

# Outline Fire Risk Management Plan

Ballyross BESS

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## Revision History

Issue	Date	Name	Latest changes
01	06/05/2025	Morgan Allan	First Created

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# 1 Introduction

This document forms the Ballyross Battery Energy Storage System (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.

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

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 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 BESS south of Ballyvally Road, Larne, Co. Antrim. The system would be capable of a maximum import and export of 120MW and consists of Battery Storage Enclosures (BSEs), Power Conversion Systems (PCSs), transformers, electrical infrastructure, foundations, access track, crane hardstanding, spares storage containers and relating ancillary works. The grid connection will be via an onsite 110kV substation intended to connect to the existing Ballyvally 110kv 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 footprint of 6.1 x 2.4m. The exact battery form factor and capacity 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.

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 prevent an environment suitable 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 into a detailed plan, 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 battery 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. Appendix C lists the locations of occupied residential properties within 1km of the centre of the site. A distance of at least 6.1m is achieved between BSEs and the site boundary, in line with NFPA 855 (2023), and there are 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 route through east and west corridors, allowing the fire service to access the site during an incident. In addition, one site entrance splitting to 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.

A wind frequency rose sourced by <https://globalwindatlas.info/> website indicates that the prevailing wind direction for the area is from the southwest. Given the relative distances between the proposed BESS compound and the split point, 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 wind rose is also shown in Appendix D.

Turning locations for emergency response vehicles are available within the site hardstanding's and at the main entrance gates.

The proposed access tracks geometry has been designed to facilitate fire response vehicle access, with a minimum width of 4m, incorporating wider sections at bends. The tracks will be designed and constructed to provide a minimum carrying capacity of 12.5t per axle.

Flood mapping indicates no watercourse or coastal flooding within the access tracks or BESS compound. Additionally mapping shows that surface water flooding is not expected within the BESS compound. Within the access tracks, surface water flooding (associated with 1-in-100-year event) is anticipated in an isolated area of the access track. During such a flood event, the secondary site access would be used in preference. The likelihood of simultaneous impassable flooding of this track and wind conditions that make the primary access unusable is considered sufficiently low to mitigate the risk of access being prevented by flooding.

### 3.3.6 Water Supply

It is intended that an onsite water supply would not be required to achieve the fire response strategy outlined in 3.2. 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 be achieved through provision of either a piped hydrant sourcing the water from an existing water main at the Ballyvallagh Road, or a permanent storage tank at the potential location identified in Appendix D.

Fire water containment will be incorporated into the overall site drainage design. Although the use of water is not anticipated while responding to an incident, boundary cooling may be employed to minimise the risk of propagation between adjacent containers. Since water would then not be applied directly to the battery enclosure it is anticipated that this run-off water would have a low concentration of contaminants. Runoff used to cool the units will be initially intercepted and contained within the gravel bases. This will allow a compartmentalised approach to the containment of water in the event of fire. Penstocks will be installed to allow further containment of potentially contaminated water for testing prior either tanking offsite if contaminated or alternatively discharged in accordance with the approved drainage strategy.

## 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 addressed in the detailed Fire Risk Management Plan.

### 4.1 Emergency Response Plan

The Emergency Response Plan will be developed in line with the detailed 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.

### 4.2 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.

### 4.3 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.

### 4.4 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 detailed 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 Consequence Assessment

Although the probability of a thermal run-away event is low, such an incident would present several hazards to the surrounding area. This section aims to assess the potential impact of these hazards, with the aim of demonstrating a low risk to the public.

### 5.1 COMAH Applicability

As per the analysis laid out in Appendix E there is no reasonably foreseeable scenario where the quantity of hazardous substances on site, either in normal operation or in the event of a thermal-runaway incident, would exceed the limits laid out in the COMAH 2015 regulations for dangerous substances present on site.

### 5.2 Toxic Cloud Assessment

In the event of a thermal run-away incident, hydrogen fluoride gas will be produced. If released, this gas will form a cloud surrounding the enclosure that presents a toxicity hazard. Based on analysis<sup>1</sup>, looking at a 5MWh containerised solution, in line with the anticipated equipment used in this project, an offset of 45m to the SLOT boundary (HSE's suggested limit for a 1% risk of fatality) is assessed and shown in Appendix F shows that no occupied premises are located within this radius around the BESS equipment, it is therefore anticipated that the risk to the public is low. It should be noted that this is a preliminary assessment based on representative, but generic, input data.

