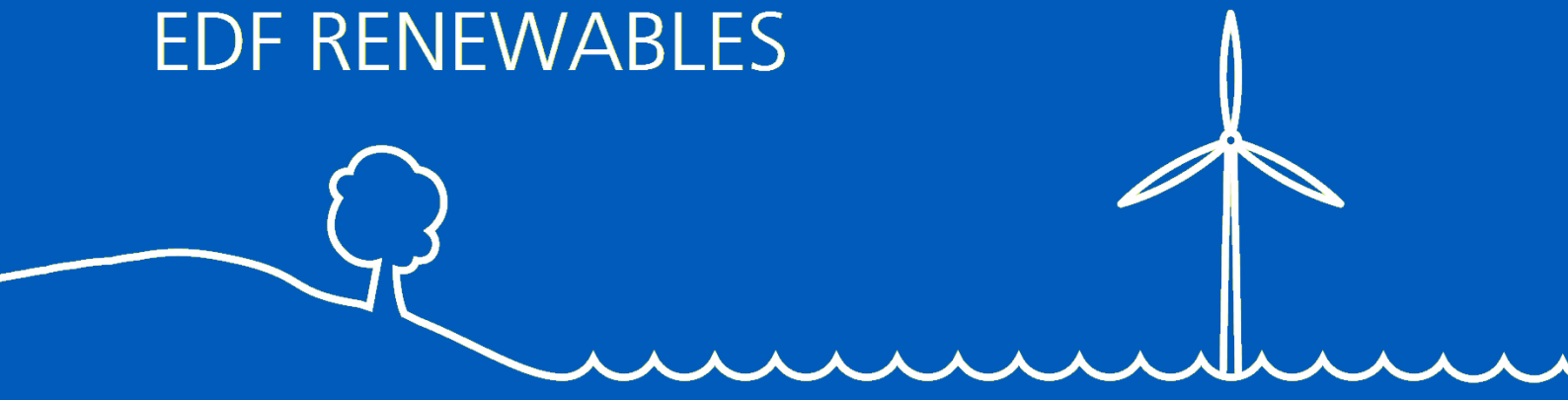


EDF RENEWABLES



KIRKBY BESS

Battery Safety Management Plan

DOCUMENT REFERENCE: KIR-BSMP-001



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INTRODUCTION

1.1 BACKGROUND

EDF Renewables on behalf of Pivoted power LLP is drafting this document. This Battery Safety Management Plan (BSMP) document provides the planning related battery safety information required to enable Merseyside County Council to determine a planning application for the Kirkby BESS project.

Battery Energy Storage System (BESS) development takes place within a framework of legislative requirements and safety regulations and guidance additional to planning. These are summarised in Section 1.4 of this report. The planning requirements are set out in the August 2023 update to Planning Practice Guidance¹ which states:

“What can applicants seeking planning permission for battery energy storage systems do to ensure they consider any potential risks?”

Where planning permission is being sought for development of battery energy storage systems of 1 MWh or over, and excluding where battery energy storage systems are associated with a residential dwelling, applicants are encouraged to engage with the relevant local fire and rescue service before submitting an application to the local planning authority. This is so matters relating to the siting and location of battery energy storage systems, in particular in the event of an incident, prevention of the impact of thermal runaway, and emergency services access can be considered before an application is made.

Applicants are also encouraged to consider guidance produced by the National Fire Chiefs Council (PDF, 488 KB) when preparing the application.

The location of such sites are of particular interest to fire and rescue services; who will seek to obtain details of the design, and firefighting access and facilities at these sites in their register of site specific risks that they maintain for the purposes of Section 7 of the Fire and Rescue Services Act 2004.”

These requirements can be summarised as follows:

- Consultation with Merseyside Fire and rescue services (MFRS) to consider:
 - Siting and location of the BESS;
 - Prevention of the impact of thermal runaway;
 - Dealing with an incident and emergency service access; and
 - Other matters covered by the National Fire Chiefs Council guidance².

This BSMP contains the following sections:

- Introduction, background, risk identification, design objectives and guidance;
- Planning application BESS design approach, including siting and location, BESS safety systems, provision for dealing with an emergency and the design response to relevant guidance; and
- A record of consultation with MFRS.

