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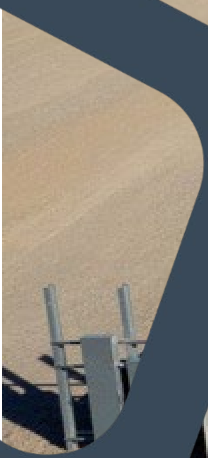
FOIGHA BATTERY ENERGY STORAGE SYSTEM

Outline Battery Safety Management Plan



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1.0	Draft for client review	18/06/2026	Shali Pavithran	Murray Urquhart	Fabio Fantozzi
2.0	Final for Issue	26/06/2026	Shali Pavithran	Murray Urquhart	Murray Urquhart

Acronyms & Abbreviations

AC	Alternating Current
AHJ	Authority Having Jurisdiction
ALARP	As Low As Reasonably Practicable
BESS	Battery Energy Storage System
BMC	Battery Management Controller
BMS	Battery Management System
BMU	Battery Management Unit
BS	British Standard
BSC	Battery System Controller
BSMP	Battery Safety Management Plan
CCR	Combustible concentration reduction
CCTV	Close Circuit Television
CFD	Computational Fluid Dynamics
CMU	Cluster Management Unit
CO	Carbon Monoxide
CSA	Canadian Standards Association
DC	Direct Current
EES	Electrical Energy Storage
EN	European harmonised standard
EPA	Environmental Protection Agency
ERP	Emergency Response Plan
ESMS	Energy Storage Management System
ESS	Energy Storage System
FACP	Fire Alarm Control Panel
FI	Further Information
FMEA	Failure modes and effects analysis
FRMP	Fire Risk Management Plan
FRS	Fire and Rescue Service
FSS	Fire Suppression System
HMA	Hazard Mitigation Analysis
HV	High Voltage
HVAC	Heating, ventilation, and air conditioning
IEC	International Electrotechnical Commission
IET	Institution of Engineering and Technology
IP	Ingress Protection
LEL	Lower Explosive Limit
LFL	Lower Flammability Limit
LFP	Lithium Iron Phosphate
LSFT	Large Scale Fire Testing
LV	Low Voltage
MW	Megawatt
NFCC	National Fire Chiefs Council
NFPA	National Fire Protection Association
NMC	Nickel Manganese Cobalt

OBSMP	Outline Battery Safety Management Plan
PCS	Power Conversion System
RGP	Relevant Good Practice
SDS	Safety Data Sheet
TRPP	Thermal runaway propagation protection
TS	Transmission Solutions
UL	Underwriters Laboratories
VOC	Volatile Organic Compound

HOLD Register

This is a live document as several decisions have not yet been made or cannot be made without input from the wider project team or external parties. To facilitate the development of this plan, the below HOLDs have been identified and will be closed out during future revisions of this document.

HOLD ID	Description	Relevant section of this document
HOLD 1	This section is to be updated following engagement with the local FRS to reflect their advice on the proposed BESS design, including firefighting access, water supplies, firefighting provisions, spacing and the firefighting strategy.	**Section 4.1**

Table of Contents

1 Introduction

1.1 Background

This Outline Battery Safety Management Plan (OBSMP) for the Foigha Battery Energy Storage System (BESS) project (Foigha) has been prepared by Cairn Risk on behalf of BayWa r.e. Ireland Ltd (BayWa).

Foigha Solar Farm Limited, a subsidiary of BayWa, is progressing the Foigha project in County Longford. Planning permission for the project was granted was granted by Longford County Council on 29 September 2025. This decision was subsequently appealed to An Coimisiún Pleanála, who issued a request for further information in relation to the BESS element of the project, including fire risk management, emergency response arrangements and firefighting water/firewater run-off management. Further detail on this request is provided in **Section 4.2**.

The Project is intended to contribute to Ireland's renewable energy targets by supporting increased renewable electricity generation and local energy self-sufficiency. The BESS will form part of the wider Foigha renewable energy development and will support the storage and management of electricity associated with the project. The available technology information reviewed for this OBSMP indicates that the proposed BESS is based on the Sungrow PowerTitan 2.0 liquid-cooled energy storage system.

The BESS has been developed in line with relevant good practice (RGP) to address hazards to people and the environment, proportionate to the current maturity of the design. RGP applicable to the development includes:

- The UK National Fire Chiefs Council (NFCC) publication *Grid scale energy storage system planning - Guidance for fire and rescue services [2]*
- NFPA 855, Standard for the Installation of Stationary Energy Storage Systems (2026) [3]

Following this RGP addresses the significant hazards associated with grid-scale BESS installations, including thermal runaway, fire, explosion, toxic gas release, firefighting water run-off and environmental impacts.

This OBSMP is focused primarily on the operational phase of the BESS. However, the site design should continue to support safe construction, commissioning, maintenance and decommissioning.

1.2 Purpose

The OBSMP outlines how the Foigha BESS will be located, designed and operated to manage the safety and environmental hazards associated with the facility. It provides the basis for demonstrating that the hazards introduced by the BESS and its surrounding environment are understood, and that appropriate measures are being taken to prevent and mitigate those hazards.

The OBSMP shall demonstrate that the Foigha BESS is being developed in line with the principles outlined in the NFCC guidance [2]:

- Effective identification and management of hazards and risks specific to the siting, infrastructure, layout, and operations at the facility.
- Siting of renewable energy infrastructure to eliminate or reduce hazards to emergency responders.
- Safe access for emergency responders in and around the facility, including to renewable energy and firefighting infrastructure.
- Provision of adequate water supply and firefighting infrastructure to allow safe and

effective emergency response. This could include the provision of water to allow for defensive firefighting to protect surrounding infrastructure.

- Siting and management of vegetation to avoid increased wildfire risk.
- Prevention of fire ignition on-site that could spread to BESS and associated infrastructure (for example, inverters, switchgear, and transformers).
- Prevention of fire spread between site infrastructure (for example, solar panel banks, wind turbines, battery containers/enclosures, transformers, inverters, and switchgear).
- Prevention of external fire impacting and igniting site infrastructure.
- Provision of accurate and current information for emergency responders during emergencies.
- Effective emergency planning and management, specific to the site, infrastructure, and operations.

At this stage of project development, the design is not at a stage of maturity to have all risk reduction measures defined and implemented. As such, this OBSMP shall also guide BayWa in what must be done in the detailed design and operational phases of the project to reduce risks to ALARP, guided by RGP and latest knowledge of BESS safety hazards. It can be used as a guide to developing an operational BSMP to provide all relevant stakeholders with key safety-related information about the BESS once the facility is operational.

2 Foigha BESS

2.1 Site overview

The Foigha Solar Farm and Battery Energy Storage project, as shown in **Figure 1,** is proposed on an approximately 130 ha site in County Longford, Ireland, within the townlands of Cornacarta, Doonacurry, Foygh, Kilcommock Glebe, Ledwithstown and Tirlickeen. The development comprises a solar farm, substation, BESS, and underground cable connection to the existing Lanesboro-Mullingar overhead line, with the BESS located within a smaller dedicated area of the overall project site, as shown in **Figure 2**.

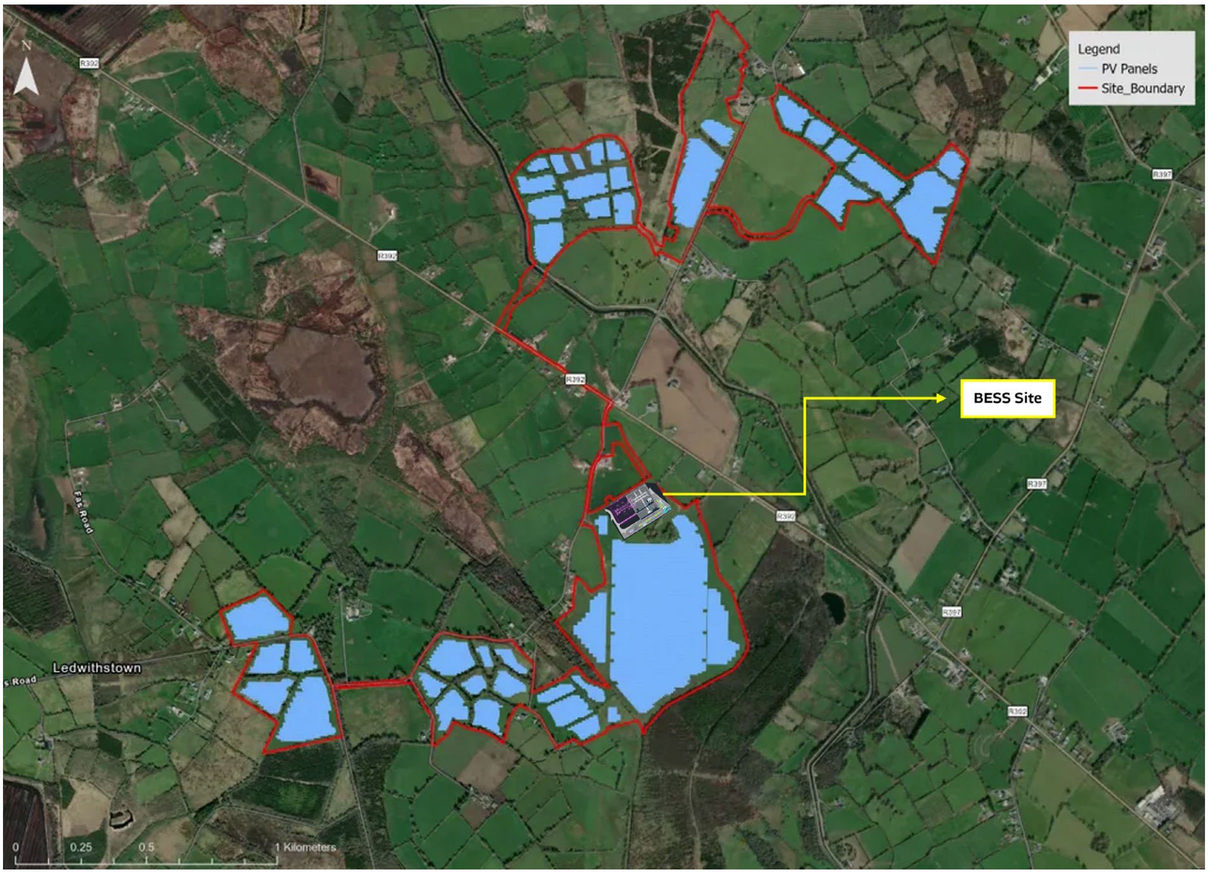


Figure 1: Foigha Location Plan

The BESS compound is located adjacent to the project substation and associated electrical infrastructure. The substation is shown at the northern edge of the southern land parcels, with the BESS units located primarily along the southern and eastern areas of the substation (see **Figure 2**). The battery units are arranged in multiple rows within the BESS compound. Power Conversion System (PCS) units and auxiliary transformer stations are located adjacent to the battery units to support power conversion and connection of the BESS to the wider electrical infrastructure.

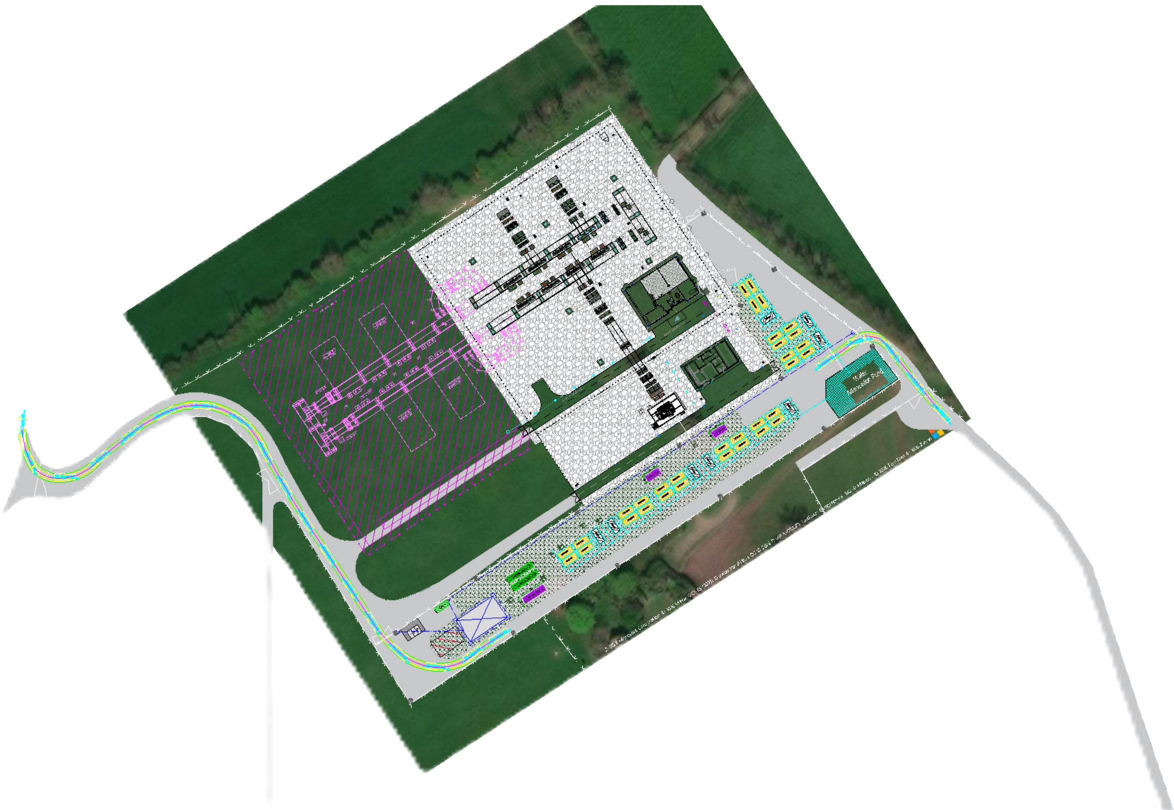


Figure 2: Foigha BESS Layout

2.2 Battery Specification

The battery system proposed for the Foigha BESS is the Sungrow PowerTitan 2.0 Liquid Cooled Energy Storage System, one of Sungrow's ST5015UX model series, shown in **Figure 3**. The PowerTitan 2.0 is a containerised lithium iron phosphate (LFP) (a subset of lithium-ion batteries) battery system intended for grid-scale energy storage applications.

Figure 3: Sungrow PowerTitan 2.0 BESS

Table 1: ST5015UX system parameters

Parameter	Description / value	Units
Cell cathode material	Lithium iron phosphate	-
Cell anode material	Graphite	-
Cell nominal voltage	3.2	V
Cell nominal capacity	314	Ah
Battery configuration	416S12P	-
Battery storage capacity	5,015	kWh
Battery DC voltage range	1123.2 to 1497.6	V
Battery nominal AC voltage	690	V
Enclosure dimensions (L x W x H)	6058 × 2896 × 2438	mm
Battery mass	42,500	kg
Ingress protection (IP) rating	IP55	-
Anti-corrosion class	C4	-
Operating temperature range	-30 to 50	°C

The PowerTitan 2.0 system uses intelligent liquid cooling to support battery temperature control and system performance.

Battery monitoring and protection are provided through the PowerTitan 2.0 Battery Management System (BMS), which consists of three layers: Battery Management Unit (BMU), Cluster Management Unit (CMU) and Battery System Controller (BSC). The BMS monitors cell voltage, system voltage, cell temperature, ambient temperature and current, with cell voltage sampling periods of up to 100 ms and cell temperature sampling periods of 1 second at BMU level.

Each PowerTitan 2.0 battery container includes integrated fire and gas safety systems. The standard package includes:

- Smoke detection
- Heat detection
- Flammable gas detection
- Fire alarm control panel
- FK5112 fire suppression
- Sounder beacon
- Alarm bell
- Warning signage
- Extinguishant abort button
- Emergency ventilation system
- Pressure relief port
- Manual/automatic switching and emergency starting device.

Sungrow also offers optional sprinkler protection, aerosol suppression and explosion vent panels.

These optional systems shall only be treated as part of the Foigha battery design when confirmed in the final installed configuration.

The PCS units of the Foigha BESS are to be the Sungrow SC210HX model. The SC210HX is a liquid-cooled, transformer-less PCS with a maximum DC voltage of 1500 V, a DC operating range of 1000 V to 1500 V, nominal AC voltage of 690 V, IP66 protection and grid support functions including active and reactive power control, voltage and frequency support.

For the purposes of this OBSMP, it is assumed the Sungrow PowerTitan 2.0 ST5015UX will be installed at the Foigha BESS. The final installed configuration, number of battery containers, total installed capacity, optional safety systems and project specific control logic should be confirmed as the Foigha design develops.

3 Relevant Good Practice

Relevant standards, guidance and good practice documentation that should be followed in the design and operation of the Foigha BESS includes, but not is limited to:

1. UL 9540, Standard for Energy Storage Systems and Equipment
2. UL 9540a, Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems
3. UL 1973, Batteries for Use in Stationary and Motive Auxiliary Power Applications, Edition 3 (2022)
4. IET, Code of Practice for Electrical Energy Storage Systems, 3rd Edition (2024)
5. IEC 62933-5-2:2025, Safety requirements for grid-integrated EES systems — Electrochemical based systems (and other relevant standards from the IEC 62933 series)
6. National Fire Protection Agency (NFPA) 855 (United States of America), Standard for the Installation of Stationary Energy Storage Systems, 2026 Edition
7. United Kingdom Power Networks (UKPN) Engineering Design Standard 07-0116: Fire Protection Standard for UK Power Networks Operational Sites, 2016
8. DNV GL-Recommended Practice-0043: Safety, Operation and Performance of Grid-Connected Energy Storage Systems, 2017 (amended 2021)
9. IEC 61936-1:2021, Power installations exceeding 1 kV AC and 1,5 kV DC – AC
10. IEC 62443, Industrial communication networks - Network and system security
11. The Waste Batteries and Accumulators Regulations 2009
12. National Fire Chiefs Council, Grid scale energy storage system planning - Guidance for fire and rescue services, 2026
13. IEC 61508 Functional Safety of electrical/electronic/programmable electronic safety-related systems
14. BS EN 16009:2011 Flameless Explosive Venting Devices
15. BS EN 14373:2021 Explosion Suppression Systems
16. BS EN 14797:2007 Explosion Venting Devices
17. NFPA 68, Standard on Explosion Protection by Deflagration Venting, 2023 Edition
18. NFPA 69, Standard on Explosion Prevention Systems, 2024 Edition

Whilst this list presents the latest good practice at the time of writing, BayWa will continue to review standards, regulations, and manufacturer's guidelines to ensure that the design meets latest good practice.

4 Consultation

4.1 Fire and Rescue Service [HOLD 1]

Engagement with the local Fire and Rescue Service (FRS) is essential in the development of large-scale projects involving BESS. This engagement is for the benefit of both parties and has the objectives of:

- Ensuring that the Foigha project team understands the provisions that local FRS requires to contain a lithium-ion battery fire and these have been incorporated in the design. This includes but is not limited to:
  - Volume of firewater stored in water tanks provided to provide boundary cooling of assets adjacent to the fire and the location of the hose tie-in points or hydrants;
  - Access roads and routes suitable for fire engines, accounting for all foreseeable wind directions;
  - Site layout, ensuring there are safe locations for first responders to locate themselves in the event of a battery fire, considering all foreseeable wind directions and potential blast radii around battery containers.
- Ensuring that local FRS are familiar with lithium-ion battery fires and that they are comfortable and competent in how to safely contain a battery fire;
- Agreeing the spacing between battery containers is sufficient in preventing propagation of fire and allowing access/egress in the event of a fire.
- Agree a firefighting strategy in consideration of Emergency Response Plans to be agreed prior to construction.