### 5.3 Explosion Over-pressure Assessment

As well as toxic gases, flammable substances such as hydrogen, carbon monoxide and methane would also be produced in a thermal run-away event. Whilst these will be partially consumed by the fire within the container there have previously been incidents where these gases have accumulated and subsequently undergone deflagration. Based on analysis<sup>1</sup>, using a conservative estimate for the quantity of flammable gas present in the container of 50m<sup>3</sup>, and assuming an upper over-pressure limit of 70mbar the anticipated area of effect is a 45m radius from the BESS equipment. Appendix G shows that no occupied premises are located within this radius, it is therefore anticipated that the overall risk to the public is low. It should be noted that this is a preliminary assessment based on representative, but generic, input data.

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<sup>1</sup> Hazard Assessment of Battery Energy Storage Systems, Atkins, Ian Lanes, Issue 01, March 2021

## 6 Conclusion

During the preliminary design, efforts have been made to mitigate fire hazards on site by incorporating specific design factors as described in this Outline Fire Risk Management Plan.

During detailed design and following battery product selection, a detailed Fire Risk Management Plan 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

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# RES BESS safety best practice principles

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Author	Geoff Elston
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Revision History

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01	06 December 2024	Geoff Elston	First created
02	12 December 2024	Geoff Elston	Correction to title block date quick part

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# 1 Introduction

This document sets out RES internal best practice for risk mitigation in BESS design.

Based on available standards, construction and operation experience, RES has developed internal best practice to manage the safety of battery energy storage systems.

It is important to be aware of hazards general to the power industry *and* specific to battery energy storage systems.

The key hazards for battery storage projects are:

- Thermal runaway - caused by mechanical or electrical abuse, or internal faults such as lithium plating of cells, resulting in spontaneous internal short circuits.
- High DC fault currents - Short circuit currents from banks of batteries can be in the range of 100kA – 150kA or more.
- Live working - The source of charge of a battery can never be completely isolated.

It is equally important to understand that these inherent hazards can all be controlled through appropriate design and operation procedures and RES is actively collaborating with both BSI/IEC and EPRI in the development of standards and best practice guidance.

## 2 Hazard mitigation analysis, risk mitigation & layers of protection

During detailed design RES projects undergo Hazard Mitigation Analysis (HMA), like Failure Mode and Effects Analysis or HazID, HazOP and LOPA) to identify hazards, and improve design to reduce risk.

### 2.1 Substitution

Lithium-ion batteries have a number of different potential chemical make ups – some of which are listed below:

- NMC – lithium nickel manganese cobalt
- NCA – lithium nickel cobalt aluminium
- LFP – lithium iron phosphate
- LMO – Lithium manganese spinel
- LTO – lithium titanate

Each chemistry has different effects on characteristics of the cell like cost, energy density, cycling life, thermal stability and specific power. NMC and LFP are the most common chemistries for stationary energy storage and while both have intrinsic hazards it is easier to make LFP cells safer as:

- They have greater thermal stability, going into thermal runaway at higher temperatures
- Produce less oxygen during electrolyte breakdown, reducing the risk of combustion

Following the hierarchy of control RES substitutes less thermally stable li-ion chemistries like NMC, for the more thermally stable LFP

### 2.2 Engineering controls

Design methods to address these hazards identified by the HMA can include:

- Protection and control layers through the system, rack and module Battery Management Systems and rack level contactors and fusing.
- Coordination of DC protection between the batteries and PCS including appropriate insulation monitoring and arc-flash assessment
- Ingress Protection rating to match the local installation environment
- Site design to mitigate any external hazards (i.e. vehicle collision, lightning strike, rodent damage)
- NFPA 855 and IEC 62933 safety design standards in conjunction with UL9540A test methods and results should be followed to design storage systems to mitigate effects of fire and explosion.
- Explosion prevention and control (such as active deflagration prevention control or passive deflagration venting), used as an additional measure to mitigate effects of explosive atmospheres in battery containers.

The design of RES' BESS adopt the following layers of protection against failure as standard, to reduce the risk of hazards impacting people and environment:

- Module level monitoring of voltage and temperature via a local battery management system (BMS).
- A secondary BMS at the rack/string level to monitor module operation and allow automatic disconnection of electrical contacts.
- Monitoring of battery storage enclosure environment and/or cell temperature ensuring system stability using RES' proprietary Energy Management System, RESolve.
- A flammable gas detection system capable of warning of an explosive atmosphere present in the system and activating forced ventilation.