1.2 RISK IDENTIFICATION

All forms of energy generation and electrical installation carry a level of risk of equipment failure. In respect of a BESS, thermal runaway poses the most significant potential hazard and associated risk of damage to health and property. If left uncontrolled, thermal runaway can result in a fire. The main objective of this BSMP is to set out the measures that have been incorporated in the design of the BESS to mitigate the fire risk and to address an emergency incident in the unlikely event of its occurrence.

¹ Guidance, Renewable and Low Carbon Energy. Paragraph: 032 Reference ID: 5-032-20230814 Available at: <https://www.gov.uk/guidance/renewable-and-low-carbon-energy#battery-energy-storage-systems> [accessed 19/10/2023]

² National Fire Chiefs Council (NFCC) November 2022. Grid Scale Battery Energy Storage System planning – Guidance for FRS. Available at: <https://nfcc.org.uk/wp-content/uploads/2023/10/Grid-Scale-Battery-Energy-Storage-System-planning-Guidance-for-FRS.pdf> [accessed 06/11/2023]

Other commonly deployed electrical systems forming part of the BESS, such as transformers, inverters, and switchgear, may also carry their own specific fire risks which are addressed by extant industry guidance and codes. This document therefore specifically focusses on the battery component of the BESS.

1.3 DESIGN OBJECTIVES

The BESS design addresses the following objectives:

- Minimise the likelihood of a fire occurring;
- Facilitate early detection and intervention;
- Minimise the consequences of a fire event should one occur;
- Ensure the safety of any personnel on Site and in surrounding areas; and
- Ensure that firefighters can operate and fight fire in reasonable safety.

1.4 RELEVANT GUIDANCE

In developing the BESS, the Applicant has taken into account the following relevant legislation and industry standards:

- National Fire Protection Agency (NFPA) 855 Standard for the Installation of Stationary Energy Storage Systems 2023;
- Underwriters Laboratories (UL) 9540A Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems; and
- United Kingdom Power Networks (UKPN) Engineering Design Standard 07-0116: Fire Energy Storage Systems, 2016.

The following guidance is also relevant, as set out in Section 1.1:

- National Fire Chiefs Council (NFCC) Grid Scale Battery Storage System Planning – Guidance for FRS (November 2022), including the following documents referenced in that guidance:
 - State of Victoria (County Fire Authority) (2022), Design Guidelines and Model Requirements: Renewable Energy Facilities
 - NFPA (2023) Standard for the Installation of Stationary Energy Storage Systems
 - FM Global 2017 Property Loss Prevention Data Sheets: Electrical Energy Storage Systems Data Sheet 5-33 (see also interim revision July 2023);
 - The Energy Institute: Battery Storage Guidance Note 1 - Battery Storage Planning August 2019;
 - The Fire Industry Association: Guidance Note on Li Ion Battery Fires 2020; and
 - DNV GL-Recommended Practice-0043: Safety, Operation and Performance of Grid Connected Energy Storage Systems 2017.

As set out in Section 1.1, the current advisory note in relation to the planning requirements recommends that applicants carry out consultation with the local fire authority, and consider the NFCC guidance cited above and therefore that is the focus of this BSMP.

2 KIRKBY BESS DESIGN APPROACH

2.1 SITING AND LOCATION OF THE BESS

Nestled in the industrious heartland of Liverpool, the innovative Battery Energy Storage System (BESS) project is strategically situated near the Kirkby National Grid substation. The BESS site is easily accessible via the M57 motorway, providing seamless connectivity for maintenance and operational management. The Kirkby substation itself stands as a critical hub in the UK's electricity network, making the adjacent BESS project an ideal counterpart for enhancing energy storage and grid stability.

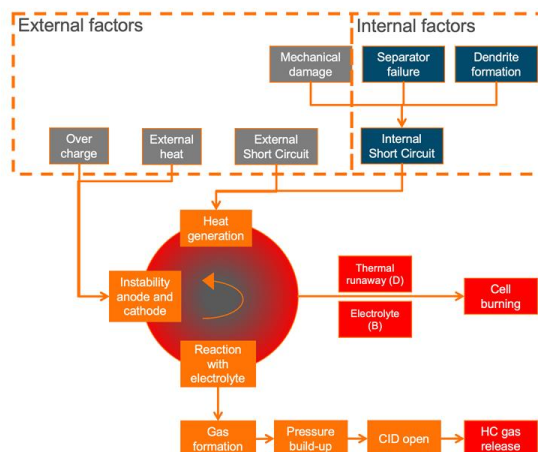
The nearest residential property is approximately 170m away with the closes access road roughly 170m too. The positioning of BESS enclosures within the Site follows the NFPA requirement for at least 3.0 m spacing between the battery units. The batteries units are located at least 10 m away from the overhead lines at the Site. Access tracks have been designed to allow for unimpeded road access to and from the Site in case of an event as it is

a circular track. The prevailing wind at this Site according to local data sources³ is inferred to be south or south-westerly from the historical data.