The NFCC guidance on grid-scale BESS states the following regarding consultation with the local FRS:

Section 4 – Planning approval process:

The UK government's planning practice guidance for renewable energy encourages both planners and developers to engage with the local fire and rescue service when planning new sites. As such, fire and rescue services should be part of early conversations regarding BESS proposals. This should continue throughout the development and into the operational phase.

Through engaging at the pre-planning or planning stage, fire and rescue services may be able to give advice about the design and layout of the site to aid operational pre-planning.

and in Section 6 - System design, construction, testing and decommissioning:

Fire and rescue services should seek to obtain as much information as possible at the earliest opportunity to enable an initial appraisal of the BESS. It is the responsibility of the applicant / developer / designer / manufacturer to provide this information to the fire and rescue service. Additionally, they must provide the fire and rescue service with appropriate evidence to support any claims made on performance, and cite appropriate standards for installation.

BayWa looks to engage with the local FRS, who will be issued this OBSMP, to discuss all of the above any will make amendments to the design and/or firefighting arrangements based on advice from the FRS.

4.2 An Coimisiún Pleanála

In a letter dated 27 February 2026, An Coimisiún Pleanála issued a letter to HWP Planning [4], working on behalf of BayWa for the development, regarding an appeal that had been submitted against the planning permission previously granted to the development in September 2025.

Regarding this appeal, An Coimisiún Pleanála stated:

The Commission has examined the appeal and is of the opinion that certain information is necessary for the purpose of enabling it to determine the appeal.

In accordance with section 132 of the Planning and Development Act 2000, (as amended), you are required to submit, on or before 26th August 2026, the following information:

Battery Energy Storage Systems (BESS)

1. *The Commission notes that Battery Energy Storage Systems (BESS) are a relatively new technology and that emergency responders are learning from actual incidents that have occurred at both Lithium-ion and Lithium-ion battery storage facilities. The Commission further notes that water is the agent of choice in the event of an incident to extinguish fires and to control thermal runaway, and that BESS facilities may carry a risk of explosion. A key environmental consideration during a thermal runaway fire is the run-off of fire water into surface and groundwater networks. The EPA's Guidance on Retention Requirements for Firewater Run-off defines "firewater" as the liquid that arises from water, foam, rainwater, or other substances that have been used for firefighting purposes, and are therefore likely to contain polluting matter, particularly arising from them having come into contact with combustion products. The Guidelines also outline that firewater arising from a fire incident typically contains high concentrations of substances which are harmful to the aquatic environment, and if it is allowed enter soil, drains, or watercourses in an uncontrolled manner, it has the potential to cause significant environmental damage.*

   In this regard, you are required to submit the following information:

   a. *The submitted Fire Safety Statement is noted however further detail is required in the form of a Fire Risk Management Plan (FRMP). The FRMP should be prepared by a suitably qualified technical expert / advisor and set out preventative measures for potential causes of fire hazard and evaluate the associated risk of same. It should also include specific measures to reduce the risk of fire occurring onsite including, for example, the safe storage and maintenance of flammable substances and materials, the intended method(s) of extinguishment, and the installation of fire safety equipment and apparatus (fire alarms, detection systems, methods of suppression, etc.). The FRMP should explicitly demonstrate how the potential risk of a fire occurring on the site would be addressed and minimised.*

   b. *Further detail is required in the form of an Emergency Response Plan (ERP). The ERP should be prepared by a suitably qualified technical expert / advisor. It should outline a reactive strategy with clear procedures to follow in the event of a fire, detailing the specific actions the facility operator must take to respond quickly and effectively in the event of fire or similar emergency.*

   c. *Firefighting Water / Fire Water Storage*

      i. *Details of the quantity and confirmation of how firefighting water will be sourced and/or retained within the proposed development site. This should be to the UK National Fire Chiefs Council (NFCC) Grid Scale Battery Energy Storage System Planning – Guidance for the FRS (Fire & Rescue Services) which states that provision should be made for BESS units to provide 1,900 litres of water for 2 hours, as a minimum, unless it can be demonstrated hat another amount is appropriate. Revised drawings and necessary arrangements are to be provided to demonstrate feasibility of same.*

      ii. *You shall submit a detailed methodology for fire water storage management along with any proposed mitigation measures (e.g., drainage systems,* *interceptors, bunded lagoons, etc.). Such measures shall be included in the ERP, as referred to in Item 2 above.*

iii. Drainage proposed designed to manage rainfall runoff and fire water runoff, with associated calculations to be informed by the anticipated fire water requirements from the proposed development. Having regard to the location of the battery energy storage system proximate to the Kiltaffrey Stream to the east, and associated flood risk identified in the submitted site-specific flood risk assessment, and in this context, having regard to the need for large quantities of water in the event of a fire / thermal runaway event, drainage proposals shall include details to demonstrate that suitable catchment, containment and on-site treatment measures would be in place for firewater runoff and other potential firefighting substances (such as foam) and also details of any mitigation necessary to ensure that there will be no contamination of surface or groundwater, and that consideration has been given to potential downstream impacts.

f. Having regard for the need for large quantities of water in the event of a fire, you should liaise with Longford County Council and Uisce Eireann in relation to any proposed connection to the public water supply. The capacity of the public water supply to service the proposed development in line with FI request no. 1 (c) above should be ascertained, and any resultant adverse impacts on public water supplies for nearby settlements should be assessed.

Note: there were further items in the letter from An Coimisiún Pleanála, but only those related to the scope of this document and the accompanying Emergency Response Plan (ERP) were included in the summary above.

In response to the letter from An Coimisiún Pleanála, this document has been prepared to address all concerns related to the hazards posed by the proposed BESS, including how thermal runaway and fire events shall be prevented, their effects mitigated, the provision of firefighting equipment/supplies on site, and how any firewater run-off will be contained to protect surrounding environmental receptors.

Cairn Risk has also prepared an outline ERP [5] which outlines how a thermal runaway / fire event will be responded to, including the responsibilities of relevant stakeholders and the proposed firefighting strategy to be adopted by the local FRS.

4.3 Other

Cairn Risk is not aware of any other consultation responses received from other stakeholders or statutory consultees that have raised concerns that are addressed in this OBSMP.

5 Foigha Energy Storage Hazards

5.1 BESS Hazards

The main hazards introduced by BESS are associated with **thermal runaway**. As illustrated in **Figure 4**, thermal runaway may be initiated by thermal, electrical, mechanical, environmental stresses, or by cell/system faults: the abuse triggers exothermic reactions, producing large volumes of gas and heat. Eventually, the heat is produced faster than it can dissipate and the exothermic reactions become self-sustaining and the cell is in uncontrolled positive thermal feedback - "thermal runaway". The gases typically include up to 50% hydrogen, c.a. 20% carbon monoxide, carbon dioxide, methane and propene, as well as toxic chemicals. The cell can then heat up adjacent cells and send them into thermal runaway – a cascade effect called "thermal propagation". The gases inside the cells will vent to the outside taking with them droplets of the organic electrolyte to form a "vapour cloud", with the following consequences:

- **Fire**, including localised fire within a unit and fire spread to adjacent equipment or vegetation;
- **Explosion**, where flammable gases accumulate and ignite, resulting in overpressure and explosion hazards;
- **Smoke/toxic gas dispersion**, which may affect nearby personnel, emergency responders, neighbouring receptors and the wider environment; and
- **Toxic liquid release**, including contaminated firewater or other run-off affecting surrounding land and watercourses.

Figure 4 provides a summary of the main BESS hazard pathways and potential consequences.

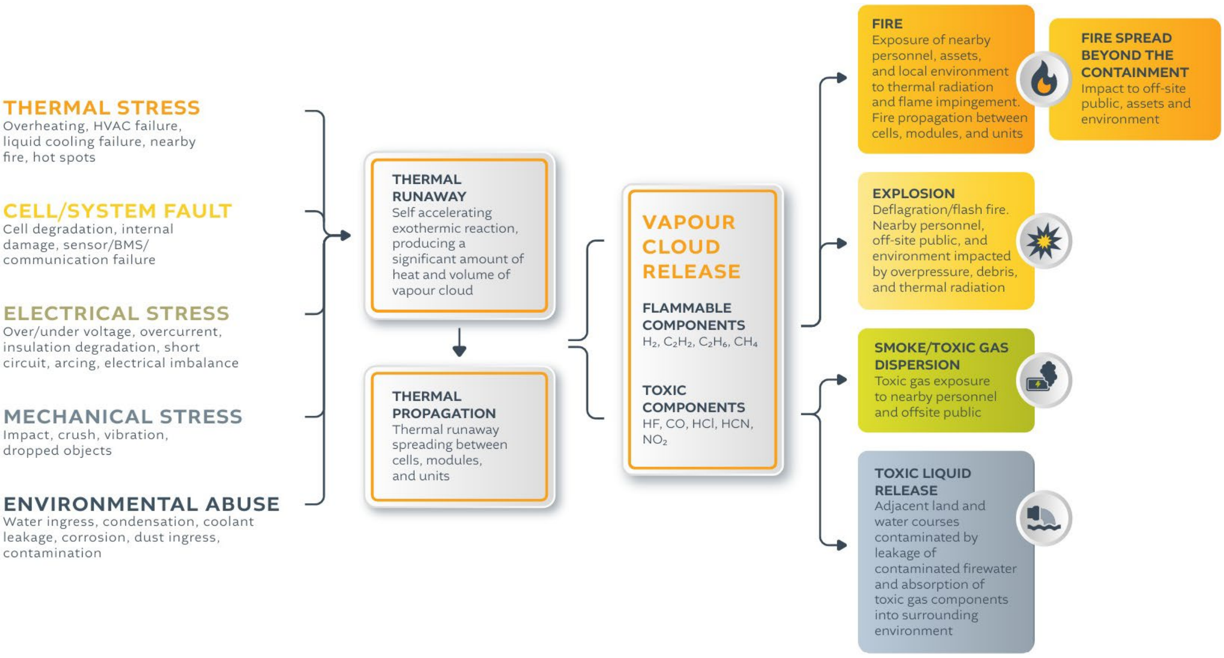


Figure 4: BESS Hazard Pathway

The other significant hazard associated with batteries is electrocution. This can be caused by the same issues highlighted against Electrical Fault above, as well as factors such as improper isolation prior to working on equipment and access to BESS containers by unauthorised personnel.

The primary goal is to prevent hazardous situations from arising, before focusing on mitigating the associated consequences. The means of preventing and mitigating the hazards outlined in

Figure 4, both through the siting and design of the facility and design of the proposed batteries, are described in the following sections of this plan:

- Thermal runaway
    - Prevention – see **Section 6.3.1**
- Fire
    - Prevention – see **Section 6.4.1**
    - Mitigation – see **Section 6.4.2**
- Explosion
    - Prevention – see **Section 6.5.1**
    - Mitigation – see **Section 6.5.2**
- Toxic gas dispersion
    - Prevention – see **Section 6.6.1**
    - Mitigation – see **Section 6.6.2**
- Toxic liquid release
    - Prevention – see **Section 6.7.1**
    - Mitigation – see **Section 6.7.2**

6 BESS Hazard Management

The following section describes what has been done and what will be done in ensuring the BESS is developed to reduce safety and environmental risks to a tolerable level.

6.1 Compliance Review

The Foigha BESS facility was assessed against the following standards and relevant good practice guidance to confirm if the installation can safely exist at the proposed location and current configuration:

1. National Fire Protection Association (NFPA) 855 (Standard for the Installation of Stationary Energy Storage Systems) [3];
2. National Fire Chiefs Council (NFCC), Grid scale energy storage system planning - Guidance for fire and rescue services [2];

The above documents were selected as the basis of assessment due to their considerations of site location and design which, in the absence of a detailed design and selected technology, is the key focus in the early development stages.

The UK NFCC guidance, whilst not directly applicable in Ireland, is widely recognised as good practice in BESS facility design and operational preparedness and alignment with this guidance has been directly requested by An Coimisiún Pleanála [4] (see **Section 4.2**).

Whilst NFPA 855 is a USA standard, it is widely recognised globally as relevant good practice. The assessment against NFPA 855 was limited to Chapters 4, 5, 7, and 9 and specifically paragraphs relating to outdoor electrochemical BESS.

This compliance review does not constitute a detailed risk assessment. Instead, it aims to give an overview which requirements are complied, partially complied, or not complied with. Based on this findings, Cairn Risk has highlighted which design aspects require further consideration or amendment to meet the requirements.

6.1.1 Primary and Secondary Safety Issues

To ensure proportionate time and effort were dedicated to risk management in the early stages of development, an approach was taken which separates “Primary” and “Secondary” safety issues.

Primary safety issues are those which are fundamental to demonstrating that the proposed facility will be safe in its planned location. They require specific risk management attention in the pre-consent phase to demonstrate that there are no “show-stoppers” (i.e., hazards that cannot be eliminated or their risk reduced to a tolerable level through design changes, which would deem the safe development of the project unfeasible at the proposed location). Post-consent, design updates relating to primary safety issues must not fundamentally alter the risk profile, such as relocating batteries closer to occupied buildings.

Secondary safety issues are not fundamental to the safety justification of the project at this stage, and the design may not be mature enough to demonstrate they have been addressed, so there is not a specific requirement to resolve them to inform a consenting decision. However, there is an action plan for these issues to be addressed through the detailed design phase, as illustrated in **Figure 5**.

Only primary safety issues have been assessed in detail in this OBSMP, with compliance against applicable requirements noted in **Section 6.1.2**.

See **Appendix 1** for a table listing all secondary safety issues, which must be addressed at detailed design stage.

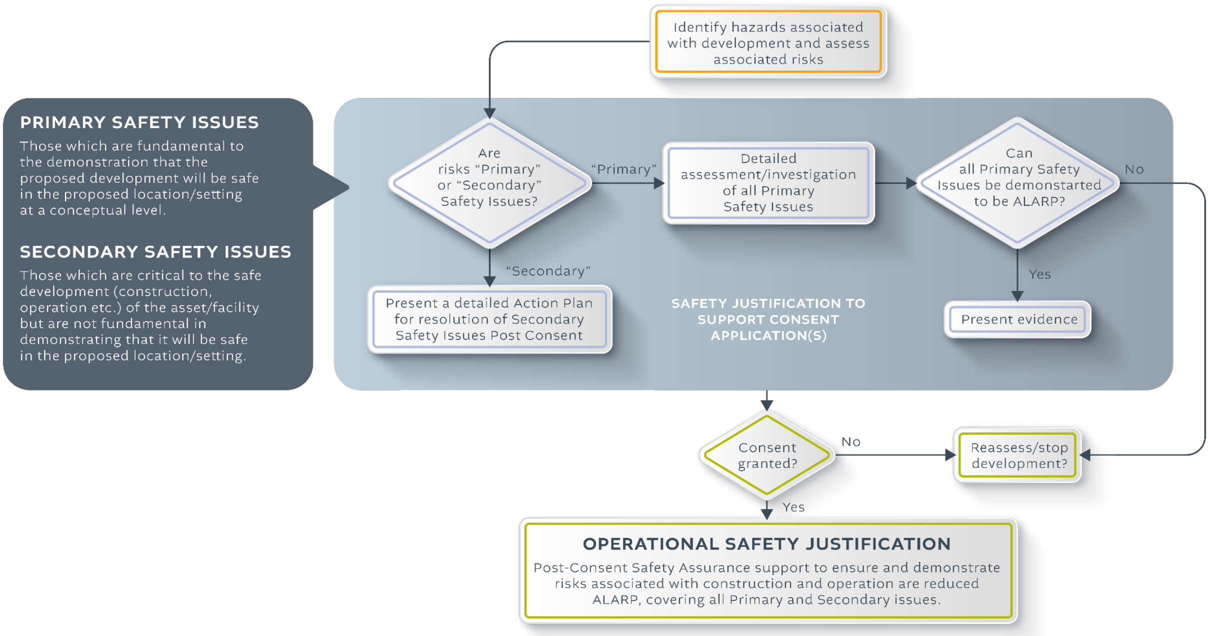


Figure 5: Safety assurance approach for development projects

6.1.2 Findings

This section summarises the findings of the compliance review against Primary safety items, with compliance against requirements of NFPA 855 and the NFCC guidance outlined in **Table 3** and **Table 4**, respectively. The justification column in each table sets out the basis for the finding using the current design information and proposed technology specification.

Where the review has found items to be in the "partially compliant", "TBC", or "not yet compliant" categories, BayWa should assign an owner to ensure that the criteria are met. Where these items relate to primary safety issues, ensuring compliance should be treated as priority. Where these items relate to secondary safety issues, they should be addressed in the detailed design of the facility, or at the latest prior to the BESS being commissioned and handed over to operations.

Table 2: Compliance Criteria

Compliance Category	Description
Compliant	The BESS hazard management arrangements meet or exceed the assessment criteria.
Partially compliant	The BESS partially meets the assessment criteria and further action may be required to align with standards, guidance, and to reduce risk ALARP.
TBC	Insufficient information was available during this assessment to conclude whether the criteria has been met, or the design is not detailed enough (i.e., required supporting evidence has not yet been produced).
Not yet compliant	The BESS does not meet the assessment criteria and changes are required.

6.1.2.1 NFCC Guidance Assessment Findings

Table 3 summarises the findings of the compliance review against the NFCC guidance [2]. This table is limited to the primary safety issues relevant to the current stage of development and indicates the extent to which the current Foigha BESS design aligns with the principal NFCC expectations that are material to the pre-consent safety justification.

Table 3: NFCC Guidance Assessment Findings – Primary Safety Items

Requirement / Query	NFCC Guidance Section Reference	OBSMP Section Reference	Foigha BESS Compliance	Justification
The UK government's planning practice guidance for renewable energy encourages both planners and developers to engage with the local fire and rescue service when planning new sites. As such, **fire and rescue services should be part of early conversations regarding BESS proposals**. This should continue throughout the development and into the operational phase. Through engaging at the pre-planning or planning stage, fire and rescue services may be able to give advice about the design and layout of the site to aid operational pre-planning.	§4. Planning approval process	**4.1**	**TBC**	Consultation with the local FRS has not yet been completed. The section will require update once FRS advice has been obtained [HOLD 1].
Fire and rescue services should seek to obtain as much information as possible at the earliest opportunity to enable an initial appraisal of the BESS. **It is the responsibility of the applicant / developer / designer / manufacturer to provide this information to the fire and rescue service**. Additionally, they must provide the fire and rescue service with appropriate evidence to support any claims made on performance, and cite appropriate standards for installation.	§6. System design, construction, testing and decommissioning	**4.1**	**TBC**	Consultation with the local FRS has not yet been completed. The section will require update once FRS advice has been obtained [HOLD 1].
What are the assumptions about active firefighting within the emergency response plan, and what measures are in place to reduce the scale of an incident? Are the incident assumptions realistic?	§6. System design, construction, testing and decommissioning	**6.8**	**Compliant**	There will be no active firefighting adopted in an attempt to extinguish a battery container which is already alight. Lithium-ion battery fires are extremely difficult to extinguish because it is necessary to both extinguish the flames and remove enough heat to cool the cells to their core and inhibit thermal runaway. Even if the fire is initially extinguished, reignition is highly likely because either, enough heat has not been removed to inhibit thermal runaway, or water ingress to other cells has initiated further cell failures. Any attempts to extinguish the fire are likely to extend the duration of the incident. Therefore, boundary cooling will be adopted to protect adjacent battery containers and other assets, reducing the likelihood of fire spread. This involves applying a water spray to adjacent batteries and assets to reduce the transfer of heat via thermal radiation. This will be conducted at a safe distance to protect first responders from thermal radiation, ejecta, and explosion overpressures/debris, should post-fire explosions occur. A battery which has ignited will be left to burn itself out. This approach aligns with the emergency response advice for lithium ion and sodium ion batteries in Guide 147 of the 2024 Emergency Response Guidebook (produced by the US Department of Transportation) [6].
What is the role of the fire and rescue service at an incident? Are they realistic? What is the expectation of the fire and rescue service in terms of the fire strategy at a thermal event?	§6. System design, construction, testing and decommissioning	**6.8**	**Compliant**	The fire and rescue service (FRS) will be expected to; 1. Access site via the entrance located upwind of the affected battery. Redundant means of access are provided to account for foreseeable wind conditions. 2. Access firewater hydrants located on site which are upwind of the affected battery. Hydrants are located near the entrances at both the east and west of the site, accounting for foreseeable wind conditions.

