## SWANSEA GREENER GRID PARK EXTENSION

# Fire Safety Strategy

## Statkraft UK Ltd

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Objective:

This document is the Fire Safety Strategy for Statkraft UK Ltd’s proposed extension to a Greener Grid Park in Swansea, UK.

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# EXECUTIVE SUMMARY

This report has been commissioned by Statkraft UK Ltd ('Statkraft') to accompany planning application for the development of an extension to a Greener Grid Park in Swansea, UK. The development will comprise a Battery Energy Storage System (BESS), associated infrastructure, landscaping, and access supporting renewable energy capacity and stability on the UK national grid.

This report contains the Fire Safety Strategy prepared by DNV for the Swansea Greener Grid Park Extension. The Fire Safety Strategy defines those fire safety features that will be included at the Greener Grid Park Extension and demonstrates the high standards of safety integral to its design. The Fire Safety Strategy has been produced in line with the *National Fire Chief Council's (NFCC) Grid Scale Battery Energy Storage System planning – Guidance for FRS* (Ref. /1/), where the NFCC guidance is the principal resource utilised by planning authorities in relation to assessment of fire safety at UK developments including battery energy storage.

# GLOSSARY OF TERMS

| Term | Description |
|---|---|
| BESS | Battery Energy Storage System |
| BMS | Battery Management System |
| BS | British Standard |
| DSEAR | Dangerous Substances and Explosive Atmospheres Regulations |
| EMS | Energy Management System |
| ER | Employers Requirements |
| ERP | Emergency Response Plan |
| FAT | Factory Acceptance Test |
| HV | High Voltage |
| kW | Kilowatt |
| LFP | Lithium Iron Phosphate |
| MAWWFRS | Mid and West Wales Fire Rescue Service |
| NFCC | National Fire Chiefs Council |
| NFPA | National Fire Protection Agency |
| OEM | Original Equipment Manufacturer |
| PDI | Post Delivery Inspection |
| SAT | Site Acceptance Test |
| SSRI | Site Specific Risk Information |
| SuDS | Sustainable Drainage System |
| UK | United Kingdom |
| UL | Underwriters Laboratories |

# 1 INTRODUCTION

## 1.1 Proposed Development

On behalf of Statkraft UK Limited ('Statkraft'), a planning application is being prepared for development of an extension to a Greener Grid Park in Swansea, UK comprising a Battery Energy Storage System (BESS), associated infrastructure, landscaping, and access.

The development will be located on land west of Rhydypandy Road, Morriston, Swansea. The battery units are arranged across non-stacked outdoor enclosures, coupled to the local electricity distribution network via a series of power conversion systems and transformer units. The point of connection for the Greener Grid Park Extension will be at Statkraft's existing Greener Grid Park, under construction to the north of the site. The proposed layout is presented in Figure 1 below.


**Figure 1 Swansea Greener Grid Park Extension - Site Layout Plan**

## 1.2 Document scope

This document presents the Fire Safety Strategy prepared by DNV for the Swansea Greener Grid Park Extension. The Fire Safety Strategy provides an overview of the potential fire risks associated with the development and demonstrates the engineering controls, and design aspects implemented to prevent, control and mitigate those risks.

The Fire Safety Strategy has been prepared in line with the *NFCC Grid Scale Battery Energy Storage System Planning – Guidance for FRS* (Ref. /1/) published 2023, and defines those features which will be included to ensure compliance. The Fire Safety Strategy also includes reference to globally recognised standards NFPA 855 and UL9540A to further qualify design and layout features.

# 2 FIRE SAFETY IN BESS

## 2.1 Statutory Requirements in England and Wales

The Swansea Greener Grid Park Extension will be subject to the legislative requirements stated in the UK Statutory Instruments. The relevant regulations to which new developments must conform concern Health and Safety, Fire Risk, Electrical Safety and Construction Management. The following apply in England and Wales:

1. *Health and Safety at Work etc. Act 1974* (Ref. /2//2/)
2. *The Regulatory Reform (Fire Safety) Order 2005* (Ref. /3/)
3. *The Building Regulations 2010 (as applicable in parts)* (Ref. /4/)
4. *Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002* (Ref./5/)
5. *Electricity at Work Regulations 1989* (Ref. /6/)

Other legislations also apply; hence this list is not to be considered comprehensive.

## 2.2 Applicable Standards and Approved Codes of Practice (ACOPs)

In the UK there is no standard, or set of standards, that have been adopted into legislation to demonstrate proper fire safety in design, installation, and testing for sites including battery energy storage. However, a number of standards and guidance document have become routine and favoured across the industry. The main standards and guidance documents applicable to the BESS at the Swansea Greener Grid Park Extension are:

1. **NFCC Grid Scale Battery Energy Storage System Planning – Guidance for FRS** (Ref. /1/)

   In the UK the NFCC has published guidance for the FRS regarding planning considerations for new battery energy storage systems. The guidance includes a number of design and operational safety recommendations in line with international standards and learnings from BESS fire incidents worldwide.

   The NFCC guidance is currently the most widely used reference by UK planning authorities in assessment of fire safety at new developments.

2. **NFPA Standard for the installation of Stationary Energy Storage Systems** (Ref. /7/)

   NFPA 855 is an international safety standard for the installation of energy storage systems. Globally NFPA 855 is considered the most well referenced standard for BESS design safety. It has been adopted by planning authorities worldwide, including the UK as guidance for issue permitting in BESS. The standard is considered the de-facto standard for BESS developments in the USA.

3. **UL9540A Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems 4th Edition** (Ref. /8/)

   UL9540A is the industry standard test methodology for evaluating the resistance to fire propagation in the event of BESS thermal runaway. The test is designed to emulate real-world thermal runaway, it involves the deliberate initiation of thermal runaway to prove the units' limits with respect to fire propagation.

   UL9540A is the dominant methodology utilised worldwide for assessing propagating fire risk in BESS. It is referenced by both the NFCC and NFPA as a means to demonstrate site safety with respect to equipment separation distances.

# 3 FIRE SAFETY STRATEGY

In this section, compliance aspects of the Swansea Greener Grid Park Extension with the NFCC's guidance for battery storage are defined and demonstrated. This section has been structured as such to mirror the order of requirements introduced by the NFCC to maximise comparability between the documents for the reader.

In each subsection, relevant excerpts from the NFCC guidance are quoted, following by compliance statements for the Swansea Greener Grid Park Extension. As preliminary material, Table 1 provides a summary of the headline compliance aspects. A layout plan highlighting the fire safety features integrated into the site design is further included in Appendix A: Fire Strategy Layout

**Table 1: NFCC Compliance Summary**

| NFCC Requirement | Swansea Greener Grid Park Extension | Compliance |
|---|---|---|
| Information Requirements | Detailed site information package will be prepared and made available to the MAWWFRS. | ☑ |
| System Design and Construction | Statkraft are committed to ensuring the highest level of safety in their selected BESS solution. Design and construction aspects at the Swansea Greener Grid Park Extension has been specifically assessed in line with the recommendations from the NFCC. | ☑ |
| Testing | The BESS technology selected will be tested in line with UL9540A to demonstrate suitability of the BESS container positioning to prevent fire spread. | ☑ |
| Design | The Swansea Greener Grid Park Extension will utilise a BESS solution from a recognised battery unit provider. The adopted BESS solution will be equipped with design features in line with the recommendations of the NFCC. | ☑ |
| Detection and Monitoring | The selected BESS shall be equipped with BMS which enacts protection, monitoring, and control functionality over the battery system. The BESS will further be equipped with internal fire detection systems monitoring heat and smoke evolution. Where deemed necessary, through risk analysis or manufacturer's recommendations, combustible gas detectors will also be installed. | ☑ |
| Suppression Systems | Integration of an internal fire suppression system will be informed through liaison with a competent system designer and the manufacturer. Statkraft will assess the need for fire suppression based on a risk analysis, considering demonstrable safety features in the BESS. Where deemed required any suppression system will be based on either aerosol, clean agent or water-based fire suppressants. | ☑ |
| Deflagration Preventing and Venting | The BESS enclosures will include suitable measures for explosion protection informed through design risk studies. Explosion protection systems will be designed and selected in consultation with the equipment manufacturer and their efficacy demonstrated with suitable evidence. | ☑ |

| NFCC Requirement | Swansea Greener Grid Park Extension | Compliance |
|---|---|---|
| Site Access | The site will be equipped with adequate access routes and internal roadways to provide unobstructed access to the battery enclosures for firefighting. Swept path analysis has been completed to demonstrate the suitability of the internal roadways for fire service vehicles. | ☑ |
| Access Between BESS Units and Unit Spacing | Spacing around the BESS units will be based on a data-driven and evidence-backed approach. The selected BESS will be tested in line with UL9540A to demonstrate suitability of the minimum clearance to prevent fire spread; that is that any thermal runaway event will be shown not to propagate between enclosures. | ☑ |
| Distance from BESS Units to Occupied Buildings and Site Boundaries | There will be no occupied buildings on site. The battery units will be clear from the site boundary by at least 25 m. | ☑ |
| Site Conditions | Vegetation will be cleared within 10 m of BESS units in line with the requirements of the NFCC. | ☑ |
| Water Supplies | The site will include above-ground water tanks sized to accommodate 228,000 L of stored water. This is directly in line with recommendations for the NFCC for provision of firewater supply equivalent to 1,900 L/min deluge over a period of two-hours. | ☑ |
| Signage | The site will be equipped with suitable electrical and battery safety signage and any other relevant information to suitably inform persons of relevant hazards and emergency procedures. | ☑ |
| Risk Management Plan | A Risk Management Plan will be prepared for the Swansea Greener Grid Park Extension in line with recommendations from the NFCC. | ☑ |
| Emergency Response Plan | An Emergency Response Plan (ERP) will be developed using guidance from the UK Health and Safety Executive (HSE), NFPA 855 (Ref. /7/) and prevailing legislation in the *Regulatory Reform (Fire Safety) Order 2005* (Ref. /9/). The ERP will be developed in collaboration with the MAWWFRS to allow effective and safe emergency response. | ☑ |
| Environmental Impacts | In the event of a fire, temporary impermeable membranes and containment berms will be available for deployment around the BESS areas to capture any contaminated firewater. The site will further feature a Sustainable Drainage System (SuDS) designed to manage any firewater runoff that may escape the temporary containment. Any firewater runoff will be directed to attenuation ponds located to the south of the site equipped with appropriate impermeable linings and control valves to prevent release of contaminants into the local environment. | ☑ |

| NFCC Requirement | Swansea Greener Grid Park Extension | Compliance |
|---|---|---|
| Recovery | Post incident recovery will be included as part of the ERP. At the end of the project life, or following any incident the BESS will be decommissioned in line with The Waste Batteries and Accumulators Regulations. | ☑ |

## 3.1 Information compliance

***NFCC Requirement*:**

*Grid scale BESS should form part of FRS planning in accordance with arrangements required under section 7(2)(d) of the Fire and Rescue Services Act (2004). Site Specific Risk Information (SSRI) should be made available to crews in the form of an effective Emergency Response Plan. Details of any site access arrangements, such as key codes, should be provided to the FRS.*

**Swansea Greener Grid Park Extension:** As introduced in section 4, Statkraft have engaged the MAWWFRS for consultation on the proposed development.

As part of the consultation Statkraft will seek to formalise a firefighting strategy with the MAWWFRS, and develop a comprehensive ERP with their input. All relevant Site Specific Risk Information (SSRI) shall be included and accounted for in the ERP and documentation package developed specially for the project.

## 3.2 System design and construction

***NFCC Requirement:***

*This information should be provided to the FRS:*

1. *The battery chemistries being proposed (e.g. Lithium-ion Phosphate (LFP), Lithium Nickel Manganese Cobalt Oxide (NMC))*
2. *The battery form factor (e.g. cylindrical, pouch, prismatic)*
3. *Type of BESS e.g. container or cabinet*
4. *Number of BESS containers/cabinets*
5. *Size/capacity of each BESS unit (typically in MWh)*
6. *How the BESS units will be laid out relative to one another.*
7. *A diagram / plan of the site.*
8. *Evidence that site geography has been taken into account (e.g. prevailing wind conditions).*
9. *Access to, and within, the site for FRS assets*
10. *Details of any fire-resisting design features*
11. *Details of any:*
    - *a. Fire suppression systems*
    - *b. On site water supplies (e.g. hydrants, EWS etc)*
    - *c. Smoke or fire detection systems (including how these are communicated)*
    - *d. Gas and/or specific electrolyte vapour detection systems*
    - *e. Temperature management systems*

*f. Ventilation systems*

*g. Exhaust systems*

*h. Deflagration venting systems*

12. *Identification of any surrounding communities, sites, and infrastructure that may be impacted as a result of an incident.*

**Swansea Greener Grid Park Extension:** Statkraft will prepare a site-specific information package including all relevant technical and design considerations required by the NFCC. The information package will be made available to the MAWWFRS. It is noted, in the planning phase where equipment supply contracts are not yet in place, specific details regarding battery technology and safety features are not confirmed. Statkraft are committed to ensuring the highest level of safety in their selected BESS solution.

The adjoining sections in this document define those safety features which are committed by Statkraft, in line with the NFCC requirements.

## 3.3 Testing

***NFCC Requirement:***

*Details of any evidence-based testing of the system design should be requested, for example, results of UL 9540A testing.*

**Swansea BESS Compliance:** The BESS technology selected will be tested in line with UL9540A to demonstrate suitability of the BESS container positioning to prevent fire spread (Ref /8/). At request, the results of UL9540A testing will be made available to the MAWWFRS for review.

The commissioning of the site will follow the guidance of the OEM. This will include functional checks of all safety systems. Initial testing will take place at the OEM's factory, where a Factory Acceptance Test (FAT) will be performed to verify that key components of the BESS are operational and safe for transit. Upon arrival, a Post Delivery Inspection (PDI) will be conducted to confirm that no damage has occurred during the shipping process followed by Site Acceptance Test (SAT) to confirm operability.

## 3.4 Design

***NFCC Requirement:***

*Design features should be made clear. These may include:*

- *Rack layout and setup*
- *Thermal barriers and insulation*
- *Container layout and access arrangements*

**Swansea Greener Grid Park Extension:** Statkraft will prepare a site-specific information package including all relevant technical and design considerations required by the NFCC. The site will utilise a BESS solution from a recognised battery unit provider and deliver BESS in line with defined Employer's Requirements (ERs). Specific features will include:

- Lithium Iron Phosphate (LFP) battery technology arranged as cells, modules, racks and purpose built non-walk-in outdoor enclosures.
- Suitably Ingress Protection (IP) rated enclosures to protect against water and particulate damage.

- Electrical control and protection equipment, Battery Management System (BMS) and Temperature Management System (TMS) to maintain the battery units within their safe operating envelope.
- Appropriate auxiliary fire detection, suppression and explosion protection systems.

Such provisions are discussed throughout this document, in line with guidance from the NFCC.

## 3.5 Detection and monitoring

***NFCC Requirement:***

*An effective and appropriate method of early detection of a fault within the batteries should be in place, with immediate disconnection of the affected battery / batteries. This may be achieved automatically through the provision of an effective Battery Management System (BMS) and / or a specific electrolyte vapour detection system.*

*Should thermal runaway conditions be detected then there should be the facility in place for the early alerting of emergency services.*

*Detection systems should also be in place for alerting to other fires that do not involve thermal runaway (for example, fires involving electrical wiring).*

**Swansea Greener Grid Park Extension:** The selected BESS shall be equipped with BMS which enacts protection, monitoring, and control functionality over the battery system. The BMS will ensure the battery cells are maintained with their safe-operating-envelope, and in case of deviation from operating norms (e.g. voltage, temperature, state of charge), will be able to enact safety functions autonomously to prevent fault or failure, including thermal runway. This will include functionality to derate the battery system on detection of any unsafe operating condition, and the ability to disconnect, shutdown, and isolate the system in case of further deviation or critical failure. Fire detection systems will be installed within the BESS enclosures, and at critical equipment on site to detect other fires that do not involve thermal runaway.

Both the BMS and fire detection systems will be interfaced with a site wide Energy Management System (EMS) and a 24/7 remote monitoring system. The EMS and remote monitoring system will be integrated with all site equipment and provide a real time view of the plant status and presence of any faults or failures. In case thermal runaway or fire is detected, the systems will raise high priority alarms to remote operating personnel and activate local audible and visual alarms to alert any persons on or nearby to the site. The operating personnel will be properly trained to respond to thermal runaway and / or fire event and will contact the FRS as appropriate. Specific procedures for responding to thermal runaway, fire and other emergency events shall be defined in the ERP.

***NFCC Requirement:***

*Continuous combustible gas monitoring within units should be provided. Gas detectors should alarm at the presence of flammable gas (yes / no), shut down the ESS, and cause the switchover to full exhaust of the ventilation system. Sensor location should be appropriate for the type of gas detected e.g. hydrogen, carbon monoxide, volatile organic compounds.*

*External audible and visual warning devices (such as cabinet level strobing lights), as well as addressable identification at control and indicating equipment, should be to linked to:*

*1. Battery Management System (when a thermal runaway event is identified)*

*2. Detection and suppression system activation*

**Swansea Greener Grid Park Extension:** The BESS will be equipped with internal fire detection systems, monitoring heat and smoke evolution. Where deemed necessary, through risk analysis or manufacturers recommendations, combustible gas detectors will also be installed. The detection systems will provide early warning of a fire event and enact immediate power down of any compromised unit

Local audible (sounder) and visual (beacon) alarms will be strategically located around the site to alert any persons present to the event of fire or thermal runaway. The audible and visual alarm systems will be interfaced with the BMS, fire detection and fire suppression functions as relevant to activate accordingly.

## 3.6 Suppression systems

***NFCC Requirement:***

*Suitable fixed suppression systems should be installed in units in order to help prevent or limit propagation between modules.*

*Where it is suggested that suppression systems are not required in the design, this choice should be supported by an evidence-based justification and Emergency Response Plan that is designed with this approach in mind (for example, risk assessed controlled burn strategies, and external sprinkler systems).*

*The choice of a suppression system should be informed by liaison with a competent system designer who can relate the system choice to the risk identified and the duration of its required activation. Such a choice must be evidence based.*

**Swansea Greener Grid Park Extension**: Any internal fire suppression system will be specified by a competent system designer appointed by the manufacturer. Statkraft will ensure the need for fire suppression is assessed based on a risk analysis, considering demonstrable safety features in the BESS (e.g. beneficial testing results in line with UL9540A) and emergency response strategy for the site.

Where deemed required, any suppression system will be selected based on assessment of its efficacy. At the time of reporting, the most common methods of fire suppression are based on either aerosol of water based suppressants. In case the industry moves to favour method other than aerosol or water based suppressant, Statkraft may consider such solutions providing ample demonstration of efficacy and safety.

