3. Description of the Proposed Development

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3.1. Introduction

3.1.1. This chapter provides a description of the proposed Limekiln Battery Energy Storage System (BESS) and Extension to the existing Limekiln Wind Farm Substation (the 'Proposed Development'). The planning application is for the construction and operation of a BESS consisting of up to 90 battery energy storage units, electrical connection and control buildings, Substation Extension, underground cable, fencing and ancillary infrastructure.

3.1.2. The Proposed Development would import and export electricity, however it would not generate any additional electricity. The BESS will have a maximum export capacity of up to 70 MW. This project has been designed with a 4-hour discharge period.

3.1.3. The battery energy storage sector is continually evolving and designs continue to improve, both technically and economically. The most suitable technology can change with time and therefore the final technical choice for the development would be made before construction through a procurement process.

3.1.4. The planning application drawings and the description of the proposals in this chapter have been based on a typical arrangement that would be expected for a BESS proposal. The number and size of battery units, the building design and the extent of external equipment required may vary as a result of the procurement process.

3.1.5. At this stage it is anticipated that the battery technology to be deployed will consist of Lithium-Ion (LI-Ion) batteries. These batteries are used widely within energy storage technology because of their high energy density and charge / discharge cycle fatigue resistance compared to other technologies. Li-Ion batteries also have a fast response time which makes them preferable for power application in grid-scape deployment.

3.1.6. The Proposed Development would be a permanent use. The battery cells within the units would need replacing at various stages in the future. It is likely that there would be initial repowering exercises after 10 – 15 years and then again at 20 – 25 years.

3.1.7. When battery cells reach the end of their life, a recycling process would be followed with an approved recycling partner. The partner would transport the batteries to a suitably licensed recycling centre, where cells would be processed. Only hydrogen, oxygen, and limited volumes of carbon dioxide would be emitted from the recycling process.

3.2. Need for the Proposed Development

3.2.1. The United Kingdom's electricity network has historically relied on large, centralised power stations. However, numerous coal fired power stations have recently been decommissioned and gas fired power stations are increasingly being used intermittently when demand is high and electricity cannot be supplied by renewable sources. Existing nuclear power stations are reaching the end of their design lives and there will be further delays before new nuclear plants come online.

3.2.2. There is an ever-increasing reliance on renewable forms of electricity generation, such as wind and solar, to meet the United Kingdom's electricity demands. The amount of renewable electricity generated from wind and solar is, however, intermittent due to weather dependency. As a consequence, electricity demand and supply are becoming more challenging to balance.

3.2.3. National and international legislation and policies are in place and set an ambitious target to reduce Scotland's emissions of all greenhouse gas emissions to net zero by 2045.

3.2.4. Battery projects located in areas where there is a large amount of renewable energy generators, play a vital role in decarbonising the energy sector whilst maintaining reliable energy security for consumers. Our current national grid has located key generation assets (coal, gas, nuclear) and transmission cables to serve areas of high energy demand with commensurate supply. In contrast, renewable generation is located to maximise optimal weather conditions such as high wind locations in northern Scotland or in the North Sea.

3.2.5. As a result, we cannot get the power where we need it or maximise the use of our own renewable electricity generation. National Grid Electricity System Operator ('NGESO') currently pays renewable generators to turn off supply in Scotland, to prevent an overload of the system, and simultaneously instructs fast response generators (normally gas power plants) in areas of high consumption to switch on to balance supply and demand.

3.2.6. Batteries are essential in overcoming this challenge and play a vital role in ensuring the full benefits of existing and future renewable energy generation and the successful transition to a net-zero future. Batteries import large amounts of renewable energy from surrounding wind or solar farms when supply is typically at its highest and in excess of demand, storing it, and then exporting it back into the grid when demand is high, but supply is low. The location of the battery storage infrastructure is driven by its proximity to the existing Limekiln Wind Farm grid connection.

3.2.7. In relation to energy security, the Proposed Development also has the potential to supply the grid with voltage support services during low voltage periods or blackouts by supplying the network with quickly dischargeable energy. Essentially the BESS would import and store electricity from the network when there is a surplus of generation and then export this again when there is a deficit. This balancing function reduces the amount of time that renewable generation needs to be 'curtailed' (i.e. switched off) reducing the need to generate electricity from fossil fuel sources; primarily gas fired power stations.

3.2.8. The operation of batteries such as the Proposed Development offer a sustainable alternative to carbon-intensive energy sources to supply and maintain the grid, which reduces the energy network's reliance on fossil fuels and ultimately contributes to achieving the UK and Scottish Governments' greenhouse gas emissions targets, whilst enabling enhanced energy security and reduced energy costs for consumers.

3.2.9. The BESS has been largely designed to fulfil a balancing function. The use of a 4-hour discharge design parameter enables the BESS to provide a sizeable amount of balancing. The Site would connect to on-site Limekiln Wind Farm Substation which would be extended (hereafter referred to as the 'Substation Extension'), and thereafter connects to the transmission network at Dounreay Substation. The BESS project is designed to utilise the spare capacity on the existing overhead line to Limekiln Wind Farm, thus no infrastructure works are required from SSEN to connect the BESS project, and the cable corridor to Dounreay is therefore not assessed as part of the application.

3.2.10. The changing generation mix (explained above) and increasing intermittency is also decreasing the level of system inertia. Lower system inertia affects the ability of the system to manage the electricity network frequency within normal operating limits (within +/- 1 % of 50 hz). If the network is not maintained within the required frequency tolerance, system stress can result in widespread power supply issues and damage network infrastructure.

3.2.11. The BESS would have the ability to discharge electricity extremely quickly and therefore it could, at least in part, be operated so that it serves a frequency response purpose, as well as a balancing function.