In the event these layers of protection fail, fire suppression can reduce the impact of those failures. Design should be informed by Fire Risk Assessment and can include:

- A fire detection system equipped with smoke and heat detectors able to rapidly alert system operators.
- A fire suppression system capable of mitigating fires in the unit not caused by thermal run-away (note: oxygen is not required for thermal run-away to propagate)
- A system to allow application of water in the event of a thermal run-away event to help absorb the heat generated, such as dry type sprinkler systems. Though there are risks associated with fire service intervention in a fire due to the chemicals produced and water may be best used to further reduce the risk of propagation outside of the initiating enclosure.
- Deflagration venting in the form of blast panels to mitigate the effects of an explosion should an explosive atmosphere form.

All of the above conform with NFPA 855 and IEC 62933 safety design standards informed by UL9540A test data to ensure the site is designed appropriately to mitigate effects of fire.

## 2.3 Administrative controls

It is important to have robust operating procedures and to engage with the local emergency services to ensure that they are aware of the hazards, and the protection and control features of the BESS. RES projects development includes:

- Ensuring appropriate signage as per NFPA 855, which includes but is not limited to:
  - Energy storage system identification sign, including type of technology, any special hazards, emergency contact information and suppression system type installed.
  - Location of all electrical power disconnectors.
- Hosting regular site visits by local emergency services to familiarise themselves with the installation.
- A premises information box positioned at a safe distance from the energy storage location and should contain the following information:

- Plans of the site.
  - Description of the site and buildings.
  - Information regarding the use of the site and significant risks.
  - Details of key personnel and emergency contact details.
  - Evacuation strategy within the local area.
  - Construction and layout including emergency access points and isolation systems.
  - Details of fire safety systems, alarms and suppression systems.
- An Emergency Response Plan developed with the local Emergency Responders including clear instruction that Emergency responders should not enter or open containers once alight.



## 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 site	<p>One site entrance splitting to 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.</p> <p>A wind frequency rose sourced by <a href="https://globalwindatlas.info/">https://globalwindatlas.info/</a> website indicates that the prevailing wind direction for the area is from the southwest. Given the relative distances between the proposed BESS compound and the split point, 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 wind rose is also shown in Appendix D</p>	No change
2	Roads/hard standing capable of accommodating fire service vehicles in all weather conditions. As such there should be not extreme grades.	The proposed access track and BESS internal compound access corridor geometry have been designed to facilitate fire response vehicle access, with a minimum width of 4m, incorporating wider sections at bends. The tracks will be designed and constructed to provide a minimum carrying capacity of 12.5t per axle.	No change

3	A perimeter road with passing place suitable for service vehicles	The BESS compound layout allows circular routes that run around the BESS and PCS units and between electrical equipment allowing access to all BESS units as indicated in Appendix D. There is adequate space within the BESS compound for vehicles to pass.	No change
4	Access tracks and BESS internal compound corridors must enable unobstructed access to all areas of the facility	The BESS internal compound corridors run around the BESS units, thus allowing access to all BESS units.  The site meets requirements of Building Regulations Approved Document B Vol 2 allowing all points on site to be within 45m of a fire appliance when required.	No change
5	Turning circles, passing places etc. size to be advised by FRS depending on fleet	The BESS internal compound corridors allow access to all BESS units (see Appendix D) in two different directions and allow for FRS vehicles to drive in and drive out without need to reverse.  In case that the FRS need to manoeuvre, the layout 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.	No change
6	Distances from BESS units to occupied buildings and site boundaries.	There are no premises within 25m of BESS units. A full list of the nearest occupied residential properties can be found in Appendix C.  The site boundary is minimum 30m distance from BESS units.	Guidance increases initial min distance to boundary to 30m - layout remains compliant with the site boundary a minimum of 30m from the BESS units.
7	Access between BESS units - minimum of 6.0m suggested.	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	Recommended spacing distance of 6.0m removed from guidance. New spacing recommendation is reduced to approx.