## 3.7 Deflagration preventing and venting

***NFCC Requirement:***

*BESS containers should be fitted with deflagration venting and explosion protection appropriate to the hazard. Designs should be developed by competent persons, with design suitability able to be evidenced. Exhaust systems designed to prevent deflagration should keep the environment below 25% of Lower Explosive Limit (LEL).*

*Flames and materials discharged as a result of any venting should be directed outside to a safe location and should not contribute to any further fire propagation beyond the unit involved or present further risk to persons. The likely path of any vented gasses or materials should be identified in Emergency Response Plans to reduce risk to responders.*

*Explosion / deflagration strategies should be built into the emergency plan such that responders are aware of their presence and the impact of their actions on these strategies.*

*Where emergency ventilation is used to mitigate an explosion hazard, the disconnect for the ventilation system should be clearly marked to notify personnel or first responders to not disconnect the power supply to the ventilation system during an evolving incident.*

**Swansea Greener Grid Park Extension:** The BESS enclosures will include suitable measures for explosion protection informed through design risk studies. Explosion protection systems will be installed in alignment with NFPA 855 (Ref. /7/), which can include NFPA 68-compliant deflagration control systems (Ref. /11/), and/or NFPA 69-compliant explosion prevention systems with gas detection (Ref. /12/) and/or other engineered solutions, where validated to be effective through testing. The design of the explosion protection system will be evidence-based and informed by manufacturer analysis and recommendation.

As per guidance from the NFCC:

- Any exhaust system shall keep the environment below 25% of Lower Explosive Limit.
- Deflagration vents will be directed to a safe location and likely path of any vented asses or materials identified and included in the ERP.
- Where emergency ventilation systems are used, disconnect systems will be clearly marked.
- All relevant information regarding explosion protection shall be included in the ERP.

## 3.8 Site access

***NFCC Requirement:***

*Suitable facilities for safely accessing and egressing the site should be provided. Designs should be developed in close liaison with the local FRS as specific requirements may apply due to variations in vehicles and equipment.*

*This should include:*

- *At least 2 separate access points to the site to account for opposite wind conditions/direction.*
- *Roads / hard standing capable of accommodating fire service vehicles in all weather conditions. As such there should be no extremes of grade.*
- *A perimeter road or roads with passing places suitable for fire service vehicles.*
- *Road networks on sites must enable unobstructed access to all areas of the facility.*
- *Turning circles, passing places etc size to be advised by FRS depending on fleet*

**Swansea Greener Grid Park Extension:** The Swansea Greener Grid Park Extension will be accessed from Heol Llangyfelach (East) via single carriageway access road. The access road will be ≈6 m wide, suitable to accommodate two (2) fire service vehicles side-by-side and provide route to the site via two (2) entrance gates at the west and north-west of the BESS compound.

The site will benefit from internal roadways designed in line with *BS 9999 Fire safety in the design, management and use of buildings* (Ref./13/) such that emergency services will have unobstructed access to all areas of the facility for firefighting. The width and sizing of the roadways have been determined according to guidance from *The Building Regulations, Fire Safety Approved Document B* (Ref. /14/) and verified through swept path analysis completed based on the dimensions of typical fire service vehicles.

The site will further include a number of emergency pedestrian egress gates positioned strategically to ensure suitable means of escape from all site areas. As part of routine maintenance procedures and inspections, Statkraft will ensure all access and egress routes are clear of debris and obstructions.

## 3.9 Access Between BESS Units and Unit Spacing

***NFCC Requirement:***

*In the event of a fire involving a BESS unit, one of the primary tactics employed will be to prevent further unit to unit fire spread. Suitable access for firefighters to operate unimpeded between units will therefore be required. This should allow for the laying and movement of hose lines and, as such, access should be free of restrictions and obstacles. The presence of High Voltage DC Electrical Systems is a risk and their location should be identified. Exclusion zones should be identified.*

*A standard minimum spacing between units of 6 metres is suggested unless suitable design features can be introduced to reduce that spacing. If reducing distances a clear, evidence based, case for the reduction should be shown.*

*Any reduction in this separation distance should be design based by a competent fire engineer. There should be consideration for the fire separation internally and the total realistic load of fire. Proposed distances should be based on radiant heat flux (output) as an ignition source.*

*The NFCC does not support the stacking of containers / units on top of one another on the basis of the level of risk in relation to fire loading, potential fire spread, and restrictions on access*

**Swansea Greener Grid Park Extension:** Spacing around the BESS units will be based on a data-driven and evidence-backed approach. Stacked container solutions will not be employed.

Test standard UL9540A is the dominant methodology utilised worldwide for assessing propagating fire risk in BESS and is referenced by both the NFCC and NFPA as a means to demonstrate site safety with respect to separation distances.

The selected BESS will be tested in line with UL9540A to demonstrate suitability of the minimum clearance to prevent fire spread; that is that any thermal runaway event will be shown not to propagate between enclosures.

## 3.10 Distance from BESS Units to Occupied Buildings and Site Boundaries

***NFCC Requirement*:**

*Individual site designs will mean that distances between BESS units and occupied buildings / site boundaries will vary. Proposed distances should take into account risk and mitigation factors. However, an initial minimum distance of 25 metres is proposed prior to any mitigation such as blast walls. Reduction of distances may be possible in areas of lower risk (e.g. rural settings). Where possible buildings should be located upwind.*

**Swansea Greener Grid Park Extension:** The Swansea Greener Grid Park Extension will be operated via a remote control centre. The site will be normally unmanned and only accessed routinely for maintenance and inspection activities. The buildings on site are hence considered unoccupied. The NFCC does not prescribe clearance distance for BESS to unoccupied buildings. NFPA 855, requires that battery units must observe clearance of 3 m from all buildings regardless of occupation. This may be reduced to 0.9 m where qualified by fire testing in line with UL9540A. Statkraft will observe minimum spacing to buildings in line with NFPA 855’s 3 m basic requirement.

Regarding spacing to site boundary, the Swansea Greener Grid Park Extension respects ≈20 m clearance of BESS units to the site red line boundary and ≈10 m to the security fencing. The site is located in a rural location such that there are no regularly occupied buildings or otherwise within 100 m of the battery compound. It is the opinion of DNV that this is a suitable inherent safety feature of the site such that the risk of harm due to proximity of the BESS to the site boundary is insignificant. It is further noted, as per NFPA 855, the minimum clearance from BESS units to site boundaries (defined as ‘lot lines’ per the standard) is 3 m.

To verify the safe clearance of the BESS units from site buildings and other adjacent premises, a Plume Dispersion Study has been prepared for the Swansea Greener Grid Park Extension. The findings demonstrate immediate danger from heat flux, smoke and toxic gases which may be evolved as a result of a BESS fire are confined to the immediate surroundings of the BESS only. The complete Plume Dispersion Study is available in Appendix B: Plume Dispersion Study.

## 3.11 Site Conditions

***NFCC Requirement*:**

*Sites should be maintained in order that, in the event of fire, the risk of propagation between units is reduced. This will include ensuring that combustibles are not stored adjacent to units and access is clear and maintained. Areas within 10 metres of BESS units should be cleared of combustible vegetation and any other vegetation on site should be kept in a condition such that they do not increase the risk of fire on site. Areas with wildfire risk or vegetation that would result in significant size fires should be factored into this assessment and additional cleared distances maintained as required.*

**Swansea Greener Grid Park Extension:** Vegetation within 10 m of BESS units will be cleared to limit risks of fire propagation. To maintain site conditions, Statkraft will develop a vegetation management plan for the operational phase of the project to ensure routine cutback / removal. Any other combustible materials (e.g. maintenance consumables) will not be stored adjacent to battery units and will be housed in dedicated areas.

## 3.12 Water supplies

***NFCC Requirement*:**

*Water supplies will depend on the size of the installation. In the majority of cases, initial firefighting intervention will focus on defensive firefighting measures to prevent fire spread to adjacent containers. As a result, proposals for water supplies on site should be developed following liaison with the local fire and rescue service taking into account the likely flow rates required to achieve tactical priorities. This should also take account of the ability of / anticipated time for the fire and rescue service to bring larger volumes of water to site (for example through the provision of High Volume Pumps).*

*IP ratings of units should be known so that risks associated with boundary cooling can be understood.*

*As a minimum, it is recommended that hydrant supplies for boundary cooling purposes should be located close to BESS containers (but considering safe access in the event of a fire) and should be capable of delivering no less than 1,900 litres per minute for at least 2 hours. Fire and rescue services may wish to increase this requirement dependant on location and their ability to bring supplementary supplies to site in a timely fashion.*

*Water supply for any automatic suppression system will be covered by the relevant standard / design depending on which system chosen as appropriate for the risk. For manual water, amounts should come from performance based requirement rather than a reference to a code, unless it can be proven that the code specifically covers BESS. Regarding water storage tanks, volumes will again need to be informed on a performance-based need. Isolation points should be identified.*

*Any static water storage tanks designed to be used for firefighting must be located at least 10 metres away from any BESS container / cabinet. They must be clearly marked with appropriate signage. They must be easily accessible to FRS vehicles and their siting should be considered as part of a risk assessed approach that considers potential fire development/impacts. Outlets and connections should be agreed with the local FRS. Any outlets and hard suction points should be protected from mechanical damage (e.g. through use of bollards).*

**Swansea Greener Grid Park Extension:** Access to firewater will be readily available on site through permanently installed above ground water tanks sized to accommodate 228,000 L of stored water. This is directly in line with recommendations from the NFCC for provision of firewater supply equivalent to 1,900 L/min deluge over a period of two-hours.

Positioning of the water tanks will be > 10 m from any BESS unit such to avoid any risk of damage in case of fire or mechanical impact (e.g. from construction activity or vehicles). Access for hose attachments will be readily accessible to the first responders in line with recommendation from the MAWWFRS and will be clearly marked with appropriate signage.

Note: Although the NFCC recommends a universal requirement of 1,900 L/min firewater flow available over a two-hour period, this recommendation is made for all BESS installations regardless of size or design safety features. DNV consider that such a blanket requirement for firewater availability is not suitable and contradicts design safety principles routinely employed in the energy and industrial sectors. DNV views that a risk-based and numerical approach, supersedes use of universal guidance providing a more accurate and informed method for decision making in relation to fire safety.

For emergency response procedures adopting boundary cooling *The Energy Institute Model Code of Safe Practice Part 19: Fire precautions at petroleum refineries and bulk storage installations* (Ref. /15/) provides means for calculating firewater requirements. The Energy Institute guidance recommends a flow rate of 2 L/min·m² for effective cooling of surfaces. This quantity of water quantity is estimated to dissipate 43 kW/m² of thermal radiation at 50% efficiency, 30 kW/m² at 35%, or 69 kW/m² at 80% efficiency[1].

The firewater flow rate required for boundary cooling purposes is calculated using the following Equation 1:

$$Flowrate\ (L/min) = 2\ (L/\text{min} \cdot m^2) \times Exposed\ Surface\ Area\ of\ Adjacent\ BESS\ (m^2) \times No.Adjacent\ BESS$$

**Equation 1. Firewater Flow Calculation (Boundary Cooling)**

## 3.13 Signage

***NFCC Requirement*:**

*Signage should be installed in a suitable and visible location on the outside of BESS units identifying the presence of a BESS system. Signage should also include details of:*

- *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 should be sized such that at least one sign is legible at night at a distance of 30 metres or from the site boundary, whichever is closer.*

*Adherence to the Dangerous Substances (Notification and Marking of Sites) Regulations 1990 (NAMOS) should be considered where the total quantity of dangerous substances exceeded 25 tonnes.*

**Swansea Greener Grid Park Extension:** The site will be equipped with suitable electrical safety signage and any other relevant information to suitably inform persons of relevant hazards and emergency procedures. All relevant requirements from the NFCC will be adhered. Signage features will include:

- Information board at the main site entrance providing contact details of Statkraft alongside a 24/7 emergency freephone number.
- Clearly indicated entries/exits in case access is required by emergency services or for emergency escape.

[1] Note: Although formally, guidance issued from the Energy Institute is targeted at facilities storing petroleum products, equations for calculation of firewater flow are considered universally applicable and hence relevant to the Swansea Greener Grid Park Extension.

- Safety hazards including indicating operating voltages, arc flash labels, suppression agents, and demarcation zones.
- Battery specific labels including enclosed cell technology (LFP).
- Emergency stop and safety critical power supplies (e.g., emergency ventilation signage informing personnel / first responders to not disconnect the power during an evolving incident).

## 3.14 Risk management plan

***NFCC Requirement*:**

*A Risk Management Plan should be developed by the operator, which provides advice in relation to potential emergency response implications including:*

- *The hazards and risks at and to the facility and their proposed management.*
- *Any safety issues for firefighters responding to emergencies at the facility.*
- *Safe access to and within the facility for emergency vehicles and responders, including to key site infrastructure and fire protection systems.*
- *The adequacy of proposed fire detection and suppression systems (e.g., water supply) on-site.*
- *Natural and built infrastructure and on-site processes that may impact or delay effective emergency response.*

**Swansea Greener Grid Park Extension:** A Risk Management Plan will be prepared for the Swansea Greener Grid Park Extension. The Risk Management Plan will include all those aspects required by the NFCC and include details and findings from the safety assessment carried out by Statkraft to systematically identify and assess all hazards and risks which may be present.

## 3.15 Emergency response plans

***NFCC Requirement*:**

*An Emergency Response Plan should be developed to facilitate effective and safe emergency response and should include:*

- *How the fire service will be alerted*
- *A facility description, including infrastructure details, operations, number of personnel, and operating hours.*
- *A site plan depicting key infrastructure: site access points and internal roads; firefighting facilities (water tanks, pumps, booster systems, fire hydrants, fire hose reels etc); drainage; and neighbouring properties.*
- *Details of emergency resources, including fire detection and suppression systems and equipment; gas detection; emergency eye-wash and shower facilities; spill containment systems and equipment; emergency warning systems; communication systems; personal protective equipment; first aid.*
- *Up-to-date contact details for facility personnel, and any relevant off-site personnel that could provide technical support during an emergency.*
- *A list of dangerous goods stored on site.*
- *Site evacuation procedures.*
- *Emergency procedures for all credible hazards and risks, including building, infrastructure and vehicle fire, grassfire and bushfire*

**Swansea Greener Grid Park Extension:** An ERP will be developed using guidance from the UK Health and Safety Executive (HSE), NFPA 855 and prevailing legislation in the *Regulatory Reform (Fire Safety) Order 2005*. The ERP will be developed with the MAWWFRS to allow effective and safe emergency response. All provisions from the NFCC regarding emergency response will be included in the ERP as relevant.

## 3.16 Environmental impacts

***NFCC Requirement*:**

*Suitable environmental protection measures should be provided. This should include systems for containing and managing water runoff. System capability/capacity should be based on anticipated water application rates, including the impact of water based fixed suppression systems.*

*Sites located in flood zones should have details of flood protection or mitigation measures.*

**Swansea Greener Grid Park Extension:** In the event of a fire at the Swansea Greener Grid Park Extension, temporary impermeable membranes and containment berms will be available for deployment around the BESS area to capture any contaminated firewater. A Sustainable Drainage System (SuDS) will also be implemented to manage any firewater that may escape the temporary containment measures.

The SuDS will follow NFCC guidelines to ensure that any runoff is captured and stored in attenuation ponds located to the south of the site. The ponds will have a total capacity of over 228,000 litres and will be secured with suitable impermeable linings and control valves to prevent discharge into the local environment. Any captured firewater will be safely disposed of through a contract with a third-party specialist contractor

## 3.17 Recovery

***NFCC Requirement*:**

*The operator should develop a post-incident recovery plan that addresses the potential for reignition of ESS and de-energizing the system, as well as removal and disposal of damaged equipment.*

**Swansea Greener Grid Park Extension Compliance**: Post incident recovery will be included as part of the ERP introduced in section 3.15. At the end of the project life, or following any incident the BESS will be decommissioned in line with The Waste Batteries and Accumulators Regulations (Ref. /16/).

# 4 CONSULTATION

## 4.1 Mid and West Wales Fire Rescue Service

The designated fire authority for the Swansea Greener Grid Park Extension is the Mid and West Wales Fire Rescue Service (MAWWFRS). Statkraft recognises the importance of early engagement with the fire rescue service in the development of a new BESS facility. This collaboration is of mutual interest and aims to:

- Ensure that Statkraft is aware of the firefighting provisions necessary for the MAWWFRS to manage a BESS fire and is able to integrate these into the design.
- Confirm that the MAWWFRS understands the nature of BESS fires and is confident and competent in safely managing them.
- Ensure that a suitable firefighting strategy is agreed upon between Statkraft and the MAWWFRS, alongside a comprehensive ERP.

Statkraft will continue to engage with the MAWWFRS throughout the planning, construction and operational phases of the project. In particular:

- The agreed firefighting strategy and emergency response procedures will be regularly reviewed and updated in collaboration with the MAWWFRS, reflecting developments in legislation, standards, and best practices as well as learnings from the wider BESS industry.
- The MAWWFRS will be invited to attend and contribute toward risk studies and any safety workshops carried out post planning consent.
- The MAWWFRS will be provided with a complete document package for the site, including but not limited to:
    - Site specific risk information in the form of an Emergency Response Plan (ERP); in accordance with Section 7(2)(d) of the *Fire and Rescue Services Act (2004)* (Ref. /10/).
    - Information on site access arrangements such as key codes.
    - Battery details: battery chemistries and form factor.
    - BESS details: type and number of BESS units, size / capacity, layout, site plan.
    - Evidence showing consideration of site geography.
    - Details on site access for MAWWFRS assets.
    - Details on the site surroundings e.g. communities, sites, infrastructure that may be at risk in the event of an incident.
    - Details of any fire suppression systems, firewater supplies, smoke or fire detection, gas detection, temperature management systems, ventilation, exhaust systems and deflagration venting systems.
    - Details of any evidence-based testing e.g. results of UL 9540A testing (Ref. /8/).
- Statkraft will welcome site surveys throughout the construction and operational phases of the project to ensure the MAWWFRS are well versed with the equipment arrangements and access controls.

**The MAWWFRS have provided formal response to Statkraft's proposed development, including communication that 'The Fire Authority has no objection to the proposed development.' The complete response from the MAWWFRS is available in Appendix C: Response from MAWWFRS.**

## 4.2 National Gas Felindre

National Gas' Felindre compressor station is located adjacent to the proposed development, to the north-west. As a gas compressor station, Statkraft recognise that National Gas Felindre could potentially suffer from a loss of containment event, resulting in leakage of flammable gases around the facility.

To ensure a comprehensive understanding of any risk, Statkraft has engaged with National Gas as part of the planning process for their existing Greener Grid Park. In assessing the potential for flammable gas concentrations, National Gas has provided flammable gas dispersion information for the Felindre Compressor Station which evaluates the potential impact of a gas loss of containment event and identifies those areas which may be at risk (Ref. /17/).

The findings confirm that, in the event of a loss of containment, flammable gas concentrations will not arise at the proposed Greener Grid Park Extension. Consequently, no additional safety or protective measures are required beyond the currently proposed technical solutions.