2.2 PREVENTION OF THE IMPACT OF THERMAL RUNAWAY

Batteries in general present a fire risk due to the combustibility of the materials and the possibility for heat generation due to short circuit potential and chemical reactions. If such energy is released uncontrollably, it could provide the conditions necessary for ignition and fire. In addition to the batteries, energy storage systems present a fire risk similar to other electrical utility equipment. The fire risk can be grouped into 3 categories:

1. Electrolyte fire risk (class B): li-ion cells are made of a cathode, anode, separator layer, terminals, electrolyte, and cell packing material. The electrolyte is often an organic ethylene like substance that is flammable. As a flammable substance the electrolyte is considered a fire risk in the event of a spill. Note that a spill is only possible in the event of mechanical damage to the cell (drop, puncture, crush, etc.) or failure. Careful handling of the batteries, visual inspection post installation, and continuous monitoring are the best mitigation measures.
2. Electrical fire risk (class C): energy storage systems contain energized electrical equipment. As such, there is an inherent fire risk. Use of proper design guidelines (NEC, IEC, etc.), proper equipment selection (appropriately rated OCPDs and conductors), and the use of insulation/touch safe covers where possible are the best mitigation measures.
3. Thermal runaway (class D): in li-ion cells, thermal runaway can be described as a process whereby the cell, after reaching a threshold temperature, enters a “positive” feedback loop where the internal oxidation reaction rate in the cell accelerates thus increasing the rate of the exothermic reactions and ultimately resulting in combustion and the total oxidation of the materials. This positive feedback loop in most li-ion batteries is the result of the reaction between the electrolyte (organic and flammable) and oxygen contained in the cathode. After reaching a certain temperature the oxygen atoms in the cathode break away and start interacting with the electrolyte fuelling this positive feedback loop.



The following are the main conditions that the BMS/EMS monitors and protects the battery from:

1. Overcharging/overvoltage: the separators used in li-ion cells do not have very high dielectric capabilities. If a cell is overcharged/overvoltage it could lead to the damage of the separator layer and a short circuited cell. The BMS/EMS monitors and controls charging such that voltage limits are never exceeded. Charging is also done more conservatively as the battery reaches full charge in order to avoid stressing the separator.

³ <https://www.worldweatheronline.com/kirkby-weather-history/merseyside/gb.aspx>

2. Over discharging: discharging at very low state of charge (SOC) values could result in overcurrent and/or dendrite formation in the separator which overtime could lead to a short circuited cell. The BMS/EMS monitors and controls discharging such that overcurrent limits are not exceeded.
3. Overtemperature: the compounds in the cathode of the cell start to react with the electrolyte at around 90C. this reaction is exothermic in nature and once triggered it could lead to cell failure. The BMS monitors the temperature at the cell surface level and in different spots to ensure proper awareness. The BMS stops battery operation once the temperature reaches ~55C during operation.
4. Under temperature: charging a battery cell during low temperatures could result in separator damage due to plating. The BMS regulates the rate of charge over certain low temperature bands in order to mitigate this potential failure mode.
5. Imbalance: it is very important for all the cells inside a module and string to be balanced from an SOC and SOH perspective to ensure electrical stresses during operation are imposed symmetrically and without hot spots/stress spots. The BMS constantly measures these parameters and ensures proper cell balancing during resting periods in order to harmonize SOC and SOH.

2.3 DEALING WITH AN INCIDENT AND EMERGENCY SERVICE ACCESS

The principal contractor hired for the Site will have an Emergency Management Plan drafted before the beginning of construction which explains how to deal with an incident and layout key steps to take during an event. An emergency response plan (ERP) will be drafted upon the completion of construction of the project. This plan provides all the key information and resources needed in the event of an incident and will be shared with MSFRS (but not released into the public domain). An ERP will include information which would help identify hazards early on. It would also contain contact information of key services and a command, control and communication structure to further minimise the impact of an event.