		<p>Guidance). This Datasheet has been revised in July 2023 and again in Jan 2024 and it now details the following items:</p> <ul style="list-style-type: none"> <li>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.</li> </ul> <p>The current site layout has been developed to include adequate spacing between the battery storage enclosure (BSE) (3m when side to side - 0.3m 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 3m between battery enclosures and any other infrastructure.</p>	<p>1m assuming that the BESS will be fire certified to UL9540A or equivalent.</p> <p>1. BESS units are not to be vertically stacked.</p> <p><b>Response:</b> The current site layout does not allow for vertical stacked BESS.</p> <p>No impact from change in guidance.</p>
8	Areas within 10m of BESS units to be cleared of combustible vegetation	There is no existing vegetation or proposed in the design within 10m of BESS units.	No change
9	Water supply	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 be achieved through provision of a piped hydrant sourcing the water from an existing water main at the Ballyvallagh Road, or a tank at the potential locations identified in Appendix D.	<p>Guidance water supply recommendation has a reduced requirement of 25 l/s (1500 l/m).</p> <p>No impact from change in guidance.</p>

10	Signage	Signage will be positioned at the entrance to the Site, including a site layout plan and details of the key personnel.	<p>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.</p> <p><b>Response:</b> 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. Additionally, it is recommended that the emergency response plan will detail the location, description and quantity of dangerous goods and appropriate precautions for dealing with them.</p>
11	Emergency Plan	An emergency response plan will be developed for the site prior construction that will be adopted during construction and operation phases.	<p>1. Guidance recommends identification of sensitive receptors within 1km to allow appropriate emergency planning.</p> <p><b>Response:</b> Please refer to Appendix D.</p> <p>Guidance recommends wind rose to be included showing north and prevailing wind direction.</p> <p><b>Response:</b> A wind rose is shown with the site layout and north direction at Appendix D.</p> <p>No impact from change in guidance</p>

12	Environmental Impacts	<p>Should it be agreed that there is a need for use of fire water, an onsite fire containment will be incorporated into the overall site drainage design. Although the use of water is not anticipated while responding to an incident, boundary cooling may be employed to minimise the risk of propagation between adjacent containers. Since water would then not be applied directly to the battery enclosure it is anticipated that this run-off water would have a low concentration of contaminants. Runoff used to cool the units will be initially intercepted and contained within the gravel bases. This will allow a compartmentalised approach to the containment of water in the event of fire and penstocks will be installed to allow further containment of potentially contaminated water for testing prior either tanking offsite if contaminated or alternatively discharged in accordance with the approved drainage strategy.</p>	<p>1. Suitable environmental protection measures should be provided. This should include systems for containing and managing water runoff.</p> <p><b>Response:</b> As noted for current guidance, the drainage scheme may optionally be modified to contain firefighting runoff.</p> <p>2. Sites located in flood zones should have details of flood protection or mitigation measures. A Flood Risk Screening and Drainage Management Plan has been submitted as part of the planning application.</p> <p><b>Response:</b> The BESS compound does not sit within flood risk areas. Although a small area of surface flooding has been identified along the access track, if flooding were to occur, access / egress from the site could still be achieved via the secondary access. The likelihood of requiring use of the main access at the same time as a flood event is considered very low. No impact from change in guidance</p>
13	System design, construction, testing and decommissioning	<p>Testing and decommissioning information will only be available at detailed design stage.</p>	<p>No change</p>