Requirement / Query	NFCC Guidance Section Reference	OBSMP Section Reference	Foigha BESS Compliance	Justification
				3. While located at a safe distance (at least 30 m from the affected battery), the FRS shall apply water spray to batteries and other assets adjacent to the battery which is alight. The aim is to provide external cooling and reduce radiant heat transfer. Water spray should only be applied to batteries/assets adjacent to the affected battery container – direct application of water to the affected container is to be avoided as far as is practicable. Only water spray should be applied. Water jets must not be used to prevent potential water ingress into unaffected battery containers, as this may initiate further battery cell failures. Prior to applying any water, the FRS must ensure that the site drainage system has been isolated from the surroundings to prevent contaminated water run-off entering the surrounding environment. 4. The situation shall be monitored for at least 24 hours after the initial fire has subsided, in case reignition occurs. The status of the fire may be assessed using thermal imaging cameras. No FRS personnel are to approach the affected battery until all parties are confident that the situation has subsided. An advisor from BayWa, the organisation overseeing the operation of the facility, and/or Sungrow shall be on site throughout to assist the FRS in the status of the incident.
What is the provision for firefighting access to, around, and within the site?	§6. System design, construction, testing and decommissioning	**6.8**	**Compliant**	There are two separate access roads entering from the east and west of the site, accounting for foreseeable wind conditions, for emergency responders accessing the facility. Within the facility, there is road access throughout and turning circles at both eastern and western ends of the site. Minimum width of the road is greater than 3.7 m and access around the BESS has been assessed via swept path to be suitable for FRS vehicles, in compliance with Approved Document B [7] (part of the UK Building Regulations relative to emergency response access). There are two hydrants located on site, to the eastern and western ends, respectively, which are to be connected to the on-site static water tank. Each hydrant is located greater than 40 m from the nearest battery containers such that first responders can access them without being at an adverse level of risk from fire and explosion effects.
What is the purpose of the water supply provision on site? Is it intended for boundary cooling / defensive firefighting or active suppression?	§6. System design, construction, testing and decommissioning	**6.7**	**Compliant**	Water provided on site is for the purposes of boundary cooling only. This involves applying a water spray to adjacent batteries and assets to reduce the transfer of heat via thermal radiation. This will be conducted at a safe distance to protect first responders from thermal radiation, ejecta, and explosion overpressures/debris, should post-fire explosions occur. A battery which has ignited will be left to burn itself out. This approach aligns with the emergency response advice for lithium ion and sodium ion batteries in Guide 147 of the 2024 Emergency Response Guidebook (produced by the US Department of Transportation) [6].
How will water run-off be managed?	§6. System design, construction, testing and decommissioning	**6.7**	**Compliant**	A water attenuation pond is to be provided on the east side of the site to collect water run-off. The volume of the water attenuation pond is approx. 350 m3. This

Requirement / Query	NFCC Guidance Section Reference	OBSMP Section Reference	Foigha BESS Compliance	Justification
				volume vastly exceeds the minimum volume of firewater required by NFCC (180 m^3). The volume shall be refined in detailed design to align for the maximum volume of firewater expected to be deployed during an incident and account for worst-case flood conditions.
What is the size, quantity, and capacity of each BESS unit?	§6. System design, construction, testing and decommissioning	**2.2**	**Compliant**	Sungrow PowerTitan 2.0 ST5015UX containerised unit, with a nominal capacity of 5,015 kWh and dimensions of 6058 mm × 2896 mm × 2438 mm.
Does the applicant / developer have relevant competence and experience in the field of BESS design and deployment on the scale of the proposed development? If not, do they have access to specialist advisors to support?	§6. System design, construction, testing and decommissioning	**N/A**	**Compliant**	The BayWa team responsible for the design and development of the Foigha have been involved in the successful delivery of many BESS facilities internationally, notably: Pfaffenweiler, Germany. 4 MWh BESS capacity (2022). Kreuth, Germany. 18 MWh BESS capacity (2023). Deisenhausen, Germany. 21 MWh BESS capacity (2024). Scurf Dyke, UK. 16 MWh BESS capacity (2024). Sellingen, Netherlands. 30 MWh BESS capacity (2024). Fekola, Mali. 13.5 MWh BESS capacity (2021). Guajillo, USA. 400 MWh BESS capacity (2025). JVR, USA. 280 MWh BESS capacity (2026).
Demonstrate that the selection battery cells/cell chemistry reduces the likelihood of thermal events occurring and reduces the magnitude of the consequences of a thermal event.	§7. Battery chemistry	**2.2**	**Compliant**	LFP cell chemistry is generally more thermally stable than chemistries such as NMC. UL 9540A unit-level testing showed thermal runaway and cell-to-cell propagation occurred, but no module-to-module propagation, no explosive gas discharge, no external flaming, no flying debris and no electrical arcing. Whilst this does not demonstrate a worst-case scenario and does not assess all failure modes of the cells, it shows a generally good resistance to thermal propagation. Note: whilst LFP cells show greater resistance to thermal runaway in UL 9540A testing, this may be due to the method of inducing thermal runaway being overheating. LFP cells vent and enter thermal runaway at higher temperatures than other li-ion cell chemistries such as NMC. However, the majority of recorded failures in grid-scale BESS have not occurred due to overheating from external sources - common failure modes are internal short circuits and ingress of liquid (water, liquid coolant). Furthermore, LFP cells undergoing thermal runaway produce large volumes of hydrogen (40-50% by volume) and do not generate oxygen, which reduces the likelihood of immediate ignition and increases the likelihood of explosions. BayWa must be aware of the associated risks of LFP cells despite their apparent stability compared to NMC.
Where water-based suppression systems are incorporated, their use should be accompanied by a plan to contain any contaminated fire water run-off.	§9. Suppression systems	**6.7**	**Compliant**	A water attenuation pond is proposed on the east side of the site to collect water run-off, which will be isolated via a one-way shut-off valve automated when fire conditions are detected in any battery on site. The drainage system on site is designed such that all water run-off will be directed to the attenuation pond.
Produce a plan that identifies all sensitive receptors within a 1km radius of the site. This plan should support discussions with planners and other stakeholders regarding site suitability and inform appropriate emergency planning. Any plans created should include a compass rose showing north and the prevailing wind direction.	§10. Explosion control	**6.6.2**	**Compliant**	The nearest residential properties are approx. 174 m from the nearest battery container. Nearest farm building is approx. 248 m from the nearest battery container. Road R392 in 188 m approx. 188 m from the nearest battery container.

<table>
<tr><th>Requirement / Query</th><th>NFCC Guidance Section Reference</th><th>OBSMP Section Reference</th><th>Foigha BESS Compliance</th><th>Justification</th></tr>
<tr><td></td><td></td><td></td><td></td><td>Foigha bar and restaurent is approx. 386 m from the nearest battery container.
Other residences and farmhouses are present in 1km radius of the BESS site, as reported on in the OBSMP.

No receptors are in the immediate vicinity of the BESS are expected to be adversely impacted in the event of a BESS fire. However, as three receptor groups (Residential Properties 9, Residential Properties 10, Main Road - R392) are downwind of the prevailing wind direction, it is recommended to conduct a toxic plume dispersion study to inform detailed emergency response arrangements.</td></tr>
<tr><td>External factors need to be considered in the selection of site location, including proximity of other BESS sites and the risk to the site from surface water flooding or spread from wildfire.
Provide details of assessment of external factors that influenced site location and design.</td><td>§10. Explosion control</td><td>6.2</td><td>Compliant</td><td>Site is located on low-risk agricultural land.

Wildfire has not been identified as a risk at the site location.

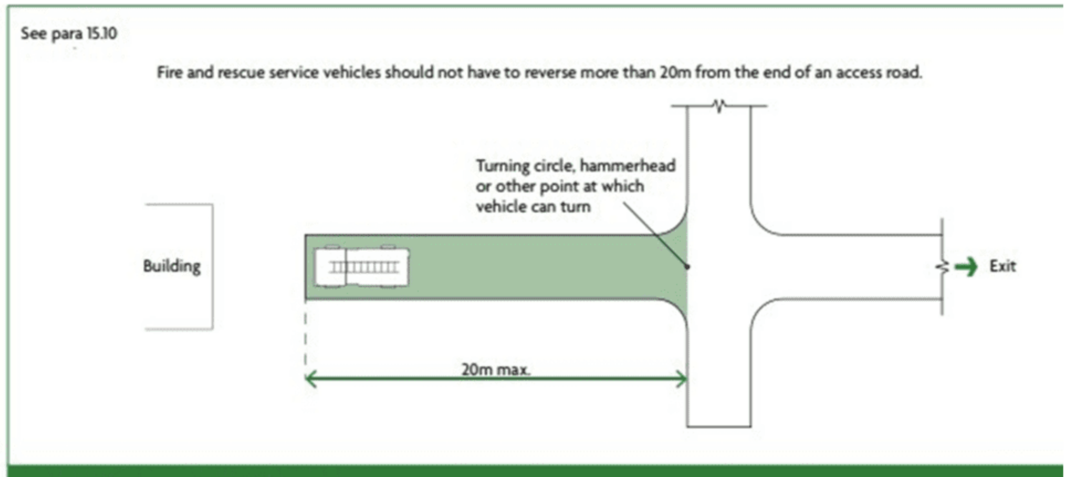
A flood risk assessment has been undertaken for the whole Foigha solar development [8], which does not show that the BESS compound is at risk from surface water flooding and does not show that it would be impacted by a 1 in 1000 year storm.

The flood risk assessment also concluded that the development would not adversely impact the drainage of water on the land being used.</td></tr>
<tr><td>Suitable facilities for safe access and egress to the site should be provided. Designs should be developed in close liaison with the local fire and rescue service, as specific requirements may apply due to variations in vehicles and equipment.
Provide evidence that the local fire and rescue service have reviewed and approved the proposed access arrangements.</td><td>§11. Access</td><td>6.8</td><td>TBC</td><td>Consultation with the local FRS has not yet been completed. The section will require update once FRS advice has been obtained [HOLD 1].</td></tr>
<tr><td>Achieving adequate vehicular access for the fire and rescue service prevents personnel from having to enter the BESS site and drive through a vapour or gas cloud to reach the scene of operation. It is therefore preferable to have an alternative access point, taking account of the likely wind direction.
If the provision of an alternative access point is not practicable, an alternative may be to provide a perimeter 'loop' type of vehicle access around the site.</td><td>§11. Access</td><td>6.8</td><td>Compliant</td><td>Layout has two access roads entering from two sides of the sites for emergency responders in and around the facility, which account for differing wind conditions.</td></tr>
<tr><td>Demonstrate that the design of access roads into and within the BESS align with the requirements of Table 15.2 in and Diagram 15.3 in Approved Document B.

<table><tr><th>Appliance type</th><th>Minimum width of road between kerbs (m)</th><th>Minimum width of gateways (m)</th><th>Minimum turning circle between kerbs (m)</th><th>Minimum turning circle between walls (m)</th><th>Minimum clearance height (m)</th><th>Minimum carrying capacity (tonnes)</th></tr><tr><td>Pump</td><td>3.7</td><td>3.1</td><td>16.8</td><td>19.2</td><td>3.7</td><td>12.5</td></tr><tr><td>High reach</td><td>3.7</td><td>3.1</td><td>26.0</td><td>29.0</td><td>4.0</td><td>17.0</td></tr></table></td><td>§11. Access</td><td>6.8</td><td>Compliant</td><td>Minimum width of the road is greater than 3.7 m and access around the BESS has been assessed via swept path.

Roads are to have a carrying capacity suitable for delivering the battery containers. The battery containers have a mass of up to 42.5 tonnes, so the carrying capacity of roads will be suitable for fire service vehicles.

Site access roads provides for the fire and rescue vehicle reverse and 20 m from the end of an access road.</td></tr>
</table>

Requirement / Query	NFCC Guidance Section Reference	OBSMP Section Reference	Foigha BESS Compliance	Justification
 Diagram 15.3 Turning facilities				
Demonstrate adequate separation between the BESS enclosure/cabinet to ensure that the radiant heat from a thermal event in one BESS enclosure/cabinet will not trigger a secondary event.	§12. Spacing between BESS	**6.4.2**	**Compliant**	Minimum spacing between the BESS is 0.9 m as set out in NFPA 855. Large scale fire testing (LSFT) conducted for the containers, in accordance with the CSA TS-800 methodology, demonstrated that the cells within an adjacent container should not be ignited if the containers are separated by 150 mm. Therefore, a separation of 0.9 m (900 mm) should be sufficient in preventing propagation between containers in the event of a fire. It is noted that the LSFT was conducted in controlled conditions, with wind speeds of up to 3 m/s. As wind conditions on site may be higher than this, which would increase the likelihood of propagation between adjacent containers, increasing the separation between containers from 150 mm to 900 mm helps in mitigating this risk.
NFCC does not support vertical stacking arrangements of containers or BESS cabinets/enclosures. This is because stacking elements on top of each other increases the level of risk in terms of vertical fire spread between the BESS, fire loading, and difficulty in gaining access. Confirm there will be no vertical stacking of containers or BESS cabinets/enclosures.	§12. Spacing between BESS	**6.4.2**	**Compliant**	There shall be no vertical stacking of BESS containers / cabinets / enclosures.
Distances between BESS cabinets/enclosures and occupied buildings will vary based on individual site designs. Proposed distances should take into account risks, including the impact of any vapour cloud. Any mitigation factors that have been incorporated into the site design should also be considered. An initial **minimum** distance of 30m is proposed between BESS cabinets (or associated infrastructure such as transformers and switchgear) and occupied buildings, before considering any mitigation such as blast walls. This distance is based upon the 100ft distance for remote installations cited in NFPA 855:2023. Confirm which risks were considered in setting distances between BESS cabinets/enclosures and occupied buildings on site and demonstrate that risks to occupants have been reduced to ALARP.	§12. Spacing between BESS	**6.5.2**	**Not yet compliant**	The nearest office building is 15.7 m away from the nearest battery, which is the only occupied building within 30 m of any battery. Consideration should be given to increasing the separation distance to align with the NFCC recommended minimum distance where reasonably practicable. Where this is not achievable, an assessment should be conducted to demonstrate that the combination of separation distance, occupancy profile and explosion mitigation measures reduces the risk to ALARP. The below points could be considered in such an assessment: 1. The building is a control building for the solar farm containing a store room, HV switchgear, metering, and other equipment. Once the site is operational, the building will only be occupied when maintenance activities are being undertaken which is expected to be once a quarter. Therefore, the time at risk to people within the building will be relatively low. 2. If explosion relief panels are installed on the battery containers, any explosion overpressure/flames/debris would be vented upwards, away from the building, further reducing the risk.

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Requirement / Query	NFCC Guidance Section Reference	OBSMP Section Reference	Foigha BESS Compliance	Justification
				3. As the building is part of the Foigha development, any alarms generated by the batteries could be transmitted to the building such that personnel within the building can be evacuated before an incident escalates.
Areas within 3m of BESS cabinets/enclosures should be kept clear of combustible vegetation.	§13. Site conditions	**6.4.2**	**Compliant**	3 m of BESS cabinets/enclosures are clear from combustible vegetation.
Areas with wildfire risk or vegetation that could result in a significant fire should be considered as part of the assessment. Additional separation distances should be included in the design to help prevent fire spread to the BESS. This also helps to avoid an increase in the ambient temperature within the BESS cabinet/enclosure beyond safe operating limits.	§13. Site conditions	**6.4.2**	**N/A**	Site is located on low-risk agricultural land, where external hazards such as wildfire and flooding are not considered as a concern.
Confirm the firefighting strategy for the BESS, following the battery manufacturer's instructions. Note: Several manufacturers of BESS now advocate that if a thermal event occurs in a BESS unit and this progresses to thermal runaway, the BESS cabinet/enclosure should be allowed to consume itself or in other words, burn itself out. Furthermore, an increasing number of BESS manufacturers suggest that applying firefighting jets to the BESS cabinet/enclosure will have limited effect and could prolong the duration of the thermal event unnecessarily. In these instances, water fog or spray pattern branches should only be directed to areas to ensure the incident does not spread to adjacent BESS. If it can be confirmed that the manufacturer's recommended firefighting tactic for the BESS cabinet/enclosure is to defensively firefight and boundary cool whilst allowing the BESS cabinet/enclosure to consume itself without spreading to neighbouring cabinets, this may reduce the water requirements – and thus the drainage / environmental protection requirements – significantly.	§14. Water supplies	**6.8**	**Compliant**	There will be no active firefighting adopted in an attempt to extinguish a battery container which is already alight. Lithium-ion battery fires are extremely difficult to extinguish because it is necessary to both extinguish the flames and remove enough heat to cool the cells to their core and inhibit thermal runaway. Even if the fire is initially extinguished, reignition is highly likely because either, enough heat has not been removed to inhibit thermal runaway, or water ingress to other cells has initiated further cell failures. Any attempts to extinguish the fire are likely to extend the duration of the incident. Therefore, boundary cooling will be adopted to protect adjacent battery containers and other assets, reducing the likelihood of fire spread. This involves applying a water spray to adjacent batteries and assets to reduce the transfer of heat via thermal radiation. This will be conducted at a safe distance to protect first responders from thermal radiation, ejecta, and explosion overpressures/debris, should post-fire explosions occur. A battery which has ignited will be left to burn itself out. This approach aligns with the emergency response advice for lithium ion and sodium ion batteries in Guide 147 of the 2024 Emergency Response Guidebook (produced by the US Department of Transportation) [6].
Demonstrate that there will be enough water available to meet firefighting requirements and to manage a reasonable worst-case scenario. Confirm how this water requirement will be met (e.g., on-site lagoon, hydrants, or mains water supply). The water requirements will be driven by: - The size of the incident to be dealt with, for example 1 x BESS cabinet/enclosure - The principles set out in the emergency response plan and the expected role of the fire and rescue service (firefighting strategy) - Access and facilities for personnel on site - BESS cabinet/enclosure location and proximity to infrastructure or populated areas - The requirement to supplement any on-site firefighting facility such as a dry pipe sprinkler or deluge system	§14. Water supplies	**6.8**	**Compliant**	A fire water tank volume of 200 m^3 has been proposed on site. The proposed tank meets the minimum requirements of the NFCC guidance (180,000 L or 180m^3).
Fire hydrants provided should achieve a flow rate of no less than 25L/sec at any hydrant on the site.This figure is based on the National Guidance Document on the Provision of Water for Firefighting (2025), produced by Water UK and the Local Government Association (LGA). The flow rate for transportation has been selected as the comparative value for flow rates, rather than that of a domestic housing development or an industrial setting.	§14. Water supplies	**6.8**	**TBC**	The achievable hydrant flow rate is to be confirmed as part of the final firefighting water supply design. Specification of fire hydrants will ensure the flow rate of at least 25 L/sec is met.