The ERP will be drafted to align with the current UK civil response procedures using the bronze (operational), silver (tactical) and gold (strategic) command and control structure. It also incorporates the UK emergency services JESIP (Joint Emergency Service Interoperability Programme principles). Complies with HMG Emergency Preparedness and response guidance, HSE (Health and Safety Executive) and EA (Environment Agency) standards for emergency response.

During construction, the appointed principal contractor will follow CDM regulations according to which a Construction phase plan (CPP) and a Health and safety file will be drafted both of which will contain adequate information to manage any emergency risks or events.

2.4 OTHER NFCC GUIDANCE REQUIREMENTS

2.4.1 Information Requirements

As mentioned before prior to the commencement of operation of the BESS, site specific risk information (SSRI) and an emergency response plan will be developed in consultation with MSFRS as mentioned before. During construction a CCP and H&S file will provide the relevant information. This information is not a planning requirement and will not be published as part of the BSMP for safety and security reasons.

2.4.2 System Design

The system design characteristics relevant to this BSMP are set out in Table 1.

Table 1 – Relevant NFCC information requirements relating to system design, construction, testing and decommissioning

NFCC Information Requirements	Planning Application Details
The battery chemistries being proposed (e.g. Lithium-ion Phosphate (LFP), Lithium Nickel Manganese Cobalt Oxide (NMC)).	Lithium-Iron-Phosphate
The battery form factor (e.g. cylindrical, pouch, prismatic)	Prismatic
Type of BESS e.g. container or cabinet	Container
Number of BESS containers/cabinets	Approximately 28 units
How the BESS units will be laid out relative to one another.	2 BESS units connecting to 1 MVS unit (Transformer)- 1 set
A diagram / plan of the Site.	See the Site Layout Plan, planning drawing reference
Evidence that Site geography has been taken into account (e.g. prevailing wind conditions).	The site has a history of being used for land works, as such the sites natural geography is close to non existent. The site will have a north to south fall with a 1 in 100 slope. Keeping this in mind, the drainage feature is located at the south border to catch any water running off the site. In terms of wind, as the site has a circular access track, it can be assumed that access to an event within the site wouldn't be obstructed. This was discussed with the Merseyside FRS representatives in an in person meeting.
Access to, and within, the Site for FRS assets ⁴	The Site will be lined with gravel throughout and the access track will be 4m wide with a turning radius of 15m. along with this a swept path analysis will be done for equipment weighing about 400T where an emergency response truck is usually 19T.
Details of any fire-resisting design features	The BESS enclosures are designed to reduce the risk of fire propagation. Each enclosure has a 1hr fire rated wall for back-to-back enclosures. Which essentially means that a fire in 1 BESS unit would have to be burning for 2hrs without an interruption to spread to the next unit.

⁴ The FM Global document referenced in the NFCC guidance section on “access between BESS units and unit spacing” was updated in July 2023 and therefore the standard minimum spacing referred to in that section should be considered with reference to the updated version of the FM Global data sheet.

NFCC Information Requirements	Planning Application Details
	A 3.3 m separation distance is provided between sets of enclosures to further reduce propagation risk. This is 0.3m larger than the NFPA guidance.
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	a. Aerosol (optional)- The enclosures are equipped with a aerosol cannisters which activate based on the smoke and heat detectors. When there is smoke and heat detected the visible alarms outside the containers are illuminated and simultaneously a 30 second countdown will commence after which an aerosol will be sprayed to extinguish the fire. b. There will be a water tank onsite with the capacity of 228m³. c. Every BESS container is equipped with smoke and heat detectors to feedback alarm and fault signals. Two smoke detectors and two heat detectors are evenly set in the battery cabinet, and one smoke detector is set in the middle of the top of the integration cabinet. When any of the flammable gas, smoke, and heat detectors alarms, it is judged as a first level alarm and the external sounder beacon will be triggered; When both smoke and heat detectors alarm simultaneously, the external alarm bell will be triggered. d. The battery container is equipped with a flammable gas detector, an air inlet device, and an outlet device. When the gas concentration reaches 10% LEL, the flammable gas detector triggers to control the opening of the accident ventilation system. e. Each enclosure has a temperature sensor which communicates to the SCADA system as mentioned before. f. and g. The battery container is equipped with explosion vent system for pressure relief and feedback the status signal of the venting plate. Six explosion vent plates are located on the top of the container and evenly distributed; Explosion vent panels are considered a "passive" solution, which means they are activated by pressure itself and do not require electronic intervention. When the internal pressure of the battery container is 0.01Mpa higher than the external pressure, the explosion vent panels will open.. h. The BESS enclosure is liquid cooled inherently mitigating the risk of deflagration as the enclosure is not an airtight space (unlike air cooled systems). However, the enclosure is equipped with a roof mounted deflagration panel that redirects forces created as a result of an explosion upwards.
Identification of any surrounding communities, sites, and infrastructure that may be impacted as a result of an incident.	Overhead lines northwest of the site are at about 10m away from the site. Nearest residential area is more than 150m away. Plume assessments or consequence analysis reports will be done which will form part of the health and safety plan and emergency response plans during construction and operations.