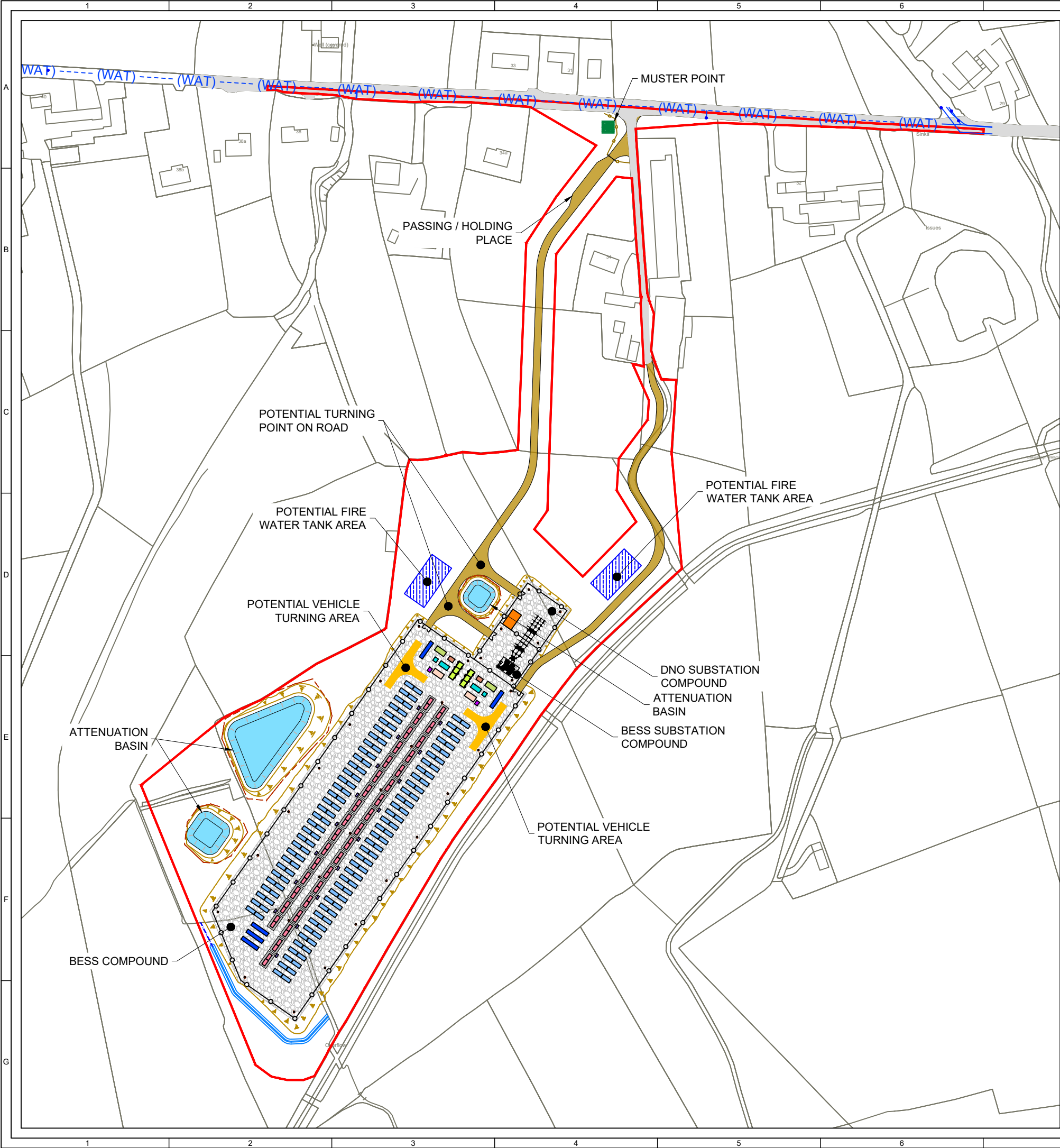
14	Deflagration Prevention and venting	Details will be available at detailed design stage, but equipment will be in line with NFPA855 which includes requirements for explosion prevention and venting.	No change
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## Appendix C List of Occupied Residential Properties Within 1km of Centre of Site

Receptor	X	Y	Distance from site midpoint (m)
<b>SITE</b>	<b>338291</b>	<b>394716</b>	<b>0</b>
H1	338971	394115	887
H2	337719	394165	770
H3	337597	394481	721
H4	339033	394681	744
H5	338929	394850	662
H6	338946	394894	690
H7	339076	394917	821
H8	339002	394940	758
H9	337805	394970	563
H10	338425	394970	318
H11	338964	394973	735
H12	338928	394983	706
H13	338307	394987	306
H14	339004	395004	784
H15	338544	395019	423
H16	337872	395024	539
H17	338739	395026	566
H18	338155	395027	370
H19	338358	395037	362
H20	337899	395038	528
H21	338196	395044	374
H22	338228	395050	373
H23	338921	395061	737
H24	337836	395072	598
H25	338072	395072	446
H26	338668	395078	548
H27	338371	395098	424
H28	338399	395099	431
H29	338252	395110	430
H30	338267	395151	470
H31	338609	395189	600
H32	338449	395238	579
Proposed House	338295	394883	201

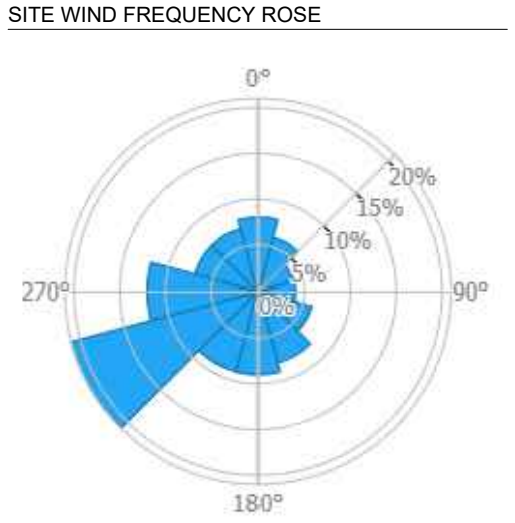
## Appendix D Outline Fire Risk Management Layout