Notwithstanding, Statkraft are committed to ongoing engagement with National Gas Felindre, ensuring the continued exchange of relevant site information as the project progresses. This will include formal consultation on the ERP to support safety and regulatory compliance.

# 5 CONCULSIONS

This document contains the Fire Safety Strategy for Statkraft's proposed Greener Grid Park Extension, in Swansea UK. The contents demonstrate the inherent safety features implemented by design in line with industry best practice, guidance, and appropriate regulation, minimise the risk of fire on site, and the mitigating features employed to reduce impact if such an event should occur. Through a rigorous assessment of safety, Statkraft has demonstrated a risk aware approach to the proposed development, wherein the primary focus throughout the project lifecycle is safety and protection of the local environment:

- Statkraft has actively addressed the requirements of the National Fire Chief Council's guidance for battery energy storage systems.
- The safety features embedded in the design and operating procedures are based on current good engineering practice and the most relevant industry standards and codes (UL9540A, NFPA 855). These minimise the fire risk at the installation to As Low as Reasonably Practicable.
- The risk to personnel and first responders in an unlikely event of a major fire will be managed effectively through an ERP
- The design and safety measures will be discussed, developed, and agreed with the MAWWFRS.
- The risk to general public is negligible due to the location and design of the site.

# REFERENCES


/1/ National Fire Chief's Council, 'Grid Scale Battery Energy Storage System planning – Guidance for FRS', 2022.

/2/ UK Public General Acts, 'Health and Safety at Work etc. Act', 1974

/3/ UK Statutory Instruments, 'No 1541 The Regulatory Reform (Fire Safety) Order, 2005

/4/ UK Statutory Instruments, 'No 2214 The Building Regulations', 2010.

/5/ UK Statutory Instruments, 'No 2276 The Dangerous Substances and Explosive Atmospheres Regulations', 2002

/6/ UK Statutory Instruments, 'No 635 The Electricity at Work Regulations', 1989

/7/ National Fire Protection Agency, 'NFPA 855 Standard for the Installation of Stationary Energy Storage Systems', 2023

/8/ Underwriters Laboratories, 'UL9540A Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems 4th Edition'; 2022.

/9/ UK Statutory Instruments, '2005 No 1541 The Regulatory Reform (Fire Safety) Order, 2005

/10/ UK Statutory Instruments, '2004 C. 21 The Regulatory Reform (Fire Safety) Order, 2004

/11/ National Fire Protection Agency, 'NFPA 68 Standard on Explosion Protection by Deflagration Venting Systems', 2024

/12/ National Fire Protection Agency, 'NFPA 69 Standard on Explosion Prevention Systems', 2023

/13/ British Standards Institute, 'BS 9999 Fire safety in the design, management and use of buildings', 2017.

/14/ HM Government, 'The Building Regulations 2010 Fire Safety Approved Document B 2019 edition incorporating 2020 and 2022 amendments – for use in England', 2022

/15/ The Energy Institute (EI), 'Guidance Model Code of Safe Practice Part 19: Fire precautions at petroleum refineries and bulk storage installations' 2023

/16/ UK Statutory instruments '2009 NO. 890 The Waste Batteries and Accumulators Regulations 2009, 2009.

/17/ National Grid, Felindre Compressor Station Hazardous Area Classification, Confidential.

# APPENDIX A
## Fire Strategy Layout

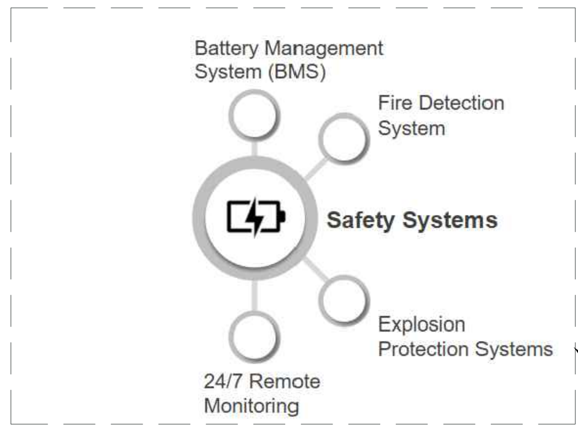
A1

## Swansea GGP - National Fire Chief's Council (NFCC) Fire Safety Compliance

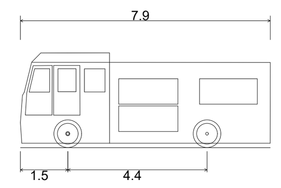
| Drawing No. | NFCC Guidance | Compliant | Notes |
|---|---|---|---|
| 1 | Battery storage systems should be designed to prevent fire, including appropriate detection, control and mitigation measures. | Yes | Battery storage containers will be equipped with industry recognised safety systems including; BMS, Fire Detection System, Explosion Prevention and 24/7 Remote Monitoring. |
| 2 | Site should include two access routes to accommodate varying wind conditions. | Yes | Site can be accessed via two vehicle gates entering from the north or east boundary. |
| 3 | Site road networks should provide unobstructed, access to all site areas and suitable to accommodate fire service vehicles. | Yes | Fully interconnected roadways permit access to all site areas. Swept pass analysis completed for fire service vehicles. |
| 4 | Site should include a perimeter road with suitable passing places. | Yes | Perimeter road encircles site, fully interconnected roadways enable multi-vehicle access and maneuverability. |
| 5 | Spacing of battery units should be 6m unless a clear, evidence based, case for the reduction is shown. | Yes | Battery units will be spaced with minimum separation 1.85m. NFCC recognised UL9540A testing will be undertaken to demonstrate suitability. |
| 6 | Spacing of battery units should be 25m from site boundaries prior to mitigation. Reduction may be possible in areas of lower risk (e.g. rural settings). | Yes | Battery units will be spaced > 25m from the site boundaries in most locations. Site location in is rural setting. BESS protection features and intended UL9540A testing considered suitable mitigation. |
| 7 | Spacing of battery units should be 25m from occupied buildings. | Yes | Site does not include occupied buildings, and there are no occupied buildings within 25m of the site boundary. |
| 8 | Areas within 10m of BESS units should be cleared of combustible vegetation. | Yes | Vegetation will be cleared with 10m of all battery units. |
| 9 | Firewater supplies equivalent to 1,900 L/min over 2-hours | Yes | Two (2) water tanks will provide 228,000 L emergency firewater supplies capable of 1,900 L/min over 2-hours |
| 10 | Suitable environmental protection measures should be provided. including systems for containing and managing water runoff. | Yes | Sustainable drainage system (SuDS) and attenuation ponds will be provided with 228,000 L capacity to capture any contaminated firewater runoff for safe disposal. |

SWANSEA BESS SITE HAS BEEN DESIGNED IN CLOSE ACCORDANCE WITH THE RECOMMENDATIONS SET OUT BY THE FIRE CHIEF COUNCIL AND IN PARTICULAR WITH REFERENCE TO THE DOCUMENT **'GRID SCALE BATTERY ENERGY STORAGE SYSTEM PLANNING – GUIDANCE FOR FRS'** THE PURPOSE OF THIS PLAN IS TO DEMONSTRATE THE CONSIDERATIONS AND COMPLIANCE OF THE DESIGN WITH THIS GUIDANCE.

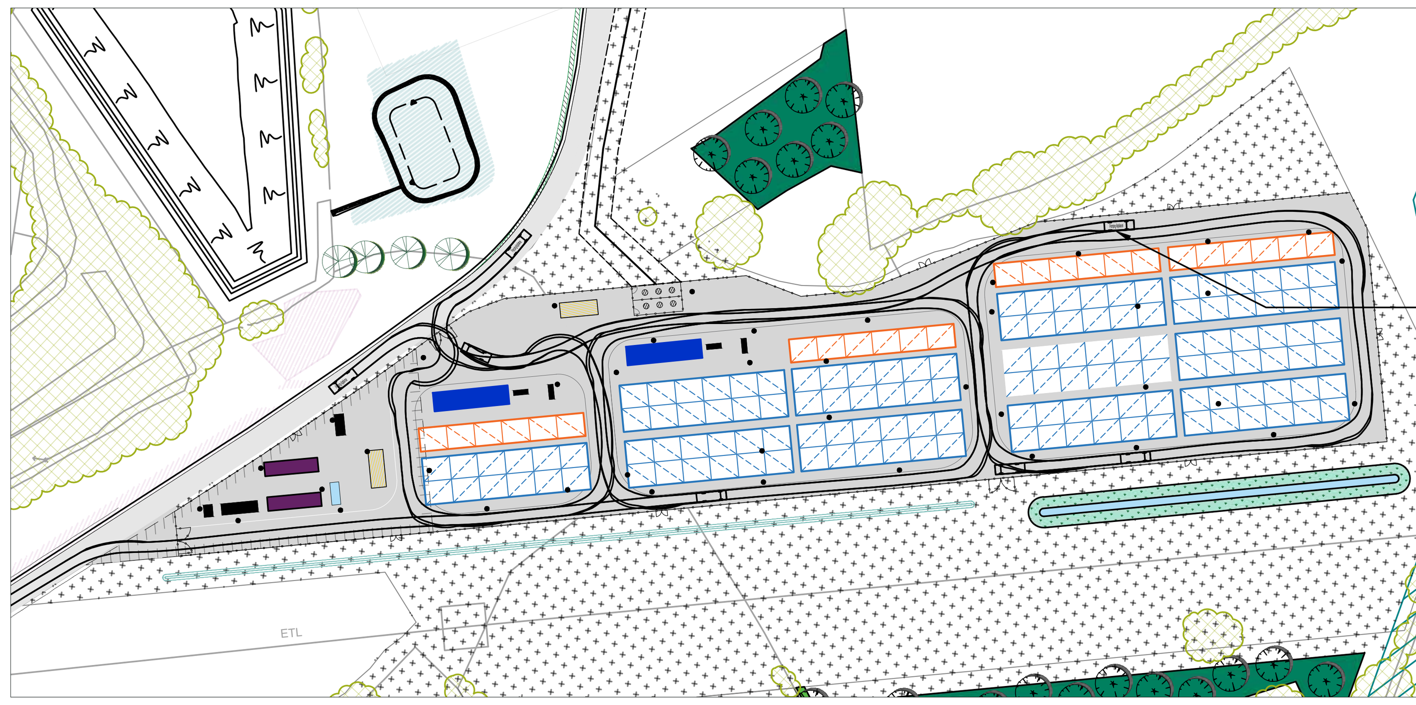
**THIS PLAN TO BE READ IN CONJUNCTION WITH THE PROPOSED SITE LAYOUT PLAN REF: PROPOSED SITE LAYOUT**




1 Tier 1 BESS solution equipped with latest industry standard safety and protection systems.




| | |
|---|---|
| Pumping Appliance | |
| Overall Length | 7.900m |
| Overall Width | 2.500m |
| Overall Body Height | 3.300m |
| Min Body Ground Clearance | 0.140m |
| Track Width | 2.500m |
| Lock to lock time | 4.00s |
| Kerb to Kerb Turning Radius | 7.750m |




3 ACCESS AND TRACKS DESIGNED FOR 7.9m RIGID VEHICLE. SWEPT PATH ANALYSIS CONDUCTED USING THE ABOVE VEHICLE SPEC

**Enlarged view: Swept Path analysis for Emergency access**

**Scale: NTS**



Scaled dimensions must not be taken from this drawing. All dimensions are to be confirmed on site prior to commencement of work

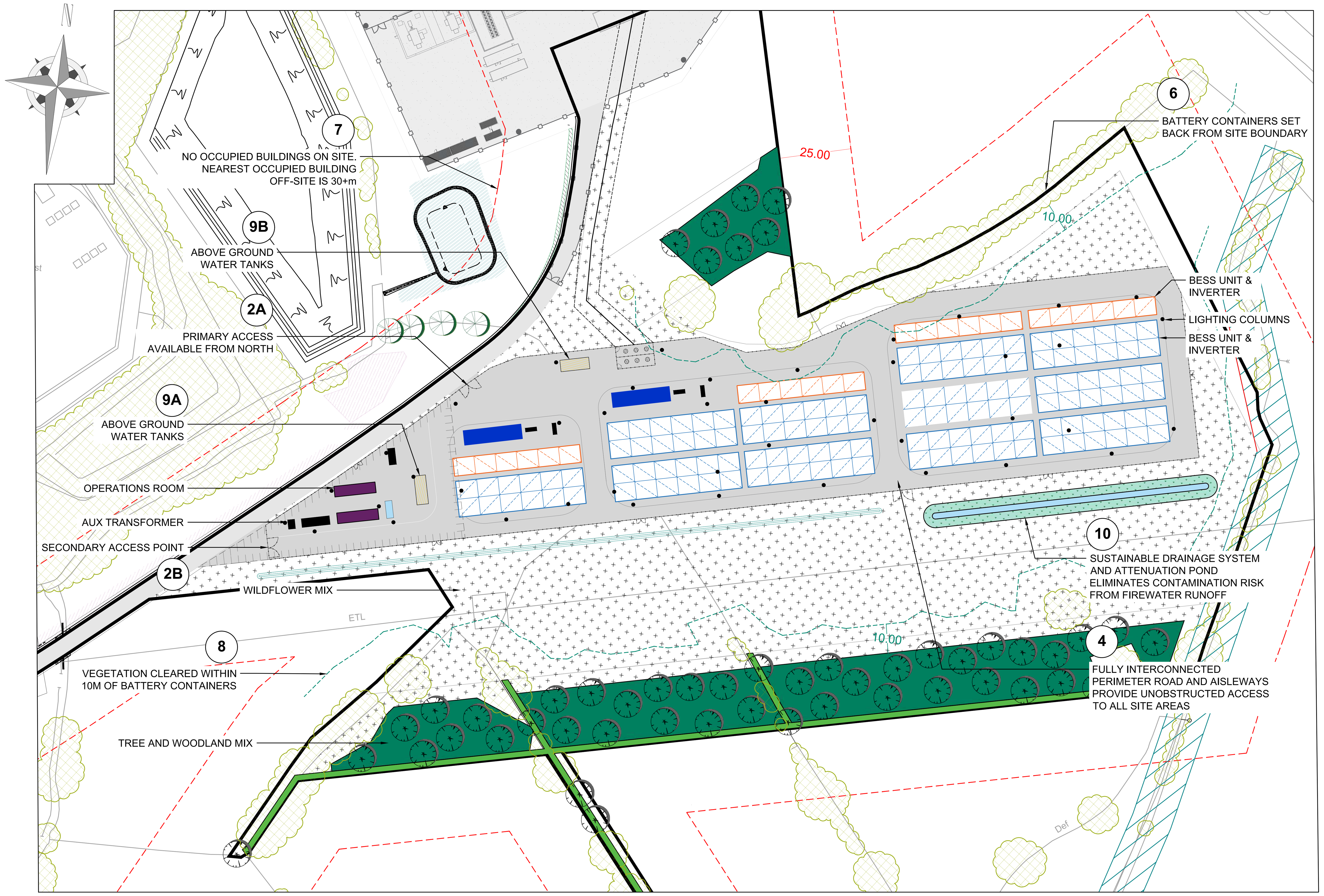
Revisions:

| Revision | Date | Revision Notes | Drawn | Inspected |
|---|---|---|---|---|
| 01 | 07.02.25 | First Issue | CS | TM |
| 02 | 13.02.25 | Fire Truck & Swept Path Amended | CS | TM |
| 03 | 01.04.25 | Site Layout Updated | RL | TM |
| 04 | 08.04.25 | Attenuation Pond Updated | OM | TM |
| 05 | 09.04.25 | Fire Engine Swept Path Updated | RL | TM |
| 06 | 14.04.25 | Landscape Updated | RL | TM |

LEGEND:

25M OFFSET FROM BOUNDARY

10M OFFSET FROM VEGETATION

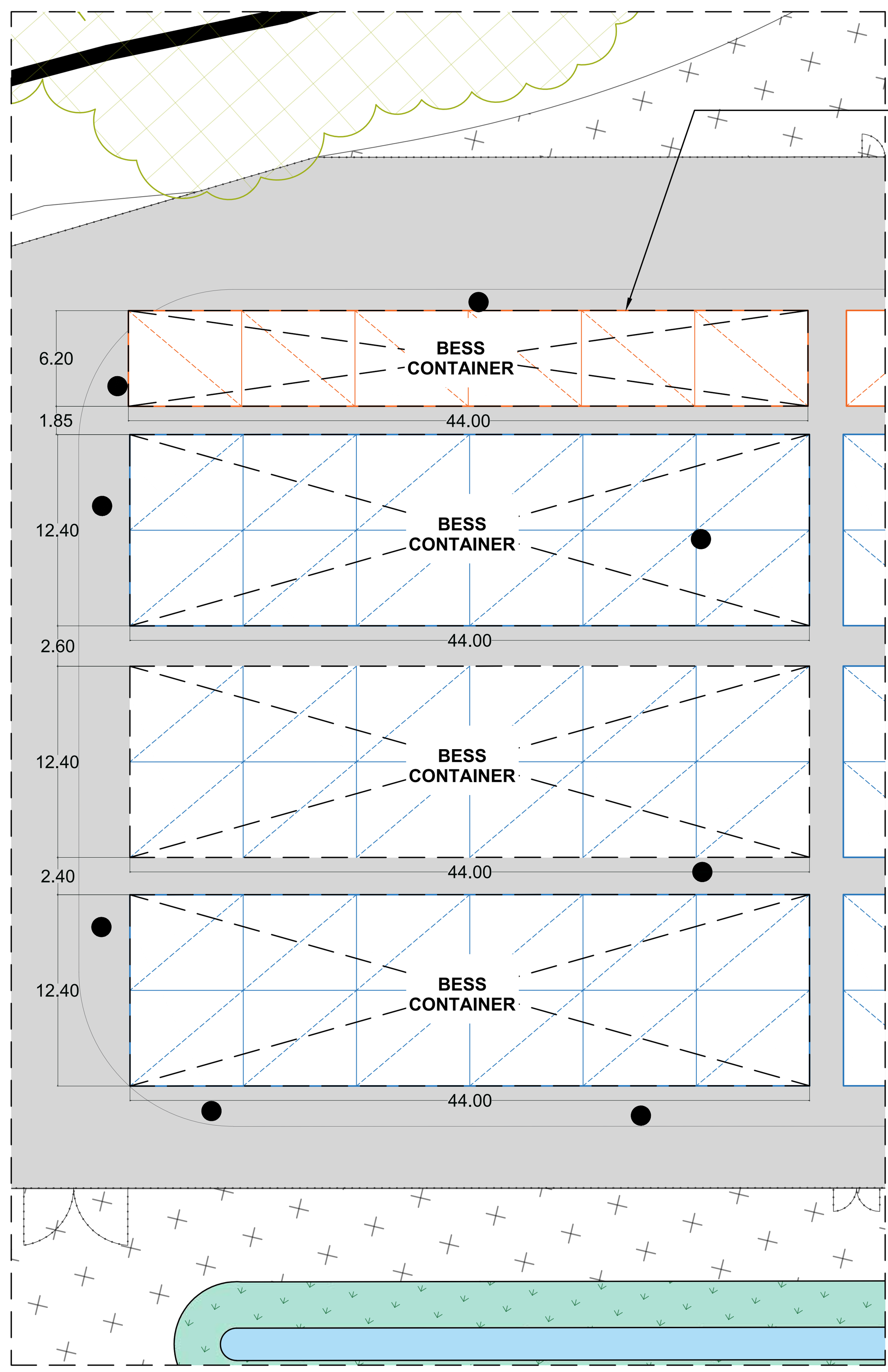



**Fire Strategy Plan**

**Scale 1:500**

0 5 10 15 20 25 30 35 40 45 50m

SCALE 1:500




5 MINIMUM BATTERY CONTAINER SPACING OF 1.85m. TO BE EVIDENCE BACKED AND SUPPORTED THROUGH INDUSTRY STANDARD UL9540A TESTING