NFCC Information Requirements	Planning Application Details
	See also section 2.4.3.

2.4.3 Environmental Impacts

The environmental impacts of the BESS are dealt with in the suite of documents provided in support of the planning application submission.

In addition to the above, a BESS Consequence Analysis is undertaken and forms a basis for designing a response plan. The analysis is conducted to predict the potential extent of the harmful effects of a cell venting event which may include toxic release, thermal radiation from a fire and overpressure from an explosion. Public health criteria and reference levels can be used to determine an area of influence where human beings may experience health impacts as a result of exposure to the impacts of thermal runaway. The BESS Consequence Analysis done found that in the worst credible cases, no relevant risk thresholds would be breached at the nearest occupied buildings or publicly accessible areas.

3 FIRE & RESCUE SERVICE CONSULTATION

3.1 MERSEYSIDE FIRE AND RESCUE SERVICE

Consultation was undertaken with the MSFRS in person on 21st January 2025

The key action points for the developer following the meeting were to:

- Submit a Battery Safety Management Plan regarding the planning application; and
- Provide information regarding gas monitoring in the BSMP.
- Adjust the access road to make sure there is additional space

Following the meeting, MSFRS has not raised any concerns with the development and the above information requests have been addressed through the provision of this document, including the information requested on gas monitoring set out in Table 1.

4 CONCLUSION

This Battery Safety Management Plan sets out the BESS design approach taken, and the information which is required to be provided (outside of the planning process) to MSFRS in advance of construction of the Kirkby BESS to demonstrate that the BESS will be constructed and operated safely.

APPENDIX A - MERSEYSIDE FIRE AND RESCUE SERVICE CONSULTATION

[REDACTED]

From: Sushitha Reddy Yellola [REDACTED]
Sent: 20 January 2025 16:32
To: Kirby, Linda
Cc: Holland, Rachel; O'Boyle, John; Williams, Stephen
Subject: RE: EDF: Kirkby early stage BESS development

Hi Linda,

Thank you so much for your email and apologies for the delay. Last week was riddled with training and travelling. But yes, I am going to be on site from 12pm till 4pm and would appreciate if you are able to meet us then. My contact number is [REDACTED], please feel free to call me when you are nearby. I would either be on site or at the Starbucks nearby.

Best regards,
Sushitha

From: Kirby, Linda <[REDACTED]>
Sent: 15 January 2025 10:33
To: Sushitha Reddy Yellola <[REDACTED]>
Cc: Holland, Rachel <[REDACTED]>; O'Boyle, John <[REDACTED]>; Williams, Stephen <[REDACTED]>
Subject: FW: EDF: Kirkby early stage BESS development

You don't often get email from [REDACTED]. [Learn why this is important](#)

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Sushitha

Following on from our brief conversation this morning – we would like to meet you on site on 21st January please.

You've confirmed you'll be present between 12.00 and 4.00 pm – we'd like to meet you there at about 1.30 pm. There will be MFRS personnel from different departments.

Hi Rachel/ John

The site position as given in previous correspondence is below.



Thanks

Regards

Linda Kirby
Fire Engineering Manager
Merseyside Fire and Rescue Service
[REDACTED]
[REDACTED]

From: Kirby, Linda
Sent: Wednesday, January 15, 2025 10:20 AM
To: [REDACTED]
Subject: FW: EDF: Kirkby early stage BESS development

Hi Sushitha

What time are you on site on 21st, please?

Thanks.

Regards

Linda

Linda Kirby
Fire Engineering Manager
Fire Engineering (Planning & Building Regulations) Team
Merseyside Fire and Rescue Service
[REDACTED]

From: Kirby, Linda **On Behalf Of** Fire Engineering Team
Sent: Wednesday, January 15, 2025 9:58 AM
To: 'Sushitha Reddy Yellola' <[REDACTED]>
Subject: RE: EDF: Kirkby early stage BESS development

Hi Sushitha

Can I get back to you re the 21st?