Requirement / Query	NFCC Guidance Section Reference	OBSMP Section Reference	Foigha BESS Compliance	Justification
Where a flow of 25L/sec cannot be achieved, it would be prudent to provide an equivalent static supply of water on site that will provide for the same flow rate for a duration of 120 minutes. This equates to approximately 180,000L of water.	§14. Water supplies	**6.8**	**Compliant**	A fire water tank volume of 200m^3 has been proposed on site. The tank meets the requirements of the NFCC guidance (180,000L or 180m^3).
The management of water run-off should be considered as part of the site design (for example, drainage systems, interceptors, and bunded lagoons).	§14. Water supplies	**6.8**	**Compliant**	A water attenuation pond is proposed on the east side of the site to collect water run-off, which will be isolated via a shut-off valve automated when fire conditions are detected in any battery on site. The drainage system on site is designed such that all water run-off will be directed to the attenuation pond.
Water supplies for any on-site suppression system must be independently calculated by a competent fire engineer, based on the design fire size of the BESS.	§14. Water supplies	**6.8**	**TBC**	A fire water tank volume of 200m^3 has been proposed on site. The tank meets the requirements of the NFCC guidance (180,000 L).
Any static water storage tanks designed to be used for firefighting should be located at least 10m away from any BESS container/cabinet to allow for safe access and usage.	§14. Water supplies	**6.8**	**Compliant**	The static firefighting water tank is located more than 10 m from the BESS containers, allowing safe access and use during an incident.
The location of any static water storage tanks should be considered as part of a risk assessed approach that takes into account potential fire development and impacts.	§14. Water supplies	**6.8**	**Compliant**	Water from the static tank is to be accessed by two hydrants on site, which are located at the eastern and western ends of the site, accounting for foreseeable wind conditions. Additionally, both hydrants are greater than 40 m from the nearest battery container so can be safely accessed during an ongoing incident.
Suitable environmental protection measures should be provided, and developers should liaise with the Water Undertakers or the Environment Agency to understand any impacts. Protection measures should include systems for containing and managing water run-off. System capability/capacity should be based on anticipated water application rates, including the impact of water-based fixed suppression systems.	§18. Environmental impacts	**6.7.2**	**Compliant**	A water attenuation pond is proposed on the east side of the site to collect water run-off, which will be isolated via a shut-off valve automated when fire conditions are detected in any battery on site. The drainage system on site is designed such that all water run-off will be directed to the attenuation pond.
Sites located in flood zones should have details of flood protection or mitigation measures.	§18. Environmental impacts	**6.2**	**N/A**	A flood risk assessment has been undertaken for the whole Foigha solar development [8], which does not show that the BESS compound is at risk from surface water flooding and does not show that it would be impacted by a 1 in 1000 year storm. The flood risk assessment also concluded that the development would not adversely impact the drainage of water on the land being used.

6.1.2.2 NFPA 855 Assessment Findings

Table 4 summarises the findings of the compliance review against NFPA 855 [3]. This table is limited to the primary safety issues relevant to the current stage of development and focuses on those requirements material to the pre-consent safety justification for the Foigha BESS.

Table 4: NFPA 855 Assessment Findings – Primary Safety Items

Description	NFPA 855 Section Reference	OBSMP Section Reference	Foigha BESS Compliance	Justification
Installation When an ESS is installed in a structure, it shall be installed in a dedicated location readily accessible to first responders.	§4.7	**6.2**	**N/A**	

Description	NFPA 855 Section Reference	OBSMP Section Reference	Foigha BESS Compliance	Justification
Means of Egress. All areas containing ESSs shall provide egress from the area in which they are located in accordance with the local building code.	§4.7.9.1	**6.8**	**Compliant**	There are two separate access/egress routes at the east and west of the site, accounting for foreseeable wind conditions. This is compliant with NFCC access requirements.
Water Supply. Where required elsewhere in this standard, sites where nonmechanical ESSs are installed shall be provided with a permanent source of water for fire protection, unless modified in Chapters 9 through 13.	§4.9.5.1	**6.8**	**Compliant**	A fire water tank volume of 200m^3 has been proposed on site. The tank meets the requirements of the NFCC guidance (180,000 L) There are two hydrants located on site, to the eastern and western ends, respectively, which are to be connected to the on-site static water tank. Each hydrant is located greater than 40 m from the nearest battery containers such that first responders can access them without being at an adverse level of risk from fire and explosion effects.
Where no permanent adequate and reliable water supply exists for firefighting purposes, the requirements of NFPA 1142 apply.	§4.9.5.2	**6.8**	**N/A**	
Accessible fire hydrants shall be provided for site ESS installations where a public or private water supply is available.	§4.9.5.3	**6.8**	**Compliant**	There are two hydrants located on site, to the eastern and western ends, respectively, which are to be connected to the on-site static water tank. Each hydrant is located greater than 40 m from the nearest battery containers such that first responders can access them without being at an adverse level of risk from fire and explosion effects. Engagement with the fire and rescue service must confirm that the location of the two hydrants on site provides sufficient coverage for all areas of the site.
Outdoor installations. Outdoor ESS installations shall be classified as follows: 1. *Remote locations*. ESSs located more than 100 ft (30.5 m) from buildings, lot lines that can be built upon, public ways, stored combustible materials, hazardous materials, high-piled stock, and other exposure hazards not associated with electrical grid infrastructure. 2. *Locations near exposures*: all outdoor ESS locations that do not comply with remote outdoor location requirements.	§9.4.2	**6.2**	**Compliant**	The BESS is classed as in a remote location.
Size and separation. ESSs shall be comprised of groups with a maximum stored energy of 50 kWh each.	§9.5.1	**6.2**	**N/A**	
Each group shall be spaced a minimum of 3 ft (0.9 m) from other groups and from walls in the storage room or area.	§9.5.2	**6.2**	**Compliant**	The layout confirms minimum spacing of 0.9 m between BESS groups/enclosures, aligning with the NFPA 855.
The AHJ shall be permitted to approve groups with larger energy capacities or smaller group spacing based on performance criteria from fire and explosion testing complying with Section 9.2	§9.5.3	**6.2**	**N/A**	Does not apply as the BESS is in a remote location.
Vegetation Control. Areas within 10 ft (3 m) on each side of outdoor ESSs shall be cleared of combustible vegetation and other combustible growth.	§9.6.2.1.1	**6.2**	**Compliant**	Areas within 3 m of the BESS cabinets/enclosures are clear from combustible vegetation.
Single specimens of trees, shrubbery, or cultivated ground cover such as green grass, ivy, succulents, or similar plans used as ground covers shall be permitted to be exempt provided that they do not form a means of readily transmitting fire.	§9.6.2.1.2	**6.2**	**N/A**	Areas within 3 m of the BESS cabinets/enclosures are clear from combustible vegetation.
Maximum size. Individual ESS cabinets that exceed 16.2 m x 2.6 m x 2.9 m in size, not including HVAC and other equipment affixed to the unit, shall be treated as indoor installations.	§9.6.2.3.1	**6.2**	**Compliant**	Sungrow PowerTitan 2.0 ST5015UX containerised unit, with a dimensions of 6058 mm × 2896 mm × 2438 mm. Which doesn't exceed the limit of outdoor installation as per NFPA requirement.
Remote Locations. When agreeable with the ESS owner and approved by the AHJ, fire suppression systems and water supply shall not be required.	§9.6.2.4	**6.2**	**N/A**	

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Description	NFPA 855 Section Reference	OBSMP Section Reference	Foigha BESS Compliance	Justification
Size and separation. Section 9.5.1 shall not apply to outdoor remote ESS installations.	§9.6.2.5	**6.2**	**N/A**	The BESS is classed as in a remote location.
Clearance to Exposures. ESSs located outdoors shall be separated by a minimum 10 ft (3 m) from the following exposures: 1. Lot lines 2. Public ways 3. Buildings 4. Stored combustible materials 5. Hazardous materials 6. High-piled stock 7. Other exposure hazards not associated with electrical grid infrastructure	§9.6.2.7.1	**6.2**	**Compliant**	The nearest battery is greater than 3 m from all of the exposures listed.
The required separation distances shall be permitted to be reduced to 3 ft (0.9 m) when a 1-hour freestanding fire barrier, suitable for exterior use, and extending 5 ft (1.5 m) above and 5 ft (1.5 m) beyond the physical boundary of the ESS installation is provided to protect the exposure.	§9.6.2.7.1.1	**6.2**	**N/A**	Separation is supported by the site layout, manufacturer spacing guidance and UL 9540A non-propagation evidence.
Clearances to buildings shall be permitted to be reduced to 3 ft (0.9 m) where non-combustible exterior walls with no openings or combustible overhangs are provided on the wall adjacent to the ESS and the fire resistance rating of the exterior wall complies with the fire resistance requirements in 9.7.5.	§9.6.2.7.1.2	**6.2**	**N/A**	The nearest office building is approximately 15.7 m from the BESS
Clearances to buildings shall be permitted to be reduced to 3 ft (0.9 m) based on fire and explosion testing complying with Section 9.2.	§9.6.2.7.1.3	**6.2**	**N/A**	The nearest office building is approximately 15.7 m from the BESS
Where approved, clearances to exposures other than buildings shall be permitted to be reduced to 3 ft (0.9 m) where fire and explosion testing of the ESS in accordance with Section 9.2 demonstrates that a fire within the ESS enclosure will not generate radiant heat flux sufficient to ignite stored materials or otherwise threaten the exposure,	§9.6.2.7.1.4	**6.2**	**N/A**	The nearest office building is approximately 15.7 m from the BESS
Clearances to buildings and exposures shall be permitted to be reduced to 3 ft (0.9 m) where the enclosure of the ESS has a 2-hour fire resistance rating established in accordance with ASTM E119 or UL 263.	§9.6.2.7.1.5	**6.2**	**N/A**	The nearest office building is approximately 15.7 m from the BESS
ESS Exhaust Outlets. ESS exhaust outlets shall comply with the following: 1. Exhaust outlets from an ESS that exhaust other than ventilation air shall be located at least 15 ft (4.57 m) from heating, ventilations, and air conditioning (HVAC) air intakes, windows, doors, loading docks, ignitions resources, and other openings into buildings and facilities. 2. Exhaust outlet(s) from an ESS shall not be directed onto means of egress, walkways, or pedestrian or vehicular travel paths.	§9.6.2.7.1.6	**6.2**	**Compliant**	There are no buildings within 4.57 m of any battery containers. As such, there are no HVAC intakes, windows, doors, loading docks, ignition sources, or other openings into building and facilities within 4.57 m of exhaust outlets. Exhaust outlets are directed vertically upwards, so are not directed onto means of egress, walkways, or other pedestrian or vehicular travel paths.
Means of Egress Separation. (A) ESSs located outdoors shall be separated from any accessible means of egress as required by the AHJ to ensure unimpeded egress under fire conditions but in no case less than 10 ft (3 m). (B) Where approved by the AHJ, clearances to accessible means of egress shall be permitted to be reduced to 3 ft (0.9 m) where fire and explosion testing in accordance with Section 9.2 demonstrates that a fire within the ESS will not adversely impact the means of egress.	§9.6.2.7.1.7	**6.2**	**Compliant**	The site layout provides separation of at least 3 m from accessible means of egress/access routes, with access roads arranged to allow emergency vehicle movement around the BESS area.
Water Supply. Sites where nonmechanical ESSs are installed shall be provided with a permanent source of water for fire protection in accordance with 4.9.5, unless modified by this chapter.	§9.7.3	**6.4.2**	**Compliant**	A fire water tank volume of 200m^3 has been proposed on site. The tank m eets the requirements of the NFCC guidance (180,000 L)

6.2 Site location and layout

Selection of a suitable site location and optimisation of the layout regarding safety hazards is essential to ensure that:

- There are no vulnerable receptors in the vicinity of the BESS that would be adversely impacted by any of the consequences outlined in **Figure 4**.
- If a thermal runaway/fire event were to occur, it can be contained to only the battery container of origin, reducing the event duration and magnitude.
- There are no hazards associated with the site and surrounding environment that could initiate or encourage propagation of a fire.
- There are no constraints that would prevent safe access and egress to the site during a major incident.

In line with the NFCC guidance and NFPA 855, these goals have been met for the Foigha BESS by:

- Locating the BESS in a remote location, where the nearest occupied building is approx. 174 m from a battery container (see **Figure 6**, **Table 5**). Section G.10.8.4 within Annex G of NFPA 855 [3] suggests that buildings within a 200 ft (61 m) diameter should be evacuated during a thermal runaway/fire event. Therefore, buildings located 174 m away should not be at significant risk of toxic exposure such that evacuation is necessary. However, as three receptor groups (Residential Properties 9, Residential Properties 10, Main Road - R392) are downwind of the prevailing wind direction, it is recommended to conduct a toxic plume dispersion study to inform detailed emergency response arrangements.
- During large-scale fire testing (LSFT) for the Sungrow PowerTitan 2.0, there was no propagation between adjacent containers when the nearest container was 150 mm from the container of origin. The separation between containers in the site layout is 900 mm – greater than the separation during LSFT. Therefore, during a fire there should be no propagation between containers, even when wind conditions at the site (compared to the conditions during LSFT) are accounted for.
- There are to be no combustibles stored on site and any combustible vegetation in the vicinity of the containers is to be managed such that it does not encourage fire propagation.
- The battery containers will not be vertically stacked, which increases the risk of fire propagation vertically if either the top of or bottom container were to ignite.
- Wildfires have not been identified as a significant risk at the Foigha BESS site location.
- A flood risk assessment has been undertaken for the whole Foigha solar development [8], which does not show that the BESS compound is at risk from surface water flooding and does not show that it would be impacted by a 1 in 1000-year storm.
- There are two separate access roads entering from the east and west of the site, accounting for foreseeable wind conditions, for emergency responders accessing the facility. All site roads meet the requirements outlined in the NFCC guidance and swept path analysis has been undertaken to show there are no spatial constraints.

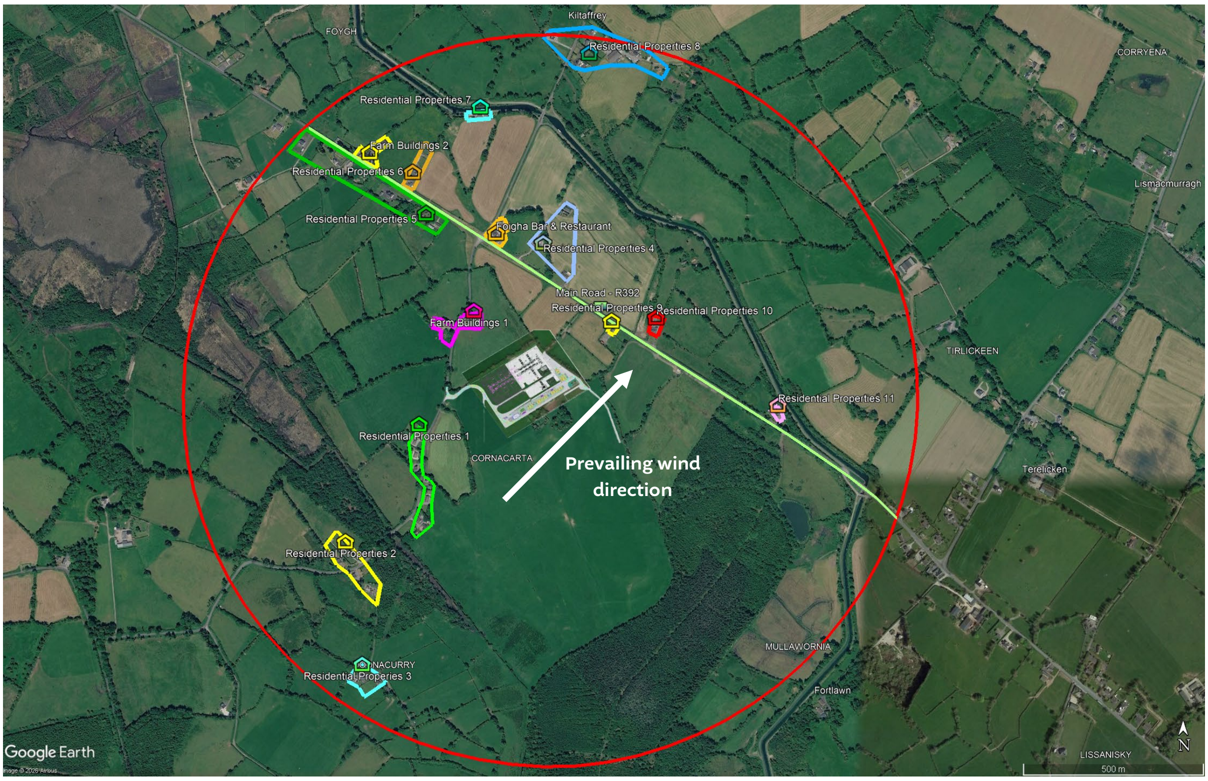

Figure 6: Receptors within 1 km of Foigha BESS

Table 5: Receptors within 1 km of Foigha BESS

Receptor	Approx. distance from nearest battery (m)	Downwind of prevailing wind direction?
Residential Properties 1	296	No
Residential Properties 2	634	No
Residential Properties 3	856	No
Residential Properties 4	247	No
Residential Properties 5	499	No
Residential Properties 6	634	No
Residential Properties 7	716	No
Residential Properties 8	831	No
Residential Properties 9	174	Yes
Residential Properties 10	268	Yes
Residential Properties 11	581	No
Farm Buildings 1	248	No
Farm Buildings 2	760	No
Foigha Bar & Restaurant	386	No
Main Road – R392	188	Yes

Note: receptors have been grouped into collections of properties to ease the assessment. Distances recorded represent the minimum distance from a battery container on site to a property within the group.

6.3 Thermal runaway

6.3.1 Prevention measures

In hazard management, the primary aim is to prevent hazardous events occurring, rather than focusing on mitigating the consequences. Thermal runaway prevention within lithium-ion batteries is achieved through prevention of, and detection and reaction to, the following threats (as per **Figure 4**):

- Thermal stress.
- Cell/system faults.
- Electrical stress.
- Mechanical stress.
- Environmental stress.

This is achieved through the design of the battery containers and the functions embedded within the Battery Management System (BMS) intended to detect and react to deviations from safe operating limits.

The Sungrow PowerTitan 2.0 includes the following design features to prevent the onset of thermal runaway:

- BMS functions providing early fault detection through continuous cell voltage, temperature and current monitoring, with alarm/control circuits to react to deviations from safe operating limits [9]. The BMS functional safety has been evaluated according to IEC/UL 60730-1 Annex H by TÜV Rheinland [10].
  - Voltage detection is provided for 104 cells across the container, with cell voltage sampling periods of up to 100 ms.
  - Cell temperature is monitored over a range of -40°C to 125°C, with a cell temperature sampling period of 1 second.
  - Current detection is provided over the range of -200 A to +200 A with a current detection period of up to 50 ms.
- Li-ion Tamer off-gas detector to detect electrolyte vapours and gases released during the early stages of lithium-ion battery failure, before cell-level thermal runaway. The detector monitors target gases including electrolyte vapours, VOCs, CO and hydrogen, with a stated response time of 5 seconds [11]. It is intended to initiate a response within the system after initial cell failure, but prior to thermal runaway. Note: in the UL 9540A testing of the battery cells [12], the average cell venting temperature was 135°C while the average cell temperature at thermal runaway was 199°C, demonstrating the margin of cell temperature during which thermal runaway can be prevented, if overtemperature is the initiating cause.
- A liquid cooling system utilising ethylene glycol as a coolant, linked with cell temperature readings communicated to the BMS, to maintain cells within their safe operating limits.
- The enclosure has an ingress protection rating of IP55, which protects the enclosures against the ingress of water and dust particles under foreseeable weather conditions and during firefighting.

