	Impact of Draft 2024 NFCC BESS Guidance
	conditions. As such there should be not extreme grades.	compound. The 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. It is anticipated that access tracks designed and constructed for wind farm construction traffic would be sufficient to accommodate emergency fire vehicles.	
3	A perimeter track with passing place suitable for service vehicles	The design provides a perimeter access solution that ensures service vehicle access to all battery units. While the BESS compound layout does not include a continuous perimeter track with designated passing places, it achieves full accessibility. If required, a secondary access track can be introduced opposite the existing one to further enhance operational flexibility.	No change
4	Access tracks and BESS internal compound corridors must enable unobstructed access to all areas of the BESS compound	The BESS internal compound corridors run around the BESS units, thus allowing access to all BESS units. The compound meets requirements of Building Regulations Approved Document B Vol 2 allowing all points on the compound to be within 45 m of a fire appliance when required.	No change
5	Turning circles, passing places etc. size to be advised by emergency services	The internal compound corridors provide access to all BESS units and facilitate vehicle movement within the compound. While the design does not accommodate a full drive-in, drive-out circulation without reversing, it minimizes the need for reversing and ensures efficient and safe manoeuvring for emergency service vehicles.	No change

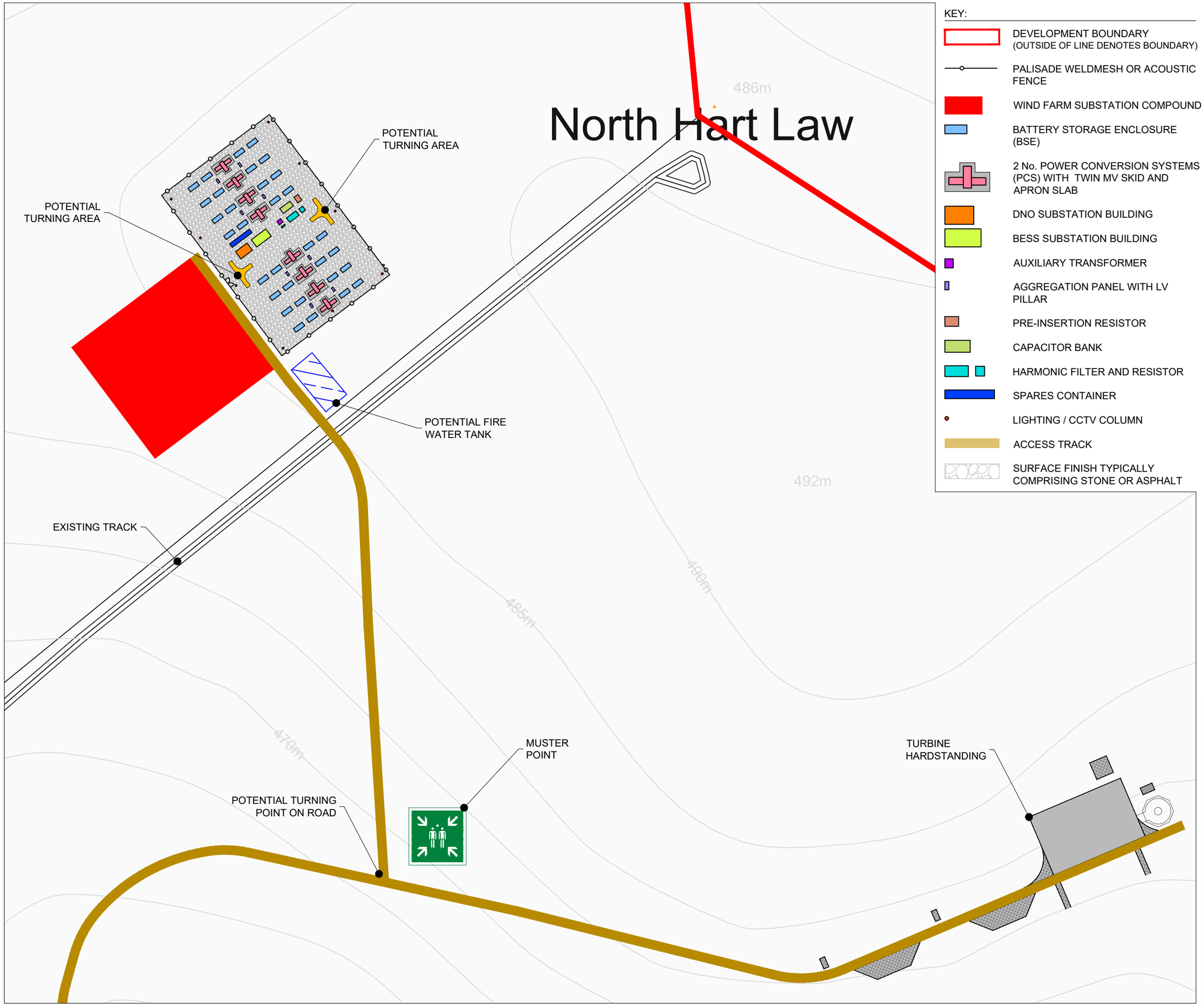
Item	NFCC 2022 BESS Guidance Recommendation	Design factors / mitigations	Impact of Draft 2024 NFCC BESS Guidance
	depending on fleet	The layout of the compound has allowed several turning points, which achieve the minimum width and bend radius outlined in Building Regulations Approved Document B Vol 2 Table 15.2.	
6	Distances from BESS units to occupied buildings and site boundaries.	There are no premises within 25 m of BESS units, the nearest residential premise to the proposed BESS compound is the Howe, located approximately 2.8 km from the BESS compound. The site boundary is minimum 35 m distance from BESS units.	Guidance increases initial min distance to boundary to 30 m Response: While the new guidance suggests 30m, the design remains safe, with no sensitive receptors nearby in a rural area. No impact from change in guidance.
7	Access between BESS units – minimum of 6.0m suggested.	The suggested 6.0 m 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 5 ft (1.5 m) on sides that contain access panels, doors, or deflagration vents. The current BESS compound layout has been developed to include adequate spacing between the battery storage enclosure (BSE) (3 m when side to side and 3m when end-to-end) to mitigate against the risk of fire spread in the event of a fire within one BSE. The layout allows minimum distance of 3 m between battery enclosures and any other infrastructure.	Recommended spacing distance of 6.0 m removed from guidance. New spacing recommendation is reduced to approx. 1 m assuming that the BESS will be fire certified to UL9540A or equivalent. BESS units are not to be vertically stacked. Response: The current BESS compound layout does not allow for vertical stacked BESS. No impact from change in guidance.
8	Areas within 10 m of BESS units to be cleared of	There is no existing vegetation or proposed in the design within 10 m of BESS units. The land all around the BESS compound is under applicant's control.	No change