For now let's set Thursday 28th at 11.00 as a definite appointment, anyway. I'll send a TEAMS invite now.

Thanks

Regards

Linda Kirby

Fire Engineering Manager

Fire Engineering (Planning & Building Regulations) Team

Merseyside Fire and Rescue Service
[REDACTED]

From: Sushitha Reddy Yellola
Sent: Wednesday, January 15, 2025 9:51 AM
To: Fire Engineering Team
Subject: RE: EDF: Kirkby early stage BESS development

Hi Linda,

Thank you so much for your reply. We are actually going to be on site in Liverpool on Tuesday 21st Jan. Would it be possible to meet you in person? No worries if this is a short notice.

If not then Thursday 28th morning at 11am work for you?

Best regards,

Sushitha

From: Kirby, Linda <[REDACTED]> **On Behalf Of** Fire Engineering Team
Sent: 15 January 2025 09:30
To: Sushitha Reddy Yellola <[REDACTED]>
Subject: RE: EDF: Kirkby early stage BESS development

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Hi Sushitha

I'm free next Tuesday, Wednesday and Thursday mornings (21, 22 and 23 Jan).

Also on the mornings of Monday 27 and Tuesday 28 Jan.

Do you have a contact number, please?

Thanks

Regards

Linda

Linda Kirby

Fire Engineering Manager

Fire Engineering (Planning & Building Regulations) Team

Merseyside Fire and Rescue Service
[REDACTED]

From: Sushitha Reddy Yellola <[REDACTED]>
Sent: Thursday, January 9, 2025 12:33 PM
To: Fire Engineering Team <[REDACTED]>
Cc: Clare McDermott <[REDACTED]>; Amy Ravitz-Williams <[REDACTED]>
Subject: RE: EDF: Kirkby early stage BESS development

Hi Linda,

Thank you so much for your previous email. Since our last communication, the project had been delayed a couple of months, but it is now close to planning submission with our current scheduled date in February.

We do have a couple of questions on the layout, access, and fire separation which I think would be best resolved with a quick call. While we have our design largely complying with the NFCC, there are some pinch points for which I would appreciate a bit more of context. Please let me know your availability over the next couple of weeks for the call if you are able to.

Best regards,
Sushitha

From: Kirby, Linda <[REDACTED]> **On Behalf Of** Fire Engineering Team

Sent: 04 October 2023 09:57

To: Sushitha Reddy Yellola <[REDACTED]>

Subject: FW: EDF: Kirkby early stage BESS development

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good morning Sushitha

Please find attached the information regarding your site as provided by our Water Section.

As discussed, our current planning consultations for BESS sites are undertaken with close reference to the NFCC guidance document 'Grid Scale Battery Energy Storage System planning – Guidance for FRS' -

<https://www.ukfrs.com/guidance/knowledge-base>

You have indicated that your planning application is likely to occur in January 2024 – thank you for the update.

Regards

Linda Kirby

Fire Engineering Manager

Fire Engineering (Planning & Building Regulations) Team

Merseyside Fire and Rescue Service

[REDACTED]

From: WaterSection <[REDACTED]>

Sent: 07 September 2023 14:58

To: Fire Engineering Team <[REDACTED]>

Cc: WaterSection <[REDACTED]>

Subject: RE: EDF: Kirkby early stage BESS development

Hi Linda

Please see attached hydrant provision we have for this area.

Kind regards

Jackie Gleaves

Water Section

Merseyside Fire & Rescue Service

[REDACTED]

From: Kirby, Linda <[REDACTED]> **On Behalf Of** Fire Engineering Team

Sent: 07 September 2023 11:55

To: WaterSection <[REDACTED]>

Subject: FW: EDF: Kirkby early stage BESS development

Good afternoon

I have had a query regarding hydrant provision in the vicinity of the site marked in red, below. Are you okay to provide details, please?