The PowerTitan 2.0 system and associated cells are certified against the following standards, which include physical testing of cells against electrical, mechanical, and thermal abuse, and verification of BMS functions, to prevent thermal runaway:

- UL 9540.

- UL 1973.
- IEC 62619.
- IEC 62933-5-2.

Furthermore, in the unit-level UL 9540A testing of the battery units contained within the PowerTitan 2.0 [13] (where thermal runaway is artificially induced within one cell and the extent of propagation is assessed), cell-to-cell propagation occurred but only to one adjacent cell and not outside of the initiating module. This shows a good resistance to thermal propagation, where the failure method is overtemperature.

6.4 Fire

Fire occurs within lithium-ion batteries when the flammable components of off-gases produced during thermal runaway are ignited when they find an ignition source, which may be sparks generated by other electrical components, or the heat generated by the chemical reaction.

If immediate ignition does not occur, fires may be prevented through a forced ventilation system that maintains the off-gas mixture below its lower flammable limit (LFL). However, if ignition does occur, lithium-ion battery fires are extremely difficult to extinguish because it is necessary to both extinguish the flames and remove enough heat to cool the cells to their core and inhibit thermal runaway. Due to the congestion within grid-scale battery containers and the layers of casing, etc. around the cells, it is very difficult to direct enough fire suppressant/coolant to the affected cells to inhibit the chemical reaction.

If the flames are extinguished but thermal runaway is not inhibited, the risk of explosion increases because off-gas (comprised up to 50% hydrogen, by volume) will continue to be produced within a confined enclosure. Explosions are less predictable than fires and are more of a hazard to people – see **Section 6.5**.

As such, it is recommended by most battery manufacturers and within good practice guidance such as the Emergency Response Guidebook [6] not to actively fight fires involving large-scale lithium-ion batteries, but instead to oversee a controlled burn while ensuring surroundings are kept cool to prevent propagation.

6.4.1 Prevention measures

Assuming cell thermal runaway has already occurred, fire prevention requires early detection of abnormal conditions and automatic initiation of protective actions before escalation.

Each Sungrow PowerTitan 2.0 container is equipped with two smoke and heat detectors and one flammable gas detector to provide alarm and fault signals [14]:

- A sounder beacon will be triggered when a Level 1 Alarm is initiated. This is when any one of the smoke, heat, or flammable gas detectors send an alarm signal.
- Alarm bells will be triggered when a Level 2 Alarm is initiated. This is when both the smoke and heat detectors send an alarm signal, indicating a fire is ongoing.

The containers are also equipped with an explosion prevention system – certified against NFPA 69 – which may also assist in preventing fires if it reacts early enough [15]:

- When flammable gases are detected at 10% LFL, the emergency ventilation system is initiated to vent the gases and maintain the average concentration below the LFL.
- If a Level 2 Alarm is initiated (i.e., a fire is ongoing), the emergency ventilation system is shut down to prevent extensive ingress of oxygen to accelerate the fire.

6.4.2 Mitigation measures

As noted in **Section 6.4**, extinguishing fires and inhibiting thermal runaway is very difficult to achieve. So, if a fire occurs, the aim shall be to limit the fire to only the container of origin to minimise the duration and magnitude of the incident. See **Section 6.2** for how this will be achieved through the site location and layout.

Additionally, the following features of the Foigha BESS will assist in mitigating fires:

- A static fire water tank is to be installed on site, which feeds two hydrants – one on the eastern side of the site and another on the western side. The hydrants will supply the fire and rescue service (FRS) with water to apply water spray to containers and other assets adjacent to the ignited battery for boundary cooling purposes, to reduce the likelihood of fire propagation. Having hydrants on opposite ends of the site means that at least one hydrant will always be accessible to the FRS, regardless of the location of the fire and the direction of the wind.

Sungrow offers the following two fire suppression systems as part of the PowerTitan 2.0:

- A FK5112 clean-agent fire suppression system, activated through smoke/heat detection. Its purpose is to suppress/control a fire within the affected cabinet and limit escalation. This system comes as standard in the PowerTitan 2.0 [14].
    - Whilst FK5112 is suitable for extinguishing electrical fires which may initiate electrochemical fires involving the cells, it is not capable of preventing cascading thermal runaway.
    - FK5112 was originally produced and patented by manufacturer 3M under the product name Novec 1230. Novec 1230 was deployed during an incident at the McMicken BESS, Arizona, in 2019 [16], and is one of the factors that led to four firefighters being seriously injured from an explosion. The clean agent suppressed the flames, but did not inhibit thermal runaway, which led to a build-up of flammable off-gases that were not vented from the container.
    - In an August 2017 letter to the NFPA 855 committee during drafts of the NFPA standard, Novec 1230 manufacturer 3M stated that clean agents could not prevent or suppress cascading thermal runaway in Li-ion battery systems [17]. This is stated in paragraph G.6.1.4 of Annex G within NFPA 855, 2026 edition [3]: *Clean-agent suppression systems can extinguish a fire but will not stop thermal runaway or off-gassing of the cells are damaged, creating a potential explosive environment.*
- Water sprinkler protection system, which is heat-actuated. This system is optional in the PowerTitan 2.0.
    - Although water-based suppression systems have been shown to be the most effective in cooling cells to their core to inhibit thermal runaway, the volume of water required to achieve this would be significant. There has been no physical testing of the system for the PowerTitan 2.0 demonstrating that this would be achieved.
    - Water ingress into cells can a cause of thermal runaway. Therefore, if there were an accidental activation of the system, it may be the cause of an incident, rather than a mitigation. Such a scenario was seen in a fire in the Moss Landing BESS in California, where smoke from an air handling unit triggered a sprinkler system, which then initiated a fire in otherwise healthy batteries [18].
- Aerosol fire suppression system. This system is optional in the PowerTitan 2.0.
    - Similar to clean-agent suppression systems, aerosols have been found to be effective in extinguishing flames but not providing enough cooling to inhibit thermal runaway. This is stated within paragraph G.6.1.6 within Annex G of NFPA

855, 2026 edition [3]: *Aerosol suppression systems can extinguish a fire but will not stop thermal runaway or off-gassing if the cells are damaged, which creates a potentially explosive environment. If gas is allowed to accumulate, a more hazardous conditions can develop.*

Therefore, the aerosol and water sprinkler systems should not be opted for as it is very unlikely that they will both extinguish a fire and inhibit thermal runaway. They may subject first responders to greater hazards, such as explosions.

BayWa have contacted Sungrow to inquire whether the PowerTitan 2.0 can be supplied without the FK5112 clean-agent system, in light of the statement within Annex G of NFPA 855 and evidence from past incidents that it is ineffective in inhibiting thermal runaway and can increase the risk of explosions during an incident. If the PowerTitan 2.0 cannot be supplied without the FK5112 system, the associated hazards (i.e., increased explosion risk) shall be clearly stated in site risk assessments and the ERP, with other mitigations put in place to protect people from explosion effects – see **Section 6.5.2**.

6.5 Explosion

Explosions may occur within the battery containers when off-gassing has not led to an immediate ignition, and therefore, a flammable vapour cloud has built up within the enclosure which rapidly combusts, producing heat, overpressure, and can project debris.

Explosions may also occur after an initial fire, if the enclosure has been starved of oxygen but thermal runaway and off-gassing have continued.

6.5.1 Prevention measures

The PowerTitan 2.0 containers are equipped with an explosion prevention system – certified against NFPA 69 – which may also assist in preventing fires if it reacts early enough:

- When flammable gases are detected at 10% LFL, the emergency ventilation system is initiated to vent the gases and maintain the average concentration below the LFL.
- Computational Fluid Dynamics (CFD) simulations of the system have been performed and evaluated against NFPA 69 by Jensen Hughes [15]. This analysis showed that the system should be capable of maintaining the average concentration of off-gases below the LFL.

6.5.2 Mitigation measures

The PowerTitan 2.0 containers come with the option of explosion relief panels which have been designed with the assistance of CFD analysis and evaluated against NFPA 68 by TÜV Rheinland [10]. This analysis confirmed that the proposed venting arrangement would limit the maximum internal overpressure beneath the maximum overpressure that can be endured by the enclosure, which would reduce the level of overpressure reached by the explosion and therefore, reduce the consequences. Furthermore, the panels would be located on the roof of the containers, so overpressure and accompanying flames would be directed upwards, away from people, if explosions occur.

It is recommended that the deflagration panels are opted for by BayWa. Deflagrations can occur after an initial fire event, past the survivability limits of the NFPA 69 explosion prevention system. It is likely that first responders will be present at this point. If deflagration panels are not installed, any deflagration overpressure will be vented via the weakest point in the container - this would be the container doors, which are at ground level and potentially facing the first responders. So, without deflagration vents installed, the risk to first responders from explosion effects would be greater. As the relief panels are a passive system (while the explosion prevention system is active), they are more reliable in acting upon demand.

Further aspects of the design and emergency response arrangements to mitigate against explosion effects are:

- The nearest occupied building to any battery container is approx. 15.7 m away, which is less than the minimum of 30 m recommended in the NFCC guidance. The NFCC guidance is informed by paragraph G.10.8.3 within Annex G of NFPA 855: *Explosion modelling has shown that the minimum distance should be 75 ft (23 m). It is recommended increasing that to a minimum clearance of 100 ft (30.5 m)*.

  Consideration should be given to increasing the separation distance to align with the NFCC recommended minimum distance where reasonably practicable. Where this is not achievable, an assessment should be conducted to demonstrate that the combination of separation distance, occupancy profile and explosion mitigation measures reduces the risk to ALARP. The below points can be considered:

  - The building is a control building for the solar farm containing a store room, HV switchgear, metering, and other equipment. Once the site is operational, the building will only be occupied when maintenance activities are being undertaken which is expected to be once a quarter. Therefore, the time at risk to people within the building will be relatively low and it may not be classed as an "occupied building".
  - If explosion relief panels are installed on the battery containers, any explosion overpressure/flames/debris would be vented upwards, away from the building, further reducing the risk.
  - As the building is part of the Foigha development, any alarms generated by the batteries could be transmitted to the building such that personnel within the building can be evacuated before an incident escalates.
- An exclusion zone around the affected battery of at least 30 m will be implemented during emergency response to protect first responders from any effects of explosions. All firefighting infrastructure, such as fire hydrants, are located greater than 30 m from the nearest battery.

6.6 Toxic gas dispersion

Dispersion of toxic gases will occur whether only thermal runaway occurs, or if this leads to a fire. As such, there are no means of preventing this consequence once thermal runaway has begun, so this must be mitigated through site location and planning emergency response arrangements with an awareness of the likely path of toxic products.

6.6.1 Prevention measures

The prevention measures described in **Sections 6.3.1** and **Section 6.4.1** will also support the reduction of toxic gas dispersion of thermal runaway products and combustion products, respectively.

6.6.2 Mitigation measures

Vulnerable receptors have been identified within 1 km of the Foigha BESS – see **Figure 6**, **Table 5**. The nearest off-site receptors and the distance from the nearest battery container are:

- Residential property – approx. 174 m.
- Farmhouse – approx. 248 m.
- R392 road - approx. 188 m.

Section G.10.8.4 within Annex G of NFPA 855 [3] suggests that buildings within a 200 ft (61 m) diameter should be evacuated during a thermal runaway/fire event. Therefore, buildings located 174 to 248 m away should not be at significant risk of toxic exposure such that evacuation is necessary.

The wind rose for Foigha, Longford, presented in **Figure 7**, indicates that the prevailing winds are predominantly from the south-west, with additional frequent winds from the west. Three receptor groups shown in **Figure 6** (Residential Properties 9, Residential Properties 10, Main Road - R392) are downwind of the prevailing wind direction, with the nearest being 174 m from the nearest battery. Therefore, it is recommended to conduct a toxic plume dispersion study to inform detailed emergency response arrangements.

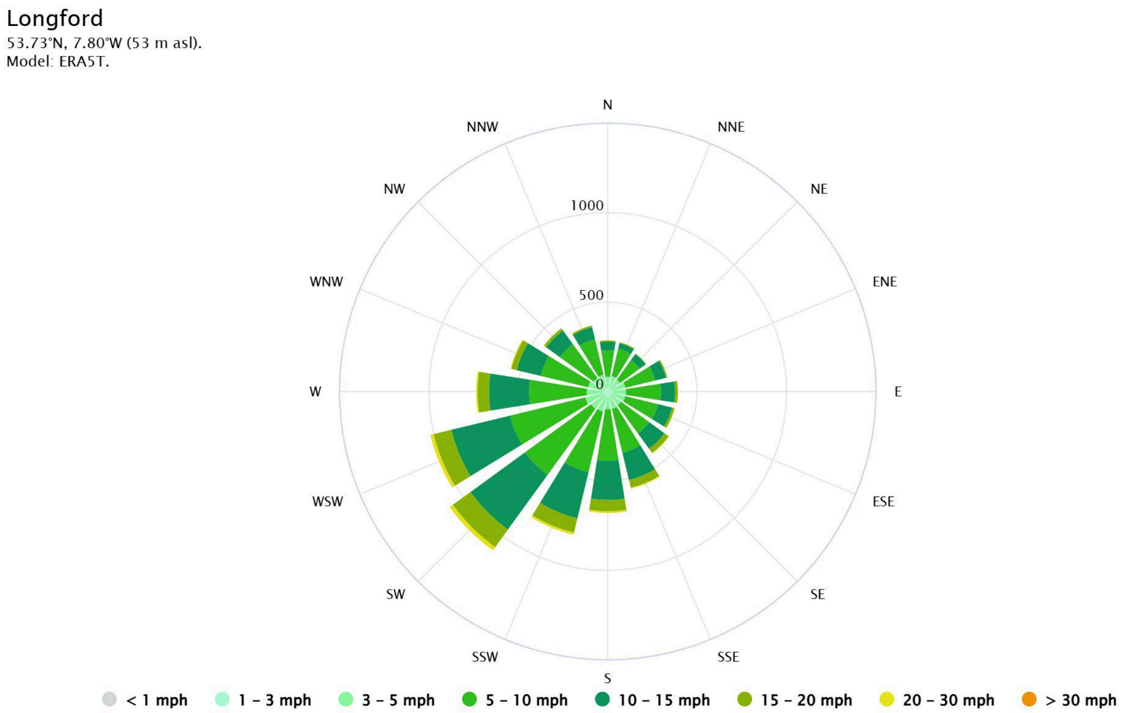

Figure 7: Wind Rose data, Longford [19]

6.7 Toxic liquid release

A concern of the use of firewater during a lithium-ion battery fire is the contamination of water with substances harmful to people and the environment, which may reach sensitive receptors unless suitably contained and treated prior to disposal.

6.7.1 Prevention measures

For the Foigha BESS, the firefighting strategy is to apply water spray for boundary cooling purposes to protect adjacent battery containers and assets to reduce the likelihood of fire spread. Therefore, there should be a minimal volume of water applied to the affected battery container. However, it cannot be entirely avoided due to the separation between containers (a minimum of 0.9 m).

However, a water attenuation pond is to be provided on the east side of the site to collect water run-off. The design of the drainage system across the site will direct all water to the pond.

The volume of the water attenuation pond is approx 350m$^{3.}$ This volume vastly exceeds the minimum volume of firewater required by NFCC (180 m^3). The final attenuation pond design shall be confirmed once the BESS layout is finalised and shall include a specified design depth and storage volume. The sizing shall account for the maximum volume of firewater expected to be deployed during an incident, rainfall run-off entering the drainage system, and worst case flood conditions. The final pond volume shall be demonstrated to provide sufficient containment capacity before any discharge, treatment or removal of contaminated firewater.

To ensure that no contaminated firewater reaches the surrounding environment, an automated isolation valve shall be installed in the outlet of the attenuation pond which automatically closes upon detection of thermal runaway/fire conditions in any battery container. There shall be further provisions for a manual isolation valve which can be operated by first responders prior to the application of any firewater, as further assurance in case the automated valve does not actuate.

A plan shall be developed with a local company to treat any water collected in the attenuation pond prior to disposal so that it can be disposed of responsibly

6.7.2 Mitigation measures

Whilst there may be contaminated firewater present on site, the ground around the battery containers shall be non-permeable to prevent contamination of the land on site which could migrate to the surroundings.

6.8 Emergency Response

Emergency response arrangements for the Foigha BESS are set out in the project specific Emergency Response Plan (ERP) [5]. The Emergency Response Plan defines the site specific response arrangements for BESS incidents, considering the consequences outlined in this document.

6.9 Operational Arrangements

BayWa are yet to finalise the operational arrangements for the Foigha BESS.

However, it is expected that the site will be normally unoccupied, with personnel only on site to conduct routine inspection and maintenance activities. Therefore, the occupancy on-site and the number of people who may be subject to the hazards outlined in this document is normally very low.

It is also expected that the site will be monitored 24/7 from a remote facility where they key operating parameters and general health of the batteries will be monitored. A responsible person will be alerted when any safety-related alarms are raised, such that they can attend site if required, and/or alert the emergency services. Response to emergency scenarios is outlined in the ERP [5].

As the site is normally unoccupied, in line with NFCC guidance, suitable signage will be provided on the outside of BESS cabinets/enclosures and at the site boundary. Signage will detail:

- Relevant hazards posed.
- The type of technology associated with the BESS.
- Any suppression system fitted.
- 24/7 emergency contact information signs on the exterior of a building or enclosure. (This should be sized such that at least one sign is legible at night at a distance of either 30 m or from the site boundary, whichever is closer, as stated in NFPA 855:2023).

The final signage wording and locations have not yet been confirmed for the Foigha BESS.

7 Recommendations

The Foigha BESS design and suitability for emergency preparedness generally shows great alignment with the requirements of the NFCC and NFPA 855 to manage the safety hazards posed by the BESS. To further reduce understand and/or reduce the risk of the facility, the following actions are recommended:

1. As three receptor groups shown in **Figure 6** (Residential Properties 9, Residential Properties 10, Main Road - R392) are downwind of the prevailing wind direction and in some cases less than 200 m from the nearest battery container, it is recommended to conduct a toxic plume dispersion study to inform detailed emergency response arrangements.
2. The nearest occupied building to any battery container is approx. 15.7 m away, which is less than the minimum of 30 m recommended in the NFCC guidance. The NFCC guidance is informed by paragraph G.10.8.3 within Annex G of NFPA 855: *Explosion modelling has shown that the minimum distance should be 75 ft (23 m). It is recommended increasing that to a minimum clearance of 100 ft (30.5 m)*.

   Consideration should be given to increasing the separation distance to align with the NFCC recommended minimum distance where reasonably practicable. Where this is not achievable, an assessment should be conducted to demonstrate that the combination of separation distance, occupancy profile and explosion mitigation measures reduces the risk to As Low As Reasonably Practicable (ALARP).
3. It is recommended that the deflagration panels, which are an optional feature of the Sungrow PowerTitan 2.0, are opted for by BayWa. Deflagrations can occur after an initial fire event, past the survivability limits of the NFPA 69 explosion prevention system. It is likely that first responders will be present at this point. If deflagration panels are not installed, any deflagration overpressure will be vented via the weakest point in the container - this would be the container doors, which are at ground level and potentially facing the first responders. So, without deflagration vents installed, the risk to first responders from explosion effects would be greater. As the relief panels are a passive system (while the explosion prevention system is active), they are more reliable in acting upon demand.
4. It is recommended that BayWa request that the product is provided without the FK5112 fire suppressant, as this increases the risk of explosion.