**Enlarged view: BESS Storage Spacing**

**Scale: NTS**

Project:

**Swansea BESS**

Applicant:

Statkraft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Status:

**PLANNING**

Drawing Title:

**Swansea Bess Fire Strategy Plan**

| Drawn: CS | Checked: TM | First Issued: 07.02.2025 |
|---|---|---|
| Project Code: STA009- | Drawing Number: FS-01 | |
| Sheet Size: A1 | Scale: A.N | Revision: 06 |

# APPENDIX B
## Plume Dispersion Study

SWANSEA GREENER GRID PARK EXTENSION

# Plume Dispersion Study

**Statkraft UK Ltd**

**Report no.:** 10547041-RMC-IE-02, Rev. 0
**Document no.:** 2559112
**Date:** 2025-04-07

| | | |
|---|---|---|
| Project name: | SWANSEA GREENER GRID PARK EXTENSION | DNV Services UK Limited |
| Report title: | Plume Dispersion Study | Energy Systems |
| Customer: | Statkraft UK Ltd, 19th Floor 22 Bishopsgate London EC2N 4BQ United Kingdom | London SHE Risk<br>5th Floor Vivo Building Vivo Building |
| Customer contact: | Wai-kit Cheung | 30 Stamford Street SE1 9LQ |
| Date of issue: | 2025-04-07 | London |
| Project no.: | 10547041 | United Kingdom |
| Organisation unit: | Risk Management Consultancy | Tel: GB 440 60 13 95 |
| Report no.: | 10547041-RMC-IE-02, Rev. 0 | |
| Document no.: | 2559112 | |

Applicable contract(s) governing the provision of this Report:
Framework #4600003062, Call Off #4500501945

Objective:
This document is the Plume Dispersion Study for Statkraft UK Ltd's proposed extension to a Greener Grid Park in Swansea, UK.

| Prepared by: | Verified by: | Approved by: |
|---|---|---|
| Callum Davis<br>Junior Consultant<br><br>Diyar Yalcin<br>Senior Consultant | Joseph Holt<br>Senior Consultant | Jasjeet Singh<br>Senior Principal Consultant |

Internally in DNV, the information in this document is classified as:

| | Can the document be distributed internally within DNV after a specific date? No | Yes |
|---|---|---|
| ☒ Open<br>☐ DNV Restricted | -- | -- |
| ☐ DNV Confidential<br>☐ DNV Secret | ☐ | ☐ |

Additional authorised personnel for distribution within DNV:

Keywords BESS, KFX, Plume

| Rev. no. | Date | Reason for issue | Prepared by | Verified by | Approved by |
|---|---|---|---|---|---|
| A | 2025/04/04 | Draft issue | C. Davis, D. Yalcin | J. Holt | J. Singh |
| 0 | 2025/04/07 | Final issue | C. Davis, D. Yalcin | J. Holt | J. Singh |

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# Table of contents

# EXECUTIVE SUMMARY

This report has been commissioned by Statkraft UK Ltd ('Statkraft') to accompany a planning application for the development of an extension to a Greener Grid Park in Swansea, UK. The development will comprise a Battery Energy Storage System (BESS), associated infrastructure, landscaping, and access supporting renewable energy capacity and stability on the UK national grid.

This report contains the Plume Dispersion Study prepared by DNV for the Swansea Greener Grid Park Extension. DNV has extensive experience globally assessing the hazards posed by various BESS including accident investigation [Ref. /10/], 2D and 3D consequence modelling and full-scale testing at DNV's facilities in the UK, USA and Europe.

The evaluation is a consequence-based study using Computational Fluid Dynamics (CFD) to evaluate the potential impact of a battery failure event and assess the impact of visibility, toxicity and heat flux on the neighbouring area in the event of a fire. The analysis has evaluated the credible worst-case scenario in terms of consequence for a fire event, where safety systems and barriers to prevent escalation were assumed to have failed, and a reasonable worst-case (full BESS) fire was modelled. Results are presented in terms of recognised hazardous exposure thresholds. The hazardous threshold is known as Immediately Dangerous to Life and Heath [IDLH, Ref. /6/].

Four scenarios were modelled that varied the wind speed and direction for a BESS fire. The main findings from the simulations were:

- There is no impact to the Site Entry Junction to the West-South-West of the nearest BESS Unit or to the Felindre Gas Compression Site to the North West of the Site for any toxic gas, visibility impairment or thermal effects for any wind conditions modelled.
- The 5.5 m/s wind speed results in the longest impairment distances, as the higher wind speed of 10 m/s disperse the flame, shortening its length and diluting the smoke plume.
- The concentrations measured of toxic gases show that the hazards posed by a battery unit fire are confined to the immediate surrounds of the battery unit, HF remaining within 3 m and CO within 5 m. This is due to the relatively high concentrations required to reach the IDLH thresholds.
- The maximum impairment distance for the Site Entrance (located 100 m away) is discussed below:
    - 20 mph Stopping Distance – 1.9 m impairment distance
    - 40 mph Stopping Distance – 5.2 m impairment distance
- Heat flux of greater than 12 kW/m$^2$ is localised to the BESS unit for all scenarios.

To add confidence to the results of the study, conservative assumptions have been used due to the uncertainty in the analysis. For example, peak fire loads have been modelled whereas in reality, the peak fire would last for 1-2 hours and the rest of the fire, another 6-8 hours would be at a low intensity and subsequently more than a day of smouldering. The aim of the analysis was to demonstrate the consequences of the reasonable worst case Battery Unit fire. With this conservatism, no impairment was observed at the site entry junction (100 m from the nearest battery unit) or the Felindre National Gas Compression Site (125 m from the nearest battery unit).

From the study, it can be concluded that there is no impact due to toxic gas, visibility impairment or heat flux on any target in the proximity of the Swansea Greener Grid Park Extension due to a reasonable worst-case (full BESS) fire. The effects of the fire are restricted to the proximity of the BESS. Emergency responders would only require breathing apparatus if located within the immediate area of the BESS that is on fire due to toxic gases potentially exceeding IDLH values at these distances. The residential areas and road targets are sufficiently far away from the BESS as to not be impaired by any of the simulated fires in terms of heat flux, visibility or toxicity.

## GLOSSARY OF TERMS

| Term | Description |
|---|---|
| BESS | Battery Energy Storage System |
| CFD | Computational Fluid Dynamics |
| CO | Carbon Monoxide |
| HF | Hydrogen Fluoride |
| HVAC | Heating, Ventilation and Air Cooling |
| IDLH | Immediately Dangerous to Life or Health |
| KFX | Kameleon FireEx |
| NFPA | National Fire Protection Association |

## DEFINITIONS

| Term | Description |
|---|---|
| Battery Cell | The basic functional unit of a battery unit contains an assembly of electrodes, electrolyte, separators, and terminals in a container. It is a source of electrical energy by direct conversion of chemical energy. |
| Battery Cluster | Battery units are designed to be installed and connected in rows (often referred to as clusters). |
| Battery Module | A battery module is comprised of many cells and can be equipped with venting fans and communication connections for remote monitoring and switch off in response to abnormal cell behaviour that indicates a potential fault. |
| Battery Unit | The main functional unit of a battery energy storage system. The battery unit can hold multiple racks of battery modules and may include a Battery Management System (BMS) controller. The battery unit is housed in a rigid metal enclosure which provides protection from weather, animal and mechanical damage. |
| BESS | Battery Energy Storage System, describes all equipment, hardware and software that makes up a working system. |
| BESS Site | The Battery Clusters are installed and connected to transformers and other equipment to form a BESS Site. |

# 1 INTRODUCTION

## 1.1 Proposed Development

On behalf of Statkraft UK Limited ('Statkraft'), a planning application is being prepared for the development of an extension to a Greener Grid Park in Swansea, UK comprising a Battery Energy Storage System (BESS), associated infrastructure, landscaping, and access.

The development will be located on land west of Rhydypandy Road, Morriston, Swansea. The battery units are arranged across non-stacked outdoor enclosures, coupled to the local electricity distribution network via a series of power conversion systems and transformer units. The point of connection for the Greener Grid Park Extension will be at Statkraft's existing Greener Grid Park, under construction to the north of the site. The proposed layout is presented in Figure 1-1: below.

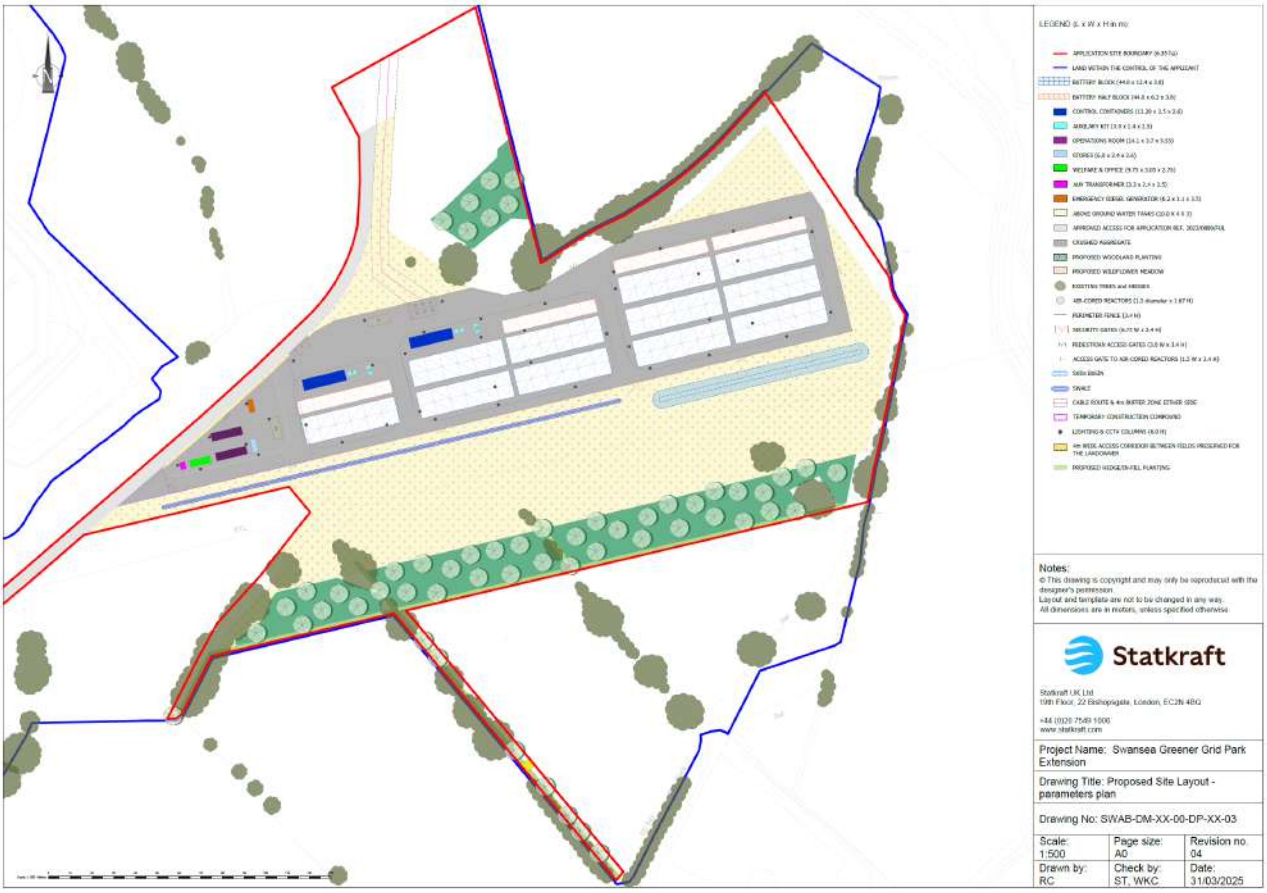


**Figure 1-1: Swansea Greener Grid Park Extension - Site Layout Plan**

## 1.2 Document Scope

This document presents the Plume Dispersion Study prepared by DNV for the Swansea Greener Grid Park Extension. The Plume Dispersion Study is a consequence-based study using Computational Fluid Dynamics (CFD) to evaluate potential impact for a battery failure event and assess the impact of smoke and toxicity on the neighbouring area in the event of a fire. The analysis evaluates the reasonable worst-case scenario in terms of consequence for a fire event.

## 2 CFD MODEL

The 3D CFD modelled software Kameleon FireEx (KFX) has been used for the fire simulations [Ref. /1/]. KFX is capable of calculating heavy and light gas dispersion and hydrocarbon fires in connection with practical fire safety studies. It can handle liquid pool fires as well as gas jet and fires, in enclosures and in open air. It has been tested against experimental data ranging from small-scale laboratory flames to large-scale jet and pool fires. KFX can be used for most safety related analysis related to gas dispersion and fire.

### 2.1 Site Layout Model

Satellite imagery of the proposed development area with the site plan superimposed is shown in Figure 2-1 (Including distances to targets) [Ref. /11/].

Figure 2-2 shows the site in detail. The two highlighted detailed BESS (Purple) have been used for simulations, due to their location being closest to the targets. The geometry model of the site is configured according to this site layout. Terrain is not considered in the modelling, which is conservative as the effective distance between BESS and target is reduced.

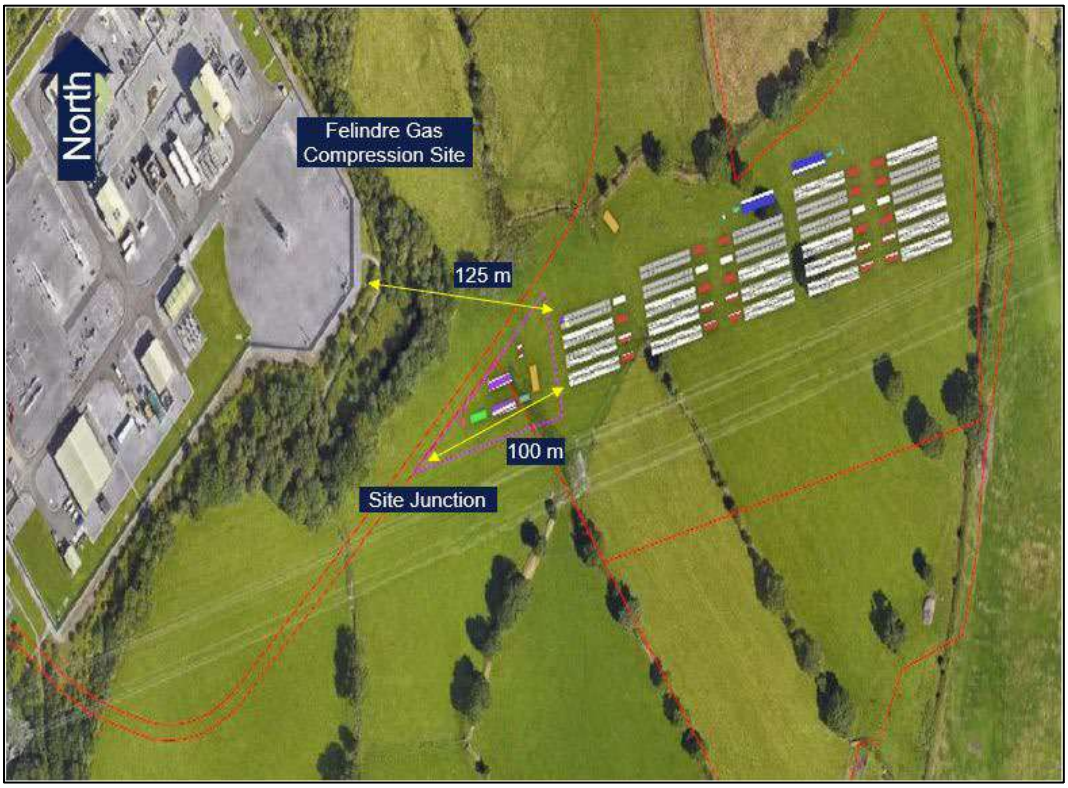


**Figure 2-1: Swansea Greener Grid Park Extension Site Model with Target Distances**

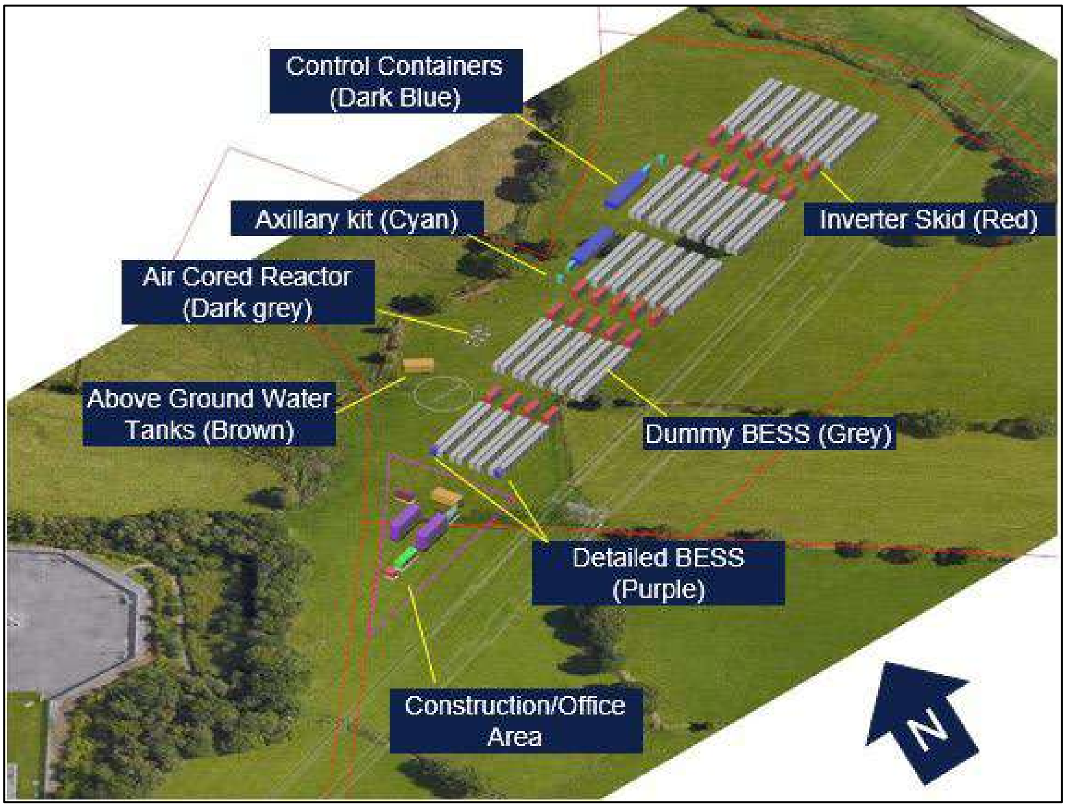


**Figure 2-2: Swansea Greener Grid Park Extension Detailed Site Model**

## 2.2 BESS Geometry

The BESS geometry and site were built in the 3D modelling software Rhinoceros [Ref. /2/]. Figure 2-3 shows the 3D geometrical representation of the BESS Unit (detailed BESS geometry was not available for the site, therefore a representative BESS Unit was built based on the site specifications). The top figure shows the outside of the BESS Unit, the bottom figure shows the BESS Unit with front walls removed. The BESS contains 2 Racks in a 1 x 2 arrangement and each rack measures 0.9 m x 1.05 m x 2.1 m. Each Battery Unit measures 2.45 m x 2.15 m x 2.6 m. Each Battery Unit has 2 deflagration panels, each located above a rack, measuring 0.65 m x 1.85 m. Each Battery Unit also has a forward-facing door with a built-in window panel, measuring 1.35 m x 1.7 m. The deflagration panels are assumed to be fully opened (100% open), as the overpressure generated by the explosion preceding the fire would exceed the panels opening pressure. The door window panel is assumed to be 20% open, a conservative assumption which accounts for the effects of any damage caused by the initial explosion overpressure on the door.