Thanks

Regards

Linda Kirby

Fire Engineering Manager

Fire Engineering Team

Protection Department

[REDACTED]

From: Sushitha Reddy Yellola

Sent: 23 August 2023 15:35

To: [REDACTED]

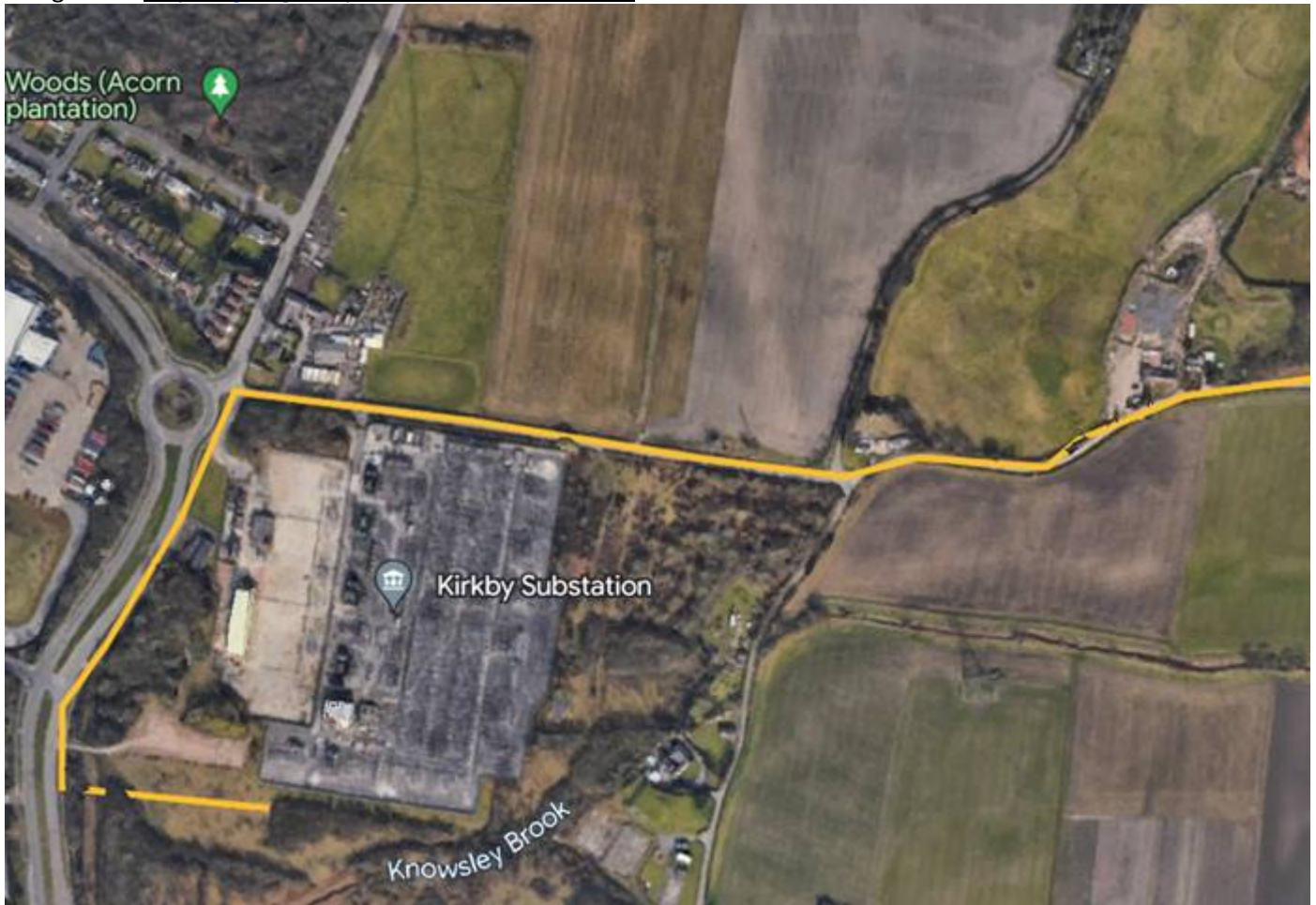
Subject: EDF: Kirkby early stage BESS development

Greetings,

Hope you are well.

I am reaching out on behalf of [REDACTED] regarding a potential BESS development near Kirkby Substation. Shown below.

Google link: [REDACTED]



The development is at its early planning/design stage and we would appreciate if you could give us some insight into BESS-Fire considerations needed.

If you have sometime next week, I would appreciate if we could have a call to discuss what the actual development is and you could share your comments on it. We are aware about the new NFCC guidelines and in its light we are keen on engaging with the local authority as early as possible. So please let us know your availability for a quick call. Looking forward to your reply.

Best Regards,



[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]