- KEY:**
- DEVELOPMENT BOUNDARY (OUTSIDE EDGE OF LINE DENOTES BOUNDARY)
  - PALISADE, WELDMESH OR ACOUSTIC FENCE
  - COMPOUND GATE
  - BATTERY STORAGE ENCLOSURE (BSE)
  - POWER CONVERSION SYSTEM (PCS) WITH SINGLE MV SKID AND APRON SLAB
  - DNO SUBSTATION BUILDING
  - BESS SUBSTATION BUILDING
  - AUXILIARY TRANSFORMER
  - LV SWITCHGEAR ROOM
  - AGGREGATION PANEL WITH LV PILLAR
  - PRE-INSERTION RESISTOR
  - CAPACITOR BANK
  - HARMONIC FILTER AND RESISTOR
  - SPARES CONTAINER
  - LIGHTING / CCTV COLUMN
  - GRAVEL OR ASPHALT FINISH TO SUIT DETAILED EARTHING DESIGN.
  - ACCESS TRACK
  - EXISTING ROAD
  - EARTHWORKS BATTER
  - SITE ENTRANCE GATE
  - EXISTING FENCE MODIFIED
  - STOCK PROOF FENCE
  - SWALE
  - CARRIER DRAIN
  - MUSTER POINT
- EXISTING BURIED UTILITIES**
- (WAT) WATER MAIN (NI WATER RECORDS)
  - WATER VALVE (NI WATER RECORDS)

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- NOTES:**
- EQUIPMENT DETAILS AND CONFIGURATION WITHIN THE ENERGY STORAGE COMPOUND ARE INDICATIVE AND SUBJECT TO DETAILED DESIGN.
  - 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.

1	BM	AP	CH	2025-06-13	First Issue
ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
PURPOSE					COORDINATES
PLANNING					TM65 IRISH GRID
SCALE					DATUM
1:2,500 @A3					N/A
LAYOUT DRAWING					T-LAYOUT NO
N/A					N/A

PROJECT TITLE  
**BALLYROSS**

DRAWING TITLE  
**OUTLINE FIRE RISK MANAGEMENT LAYOUT**

RES DRAWING NUMBER	REV
05646-RES-LAY-DR-PE-002	1

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## Appendix E COMAH Applicability Assessment

28/01/2025

# Hazardous Substances Consent and COMAH Applicability Assessment

Author	Martin O'Connor
Date	04/02/2025
Ref	ENG01-9389999

Issue	Date	Name	Latest changes
1	28/01/2025	Martin O'Connor	First Issue

# 1 COMAH Classification

The classification of a site under COMAH regulations is based on the quantity of a given hazardous substance present, these hazardous substances follow the definition laid out in The Classification, Labelling and Packaging (CLP) regulations implemented by the European Union. However, as per the Guidance on Requirements for Substances in Articles [1], referenced in the Introductory Guidance on the CLP Regulation [2], a lithium ion battery cell should be considered an article, not a substance and is therefore not covered by CLP regulations.

A thermal run-away, and subsequent toxic gas release, is a rare event and should not be considered the basis for an “Intended release of substances from articles” requiring regulation of the substance released. For the purpose of this document such a scenario is considered to assess whether a reasonably foreseeable release of toxic gas would exceed the limits of the COMAH regulations. As per publicly available MSDS for hydrogen fluoride [3] it should be treated as a category I toxic substance and therefore as per COMAH regulations [4] there should be no more than 5 tonnes present on site at any time.

Available literature based on physical testing of LFP battery cell fires suggests an upper limit on hydrogen fluoride generated in a thermal runaway event of 200g/kWh [5]. Applying this proportionality factor to the current offering of RES’s preferred supplier, a 20ft container rated to 5MWh, this suggests a potential for 1 tonne of hydrogen fluoride being produced in the event of a thermal run-away event affecting all cells within a container. Therefore COMAH regulations should only be applied if a credible scenario can be found where all cells within 5 containers will combust simultaneously.

## 2 Mitigations

### 2.1 Control System

All battery containers are equipped with multiple levels of control to keep cells operating within a safe operating range, including monitoring of individual cell temperatures and voltages to protect against electrical abuse in normal operation. Being a containerised system the cells are also protected from physical abuse, the other major initiator of thermal runaway. This ensures that the risk of a thermal runaway in normal operation is low, and will be primarily due to defects introduced at the cell manufacturing stage, which are minimised via quality control requirements and supplier selection. Therefore the chance of a cell going into runaway independently is significantly reduced.