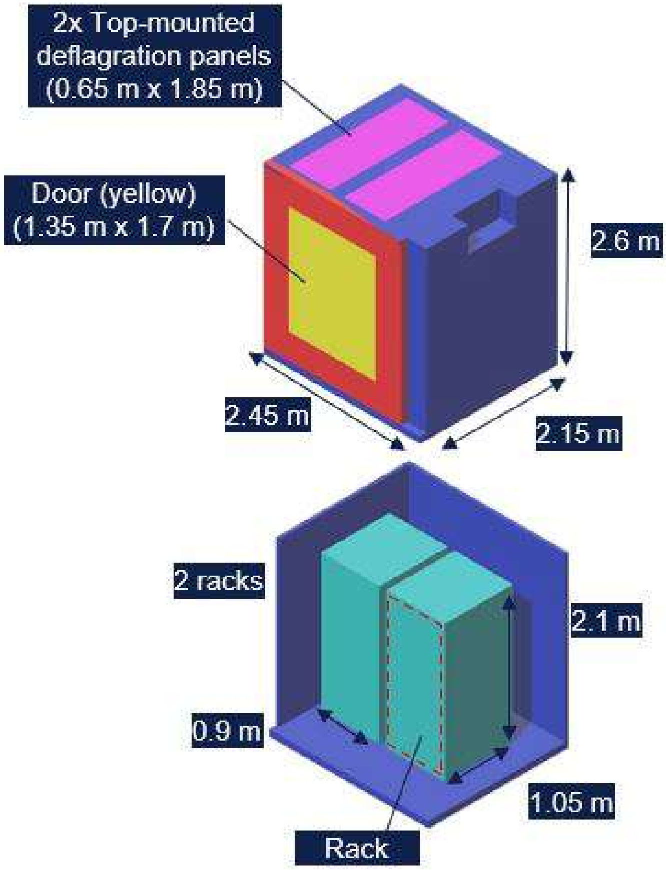


**Figure 2-3: 3D Model. Top – BESS from outside. Bottom – Front walls removed**

## 2.3 Input and Assumptions

A battery failure event is caused by a fault in a battery cell which can lead to thermal runaway in the cell. During thermal runaway, off-gas is produced and released from the cell. Off-gas is a flammable mixture of gases consisting mainly of hydrogen, some hydrocarbons, carbon dioxide and other gases (including hydrogen fluoride) at lower percentages. During the release, it is possible for a cascading failure of multiple cells in a module, or the entire BESS. The initial fuel source of the fire is the off-gas released by the cells. After some time, the other combustible items in the BESS are consumed in the fire, these are mainly plastic items.

The following safety systems and CFD input data have been acknowledged for the basis of the study assumptions. Test data was not available for the site. Instead, the assumptions are based on aggregated test data from BESS of similar size and capacity to the BESS proposed for the development.

Propagation between cells:

- No module level test report was available. Previous UL 9540A module level test reports have indicated it is possible to have cell to cell propagation within a module.
- **Assumption**: It is assumed that all cells within a module can fail.

Propagation between modules:

- No unit level test report was available. Previous UL 9540A unit level test reports have indicated module to module propagation is unlikely, however full-scale fire tests have shown this was possible.
- **Assumption**: It is assumed that in the event of thermal runaway in the Battery Unit that module-to-module propagation will occur, and that all modules of the Battery Unit could be engaged in the fire.

Propagation between Battery Units:

- Full-scale fire tests show that Battery Unit to Battery Unit propagation is unlikely with appropriate spacing.
- **Assumption**: It is assumed that in the event of a fire in a battery unit it does not propagate to the neighbouring Battery Units, limiting the failure to the Battery Unit of origin.

Ventilation system:

- The Battery Unit would have a HVAC system for cooling the internal components.
- **Assumption**: The HVAC will be shut down in the event of a fire.

Gas composition and properties:

- Gas composition was derived from previous UL 9540A test data.
- **Assumption**: The combustion of plastic items in the Battery Unit has also been considered with additional propane added to the offgas composition. Propane has similar yields of CO and CO2 to polypropylene plastic which is typical for battery casings [Ref. /3/]. The gas composition accounting for the plastics can be seen in Table 2-1.

**Table 2-1 Gas Composition Data**

| Gas | | Adjusted for Plastic (%) |
|---|---|---|
| Hydrogen | $H_2$ | 41 |
| Carbon Dioxide | $CO_2$ | 23 |
| Carbon Monoxide | $CO$ | 8 |
| Propane | $C_3H_8$ | 17 |
| Ethane | $C_2H_6$ | 1 |
| Ethylene | $C_2H_4$ | 4 |
| Methane | $CH_4$ | 6 |

Note: Hydrogen Fluoride is assumed to be present in off gas with a concentration of 1000ppm. See below for further detail.

Offgas release rate (mass/time):

- Offgas release rate was averaged from previous test data where cells are assumed to fail in a module and then propagate to adjacent cells and adjacent modules.
- **Assumption**: The peak release rate is 0.134 kg/s (134 g/s) for a BESS Unit and is aggregated from data for previous BESS of similar size and capacity to the BESS proposed for the Swansea Greener Grid Park Extension.

Toxic gas content in battery unit fire:

- Toxic gases are produced in a battery fire, the most dangerous of which is hydrogen fluoride. While other toxic gases are produced, depending on the battery chemistry, hydrogen fluoride is the most abundant and has the lowest threshold, meaning it is the most restrictive.
- **Assumption**: Based on DNV's experience and testing [Ref. /4/], around 0.1% of the combustion product is hydrogen fluoride. This equates to around 1000 ppm at source. It is therefore assumed that there is 0.1% of hydrogen fluoride in the combustion product.

## 2.4 Simulations

The inputs and assumptions made in the previous section are conservative and define a reasonable worst-case fire. This fire was modelled with varying wind speeds and directions to obtain the maximum impact due to the smoke plume at the different targets of interest.

A total of four scenarios have been identified to model the BESS fires as shown in Table 2-2. Two scenarios target the Site Entry Junction to the West-South-West of the BESS site, and the other two scenarios target the Felindre Gas Compression Site to the West-North-West. A wind speed of 5.5 m/s (20 km/h) was used as this is the annual average for the closest weather station (the meteorological data considered is 3.6 km from the site) [Ref. /5/], and 10 m/s (36 km/h) was used as a conservatively higher wind speed. This wind speed represents the $90_{th}$ percentile wind condition, averaged over a year. Lower and higher wind speeds are chosen to cover the range of conditions, where lower wind speeds may not sufficiently dilute the plumes, but higher wind speeds may have more potential to elongate and bend the plumes.

The Site Junction Entrance is 100 m West-South-West from the nearest BESS Unit. Wind blowing from the East-North-East (ENE) represents the worst-case scenario for this target as the smoke plume will be blown towards it. Wind blowing from ENE accounts for 7 % of the average annual wind probability. The Felindre Gas Compression Site is 125 m West-North-West from the nearest BESS Unit. Wind blowing from the East-South-East (ESE) represents the worst-case scenario for this target and accounts for 6 % of the average annual wind probability. The predominant wind direction at the site is from the from the West and accounts for 10 % of the average annual wind probability.

**Table 2-2 Simulation Scenarios**

| Simulation ID | Fire Size | Target | Wind Direction (from) | Wind Speed (m/s) |
|---|---|---|---|---|
| 101 | Battery Unit | Site Junction | ENE | 5.5 |
| 102 | | | ENE | 10 |
| 103 | | Felindre National Gas Site | ESE | 5.5 |
| 104 | | | ESE | 10 |

## 2.5 Impairment Thresholds

The following thresholds are defined for impairment to people and are based on industry best practise [Ref. /6/, /7/, /8/, and /9/]. The simulation results will be compared to the below criteria to determine the severity of the consequences on the identified targets.

### 2.5.1 Safe Exposure Limits

Exposure to hazardous substances can lead to adverse health effects. This is dependent on the concentration of the gas and the exposure time. One measure for exposure limits to toxic gases is the Immediately Dangerous to Life or Health (IDLH) values [Ref. /6/]. This was developed to enable the safe escape of workers if their breathing apparatus failed in a contaminated environment in 30 minutes, to provide maximum worker safety.

In this study, the IDLH values are used to indicate that there is an immediate danger to health without a breathing apparatus. The following hazardous substances and their IDLH limits are provided below.

Hydrogen Fluoride (HF):

- IDLH level is 30 ppm.

Carbon monoxide (CO):

- IDLH level is 1,200 ppm.

### 2.5.2 Visibility Impairment

Reduced visibility due to smoke produced in a fire can prevent the safe escape of personnel. A visibility of 10 m is typically considered acceptable for personnel to escape from a fire.

Reduced visibility is also a hazard for vehicles driving on nearby roads that would have reduced visibility if the smoke plume obstructed the road. This is potentially dangerous as they would have a reduced effective stopping distance. Of particular importance is the impact of low visibility on any emergency vehicles attempting to enter the site. The public road closest to the BESS site, B4489, is a 40 mph road and the proposed site access road is expected to have a speed limit of 20 mph. The stopping distances at 40 mph and 20 mph are 36 m and 12 m, respectively [Ref. /7/]. Any reduction on these visibilities would be considered as impaired. As such, 36 m and 12 m have been set as impairment of the roads for this study, with 12 m being the threshold of interest.

### 2.5.3 Heat Flux

The heat flux (thermal radiation) plots will be shown for the thresholds below:

- 2 kW/m$^2$ Minimum to cause pain after 60 s.
- 12 kW/m$^2$ Piloted ignition of wood [Ref./8/] Reference for extreme pain within 20 s. Fatal if no escape (70% lethality outdoors) is 12.5kW/m$^2$, this will conservatively be lowered to 12 kW/m$^2$. This is the threshold of interest.
- 25 kW/m$^2$ Unprotected steel will reach thermal stress temperatures than can cause failure.
- 35 kW/m$^2$ Immediate fatality (100% lethality). Reference for structural time to failure of steel plate in 20 minutes is 37.5 kW/m$^2$ [Ref./9/], this will conservatively be lowered to 35 kW/m$^2$ for this study.
- 250 kW/m$^2$ Reference for structural time to failure in 5-10 minutes.

# 3 RESULTS

The results evaluate the potential impact of a Battery Unit failure and assess the impact of thermal effects and smoke on the neighboring targets in the event of a fire.

Contour plots for all simulations are presented in Appendix A for visibility impairment, toxicity and heat flux. The following observations are made from the results:

- There is no impact to the site junction (to the West-South-West of the site) or the Felindre National Gas Compression Site (to the West-North-West of the site) for any toxic gas, visibility impairment, or heat flux for any wind conditions modelled.
- By inference, the nearby residential buildings would not be impacted by a battery fire, as they are located at greater distances (>300 m) from the BESS site than either target explicitly modelled.
- The wind speed of 5.5 m/s produces the largest distance to impairment compared to the higher wind speed of 10 m/s. This is due to the flame being dispersed by the higher wind speeds, which reduces the flame length and dilutes the smoke plume. The lower wind speed by contrast is less turbulent, disrupting the flame less and the smoke plume travels for a greater distance.
- The concentrations measured of toxic gases show that the hazards posed by a battery unit fire are confined to the immediate surrounds of the battery unit, HF remaining within 3 m and CO within 5 m. This is due to the relatively high concentrations required to reach the IDLH thresholds.
- The maximum impairment distance for the Site Entrance (located 100 m away) is discussed below:
    - 20 mph Stopping Distance – 1.9 m impairment distance
    - 40 mph Stopping Distance – 5.2 m impairment distance
- Heat flux of greater than 12 $kW/m^2$ is localised to the BESS unit for all scenarios.
- For the targets identified in the study to be impacted by a battery fire, a significant number of Battery Units would need to simultaneously fail. However, the full-scale fire test showed that battery unit to battery unit escalation is unlikely when the separation distance is in line with industry best practices (NFPA 855).

To add confidence to the results of the study, conservative assumptions have been used due to the uncertainty in the analysis. For example, peak fire loads have been modelled whereas in reality, the peak fire would last for 1-2 hours and the rest of the fire, another 6-8 hours would be at a low intensity and subsequently more than a day of smouldering. The aim of the analysis was to demonstrate the consequences of the reasonable worst case Battery Unit fire. With this conservatism, no impairment was observed of the nearest road target (Site Junction, 100 m from the nearest battery unit) or the nearest offsite structure (Felindre National gas Compression Site, 125 m from the nearest battery unit).

# 4 CONCLUSIONS

This document contains the Plume Dispersion Study for Statkraft's proposed Greener Grid Park Extension, in Swansea UK. From the study, it can be concluded that there is no impact due to toxic gas, visibility impairment or heat flux on any target in the proximity of the site due to a reasonable worst-case (full BESS) fire. The effects of the fire are restricted to the proximity of the BESS. Emergency responders would only require breathing apparatus if located within the immediate area of the BESS that is on fire due to toxic gases potentially exceeding IDLH values at these distances. The residential areas and road targets are sufficiently far away from the BESS as to not be impaired by any of the simulated fires in terms of heat flux, visibility or toxicity.

# REFERENCES


/1/ https://www.dnv.com/services/fire-simulation-software-cfd-simulation-kameleon-fireex-kfx-110598

/2/ Rhinoceros, https://www.rhino3d.com/, 2024

/3/ SFPE Handbook of Fire Protection Engineering – 3rd edition – 2002

/4/ Considerations for ESS Fire Safety, Jan 2017

/5/ https://weatherspark.com/y/36239/Average-Weather-in-Pontlliw-United-Kingdom-Year-Round

/6/ IDLH is defined by US National Institute for Occupational Safety and Health (NIOSH), https://www.cdc.gov/niosh/idlh/default.html

/7/ https://assets.publishing.service.gov.uk/media/559afb11ed915d1595000017/the-highway-code-typical-stopping-distances.pdf

/8/ An Introduction to Fire Dynamics, D. Drysdale, 2nd ed., p. 221

/9/ CMPT, A Guide to Quantitative Risk Assessments for Offshore Facilities, 1999

/10/ McMicken Battery Energy Storage System Event Technical Analysis and Recommendations, July 2022

/11/ 20250129 Swansea BESS - Proposed Site Layout 1_500.pdf

# APPENDIX A
## CFD Plots

Figure A 1 to Figure A 16 show the contour plots for hydrogen fluoride, carbon monoxide, visibility distance, and heat flux for all simulations with targets and wind directions labelled.