   FK5112 was originally produced and patented by manufacturer 3M under the product name Novec 1230. Novec 1230 was deployed during an incident at the McMicken BESS, Arizona, in 2019, and is one of the factors that led to four firefighters being seriously injured from an explosion. The clean agent suppressed the flames, but did not inhibit thermal runaway, which led to a build-up of flammable off-gases that were not vented from the container.

   In an August 2017 letter to the NFPA 855 committee during drafts of the NFPA standard, Novec 1230 manufacturer 3M stated that clean agents could not prevent or suppress cascading thermal runaway in Li-ion battery systems. This is stated in paragraph G.6.1.4 of Annex G within NFPA 855, 2026 edition: *Clean-agent suppression systems can extinguish a fire but will not stop thermal runaway or off-gassing of the cells are damaged, creating a potential explosive environment*.
5. For all requirements of the NFCC Guidance and NFPA 855 that are currently categorised as “partially compliant”, “TBC”, or “not yet compliant”, BayWa should assign an owner to ensure that the criteria are met. Where these items relate to primary safety issues, ensuring compliance should be treated as priority. Where these items relate to secondary safety issues, they should be addressed in the detailed design of the facility, or at the latest prior to the BESS being commissioned and handed over to operations.

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APPENDIX 1 - SECONDARY SAFETY ISSUES

1. NFCC Guidance Assessment Findings

Table 6 summarises the secondary safety issues findings of the compliance review against the NFCC guidance **Error! Reference source not found.**.

Table 6: NFCC Guidance Assessment Findings - Secondary Safety Issues

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
9. Provision of accurate and current information for emergency responders during emergencies.	§3. Principles	**TBC**	Consultation with the local FRS has not yet been completed. The section will require update once FRS advice has been obtained.
10. Effective emergency planning and management, specific to the site, infrastructure, and operations.	§3. Principles	**TBC**	Should be covered in ERP.
Describe how the proposed BESS will perform in a thermal event / deflagration, and what proactive or reactive systems are proposed to mitigate this.	§6. System design, construction, testing and decommissioning	**Compliant**	The DNV large scale fire test demonstrated that the PowerTitan 2.0 BESS fire remained limited to the initiating container A. The flames lasting for several hours in container A and deflagration panels opening as intended, but no fire or thermal runaway propagation was observed to adjacent containers B, C or D. Adjacent containers remained below critical thermal runaway temperatures, with no fire spread into their interiors. UL 9540A unit-level testing confirms thermal runaway and cell-to-cell propagation, but no module-to-module propagation, no explosive gas discharge, no external flaming, no flying debris and no electrical arcing. The deflagration risk is addressed through NFPA 68 venting assessment and NFPA 69 CFD modelling, which confirms the emergency ventilation strategy can remove battery gas and maintain the overall flammable gas concentration below 25% LFL after activation. The proposed proactive/reactive mitigations include liquid cooling, BMS monitoring, gas detection, emergency ventilation, fire detection, alarms/warnings, FK5112 extinguishant release and explosion venting, with sprinklers/aerosol systems noted as optional.
Describe how the thermal event will be contained to the BESS cabinet of origin without the radiant heat affecting other cabinets.	§6. System design, construction, testing and decommissioning	**Compliant**	The DNV large scale fire test demonstrated that the PowerTitan 2.0 BESS fire remained limited to the initiating container A. The flames lasting for several hours in container A and deflagration panels opening as intended, but no fire or thermal runaway propagation was observed to adjacent containers B, C or D. Adjacent containers remained below critical thermal runaway temperatures, with no fire spread into their interiors. LSFT was undertaken with only 150 mm separation between the initiating container A and closest container B, with wind predominantly blowing towards the container B, despite this conservative arrangement, no fire or thermal runaway propagation occurred. The project layout provides a greater minimum separation of 0.9 m between BESS. Although actual site wind conditions may be higher than those recorded during the test, the increased separation provides additional margin. UL 9540A unit-level testing confirms thermal runaway and cell-to-cell propagation, but no module-to-module propagation, no explosive gas discharge, no external flaming, no flying debris and no electrical arcing.
Describe how the performance of the BESS in a thermal runaway event has influenced site design.	§6. System design, construction, testing and decommissioning	**Compliant**	BESS thermal runaway report has influenced the site design with manufacturer defined layout and separation requirements, including minimum spacing between battery containers, clearances to walls/other

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
			equipment, and access space for maintenance, transport and fire response. LSFT was undertaken with only 150 mm separation between the initiating container A and closest container B, with wind predominantly blowing towards the container B, despite this conservative arrangement, no fire or thermal runaway propagation occurred. The project layout provides a greater minimum separation of 0.9 m between BESS. Although actual site wind conditions may be higher than those recorded during the test, the increased separation provides additional margin.
Confirm the proposed equipment undergone any full-scale fire testing or has been certified by a reputable body such as Underwriters Laboratory (UL 9540A).	§6. System design, construction, testing and decommissioning	**Compliant**	PowerTitan 2.0 BESS has undergone DNV large-scale fire testing, following the CSA TS-800:24 Large-scale Fire Test procedure, and also has UL 9540A unit-level testing by TÜV Rheinland. The LSFT created a fully developed fire in the initiating container, with deflagration panels opening as intended, but no fire or thermal runaway propagation to adjacent containers. The UL 9540A unit-level test also confirmed thermal runaway and cell-to-cell propagation, but no module-to-module propagation, no explosive gas discharge, no external flaming, no flying debris and no electrical arcing.
Confirm the type, purpose, and effect of any fire suppression system installed.	§6. System design, construction, testing and decommissioning	**Compliant**	BESS is provided with an FK5112 clean-agent fire suppression system, activated through smoke/heat detection and controlled via the FACP. Its purpose is to suppress/control a fire within the affected cabinet and limit escalation, while associated alarms, warning signs and abort/manual-auto controls support safe response. Sprinklers/aerosol systems are noted as optional. It must be noted that, whilst FK5112 is suitable for extinguishing electrical fires which may initiate electrochemical fires involving the cells, it is not capable of preventing cascading thermal runaway. FK5112 was originally produced and patented by manufacturer 3M under the product name Novec 1230. Novec 1230 was deployed during an incident at the McMicken BESS, Arizona, in 2019, and is one of the factors that led to four firefighters being seriously injured from an explosion. The clean agent suppressed the flames, but did not inhibit thermal runaway, which led to a build-up of flammable off-gases that were not vented from the container. In an August 2017 letter to the NFPA 855 committee during drafts of the NFPA standard, Novec 1230 manufacturer 3M stated that clean agents could not prevent or suppress cascading thermal runaway in Li-ion battery systems.
Confirm the BESS design is appropriate for the weather at the proposed location in terms of preventing water ingress and impact of temperature range on cooling systems.	§6. System design, construction, testing and decommissioning	**Compliant**	BESS enclosure rated IP55 / Type 3S for water ingress protection and an ambient operating range of -30°C to 50°C. The liquid cooling system is designed for the same -30°C to 50°C ambient range, uses an ethylene glycol solution, supporting temperature control in both hot and cold conditions.
Confirm the arrangements for ongoing monitoring of the BESS.	§6. System design, construction, testing and decommissioning	**TBC**	Ongoing BESS monitoring arrangements are to be confirmed, including whether monitoring will be undertaken from the substation control building and/or via remote monitoring systems. To be addressed post-consent.

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
Confirm the response time for onsite technical assistance in the event of an incident.	§6. System design, construction, testing and decommissioning	**TBC**	Onsite technical response times are to be confirmed once the operations team has been appointed.
Confirm how the BESS and associated equipment will be monitored, and what the process is for alerting the fire and rescue service.	§6. System design, construction, testing and decommissioning	**TBC**	Should be covered in ERP.
Confirm how the fire and rescue service will align their approach to handling calls to BESS sites to their unwanted fire signals position.	§6. System design, construction, testing and decommissioning	**TBC**	Consultation with the local FRS has not yet been completed. The section will require update once FRS advice has been obtained.
An effective and appropriate method of early fault detection within the batteries should be in place, making it possible to immediately disconnect the affected battery/batteries remotely. This may be achieved through an effective battery management system (BMS).	§8. Detection and monitoring	**Compliant**	The BMS includes a three-layer, BMU, CMU and BSC providing early fault detection through continuous cell voltage, temperature and current monitoring, with alarm/control circuits able to react when nominal values change. The BMS functional safety has been evaluated according to IEC/UL 60730-1 Annex H by TÜV Rheinland.
Identify if the battery technology contains specific systems that detect the early components of electrolyte degradation and 'off gassing', which may be helpful as an early warning. However, these systems should not be relied on alone to predict or prevent a thermal event.	§8. Detection and monitoring	**Compliant**	BESS includes a Li-ion Tamer off-gas detector, which is intended to detect early stage lithium-ion battery off-gassing before cell level thermal runaway via detection of electrolyte vapours, VOCs, CO and H_2.
State whether the battery technology provides temperature detection via the BMS as a critical first warning of thermal runaway.	§8. Detection and monitoring	**Compliant**	BMS provides temperature detection as an early warning layer, with the BMU monitoring cell temperatures across a -40°C to 125°C range. Temperature readings are taken on a frequency of 1 second. The BMS functional safety has been evaluated according to IEC/UL 60730-1 Annex H by TÜV Rheinland.
The risk management process should include detection systems to alert the operator of an event at the site.	§8. Detection and monitoring	**TBC**	
Appropriate automatic detection such as smoke, gas, or radiant heat detectors, as well as continuous combustible gas monitoring within BESS cabinets/enclosures should be provided in all BESS. Where systems are installed, gas detectors should alarm when flammable gas is detected, shut down the BESS, and initiate full exhaust ventilation. Sensor placement should ensure that gases are detected quickly enough for an effective response. Sensor placement should take into account the device's response times and the type of gas being monitored (for example, hydrogen, carbon monoxide, or other volatile organic compounds).	§8. Detection and monitoring	**Compliant**	BESS includes automatic smoke, heat and flammable gas detection, with continuous gas monitoring via a Li-ion Tamer off-gas/flammable gas detector. When the gas concentration reaches 10% LEL, the flammable gas detector controls the opening of the emergency ventilation system. The flammable gas detector outputs an alarm dry contact signal to the Fire Alarm Control Panel (FACP) and communicates with the BSC through RS485, the BSC reads the alarm and fault signals for shutdown. The NFPA 69 study also evaluated the suitability of gas detection time at detector locations and included the emergency ventilation ramp-up time in the modelling, confirming the system should be capable of maintaining an average concentration of off-gases lower than 25% LEL. The UL 9540A cell-level test report shows the off-gas should comprise approx. 40%vol hydrogen, which is naturally buoyant, justifying the location of detectors at the top of the container. When an alarm signal is generated by both the smoke and radiant heat detectors, the external alarm bell will be activated and the FK5112 fire suppression system will be activated. This level of alarm will also stop the fans of the ventilation system to prevent ingress of oxygen fuelling a fire. **BayWa should confirm that:** **1. The product can be provided without the FK5112 fire suppressant, as**

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
			this increases the risk of explosion. **2. Deployment of the FK5112 would not override the explosion prevention system.**
As an alternative to actively managing the release of flammable gas, deflagration panels could be used to deal with any over-pressurisation of the BESS cabinet/enclosure. Any deflagration panels present should be conspicuously indicated.	§8. Detection and monitoring	**TBC**	BESS uses both active gas management (via the flammable gas detector paired with forced ventilation system) and provides the option for passive deflagration protection via deflagration panels. The UL 9540A report states that mechanical ventilation is used as a protection measure evaluated to NFPA 69. If opted for, the battery container can be equipped with 6 explosion vent plates on the top of the container, which open when internal pressure is 0.01 MPa higher than external pressure. **It is recommended that the deflagration panels are included in the design. Deflagrations can occur after an initial fire event, past the survivability limits of the NFPA 69 explosion prevention system. It is likely that first responders will be present at this point. If deflagration panels are not installed, any deflagration overpressure will be vented via the weakest point in the container - this would be the container doors, which are at ground level and potentially facing the first responders. So, without deflagration vents installed, the risk to first responders from explosion effects would be greater.**
External audible and visual warnings should be clearly visible to operational crews, along with addressable identification, control, and indicating equipment. This equipment should be linked to: - Battery management system (when a thermal runaway event is identified) - Detection and suppression system activation This will help operational crews understand what the warning relates to, improving their decision-making and incident planning.	§8. Detection and monitoring	**TBC**	The battery containers will be equipped with both audible and visual indicators - sounder beacons and alarm bells. The sounder beacon will be triggered when a Level 1 Alarm is initiated. This is when any one of the smoke, heat, or flammable gas detectors send an alarm signal. The alarm bells will be triggered when a Level 2 Alarm is initiated. This is when both the smoke and heat detectors send an alarm signal, indicating a fire is ongoing. **TBC if the external alarms area also linked with BMS fault signals.**
Confirm the suppression system that will be installed within the battery enclosures and the justification for this selection. Suppression systems will either use inert gas or aerosol suppression, or water-based suppression. The type of suppression system should be dictated by the battery technology used within the BESS, and not by site conditions or constraints. For example, gaseous suppression should not be used to compensate for the lack of availability and accessibility of water supplies at a particular site.	§9. Suppression systems	**Partially compliant**	BESS is provided with an FK5112 clean-agent fire suppression system, activated through smoke/heat detection and controlled via the FACP. Its purpose is to suppress/control a fire within the affected cabinet and limit escalation, while associated alarms, warning signs and abort/manual-auto controls support safe response. Sprinklers/aerosol systems are noted as optional. It must be noted that, whilst FK5112 is suitable for extinguishing electrical fires which may initiate electrochemical fires involving the cells, it is not capable of preventing cascading thermal runaway. FK5112 was originally produced and patented by manufacturer 3M under the product name Novec 1230. Novec 1230 was deployed during an incident at the McMicken BESS, Arizona, in 2019, and is one of the factors that led to four firefighters being seriously injured from an explosion. The clean agent suppressed the flames, but did not inhibit thermal runaway, which led to a build-up of flammable off-gases that were not vented from the container.

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
			In an August 2017 letter to the NFPA 855 committee during drafts of the NFPA standard, Novec 1230 manufacturer 3M stated that clean agents could not prevent or suppress cascading thermal runaway in Li-ion battery systems. **It is recommended that BayWa request that the product is provided without the FK5112 fire suppressant, as this increases the risk of explosion.**
Provide evidence that the suppression system selected is suitable for its intended purpose. If a gaseous suppression system is selected, it must be specific to the use of the BESS in question and designed by a competent person (note: **gaseous suppression systems have limited cooling ability and cannot suppress thermal runaway, which will continue even without oxygen**.) Note: The primary role of a fire suppression system in a BESS is to **prevent a fire in the ancillary electrical equipment spreading to the battery modules**. It may have a limited effect to protect the BESS from an external fire spreading to it. All claims of performance of suppression systems need to be supported with appropriate evidence for that specific use case.	§9. Suppression systems	**Partially compliant**	BESS is provided with an FK5112 clean-agent fire suppression system, activated through smoke/heat detection and controlled via the FACP. Its purpose is to suppress/control a fire within the affected cabinet and limit escalation, while associated alarms, warning signs and abort/manual-auto controls support safe response. Sprinklers/aerosol systems are noted as optional. It must be noted that, whilst FK5112 is suitable for extinguishing electrical fires which may initiate electrochemical fires involving the cells, it is not capable of preventing cascading thermal runaway. FK5112 was originally produced and patented by manufacturer 3M under the product name Novec 1230. Novec 1230 was deployed during an incident at the McMicken BESS, Arizona, in 2019, and is one of the factors that led to four firefighters being seriously injured from an explosion. The clean agent suppressed the flames, but did not inhibit thermal runaway, which led to a build-up of flammable off-gases that were not vented from the container. In an August 2017 letter to the NFPA 855 committee during drafts of the NFPA standard, Novec 1230 manufacturer 3M stated that clean agents could not prevent or suppress cascading thermal runaway in Li-ion battery systems. **It is recommended that BayWa request that the product is provided without the FK5112 fire suppressant, as this increases the risk of explosion.**
If it is proposed that suppression systems are not required in the design, confirm the fire and rescue service are satisfied that alternative controls are in place to prevent a fire or other thermal event in the BESS cabinet/enclosure of origin, from propagating to adjacent equipment. Note: It is becoming increasingly common for BESS to be designed and manufactured without any suppression system, and to be specifically designed so that a fire can be contained within the BESS cabinet/enclosure. **Even in cases where no water-based suppression system is installed, local water sources will always be needed for exposure protection to limit cabinet-to-cabinet fire spread**.	§9. Suppression systems	**N/A**	Firewater is to be provided on-site, Large-scale fire testing of the Sungrow PowerTitan 2.0 showed that the battery containers are capable of preventing fire propagation to adjacent containers if the layout recommended by Sungrow is adopted (ajusting to account for foreseeable wind conditions, as necessary).
Where dry pipe or fire service inlets are provided for BESS cabinets/enclosures, they should be clearly marked with appropriate signage in a prominent position for the fire and rescue service to use. This signage should clearly indicate which cabinets/enclosures each inlet serves. For sites where a dry pipe system is installed, the following considerations apply: - Fire and rescue service attendance is dependent on many factors. The developer and the relevant fire and rescue service should discuss attendance expectations early in the planning process, as response times and weight of attendance will vary between services. - Fire and rescue service inlets need to be positioned where operational crews are safe from the effects of a BESS event. Poor placement may render the system unusable.	§9. Suppression systems	**N/A**	The PowerTitan 2.0 does not offer a dry pipe connection.

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
- An appropriately sized water supply must be provided in a location that allows quick access for the fire and rescue service.			
Any calculations to determine the required water supply for an appropriate suppression system should be completed by a competent person. They should take into account the appropriate risk and duration of any fire.	§9. Suppression systems	**TBC**	No water-based suppression systems are to be installed directly into the battery containers. Hydraulic calculations for the firewater system for boundary cooling are to be developed in the detailed design phase.
BESS containers should be fitted with explosion protection or deflagration venting appropriate to the hazard and battery technology deployed. Designs should be developed by competent persons, with design suitability able to be evidenced by utilising British Standards or equivalent National Fire Protection Association (NFPA) Standards, as follows: BS EN 16009:2011 Flameless Explosive Venting Devices BS EN 14373:2021 Explosion Suppression Systems BS EN 14797:2007 Explosion Venting Devices NFPA 68 Standard on Explosion Protection by Deflagration Venting NFPA 69 Standard on Explosion Prevention Systems	§10. Explosion control	**TBC**	BESS includes explosion/deflagration protection appropriate to the LFP battery hazard. The deflagration venting system has been evaluated against NFPA 68, and the emergency ventilation/explosion prevention strategy has been assessed through NFPA 69 CFD modelling. The explosion prevention system comes as standard with the PowerTitan 2.0, whilst the deflagration panels are optional. **It is recommended that the deflagration panels are included in the design. Deflagrations can occur after an initial fire event, past the survivability limits of the NFPA 69 explosion prevention system. It is likely that first responders will be present at this point. If deflagration panels are not installed, any deflagration overpressure will be vented via the weakest point in the container - this would be the container doors, which are at ground level and potentially facing the first responders. So, without deflagration vents installed, the risk to first responders from explosion effects would be greater.**
Exhaust systems designed to prevent deflagration should keep the environment below 25% of the lower explosive limit (LEL).	§10. Explosion control	**Compliant**	The NFPA 69 CFD report demonstrates the emergency ventilation system should be capable of maintaining the average concentration of off-gas below 25% LEL, if the worst-case event aligns with the scenario modelled.
Flames and materials discharged during venting should be directed safely outside. Measures must be in place to ensure they do not cause fire spread beyond the affected unit, or pose additional risks to people near the originating BESS cabinet or enclosure. The likely path of any vented gases or materials should be identified in emergency response plans to reduce the risk to responders.	§10. Explosion control	**TBC**	Should be covered in ERP. Forced ventilation system outlets and deflagaration panels (if opted for) are located on the roof the containers, so would not direct flames or debris towards people. This shall be clearly stated in the ERP. **TBC if deflagration panels are to be opted for.**
The position of any venting should take account of the likelihood of weather-related ingress of water. The aim is to minimise the risk of water damage during the ordinary functioning of the BESS.	§10. Explosion control	**Compliant**	The container is rated IP55, the ventilation devices are also IP55. IP55 provides protection against water jets.
Designs should also give consideration to leakage paths for explosive vapour via cable trunks and routes to other structures, which could result in a secondary remote vapour cloud explosion, as in the Dahongmen incident in Beijing in 2021.	§10. Explosion control	**TBC**	To be considered in detailed design.
Explosion/deflagration strategies should be built into the emergency response plan to ensure that responders understand the strategies and how their actions may influence them. For example, personnel may open the door to a unit, which may negate the potential effect of deflagration vents due to an alternative path of least resistance having been created.	§10. Explosion control	**TBC**	Shall be covered in ERP.
Where emergency ventilation is used to mitigate an explosion hazard, the isolation/disconnect for the ventilation system should be clearly marked. Signage should warn personnel or operational crews not to disconnect the power supply to the ventilation system during an evolving incident (NFPA (2023) Standard for the Installation of Stationary Energy Storage Systems, paragraph G.1.4.3.3). The remaining unaffected cells need to continue to be maintained within their operating temperature.	§10. Explosion control	**TBC**	Shall be covered in ERP.