Item	NFCC 2022 BESS Guidance Recommendation	Design factors / mitigations	Impact of Draft 2024 NFCC BESS Guidance
	combustible vegetation		
9	Water supply	The proposed fire response strategy, as outlined in Section 3.2, is designed to be implemented without the need for an onsite water supply. However, should the Fire Risk Management Plan determine that a dedicated water supply is required, provisions will be made to ensure a flow rate of 1,900 litres per minute for a minimum duration of two hours, in accordance with NFCC Guidance. The wind farm substation is expected to include water supply facilities. Potential water provisions for the BESS will be accommodated either through a piped hydrant connected to the same source as the substation or via a dedicated water storage tank, as identified in Outline Fire Risk Management Layout provided in Appendix C.	Guidance water supply recommendation has a reduced requirement of 25 l/s (1500 l/m). Response: The current requirement is less onerous than the proposed in the draft NFCC 2024. No impact from change in guidance.
10	Signage	Signage will be positioned at the entrance to the BESS compound, including a layout plan and details of the key personnel.	Guidance notes that 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. Response: It is understood that lithium-ion batteries are Class 9 dangerous goods under the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) which is applicable under NAMOS via Carriage of Dangerous Goods (CDG). NAMOS will be adhered to, and the emergency response plan will detail the location, description and quantity

Item	NFCC 2022 BESS Guidance Recommendation	Design factors / mitigations	Impact of Draft 2024 NFCC BESS Guidance
			of dangerous goods and appropriate precautions for dealing with them.
11	Emergency Plan	An emergency response plan will be developed for the BESS compound prior construction that will be adopted during construction and operation phases.	Guidance recommends identification of sensitive receptors within 1km to allow appropriate emergency planning. Response: There are not sensitive receptors identified within 1 km from BESS compound Guidance recommends wind rose to be included showing north and prevailing wind direction. Response: A wind rose is shown with the layout and north direction at **Diagram 1**. No impact from change in guidance
12	Environmental Impacts	The applicant has undertaken a comprehensive environmental assessment for the BESS compound and was submitted with the planning application. Should it be agreed that there is a need for use of fire water in a manner that risks mobilising combustion contaminants be agreed, the drainage design may be modified to attenuate fire water for later testing and offsite disposal as necessary.	Suitable environmental protection measures should be provided. This should include systems for containing and managing water runoff. Response: As noted for current guidance, the drainage scheme may optionally be modified to attenuate firefighting runoff. Sites located in flood zones should have details of flood protection or mitigation measures. A Flood Risk Screening and Drainage Management