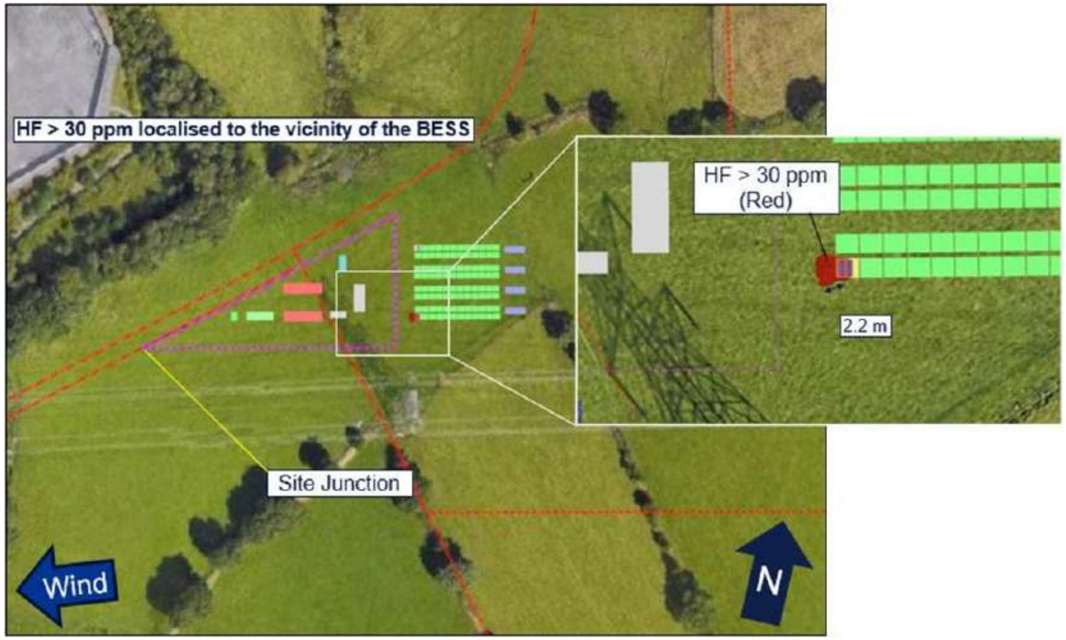


**Figure A 1: Case 101 – Hydrogen Fluoride Plot with Wind from ENE at 5.5 m/s**

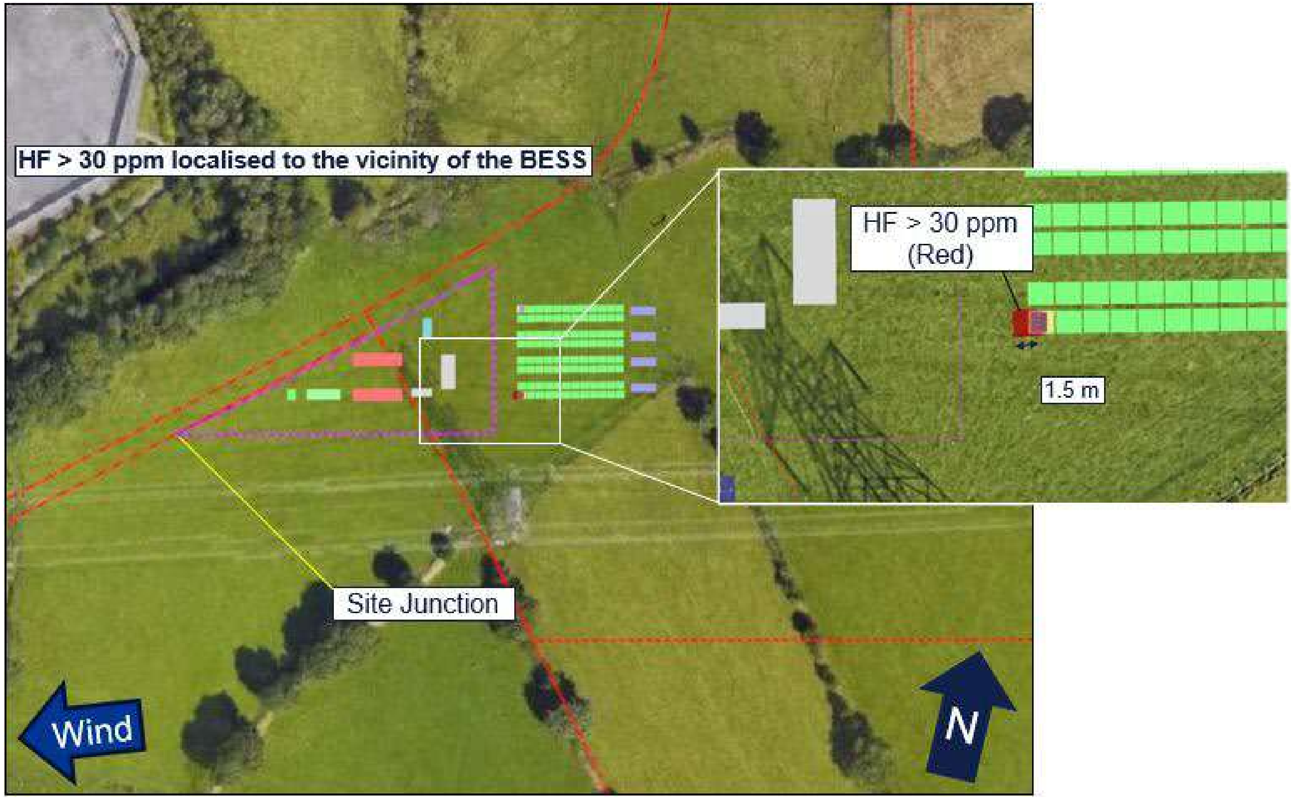


**Figure A 2: Case 102 – Hydrogen Fluoride Plot with Wind from ENE at 10 m/s**

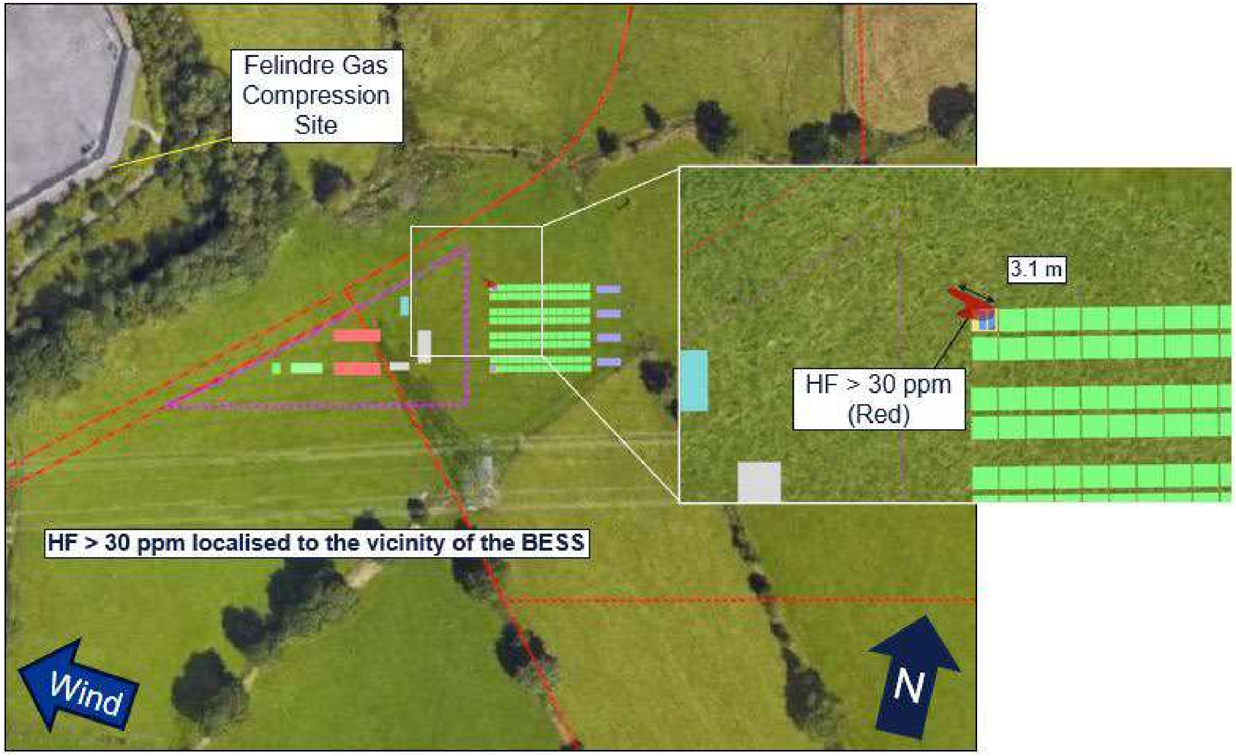


**Figure A 3: Case 103 – Hydrogen Fluoride Plot with Wind from ESE at 5.5 m/s**

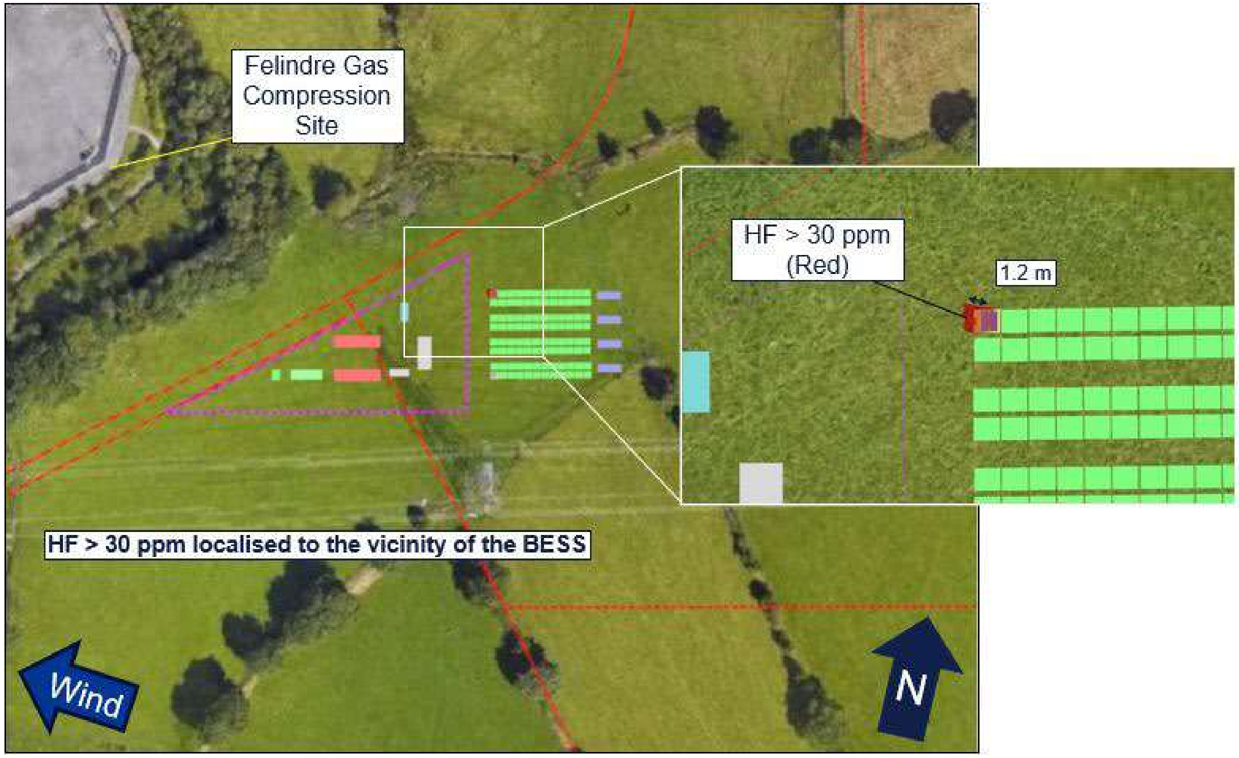


**Figure A 4: Case 104 – Hydrogen Fluoride Plot with Wind from ESE at 10 m/s**

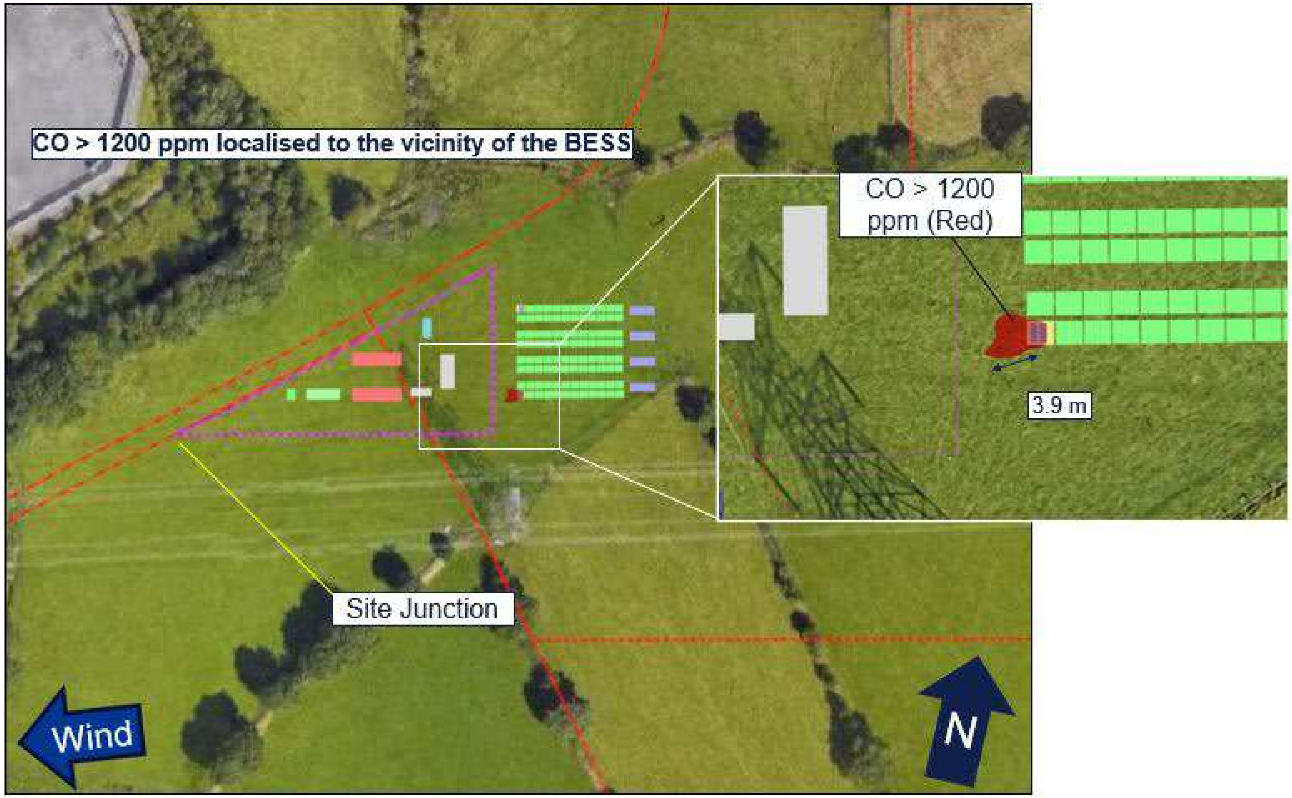


**Figure A 5: Case 101 – Carbon Monoxide Plot with Wind from ENE at 5.5 m/s**

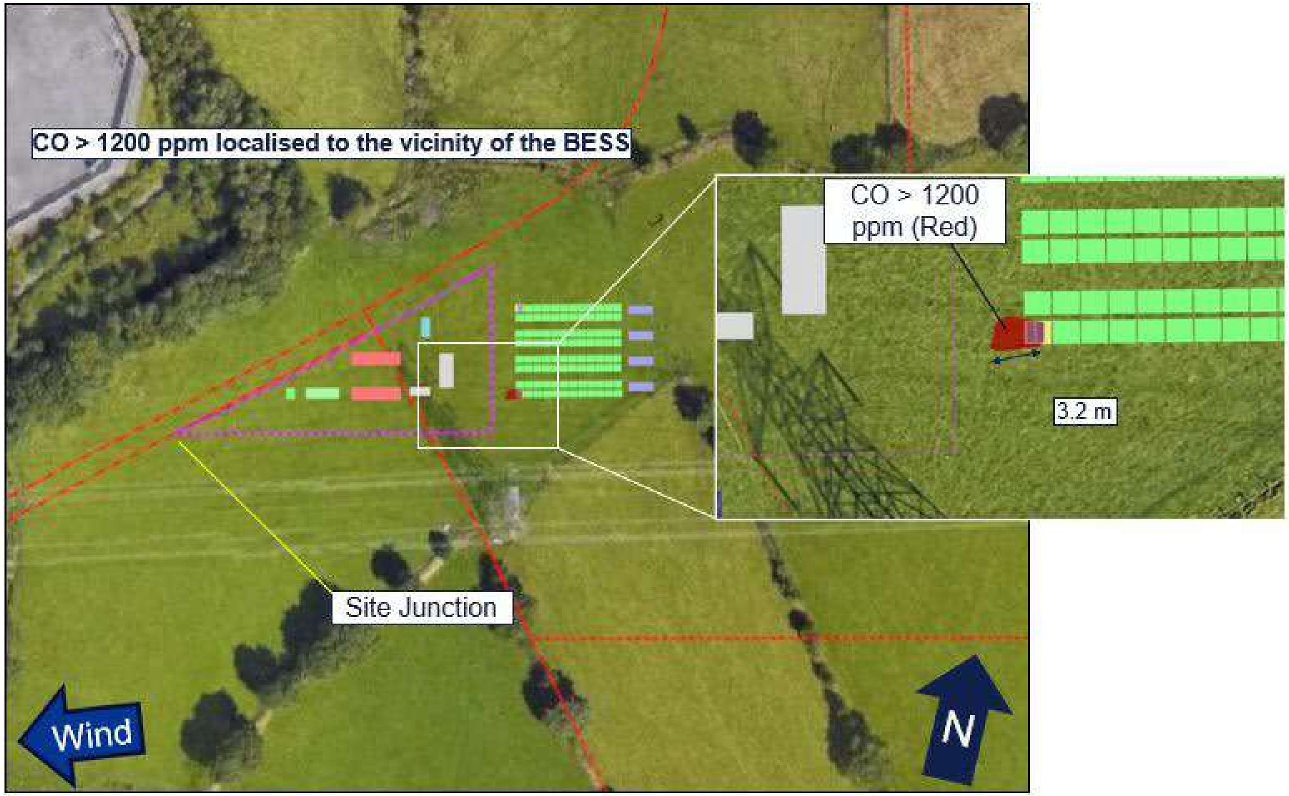


**Figure A 6: Case 102 – Carbon Monoxide Plot with Wind from ENE at 10 m/s**

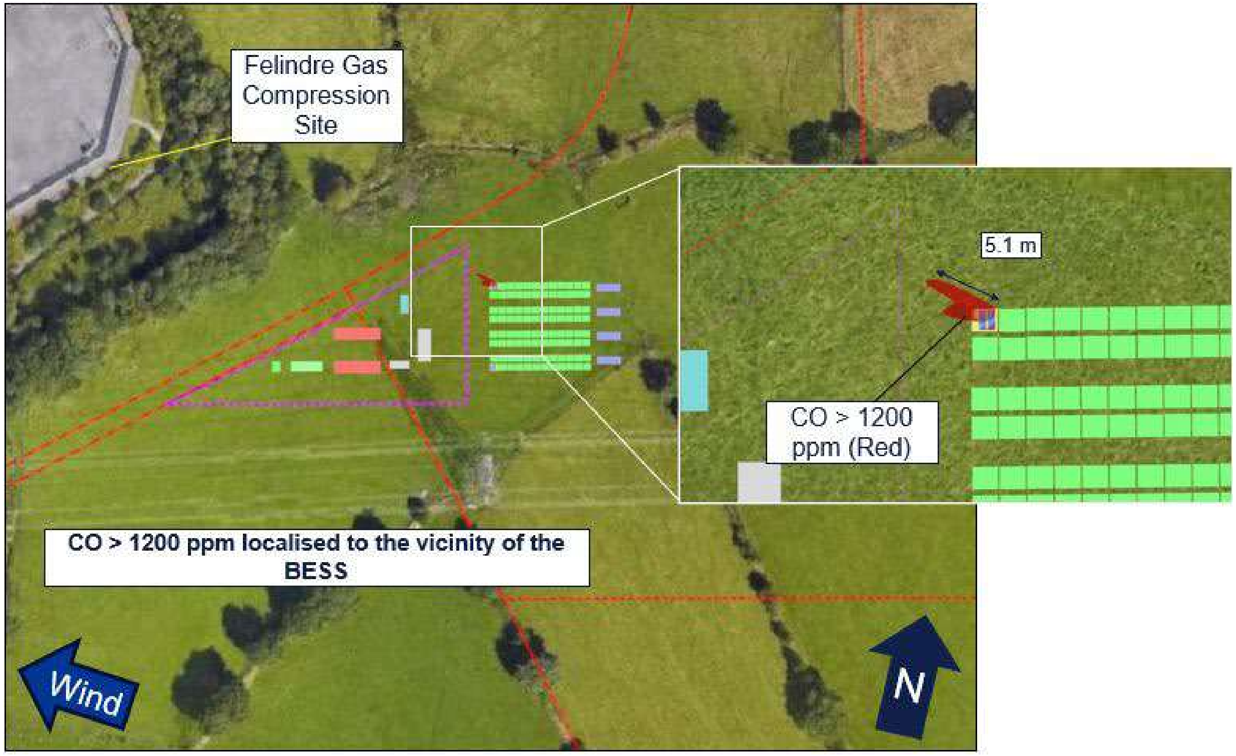


**Figure A 7: Case 103 – Carbon Monoxide Plot with Wind from ESE at 5.5 m/s**

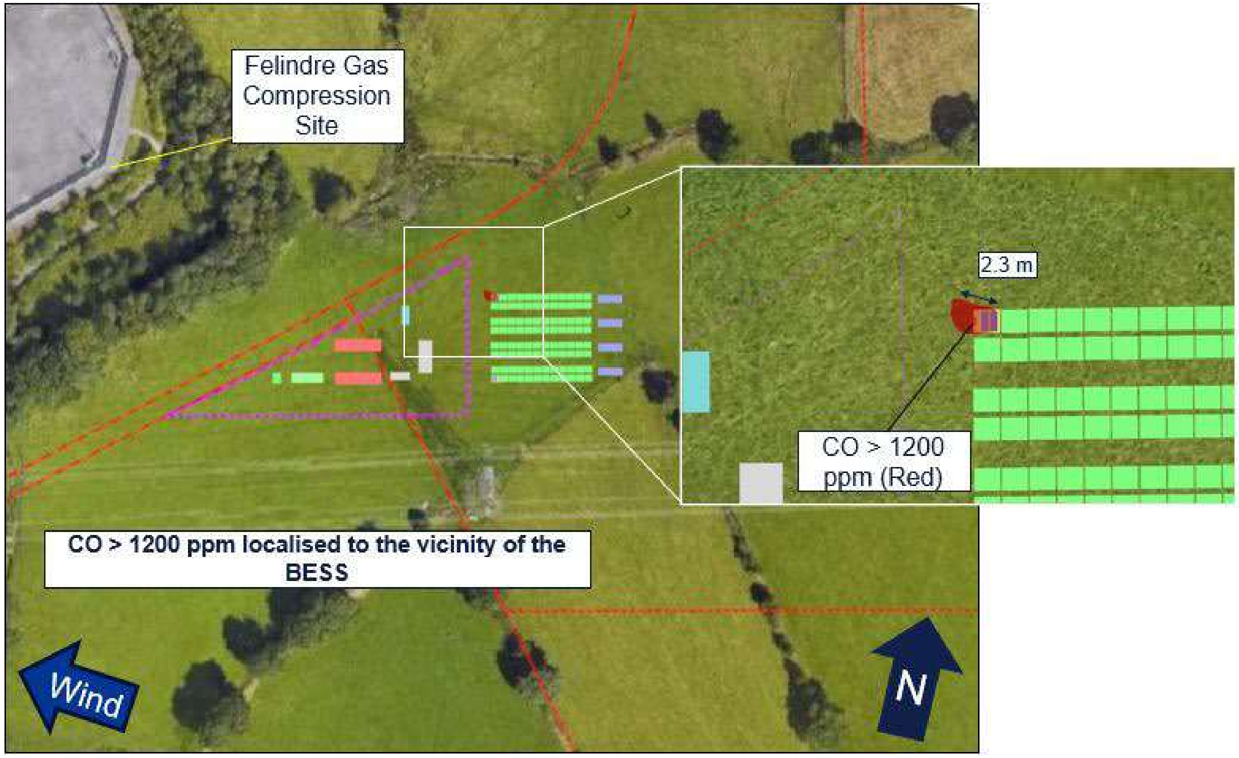


**Figure A 8: Case 104 – Carbon Monoxide Plot with Wind from ESE at 10 m/s**

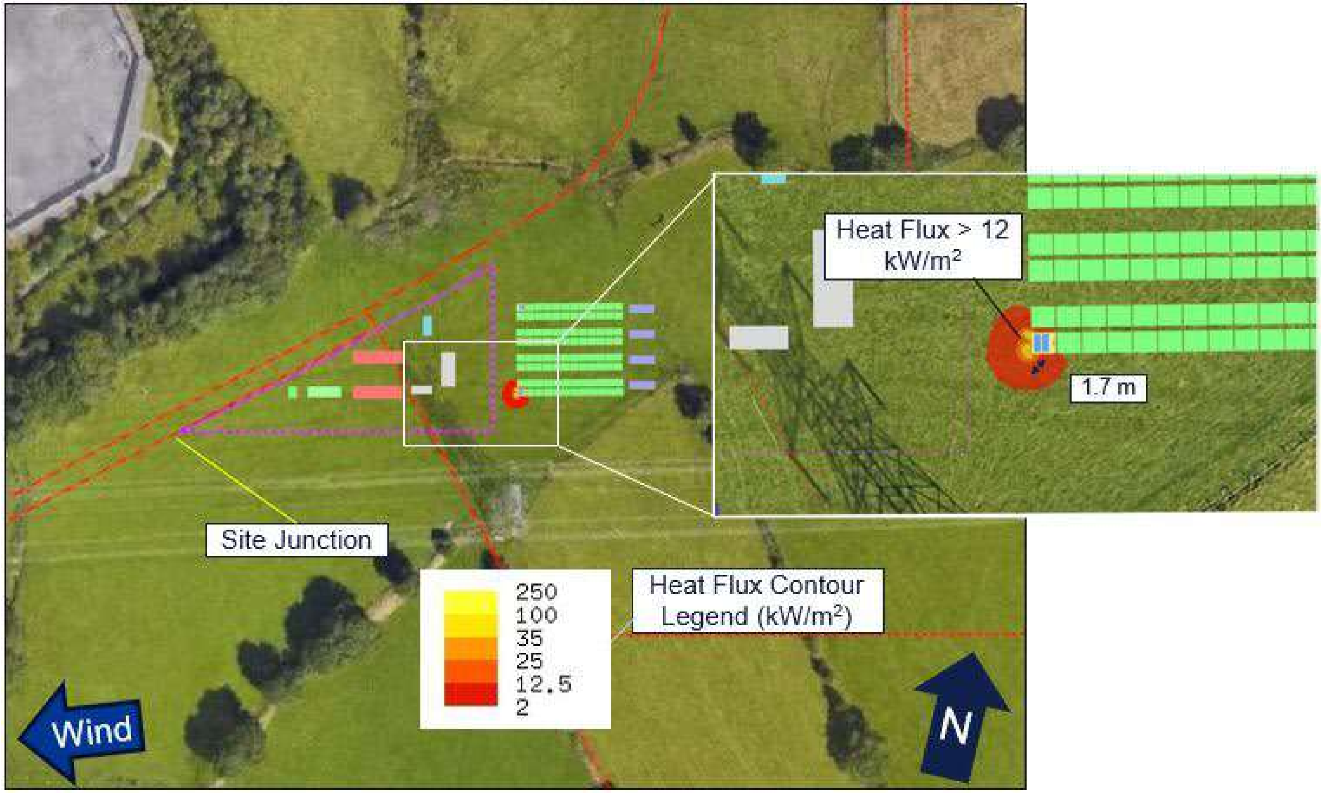


**Figure A 9: Case 101 – Heat Flux Plot with Wind from ENE at 5.5 m/s**

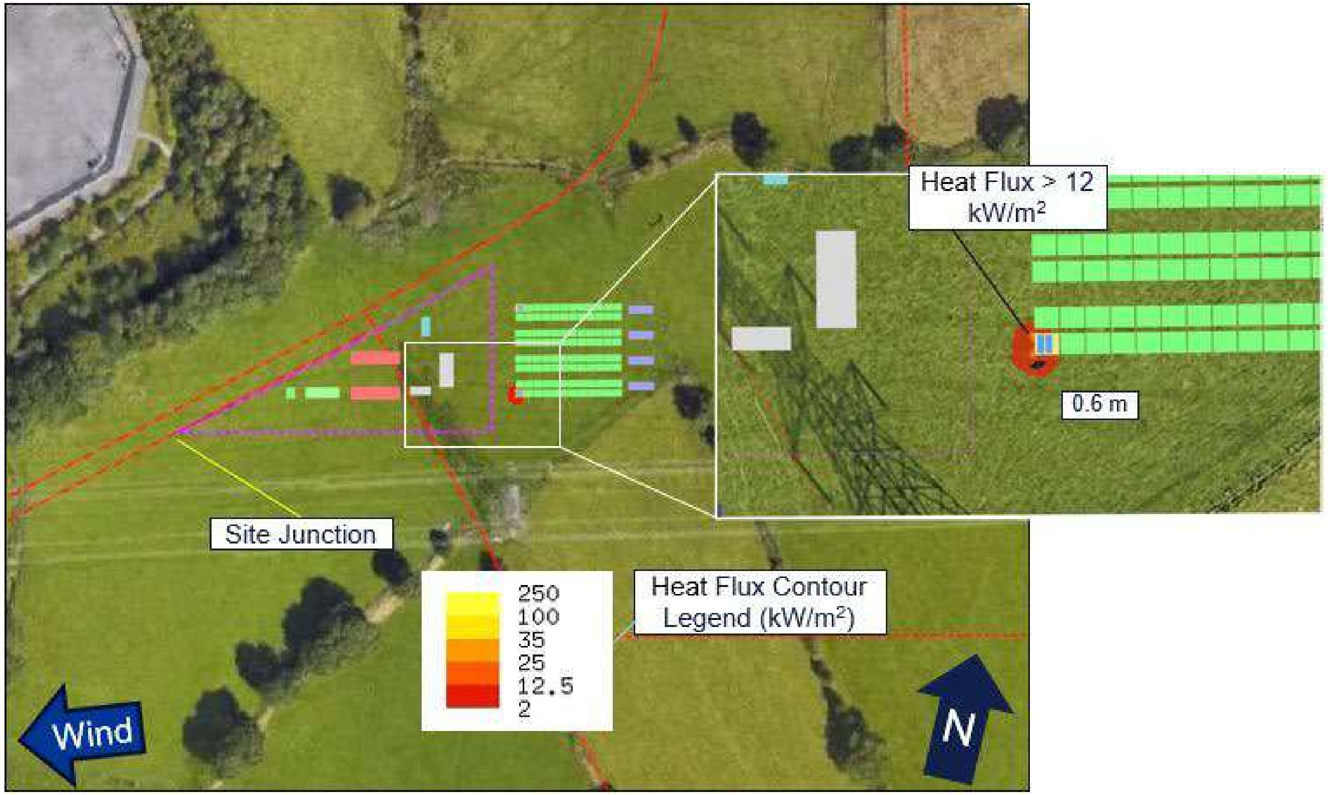


**Figure A 10: Case 102 – Heat Flux Plot with Wind from ENE at 10 m/s**

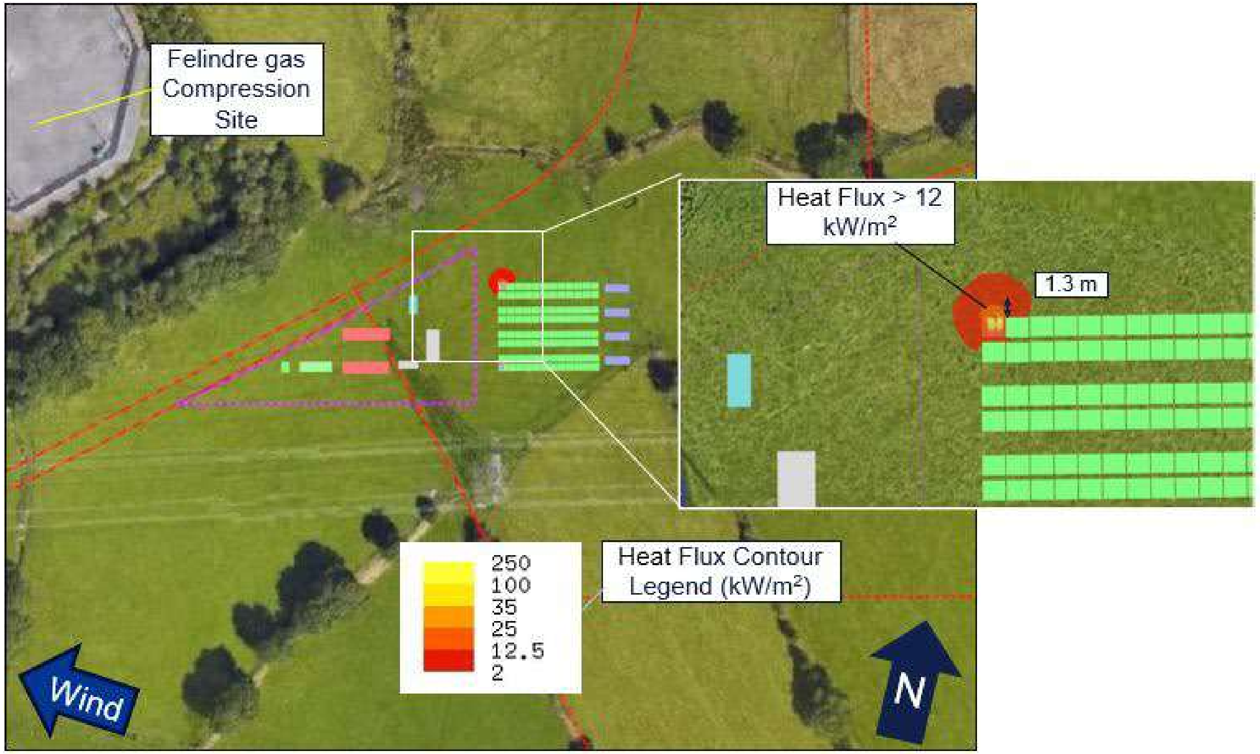


**Figure A 11: Case 103 – Heat Flux Plot with Wind from ESE at 5.5 m/s**

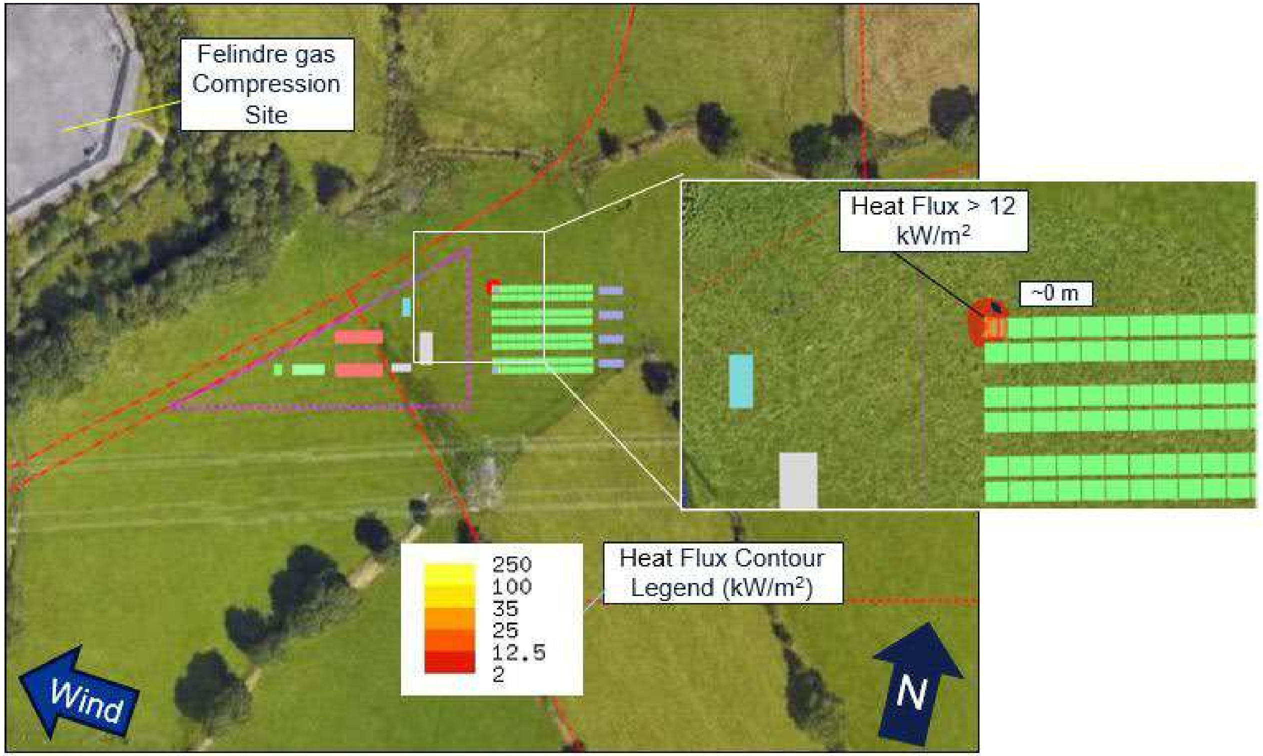


**Figure A 12: Case 104 – Heat Flux Plot with Wind from ESE at 10 m/s**

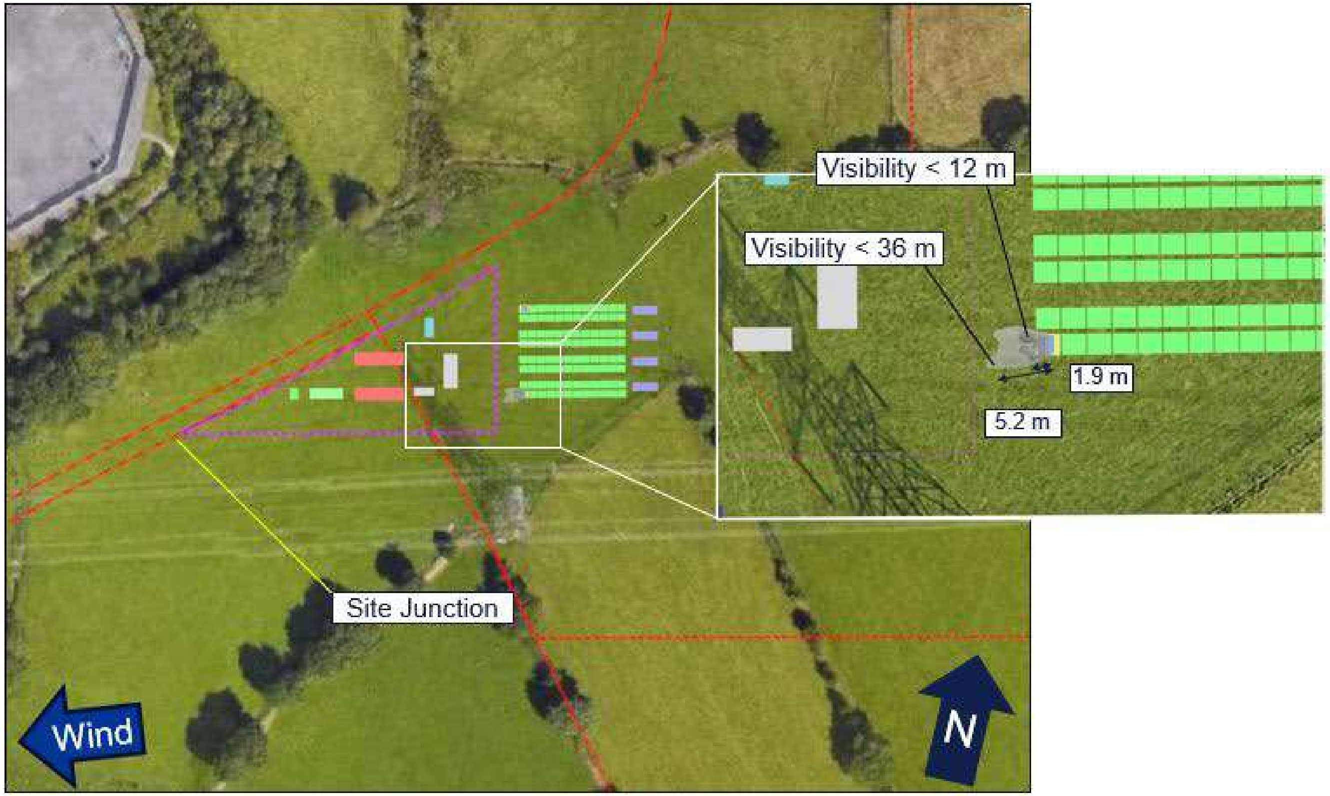


**Figure A 13: Case 101 – Visibility Plot with Wind from ENE at 5.5 m/s**

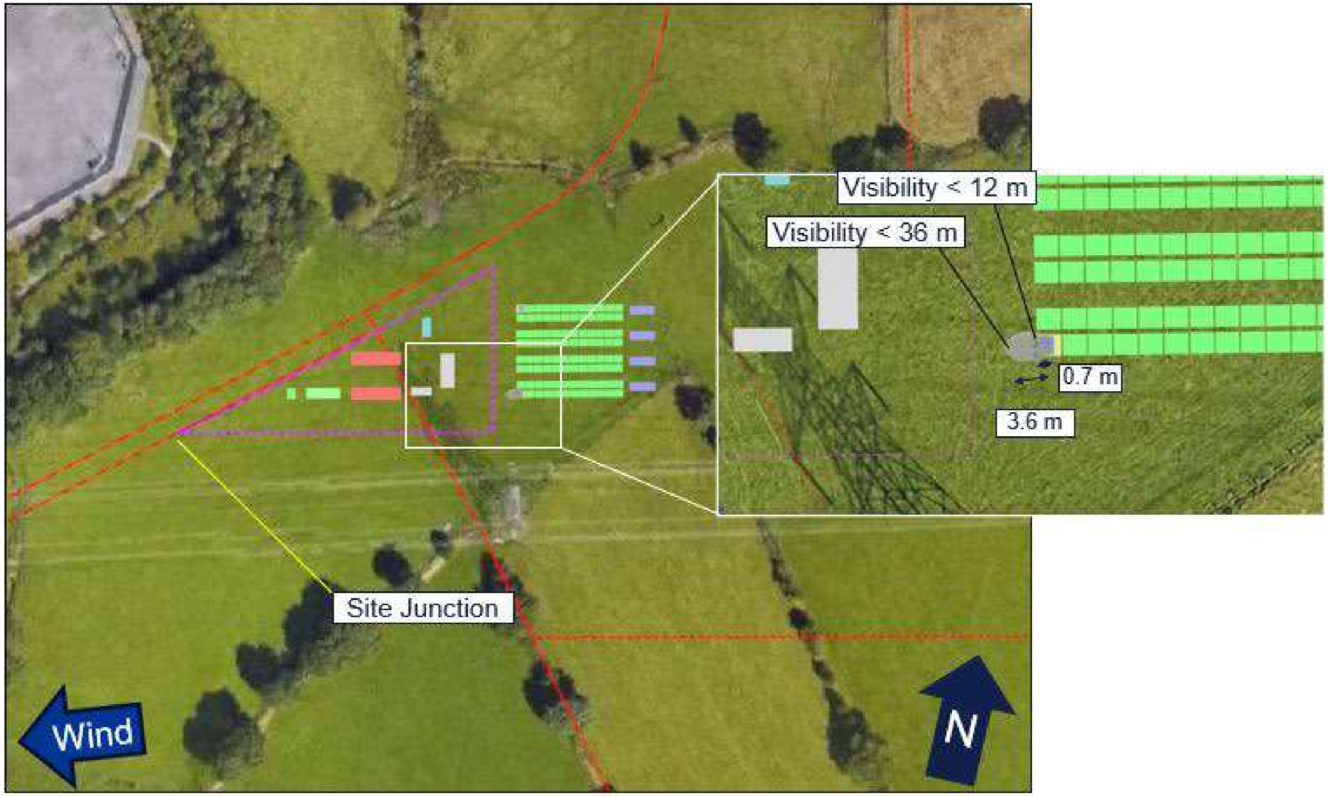


**Figure A 14: Case 102 – Visibility Plot with Wind from ENE at 10 m/s**

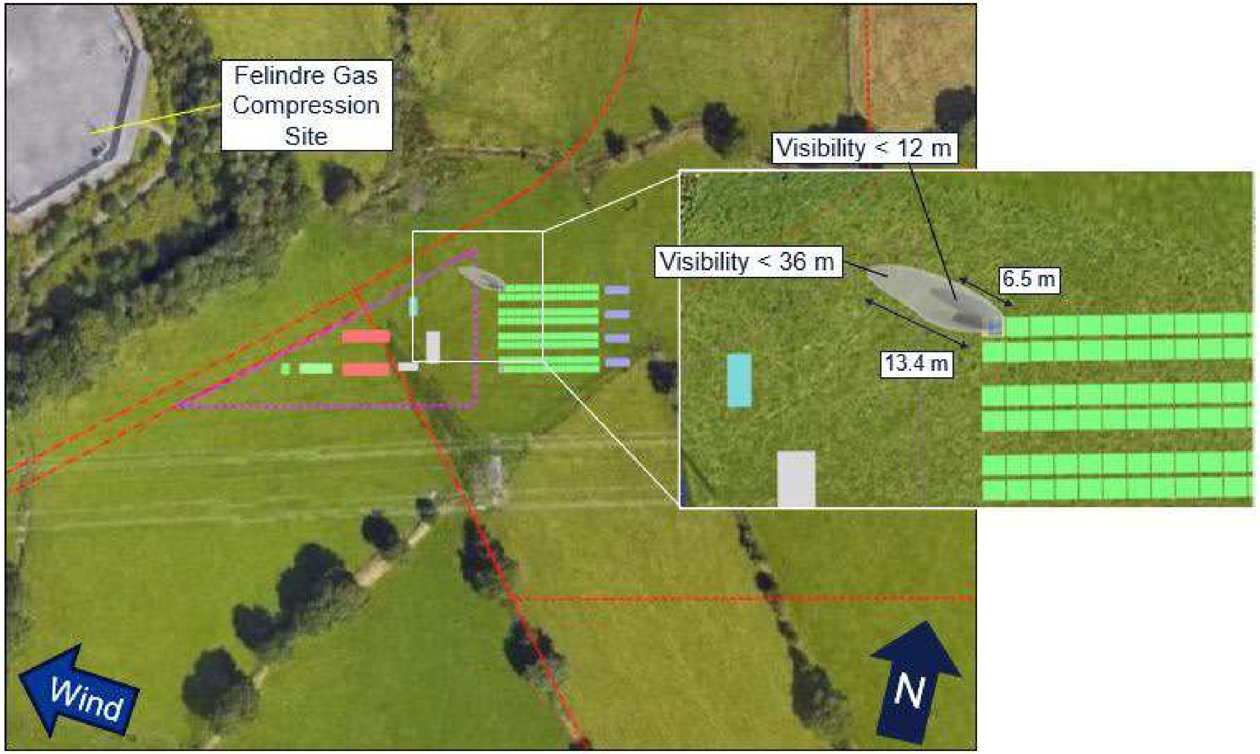


**Figure A 15: Case 103 – Visibility Plot with Wind from ESE at 5.5 m/s**

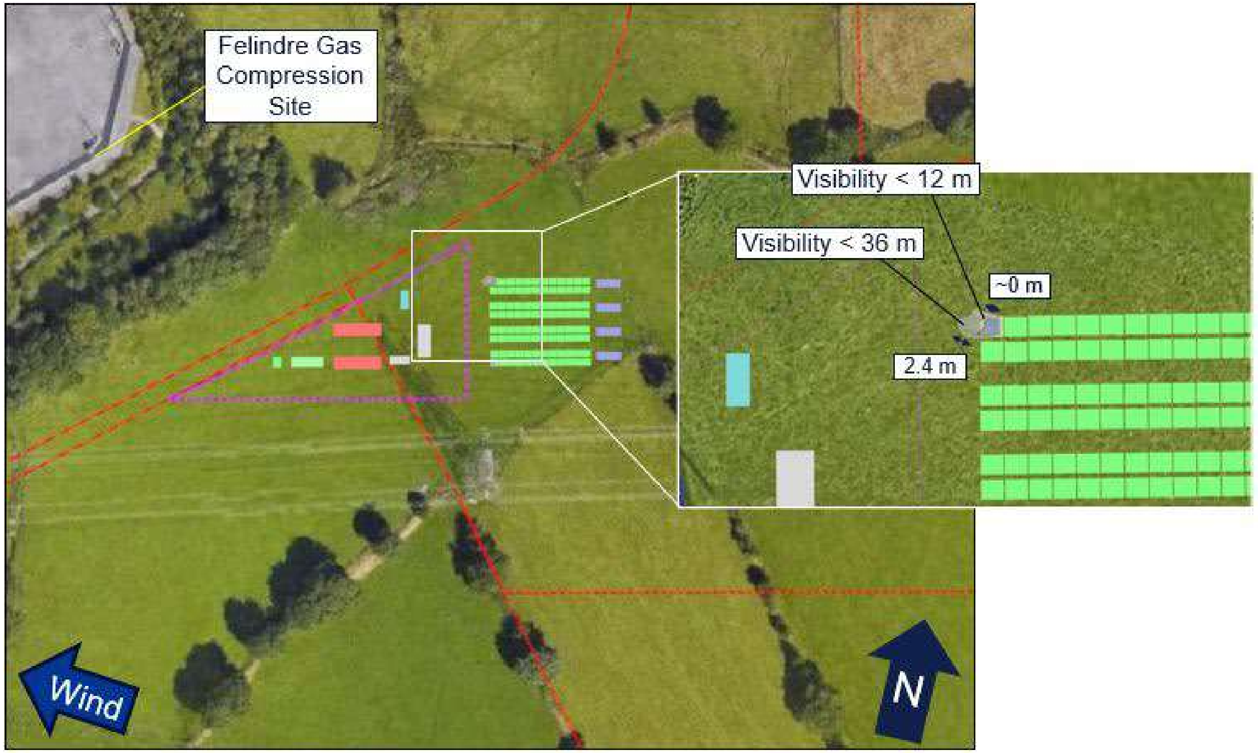


**Figure A 16: Case 104 – Visibility Plot with Wind from ESE at 10 m/s**

## About DNV

DNV is the independent expert in risk management and assurance, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry benchmarks, and inspires and invents solutions.

Whether assessing a new ship design, optimizing the performance of a wind farm, analyzing sensor data from a gas pipeliESE or certifying a food company's supply chain, DNV enables its customers and their stakeholders to make critical decisions with confidence.

Driven by its purpose, to safeguard life, property, and the environment, DNV helps tackle the challenges and global transformations facing its customers and the world today and is a trusted voice for many of the world's most successful and forward-thinking companies.

# APPENDIX C
## Response from MAWWFRS

Gwasanaeth Tân ac Achub Canolbarth a Gorllewin Cymru
Mid and West Wales Fire and Rescue Service

Prif Swyddog Tân | Chief Fire Officer
**R.S. Thomas** KFSM BA(Hons) MSc

Y Pencadlys, Heol Llwyn Pisgwydd, Caerfyrddin, Sir Gâr, SA31 1SP
[redacted]

Headquarters, Lime Grove Avenue, Carmarthen, Carmarthenshire, SA31 1SP
[redacted]

[redacted]

DWD
Chartered Surveyors & Town Planners
69 Carter Lane
London
EC4V 5EQ

**Via Email to:**
[redacted]

| | |
|---|---|
| *Gofynner am/ Please ask for:* | Station Manager Dean Charles |
| *Rhif Est/Extn. No.* | 4433 |
| *E-bost/E-mail:* | [redacted] |
| *Fy Nghyf/My Ref:* | DC/KDT/00356077 |
| *Dyddiad/Date:* | 20 February 2025 |

Dear Sir,