### 2.2 Physical Propagation Testing

As part of the UL9540 certification process a physical test, where thermal runaway was induced in a single module by externally heating a cell within it using a resistive heater, controlled to a rate of between 4°C & 7°C a minute. This module is installed in a rack positioned next to other populated racks, representative of installation in a battery storage enclosure. This test is conducted to prove that the system has been appropriately designed to prevent the propagation of a thermal run-away event within a battery storage enclosure. The unit level UL9540A test reports of RES preferred suppliers advise that in the event of a thermal run-away event initiated at a single module, this would not propagate to either neighbouring modules in the same rack, or to modules in neighbouring racks, the full performance criteria for this test are:

- Target BESS temperature less than cell surface temperature at gas venting, and meets heat flux limits for means of egress.
- Temperature increase of target walls less than 97°C (175°F)

- No explosion hazards exhibited by product.
- No flaming beyond outer dimensions of BESS unit (indoor, wall mount)

It is therefore considered very unlikely that even in the event of a thermal runaway the whole container would be affected and would most likely be confined to a single module.

## 2.3 Fire Propagation Resistance

RES best practice specifies each battery storage enclosure shall be fitted with FD90 fire-resistant doors, meaning that in the event of a thermal run-away incident heat-flux generated would be significantly reduced beyond the initiating container. The 3m separation distance between adjacent rows of containers, as per RES standard layout guidelines, will ensure that any heat leaving the container will be further reduced and unlikely to affect the cells within the neighbouring container given the better thermal stability of LFP cells compared to other lithium chemistries.

Where spacing between two containers is reduced below 3m to achieve improved energy density via a “back-to-back” configuration these multiple containers may be assessed as a single unit in a fire event. In this scenarios the maximum release volume from a single thermal run-away event should be considered as 2 tonnes.

## 3 Conclusion

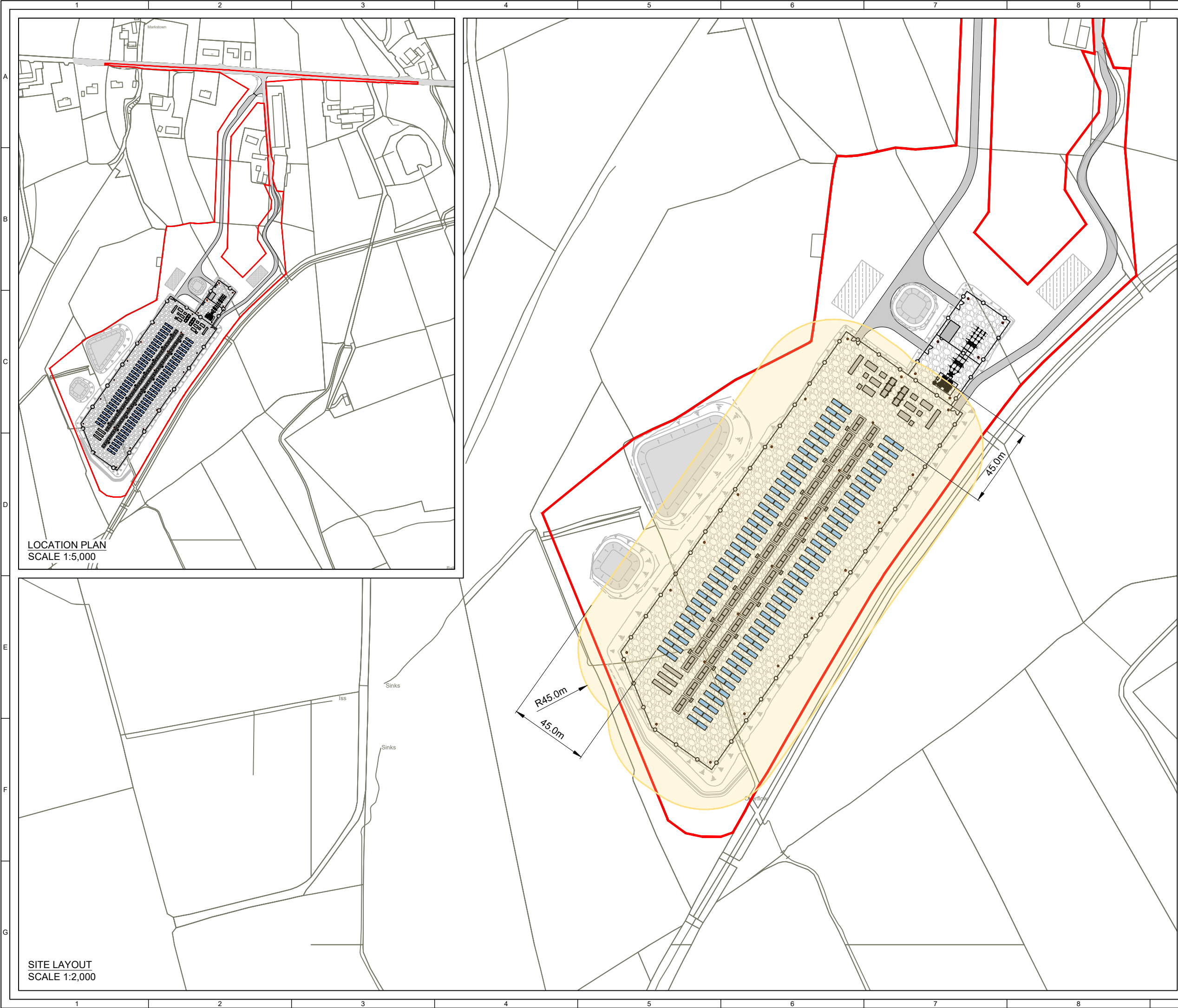
As per the information supplied above 5 battery storage containers (or 3 units in a back-to-back configuration) would need to undergo thermal run-away, with all cells within each container being affected, to generate the quantity of hydrogen fluoride gas required to make COMAH regulations applicable. Based on the multiple layers of protection summarised in section 2 this is not deemed a credible scenario and therefore COMAH regulations should not apply for projects utilising the proposed system configuration.