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
The chosen method of explosion control system should be supported by evidence from a competent person or an approved institution, such as Underwriters Laboratories (UL) or the NFPA.	§10. Explosion control	**Compliant**	Deflagration venting system has been evaluated using against NFPA 68 by TÜV Rheinland, which confirmed that the proposed venting arrangement would limit the maximum internal overpressure beneath the maximum overpressure that can be endured by the enclosure. Pressure and accompanying flames would be directed upwards, away from people. Emergency ventilation/explosion prevention system has been evaluated against NFPA 69 by Jensen Hughes. The method of assessment against NFPA 69 was CFD modelling, which showed that the system should be capable of maintaining the average concentration of off-gas below 25% LFL. However, it must be noted that this is true for the average concentration, but there were pockets of gas which reached approx. 50% LFL in the container.
Whilst incidents involving BESS are relatively rare at the time of publication, they can result in extended disruption and may impact business continuity in the adjacent area. Since UK fire safety principles and design documents are based on the assumption that an incident or fire will occur (typically one fire at one time), **applicants or developers should assess the potential impact of such an incident on the surrounding area**. This should include consideration of business continuity, neighbourhood disruption, and wider impact. The assessment should be inextricably linked to the battery technology type, the expected incident response from the fire and rescue service (controlled burn or active firefighting), and the proximity of any significant transport infrastructure and public buildings. The assessment should recognise that any incident may last several hours. It should outline any disruption to the local and/or national economy.	§10. Explosion control	**TBC**	To be considered in detailed design. The location of the BESS is not directly adjacent to any major transport infrastructure or public buildings such that it poses a threat to ongoing operation of public infrastructure in the event a fire.
Where there are concerns that a potential toxic vapour cloud could affect nearby sensitive receptors, developers may also wish to commission an analysis of fire gas plume modelling under different scenarios. This helps to understand the impact on local communities from conditions such as prevailing wind. Such modelling, if undertaken, should be completed by a competent person.	§10. Explosion control	**Compliant**	No receptors are in the immediate vicinity of the BESS that has major impact from a BESS incident. **This can be demonstrated by toxic gas dispersion modelling of Sungrow PowerTitan 2.0 contours on Foigha BESS site within the OBSMP.**
Demonstrate provision of fire-resistant materials that will prevent direct flame impingement or radiated heat affecting adjacent BESS and prevent the incident developing beyond BESS of origin.	§12. Spacing between BESS	**Compliant**	PowerTitan 2.0 includes fire resistant fillings between the walls and partitions to provide an additional fire insulation layer, with the battery, PCS and integration compartments, which are mutually independent. Large scale fire testing (LSFT) conducted for the containers, in accordance with the CSA TS-800 methodology, demonstrated that the cells within an adjacent container should not be ignited if the containers are separated by 150 mm. This has been aided by the fire resistance of the container materials.
All other vegetation within the curtilage of the site should be managed appropriately to avoid increased risk of a fire on the site.	§13. Site conditions	**TBC**	
Confirm the Ingress Protection (IP) ratings of the battery cabinets/enclosures and that the proposed firefighting strategy will not pose a risk of water ingress.	§14. Water supplies	**Compliant**	BESS enclosure is confirmed as IP55, however firefighting strategy has not been assessed to avoid water ingress during emergency response. IP55 protects against water jets, so is suitable for adoption of applying water spray, as per the firefighting strategy.
Any required installations of fire hydrants and connections to any dry pipe on the BESS site should comply with BS 9990 Non-automatic firefighting systems in buildings code of practice (current edition). They should be identified in accordance with BS 3251 Indicator Plates for Fire Hydrants (current edition).	§14. Water supplies	**TBC**	Specification of fire hydrants to be completed in detailed design phase.

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
Static water storage tanks should be clearly marked with appropriate signage and be easily accessible to fire and rescue service vehicles.	§14. Water supplies	**TBC**	Site-wide signage to be specified in detailed design phase.
The outlets and connections of any static water storage tanks should be agreed with the local fire and rescue service.	§14. Water supplies	**TBC**	Specification of fire hydrants and static water tank to be completed in detailed design phase in liaison with the local FRS.
Any outlets and hard suction points of static water storage tanks should be protected from mechanical damage (for example, through use of bollards).	§14. Water supplies	**TBC**	Specification of static water tank to be completed in detailed design phase.
Signage to indicate the presence of a BESS should be installed in a suitable and visible location on the outside of BESS cabinets/enclosures. Safety signage should be installed in accordance with Health and Safety (Safety Signs and Signals) Regulations. Signage should also include of the following details: - Relevant hazards posed - The type of technology associated with the BESS - Any suppression system fitted - 24/7 emergency contact information signs on the exterior of a building or enclosure. (This should be sized such that at least one sign is legible at night at a distance of either 30m or from the site boundary, whichever is closer, as stated in NFPA 855:2023).	§15. Signage	**TBC**	Site-wide signage to be specified in detailed design phase.
How the fire and rescue service will be alerted	§16. Outline battery safety management plan	**TBC**	Shall be covered in ERP.
A facility description, including infrastructure details, operations, number of personnel, and operating hours.	§16. Outline battery safety management plan	**TBC**	Shall be covered in ERP.
A site plan depicting key infrastructure: site access points and internal roads, firefighting facilities (for example, water tanks, pumps, booster systems, fire hydrants, and fire hose reels), drainage, and neighbouring properties.	§16. Outline battery safety management plan	**TBC**	Shall be covered in ERP.
Details of the emergency response coordinator, including the subject-matter expert for the site.	§16. Outline battery safety management plan	**TBC**	Shall be covered in ERP.
Safe access to and within the facility for emergency vehicles and responders, including to key site infrastructure and fire protection systems.	§16. Outline battery safety management plan	**TBC**	Shall be covered in ERP.
Details and explanation of warning systems and alarms on site and locations of alarm annunciators with alarm details (smoke, gas, temperature).	§16. Outline battery safety management plan	**TBC**	Shall be covered in ERP.
Hazards and potential risks at the facility and details of their proposed management.	§16. Outline battery safety management plan	**TBC**	Shall be covered in ERP.
The role of the fire and rescue service at incidents involving a fire, thermal event or fire spreading to the site.	§16. Outline battery safety management plan	**TBC**	Shall be covered in ERP.
Emergency shutoff or isolator locations.	§16. Outline battery safety management plan	**TBC**	Shall be covered in ERP.
The layout of structures.	§17. Site plans and maps	**TBC**	
Any areas where hazardous and flammable materials are stored on site (location of gas cylinders, process areas, chemicals, piles of combustible wastes, oil and fuel tanks).	§17. Site plans and maps	**TBC**	
All permanent ignition sources on the site and show they are a minimum of 6m away from combustible and flammable waste.	§17. Site plans and maps	**TBC**	
Any areas where combustible waste is being treated or stored, including non-waste material.	§17. Site plans and maps	**TBC**	
All separation distances.	§17. Site plans and maps	**TBC**	
Any areas where combustible liquid wastes are being stored.	§17. Site plans and maps	**TBC**	
Main access routes for fire engines and any alternative access.	§17. Site plans and maps	**TBC**	
Access points around the site perimeter to assist firefighting.	§17. Site plans and maps	**TBC**	

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
Hydrants and water supplies.	§17. Site plans and maps	**TBC**	
Areas of natural and unmade ground.	§17. Site plans and maps	**TBC**	
The location of fixed plant or storage location of mobile plant when not in use.	§17. Site plans and maps	**TBC**	
The location of spill kits.	§17. Site plans and maps	**TBC**	
Any other relevant site-specific information.	§17. Site plans and maps	**TBC**	
Drainage runs, pollution control features such as drain closure valves, and fire water containment systems such as bunded or kerbed areas (this may be easier to show on a separate drainage plan).	§17. Site plans and maps	**TBC**	
Plans provided must show all sensitive receptors within a 1km radius of the site that could be affected by a fire. Examples of sensitive receptors may include: - Schools, hospitals, nursing and care homes, residential areas, and workplaces. - Protected habitats, watercourses, groundwater, boreholes, wells, and springs supplying water for human consumption (Further habitat information can be found on the - Defra MAGiC map). - Roads, railways, bus stations, pylons (on or immediately adjacent to the site only), utilities, and airports. Plans should have a compass rose showing north and the prevailing wind direction.	§17. Site plans and maps	**Complaint**	The nearest residential properties are approx. 174 m from the nearest battery container. Nearest farm building is approx. 248 m from the nearest battery container. Road R392 in 188 m approx. 188 m from the nearest battery container. Foigha bar and restaurent is approx. 386 m from the nearest battery container. Other residences and farmhouses are present in 1km radius of the BESS site, as reported on in the OBSMP. No receptors are in the immediate vicinity of the BESS are expected to be adversely impacted in the event of a BESS fire. However, as three receptor groups (Residential Properties 9, Residential Properties 10, Main Road - R392) are downwind of the prevailing wind direction, it is recommended to conduct a toxic plume dispersion study to inform detailed emergency response arrangements.
The operator should develop a post-incident recovery plan that addresses the potential for re-ignition of BESS and de-energising the system. The plan should also include provisions for removal and disposal of damaged equipment and contaminated fire water effluent.	§19. Recovery	**TBC**	

2. NFPA 855 Guidance Assessment Findings

Table 7 summarises the secondary safety issues findings of the compliance review against the NFPA 855 guidance Error! Reference source not found..

Table 7: NFPA 855 Guidance Assessment Findings - Secondary Safety Issues

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
Construction documents Plans and specifications include 1. Location and layout diagram of the room or area in which the ESS is to be installed 2. Details on hourly fire-resistant-rated assemblies provided or relied upon in relation to the ESS 3. The quantities and types of ESS units 4. Manufacturer's specifications, ratings, and listings of ESSs 5. Description of energy storage management systems and their operation 6. Location and content of required signage 7. Details on fire suppression, smoke detection, fire detection, gas detection, thermal management, exhaust ventilation, and explosion control and prevention systems, where installed 8. Support arrangement associated with the installation, including any required seismic support	NFPA 855 §4.2.1.1	**Partially compliant**	Sungrow's document confirms BESS unit specification, capacity, BMS, fire detection, gas detection, ventilation, fire suppression and explosion control systems. Site layout information is available for access and spacing, however signage, support arrangements, full construction issue drawings and final project-specific documentation should be confirmed.
The following test data, evaluation information and calculations shall be provided: (1) Fire and explosion testing data in accordance with Section 9.2	NFPA 855 §4.2.1.3	**Compliant**	The DNV large scale fire test demonstrated that the PowerTitan 2.0 BESS fire remained limited to the initiating container A. The flames lasting for several hours in container A and deflagration panels opening as intended, but no fire or thermal runaway propagation was observed to adjacent containers B, C or D. Adjacent containers remained below critical thermal runaway temperatures, with no fire spread into their interiors. UL 9540A unit-level testing confirms thermal runaway and cell-to-cell propagation, but no module-to-module propagation, no explosive gas discharge, no external flaming, no flying debris and no electrical arcing.
(2) Hazard mitigation analysis (HMA) in accordance with Section 4.4	NFPA 855 §4.2.1.3	**TBC**	A Hazard Mitigation Analysis (HMA) should be conducted in the detailed design phase to demonstrate compliance with NFPA 855.
(3) Calculations or modelling data to determine compliance with explosion control and prevention in accordance with 9.7.6.7.3	NFPA 855 §4.2.1.3	**Compliant**	Deflagration venting system has been evaluated using against NFPA 68 by TÜV Rheinland, which confirmed that the proposed venting arrangement would limit the maximum internal overpressure beneath the maximum overpressure that can be endured by the enclosure. Pressure and accompanying flames would be directed upwards, away from people. Emergency ventilation/explosion prevention system has been evaluated against NFPA 69 by Jensen Hughes. The method of assessment against NFPA 69 was CFD modelling, which showed that the system should be capable of maintaining the average concentration of off-gas below 25% LFL. However, it must be noted that this is true for the average concentration, but there were pockets of gas which reached approx. 50% LFL in the container.
(4) Other test data, evaluation information, or calculations as required elsewhere in this standard. If modelling data is provided, validation of the modelling results shall also be included.	NFPA 855 §4.2.1.3 NFPA 855 §4.2.1.4	**TBC**	
Operations and maintenance manuals shall be prepared by ESS and supplied to personnel responsible	NFPA 855 §4.2.3	**TBC**	
Commissioning Plan shall be provided	NFPA 855 §4.2.4	**TBC**	
Emergency Planning and Training ESS emergency planning and training shall be provided by the owner of the ESS or their authorized representative.	NFPA 855 §4.3	**TBC**	

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
The emergency operations plan shall be reviewed annually.	NFPA 855 §4.3.2.1.5	**TBC**	
The emergency response plan shall be in accordance with Chapters 1 through 3, and Chapters 17 through 23 of NFPA 1660	NFPA 855 §4.3.3.2.1	**TBC**	
Facility Staff Training	NFPA 855 §4.3.2.2	**TBC**	
The emergency response plan shall, at a minimum, address the following: (1) Mitigation (2) Preparedness (3) Response (4) Recovery	NFPA 855 §4.3.3.2.2	**TBC**	
Personnel responsible for the installation of the ESS shall be trained in the procedures included in the emergency response plan in 4.3.3 prior to the ESS arriving onsite.	NFPA 855 §4.3.3.3.3	**TBC**	
Refresher training shall be conducted by ESS facility operations personnel at least annually. And records kept	NFPA 855 §4.3.3.3.4	**TBC**	
The emergency operations plan shall include: (1) Roles and responsibilities (2) Procedures for safe shutdown, de-energizing, or isolation of equipment and systems under emergency conditions to reduce the risk of fire, electric shock, and personal injuries (3) Emergency procedures and notifications to be undertaken in the event of emergency alarms, fire, explosion, release of liquids or vapors, damage to critical moving parts, or other potentially dangerous conditions (4) Response considerations similar to a safety data sheet (SDS) that will address response safety concerns and extinguishment when an SDS is not required (5) Other procedures as determined necessary by the AHJ to provide for the safety of occupants and emergency responders	NFPA 855 §4.3.4	**TBC**	
Hazard Mitigation Analysis (HMA) Failure modes in 4.4.2.1: (1) A thermal runaway or mechanical failure condition in a single ESS unit (2) Failure of an energy storage management system or protection system that is not covered by the product listing failure modes and effects analysis (FMEA) (3) Failure of a required system including, but not limited to HVAC, liquid cooling system, BMS, communication system, or other critical systems that might impact normal operations (4) Other failure modes required by the AHJ	NFPA 855 §4.4	**TBC**	
HMA The HMA shall evaluate the reliability and survivability of the following critical safety components or systems, during a thermal runaway propagation or single failure event: Exhaust ventilation, Smoke detection, Fire detection, Fire suppression, Combustible concentration reduction (CCR) system, Gas detection, Explosion control and prevention	NFPA 855 §4.4.2.3	**TBC**	
The AHJ shall be permitted to approve the hazard mitigation analysis as documentation of the safety of the ESS installation if the consequences of the analysis demonstrate the following:(1) Fires will be contained within unoccupied ESS rooms for the minimum duration of the fire resistance rating specified in 9.7.5.(2) Fires and products of combustion will not prevent occupants from evacuating to a safe location.(3) Deflagration hazards will be addressed by an explosion control and prevention system	NFPA 855 §4.4.3	**TBC**	
Combustible Storage 4.5.1 Combustible materials not related to the ESS shall not be stored in dedicated rooms, cabinets, or enclosures containing ESS equipment. 4.5.2 Combustible materials related to the ESS shall not be stored within 3 ft (0.9 m) from ESS equipment. 4.5.3 Combustible materials in occupied work centers shall not be stored within 3 ft (0.9 m) of ESS equipment. 4.5.4 Combustible materials in occupied work centers shall comply with Section 10.19 of NFPA 1 or other applicable fire codes.	NFPA 855 §4.5	**TBC**	
Listings. ESSs shall be listed in accordance with UL 9540, unless specifically exempted in other sections of this standard.	NFPA 855 §4.6.1	**Compliant**	The ESS has been tested to UL 9540:2023 with a pass result. It is also certified against IEC 62933-5-2:2020, which provides equivalent European market safety evidence for grid scale energy storage systems.