**THE TOWN AND COUNTRY PLANNING (DEVELOPMENT MANAGEMENT PROCEDURE) (WALES) ORDER 2012**

**THE DEVELOPMENTS OF NATIONAL SIGNIFICANCE (PROCEDURE) (WALES) ORDER 2016**

**DEVELOPMENT PROCEDURE (CONSULTEES) (WALES) (MISCELLANEOUS AMENDMENTS) ORDER 2021 – FIRE AND RESCUE AUTHORITIES**

**RE: Construction and Operation of a Battery Energy Storage System and Associated Infrastructure – Land West of Rhydypandy Road, Rhydypandy Road, Morriston, Swansea**

**APPLICATION NUMBER: N/A**

I acknowledge receipt of the notification to the Mid and West Wales Fire and Rescue Authority in relation to the above application.

The site plan/s of the above proposal has been examined and the Fire and Rescue Authority would wish the following comments to be brought to the attention of the planning committee/applicant. It is important that these matters are dealt with early on in any proposed development (delete as appropriate):

- The Fire Authority has no objection to the proposed development and refers the Local Planning Authority to any current standing advice by the Fire Authority about the consultation.

The developer should consider the need to provide adequate water supplies and vehicle access for firefighting purposes on the site and general guidance on this matter is given in the attached Appendix and the following links: https://www.water.org.uk/guidance/national-guidance-document-on-the-provision-of-water-for-firefighting-3rd-edition-jan-2007/
https://www.ukfrs.com/index.php/promos/16847

Furthermore, the applicant should be advised to contact the appropriate Authority responsible for ensuring safety and compliance for these types of developments i.e., Health & Safety Executive / Local Authority Building Control.

The plan/s has been retained for record purposes.

Yours faithfully

[redacted]

Station Manager D Charles
Authorised Fire Safety Inspector
On behalf of the Mid and West Wales Fire and Rescue Authority

Encs.

## MID AND WEST WALES FIRE AND RESCUE SERVICE

### Advice on Water Supplies

### 1. WATER SUPPLIES FOR FIREFIGHTING

The existing output of the statutory water supply network may need to be upgraded in certain parts of the local plan area to care for firefighting needs of new developments. It is recommended that this provision be a condition of planning consent.

Reference to the National Guidance Document on the Provision of Water for Fire Fighting 2007.

***Access to Open Water Supplies***

Where development of water-front sites takes place, the need for permanent and unobstructed access for firefighting appliances to the water should be made a condition of any planning consent.

Consultation must take place with the Fire and Rescue Authority during the earliest planning stages of any development to ensure access for fire pumping appliances is satisfactory.

### 1.1. HOUSING

Minimum main size 100 millimetres. Housing developments of units of detached or semi-detached houses of not more than two floors should have a water supply capable of delivering a minimum of eight litres per second through any hydrant on the development.

The Fire and Rescue Authority should be consulted at the outline planning stage of any proposed projects to ascertain the exact requirements.

### 1.2. TRANSPORTATION

***Lorry/Coach Parks - Multi-Storey Car Parks-Service Stations***

Minimum main size 100 millimetres. All of these amenities should have a water supply capable of delivering a minimum of 25 litres per second through any hydrant on the development or within a vehicular distance of 90 metres from the complex.

### 1.3. INDUSTRY

In order that an adequate supply of water is available for use by the Fire and Rescue Authority in case of fire, it is recommended that the water supply infrastructure to any commercial industrial estate is as follows:

***Light Industrial/Commercial***

Up to one hectare, 20 litres per second - Minimum Main Size 100 millimetres

Up to two hectares, 35 litres per second - Minimum Main Size 150 millimetres

***High Risk Industrial***

Up to three hectares 50 litres per second - Minimum Main Size 150 millimetres

Over three hectares, 75 litres per second - Minimum Main Size 150 millimetres

In rural areas it may not be possible to provide sufficient mains water. To overcome this, static or river supplies would be considered on site if they are capable of supplying the above flow rates for at least one hour.

The Fire and Rescue Authority should be consulted at the outline planning stage of any proposed projects to ascertain the exact requirements, as high-risk premises may require a greater flow.

## 1.4. SHOPPING, OFFICES, RECREATION AND TOURISM

Commercial developments of this type should have a water supply capable of delivering a minimum of 20 to 75 litres per second to the development site. The Fire and Rescue Authority should be consulted at the outline planning stage of any proposed projects to ascertain the exact requirements.

## 1.5. EDUCATION, HEALTH AND COMMUNITY FACILITIES

***Village Halls***

Should have a water supply capable of delivering a minimum of 15 litres per second through any hydrant on the development or within a vehicular distance of 100 metres from the complex.

***Primary Schools and Single Storey Health Centres***

Should have a water supply capable of delivering a minimum of 20 litres per second through any hydrant on the development or within a vehicular distance of 70 metres from the complex.

***Secondary Schools, Colleges, Large Health and Community Facilities***

Should have a water supply capable of delivering a minimum of 35 litres per second through any hydrant on the development or within a vehicular distance of 70 metres from the complex.

## 1.6. DISTANCES BETWEEN FIRE HYDRANTS

The distance between fire hydrants should not exceed the following:

| | | |
|---|---|---|
| Residential areas | - | 200 metres |
| Industrial Estates | - | 150 metres |
| Town Centre Areas | - | 90 metres |
| Commercial (Offices & Shops) | - | 100 metres |
| Residential Hostels | - | Adjacent to access |
| Hotels | - | Adjacent to access |
| Institutional (Hospitals & Old Persons Home) | - | Adjacent to access |
| Old Persons Home | - | Adjacent to access |
| Educational (Schools & Colleges) | - | Adjacent to access |

## 1.7. CONCLUSION

Developers should hold joint discussions with the relevant Water Authority or the Environmental Agency and the Fire and Rescue Authority to ensure that adequate water supplies are available in case of fire.

The Fire and Rescue Authority reserve the right to ask for static water supplies for firefighting on site, as a condition of planning consent, if the supply infrastructure is inadequate for any given risk.

## About DNV

DNV is the independent expert in risk management and assurance, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry benchmarks, and inspires and invents solutions.

Whether assessing a new ship design, optimizing the performance of a wind farm, analyzing sensor data from a gas pipeline or certifying a food company's supply chain, DNV enables its customers and their stakeholders to make critical decisions with confidence.

Driven by its purpose, to safeguard life, property, and the environment, DNV helps tackle the challenges and global transformations facing its customers and the world today and is a trusted voice for many of the world's most successful and forward-thinking companies.