## 4 References

Number	Title	Source
1	Guidance on Requirements for Substances in Articles	ECHA, Version 4.0, June 2017
2	Introductory Guidance on the CLP Regulations	ECHA, Version 3.0, January 2019
3	Safety Datasheet – Hydrogen Fluoride	Airgas, Version 0.05, November 2018
4	The Control of Major Accident Hazards Regulations	HSE, 3 <sup>rd</sup> Edition, June 2015
5	Toxic Fluoride Gas Emissions from Lithium-ion Battery Fires	Scientific Reports, F. Larsson et al. Volume 7, Art. Nr. 10018, August 2017

## Appendix F Toxic Cloud Assessment





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KEY:

- DEVELOPMENT BOUNDARY (OUTSIDE OF LINE DENOTES BOUNDARY)
- PALISADE, WELDMESH OR ACOUSTIC FENCE
- BATTERY STORAGE ENCLOSURE (BSE)
- OTHER INFRASTRUCTURE
- GRAVEL OR ASPHALT FINISH TO SUIT DETAILED EARTHING DESIGN
- HYDROGEN FLUORIDE TOXICITY LIMIT

NOTES:

- DRAWING TO BE READ IN CONJUNCTION WITH REF. [1].
- ASSESSMENT IS BASED ON DISPERSION MODELLING OF HF GAS RELEASE OF 1,000kg PRODUCED FROM ANY INDIVIDUAL BSE, OVER A PERIOD OF 30 MINUTES.
- EXTENT OF BOUNDARY BASED ON SLOT LEVELS, AS DEFINED BY HSE, AND ASSUMING AN EXPOSURE DURATION OF 30 MINUTES (400ppm).
- NO TOPOGRAPHIC FEATURES HAVE BEEN FACTORED INTO THIS ASSESSMENT.
- ALTHOUGH BASIS OF ASSESSMENT IS REPRESENTATIVE OF THE PROPOSED BESS SYSTEM, THIS ANALYSIS SHOULD BE TREATED AS PRELIMINARY.

REFERENCES:

- [1] INFRASTRUCTURE LAYOUT - 05446-RES-LAY-DR-PT-001



1	BM	AP	DR	2025-06-19	First Issue
ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
PURPOSE					COORDINATES
PLANNING					TM65 IRISH GRID
SCALE					DATUM
AS SHOWN @A3					N/A
LAYOUT DRAWING					T-LAYOUT NO
N/A					N/A

PROJECT TITLE  
BALLYROSS

DRAWING TITLE  
POTENTIAL TOXIC GAS CLOUD EXTENTS

RES DRAWING NUMBER  
05646-RES-LAY-DR-PE-003

REV  
1

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## Appendix G Explosion Over-pressure Assessment