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
Environment - The temperature, humidity, and other environmental conditions in which an ESS is located shall be maintained in accordance with the listing and the manufacturer's specifications.	NFPA 855 §4.6.7	**Compliant**	BESS enclosure is rated IP55 / Type 3S for water ingress protection and has an ambient operating range of -30°C to 50°C. The liquid cooling system is designed for the same -30°C to 50°C ambient range and uses ethylene glycol solution.
Enclosures shall be of a non-combustible construction.	NFPA 855 §4.6.12.1	**Compliant**	The DNV large scale fire test demonstrated that the PowerTitan 2.0 BESS fire remained limited to the initiating container A. The flames lasting for several hours in container A and deflagration panels opening as intended, but no fire or thermal runaway propagation was observed to adjacent containers B, C or D. Adjacent containers remained below critical thermal runaway temperatures, with no fire spread into their interiors. This is a demonstration of the non-combustible nature of the containers.
Signage Approved signage shall be provided in the following locations: (1) On the front of doors to rooms or areas containing ESSs or in approved locations near entrances to ESS rooms (2) On the front of doors to outdoor occupiable ESS containers or in approved locations near ESS site entrances (3) In approved locations on outdoor ESSs that are not enclosed in occupiable containers or otherwise enclosed	NFPA 855 §4.7.5.1	**TBC**	
ESSs shall be located or protected to prevent physical damage from impact where such risks are identified.	NFPA 855 §4.7.6.1	**TBC**	
Vehicle impact protection consisting of guard posts or other approved means shall be provided where ESSs are subject to impact by motor vehicles.	NFPA 855 §4.7.6.2	**TBC**	
Security of Installations. ESSs shall be secured against unauthorized entry and safeguarded in an approved manner.	NFPA 855 §4.7.7.1	**TBC**	
Security barriers, fences, landscaping, and any other enclosures shall not inhibit the required air flow or exhaust from the ESS and its components.	NFPA 855 §4.7.7.2	**TBC**	
Required egress doors shall be provided with emergency lighting as required by the local building code.	NFPA 855 §4.7.9.2	**TBC**	
Required egress door(s) shall open in the direction of egress.	NFPA 855 §4.7.9.3	**TBC**	
Required egress door(s) shall be equipped with listed panic hardware.	NFPA 855 §4.7.9.4	**TBC**	
Fire Barriers. Rooms or spaces containing ESSs shall be separated from other areas of the building by fire barriers with a minimum 2-hour fire resistance rating and horizontal assemblies with a minimum 2-hour fire resistance rating and constructed in accordance with the local building code, unless modified in Chapters 9 through 13.	NFPA 855 §4.7.14	**N/A**	
Smoke and Fire Detection. Where required elsewhere in this standard, areas containing ESSs shall be provided with smoke detection, thermal imaging fire detection, or radiant-energy-sensing system in accordance with NFPA 72, unless modified by the requirements in Chapters 9 through 13.	NFPA 855 §4.8.1	**Compliant**	BESS includes automatic smoke, heat and flammable gas detection, with continuous gas monitoring via a Li-ion off-gas/flammable gas detector. Smoke detector - EN54-7 Heat detector - EN 54-5 Li-ion Tamer gas detector - UL/IEC 61010, CSA C22.2 No. 61010, EN 61326-1 EN 54 is the European equivalent of NFPA 72, so the Sungrow PowerTitan 3.0 meets this requirement.
Fire Control and Suppression. Automatic fire control and suppression systems shall comply with the following standards, or their equivalent, unless modified in Chapters 9 through 17: 1, NFPA 13 2. NFPA 12 3. NFPA 15	NFPA 855 §4.9.4.1	**Compliant**	BESS is provided with an FK5112 clean-agent fire suppression system, activated through smoke/heat detection and controlled via the FACP. Its purpose is to suppress/control a fire within the affected cabinet and limit escalation.

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
4. NFPA 750 5. NFPA 770 6. NFPA 2001 7. NFPA 2010			FK5112 - VDS 2344, VDS 2454 - European certification evidence for gas extinguishing systems.
Other automatic fire control and suppression systems shall be permitted based on reports issued as a result of large-scale fire and explosion testing in accordance with Section 9.2.	NFPA 855 §4.9.4.2	**N/A**	No fire control or suppression systems were tested in the large-scale fire testing of the PowerTitan 2.0.
Fire control and suppression systems used as a component of thermal runaway propagation protection (TRPP) systems shall meet the requirements of 9.7.6.6.	NFPA 855 §4.9.4.3	**N/A**	The PowerTitan 2.0 does not include a TRPP system.
Emergency Power Supply Systems. Critical safety systems that rely on power shall be provided with reliable EPSS or SEPSS power in accordance with NFPA 110 or NFPA 111.	NFPA 855 §4.10	**TBC**	
Critical Safety System Control and Power - multiple ESS enclosure. One fault shall not impair the operation of critical systems of other enclosures.	NFPA 855 §4.11	**TBC**	
General System interconnections shall comply with Section 5.2 through Section 5.4, as applicable	NFPA 855 §5.1	**TBC**	
Disconnecting Means. A readily accessible disconnecting means for the ESS shall be provided.	NFPA 855 §5.2	**TBC**	
The system installer or commissioning agent shall prepare a written commissioning plan that provides a description of the means and methods necessary to document and verify the system and its associated controls and safety systems, as required by this standard, are in proper working condition.	NFPA 855 §6.1	**TBC**	
System Operation. All ESSs shall be operated in accordance with the manufacturer's instructions and the operation and maintenance documentation.	NFPA 855 §7.1	**TBC**	
The operation and maintenance documentation shall include the following: (1) Procedures for the startup and shutdown of the ESS and associated equipment (2) Procedures for inspection and testing of associated alarms, interlocks, and controls (3) Procedures for maintenance and operation of the following, where applicable: (a) Energy storage management systems (ESMS) (b) Fire protection equipment and systems (c) Spill control and neutralization systems (d) Exhaust and ventilation equipment and systems (e) Gas detection systems (f) Other required safety equipment and systems	NFPA 855 §7.1.1	**TBC**	
System Maintenance. The ESS shall be maintained in accordance with the system manufacturer's instructions.	NFPA 855 §7.2	**TBC**	
The maintenance documentation shall include a detailed schedule covering all affected equipment and the activities to be performed.	NFPA 855 §7.2.1	**TBC**	
Maintenance shall be performed by qualified individuals.	NFPA 855 §7.2.2	**TBC**	
Maintenance documentation indicating the maintenance action taken, the date of the actions, who implemented the action, and the results associated with the action shall be maintained ad required by NFPA 855 §6.3.	NFPA 855 §7.2.3	**TBC**	
Maintenance documentation shall record information on any repair, reneawal, or renovation made to the ESS.	NFPA 855 §7.2.4	**TBC**	
Training shall be provided to all those responsible for system operation and maintenance.	NFPA 855 §7.2.5	**TBC**	
Training on system operation and maintenance shall be provided by the system owner or their designated agent.	NFPA 855 §7.2.5.1	**TBC**	
After recommissioning the ESS, training on any changes to the procedures and documentation related to the operation and maintenance of the system shall be provided to the owner and operators.	NFPA 855 §7.2.5.2	**TBC**	
Updated information shall be transmitted to the AHJ* if the recommissioned system presents a change in the hazard. *Whilst the AHJ is not a position held in the UK, any changes to the system that present a change in the hazard must be communicated to all relevant stakeholders.	NFPA 855 §7.2.5.3	**TBC**	

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
Training records of site operations and maintenance personnel shall be retained and accessible to the AHJ*, indicating the training taken, the name(s) of those taking the training, and the training date. *Whilst the AHJ is not a position held in the UK, this information should be available to the site owner/operator, as they are responsible for the health and safety of their employees and any subcontractors operating on their property.	NFPA 855 §7.2.5.4	**TBC**	
System Testing. System testing shall be performed when required by the operating instructions or maintenance documentation in accordance with testing procedures provided by the ESS manufacturer.	NFPA 855 §7.3.1	**TBC**	
A record of all testing shall be maintained in accordance with the requirements of NFPA 855 §6.3.	NFPA 855 §7.3.2	**TBC**	
Testing records shall be permitted to be made available electronically.	NFPA 855 §7.3.3	**TBC**	
Fire and Explosion Testing Where required elsewhere in this standard, fire testing in accordance with Section 9.2 shall be conducted on a representative ESS in accordance with UL 9540A and large-scale fire testing to collect data for gas production at a cell level, thermal runaway propagation potential at a module level, and thermal runaway propagation potential between ESSs.	NFPA 855 §9.2.1	**Compliant**	The DNV large scale fire test demonstrated that the PowerTitan 2.0 BESS fire remained limited to the initiating container A. The flames lasting for several hours in container A and deflagration panels opening as intended, but no fire or thermal runaway propagation was observed to adjacent containers B, C or D. Adjacent containers remained below critical thermal runaway temperatures, with no fire spread into their interiors. UL 9540A testing has been completed for the representative BESS, including cell, module and unit-level assessment. The unit-level test confirms thermal runaway and cell-to-cell propagation occurred, but there was no module-to-module thermal runaway propagation, no external flaming, no explosive gas discharge, no flying debris and no electrical arcing.
Where cell thermal runaway results in the release of flammable gases during a cell- or module-level test, an additional unit-level test shall be conducted involving intentional ignition of the vent gases to assess the fire propagation hazard.	NFPA 855 §9.2.1.2	**Compliant**	UL 9540A testing has been completed for the representative BESS, including cell, module and unit-level assessment.
The large-scale fire testing in accordance with 9.2.1.2 shall be conducted or witnessed and resported by an approved testing laboratory to characterise the composition of the gases generated and show that a fire involving one ESS unit will not propagate to an adjacent unit,	NFPA 855 §9.2.1.2.1	**Compliant**	The LSFT for the PowerTitan 2.0 was conducted by DNV China Company Limited (DNV China) with support from Mark Kellenberger (DNV Canada, Ltd.) and Martin Plass (ZeroPlus Consulting). During the test, the fire remained limited to the initiating container A. The flames lasting for several hours in container A and deflagration panels opening as intended, but no fire or thermal runaway propagation was observed to adjacent containers B, C or D. Adjacent containers remained below critical thermal runaway temperatures, with no fire spread into their interiors. Gases produced during the test were analysed for major components including hydrogen, carbon monoxide, carbon dioxide, and hydrocarbons.
Proposed spacing between enclosures for ouotdoor ESS installations consisting of multiple enclosures shall comply with the all of the following:1. Be analysed using anticipated wind conditions.2. Be validated using large-scale fire testing in accordance with Section 9.13. Be reviewed by a registered professional to verify that complete combustion of one enclosure shall not result in propagation to adjacent enclosures.	NFPA 855 §9.2.1.2.2	**Compliant**	Minimum spacing between the BESS is 0.9 m as set out in NFPA 855.Large scale fire testing (LSFT) conducted for the containers, in accordance with the CSA TS-800 methodology, demonstrated that the cells within an adjacent container should not be ignited if the containers are separated by 150 mm. Therefore, a separation of 0.9 m (900 mm) should be sufficient in preventing propagation between containers in the event of a fire.It is noted that the LSFT was conducted in controlled conditions, with wind speeds of up to 3 m/s. As wind conditions on site may be higher than this, which would increase the likelihood of propagation between adjacent containers, increasing the separation

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
			between containers from 150 mm to 900 mm helps in mitigating this risk.
The representative cell, modules, and units tested, including any optional integral fire suppression system, shall match the intended installation configuration other than the addition of the cell failure mechanism utilised for cell thermal runaway initiation.	NFPA 855 §9.2.1.3	**TBC**	
Use of stacked enclosures shall be permited based on a large-scale fire test that the fire will not propagate beyond the stacked enclosure.	NFPA 855 §9.2.1.3.1	**N/A**	
The testing shall evaluate deflagration mitigation measures when designed into ESS cabinets.	NFPA 855 §9.2.1.4	**Compliant**	Deflagration mitigation measures have been evaluated through the NFPA 68 deflagration venting assessment and NFPA 69 CFD modelling. Large scale fire testing (LSFT) conducted for the containers, in accordance with the CSA TS-800, included testing of the deflagration vent panels. An explosion occurred 2.5 hours into the test, which opened the panels as intended, while the cabinet doors did not open, demonstrating the benefit of the deflagration panels.
Test Reports. The complete test report and its supporting data shall be provided to the AHJ for review and approval.	NFPA 855 §9.2.2.1	**TBC**	
The test report shall be accompanied by a supplemental report prepared by a registered design professional with expertise in fire protection engineering that provides interpretation of the test data in relation to the installation requirements for the ESS.	NFPA 855 §9.2.2.2	**TBC**	
HMA for Electrochemical ESSs. Existing lithium-ion ESSs that are not UL 9540 listed shall require a hazard mitigation analysis in accordance with Section 4.4.	NFPA 855 §9.3.2.1	**N/A**	
Lithium-ion ESSs shall be upgraded with additional hazard mitigation measures where required by the AHJ based on the findings in the hazard mitigation analysis.	NFPA 855 §9.3.2.2	**N/A**	
Energy Storage Management System (ESMS). Where required by the equipment listing in accordance with 4.6.1 or the hazard mitigation analysis in accordance with Section 4.4, an approved ESMS or BMS shall be provided for monitoring operating conditions and maintaining voltages, currents, and temperatures within the manufacturer's specifications.	NFPA 855 §9.3.3.1	**TBC**	
The ESMS or BMS shall electrically isolate the ESS or affected components of the ESS if potentially hazardous conditions are detected.	NFPA 855 §9.3.3.2	**TBC**	
When required by the AHJ, visible annunciation shall be provided on the cabinet exterior or in an approved location to indicate potentially hazardous conditions associated with the ESS exist.	NFPA 855 §9.3.3.3	**TBC**	
Smoke and Fire Detection. ESSs shall be provided with a smoke detection, thermal image fire detector, or radiant-energy-sensing system in accordance with NFPA 72, unless modified by this chapter.	NFPA 855 §9.7.1	**Compliant**	BESS includes automatic smoke, heat and flammable gas detection, with continuous gas monitoring via a Li-ion off-gas/flammable gas detector. Smoke detector - EN54-7 Heat detector - EN 54-5 Li-ion Tamer gas detector - UL/IEC 61010, CSA C22.2 No. 61010, EN 61326-1 EN 54 is the European equivalent of NFPA 72, so the Sungrow PowerTitan 3.0 meets this requirement.
All required annunciation means shall be located as required by the authority having jurisdiction to facilitate an efficient response to the situation.	NFPA 855 §9.7.1.4	**TBC**	
Smoke and fire detection systems protecting an ESS with lithium-ion batteries shall be required to provide a secondary power supply in accordance with Section 4.10.	NFPA 855 §9.7.1.6	**Compliant**	FACP/fire detection control panel includes a secondary battery supply, with two 12 V 7 Ah sealed lead acid batteries in series.

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
Alarm signals from detection systems shall be transmitted to a supervising station in accordance with NFPA 72.	NFPA 855 §9.7.1.7	**TBC**	
Testing and Commissioning of Integrated Critical Safety Systems. Basic Testing. Where installations involving two or more integrated critical safety systems are present, the systems shall be tested to verify the operation and function of such systems in accordance with 9.7.4.1.1 and 9.7.4.1.2.	NFPA 855 §9.7.4.1	**TBC**	
When a critical safety system is tested, the response of the critical safety systems shall be verified.	NFPA 855 §9.7.4.1.1	**TBC**	
Technology-Specific Requirements.The following are requirements of lithium-ion ESSs:Thermal runaway (9.7.6.5)Explosion control and prevention (9.7.6.7) Thermal runaway protection. Where required by Table 9.7.6, a listed device evaluated as part of the ESS or other approved method shall be provided to manage charging and discharging during normal operation of the ESS to maintain batteries and capacitors within their operating parameters and preclude thermal runaway.	NFPA 855 §9.7.6.5	**Compliant**	Thermal runaway protection is provided by LFP chemistry, BMS monitoring, liquid cooling, smoke/heat/gas detection and suppression systems. The BMS includes a three-layer architecture comprising BMU, CMU and BSC, providing early fault detection through continuous monitoring of cell voltage, temperature and current. The UL 9540 test report confirms this requirement as Pass, including voltage monitoring for every series element, temperature monitoring throughout the battery pack, continuous battery-level current monitoring, alarm/control circuits able to react, and recording of off-nominal values by the BMS. The BMS functional safety has been evaluated according to IEC/UL 60730-1 Annex H by TÜV Rheinland.
Thermal runaway protection shall be permitted to be provided by the battery management system or capacitor ESS management system that has been evaludated as part of the UL 1973 or UL 9540A listing.	NFPA 855 §9.7.6.5.2	**Compliant**	Thermal runaway protection is provided through the BMS, which monitors cell voltage, temperature and current to maintain the batteries within operating limits. The BMS is part of the evaluated ESS design, and the UL 9540A evidence supports the system-level safety assessment. The cell has IEC 62619:2022 certification, equivalent to UL 1973. However, the certificate provided is for the rechargeable Li-ion cell only and does not confirm BMS evaluation. **Confirmation is still required from BayWa/Sungrow that the BMS has been evaluated as part of the applicable UL 1973 / IEC 62619. One document states the BMS has been assessed against IEC/UL 60730 regarding functional safety requirements - can this report be provided?**
Explosion Control and Prevention. Where required elsewhere in this standard, explosion control and prevention shall be provided in accordance with this section.	NFPA 855 §9.7.6.7.1	**Compliant**	The emergency ventilation/explosion prevention system has been assessed using NFPA 69 CFD modelling, and the deflagration venting system has been evaluated against NFPA 68.
Explosion control and prevention shall not be required if a deflagration hazard study, demonstrating that flammable gas concentrations cannot accumulate and exceed 25 percent of the LFL, on average, is submitted to the AHJ for review and approval.	NFPA 855 §9.7.6.7.1.1	**N/A**	The emergency ventilation/explosion prevention system has been assessed using NFPA 69 CFD modelling, and the deflagration venting system has been evaluated against NFPA 68. **It is recommended that the deflagration panels are included in the design. Deflagrations can occur after an initial fire event, past the survivability limits of the NFPA 69 explosion prevention system. It is likely that first responders will be present at this point. If deflagration panels are not installed, any deflagration overpressure will be vented via the weakest point in the container - this would be the container doors, which are at ground level and potentially facing the first responders. So, without deflagration vents installed, the risk to first responders from explosion effects would be greater.**
Protection against the release of flammable gases during normal operation shall be in accordance with 9.7.6.1.	NFPA 855 §9.7.6.7.2	**Compliant**	Flammable gas release is not expected during normal operation, as the BESS uses LFP cells with BMS monitoring, liquid cooling and electrical

Requirement / Query	NFCC Guidance Section Reference	Foigha BESS Compliance	Justification
			protection to maintain cells within operating limits. For abnormal off-gassing conditions, the system includes flammable gas detection linked to alarm, shutdown response and emergency ventilation.
All ESSs shall be provided with a reliable explosion control and prevention system designed, installed, operated, maintained, and tested in accordance with NFPA 69.	NFPA 855 §9.7.6.7.3	**Compliant**	Emergency ventilation/explosion prevention system has been evaluated against NFPA 69 by Jensen Hughes. The method of assessment against NFPA 69 was CFD modelling, which showed that the system should be capable of maintaining the average concentration of off-gas below 25% LFL. However, it must be noted that this is true for the average concentration, but there were pockets of gas which reached approx. 50% LFL in the container.
A partial volume deflagration evaluation shall be conducted in accordance with NFPA 68.	NFPA 855 §9.7.6.7.3.1	**Compliant**	Deflagration venting system has been evaluated using against NFPA 68 by TÜV Rheinland, which confirmed that the proposed venting arrangement would limit the maximum internal overpressure beneath the maximum overpressure that can be endured by the enclosure. Pressure and accompanying flames would be directed upwards, away from people.
Design of explosion control and prevention systems shall be based upon the gas composition and volume identified by testing conducted in accordance with Section 9.2.	NFPA 855 §9.7.6.7.3.2	**Compliant**	The explosion prevention and control system CFD simulations, as per NFPA 69 and NFPA 68 respectively, were based on gas composition and volumes reported in the module and unit level UL 9540A test reports.
Where approved, ESSs designed to ensure that no hazardous pressure waves, debris, shrapnel, or enclosure pieces are ejected, as validate by installation-level fire and explosion testing and an engineering evaluation performed by a registered design professional complying with Section 9.2 that includes the cabinet, shall be permitted in lieu of providing explosion control and prevention that complies with NFPA 69.	NFPA 855 §9.7.6.7.3.3	**N/A**	Explosion prevention is provided in compliance with NFPA 69.
Flammable gases shall not migrate into interconnecting ESSs.	NFPA 855 §9.7.6.7.3.5	**TBC**	**Confirm with Sungrow that flammable gases cannot migrate into interconnecting ESSs or adjacent compartments via cable routes, ducts or penetrations.** **This should consider the LSFT finding where deflagration occurred within the control cabinet, indicating potential gas migration into areas with ignition sources and potentially lower ventilation coverage.**

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t: +44(0)141 280 8007 | e: hello@cairnrisk.com | w: cairnrisk.com | cairn-risk

Cairn Risk Consulting Ltd.