Item	NFCC 2022 BESS Guidance Recommendation	Design factors / mitigations	Impact of Draft 2024 NFCC BESS Guidance
			Plan has been submitted as part of the planning application. Response: SEPA flood mapping indicates a short section with a 10% chance of surface water and river flooding. This flooding is caused by two undersized culverts near the site. As part of the site access design, these culverts will be replaced with appropriately sized structures to resolve the issue. The detailed design will ensure that flood risk is eliminated or reduced to a negligible level, guaranteeing that emergency services access to the BESS compound remains unobstructed at all times. No impact from change in guidance
13	System design, construction, testing and decommissioning	Testing and decommissioning information will only be available at detailed design stage.	No change
14	Deflagration Prevention and venting	Details will be available at detailed design stage, but equipment will be in line with *NFPA 855* which includes requirements for explosion prevention and venting.	No change

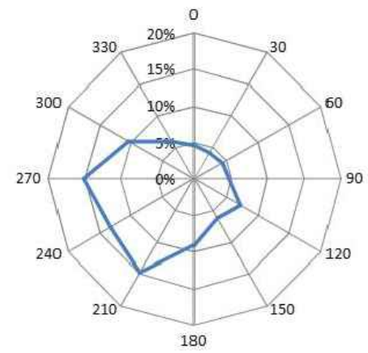
Appendix C: Outline Fire Risk Management Layout



KEY:

- DEVELOPMENT BOUNDARY (OUTSIDE OF LINE DENOTES BOUNDARY)
- PALISADE WELDMESH OR ACOUSTIC FENCE
- WIND FARM SUBSTATION COMPOUND
- BATTERY STORAGE ENCLOSURE (BSE)
- 2 No. POWER CONVERSION SYSTEMS (PCS) WITH TWIN MV SKID AND APRON SLAB
- DNO SUBSTATION BUILDING
- BESS SUBSTATION BUILDING
- AUXILIARY TRANSFORMER
- AGGREGATION PANEL WITH LV PILLAR
- PRE-INSERTION RESISTOR
- CAPACITOR BANK
- HARMONIC FILTER AND RESISTOR
- SPARES CONTAINER
- LIGHTING / CCTV COLUMN
- ACCESS TRACK
- SURFACE FINISH TYPICALLY COMPRISING STONE OR ASPHALT

SITE WIND FREQUENCY ROSE



NOTES:

1. EQUIPMENT DETAILS AND CONFIGURATION WITHIN THE ENERGY STORAGE COMPOUND ARE INDICATIVE AND SUBJECT TO DETAILED DESIGN.
2. THIS DRAWING DEFINES OUTLINE FIRE RISK MANAGEMENT INFORMATION FOR THE SITE AND SHALL BE DEVELOPED AS APPROPRIATE ALONGSIDE THE PROJECT DETAILED FIRE RISK MANAGEMENT PLAN.

SHEET 1 OF 2

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
1	AL	AP	CH	2025-04-11	First Issue

PURPOSE: PRELIMINARY	COORDINATES
SCALE: 1:2000 @A3	DATUM: N/A
LAYOUT DRAWING: N/A	T-LAYOUT NO: N/A

PROJECT TITLE
GLENBURNIE WIND FARM

DRAWING TITLE
BESS OUTLINE FIRE RISK MANAGEMENT LAYOUT

RES DRAWING NUMBER	REV
04728-RES-LAY-DR-PE-004	1

BEAUFORT COURT,
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BESS SITE LOCATION

PROPOSED WATER TANK

MUSTER POINT

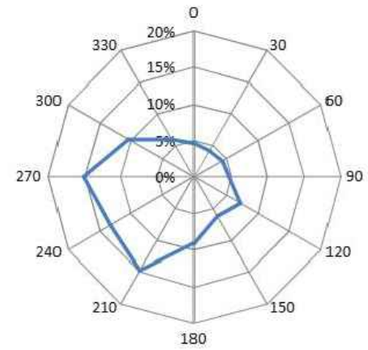
T5 T6 T7 T8 T9 T10 T11 T12 T13 T14 T15 T16

PERMANENT ACCESS TRACK LAYOUT

KEY:

- DEVELOPMENT BOUNDARY (OUTSIDE OF LINE DENOTES BOUNDARY)
- WIND FARM SUBSTATION COMPOUND
- PERMANENT ACCESS TRACK
- TURBINE HARDSTANDING
- SITE ACCESS
- T No. TURBINE

SITE WIND FREQUENCY ROSE



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SHEET 2 OF 2

ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
1	AL	AP	CH	2025-04-11	First Issue

PURPOSE: PRELIMINARY	COORDINATES
SCALE: 1:25000 @A3	DATUM: N/A
LAYOUT DRAWING: N/A	T-LAYOUT NO: N/A

PROJECT TITLE
GLENBURNIE WIND FARM

DRAWING TITLE
BESS OUTLINE FIRE RISK MANAGEMENT LAYOUT

RES DRAWING NUMBER	REV
04728-RES-LAY-DR-PE-004	1

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