3.3. Proposed Development Layout

3.3.1. The overall layout of the Proposed Development is shown in Figures 'Site Plan' and 'Site Plan Detail'. The footprint of the BESS compound including a potential future augmentation area is approximately 1.2 ha. The footprint of the Substation Extension is approximately 0.3 ha.

3.3.2. The BESS compound would measure 115 m x 80 m, and the neighbouring potential future augmentation hardstand would measure 80 m x 50 m.

3.3.3. The proposed Substation Extension would sit immediately adjacent to the operational Limekiln Wind Farm Substation, wrapping around its northern edge.

3.3.4. The approximate grid reference of the centre of the BESS compound is (easting) 298150 (northing) 962102. The approximate grid reference of the proposed Substation Extension is (easting) 297634 (northing) 962781.

3.4. Description of the Proposed Development Elements

Energy Storage Units

3.4.1. The main BESS compound is likely to contain up to 90 energy storage units, which would be installed typically in sets of two units, in a grid arrangement, as shown in Figure 'Indicative BESS Layout'. Each unit would be approximately 6 m long, 2.5 m wide and 3 m high.

3.4.2. Figure 'Indicative BESS Container Details' shows a typical energy storage unit. The units will consist of steel containers which are designed to be secure and protect the contents from weather. The containers will have an appropriate RAL light grey and / or green finish, which will be agreed with the local planning authority.

3.4.3. The container units will house rows of battery modules arranged in racks. The battery cells are likely to be of the Li-Ion type.

3.4.4. The battery units are likely to incorporate a liquid cooling system rather than an air conditioning-based cooling system. It is therefore unlikely that there would be HVAC (Heating Ventilation and Air Conditioning) units on top or on the side of the container units.

3.4.5. It is likely that each unit would have a vent which would be flush with the side of the unit. As explained in more detail below the units will also include fire detection and suppression systems.

3.4.6. It is likely that the units will sit on small, concrete footings or bases that will be approximately 0.5 m high.

3.4.7. It is proposed that the final approval of the appearance and specification of the energy storage units should be made the subject of an appropriate planning condition.

Inverter and Transformer Units

3.4.8. At the BESS compound, the Direct Current (DC) battery voltage needs to be converted into Alternating Current (AC) using inverters and then transformed to a network voltage. Each group of four energy storage units would be associated with a single combined inverter and transformer unit (Power Conversion System, PCS), which means that circa 18 of these would be required, as shown in Figure 'Indicative BESS Layout'.

3.4.9. The combined inverter and transformer units would typically be 6.1 m long, 2.4 m wide and 2.9 m high. An indicative elevation is shown in Figure 'Indicative Power Conversion System Details'.

Switchgear and Control Building

3.4.10. As shown in Figure 'Indicative BESS Layout' there would be one switchgear and control building situated on the BESS compound. They are typically 21.5 m long, 6.0 m wide and have a height to the ridgeline of the roof of 4.0 m. Figure 'Indicative Control Room Plan and

Elevations' provides a typical elevation for the building. The control building would be for the battery facility operator. Part of this building would house switchgear and other connection equipment. It would also contain the control room which would include the supervisory control and data acquisition (SCADA) and the battery management system (BMS) equipment. There would be an office with stores and welfare facilities within another part of the building. No staff would be based at the Proposed Development. Four parking places would be provided adjacent to the battery facility operator's building for visiting maintenance personnel.

3.4.11. The Proposed Development would not have a foul sewer connection. Foul drainage from staff welfare facilities on site would be disposed of either by a packaged biological foul treatment plant with discharge to the surface water system or to a storage tank for offsite disposal via road tanker.

3.4.12. The battery units would be connected to the onsite switchgear and control building via cables which would be buried in trenches of around 0.5 m to 1 m in depth, within the compound.

Potential Future Augmentation Area

3.4.13. The storage capacity and maximum output from the battery units is likely to diminish after a period of about 10 years. There are various methods of maintaining the output including: progressive replacement of battery cells within units, replacement of whole units within the main facility (commonly known as repowering) or installing additional battery units within or next to the main facility.

3.4.14. The decision on whether to install further battery units would be taken at a later date. As a precaution, a potential future augmentation area measuring 80 m by 50 m has been included in the BESS layout design and planning application. This is located immediately to the west of the main BESS compound.

Construction Compound

3.4.15. During the construction phase a temporary construction compound area will be required. This would be located within the potential future augmentation area. The compound would be used to store materials, provide vehicle parking, and would form a location for site cabins, offices and welfare facilities.

3.4.16. The construction plant and materials would remain for the anticipated 36-week duration of the groundwork and installation phases of construction but would be removed during the commissioning stage to leave a clear hardstanding.

Attenuation Basin

3.4.32. An attenuation basin has been included in the overall scheme layout and designed as a SuDS feature. Runoff from the impermeable elements of the BESS compound would be collected and directed into the pond which will provide treatment and attenuation prior to discharge to the receiving watercourse.

3.4.33. The pond would have graduated margins and will be natural in shape so that it is well integrated into the surrounding landscaping area.

3.4.52. The detailed design of the pond will be provided as part of a surface water drainage scheme which will be submitted to satisfy a planning condition.

Hardstanding

3.4.17. The BESS compound will be located on the reinstated temporary construction compound used previously for the Limekiln Wind Farm development.

3.4.18. The Substation Extension would be located adjacent to the operational Limekiln Wind Farm Substation, wrapping around its northern edge.

3.4.19. The BESS compound and Substation Extension hardstanding would be formed of crushed aggregate laid on permeable membranes. The aggregate will be sourced from local quarries and transported to the site via the A836, utilising the existing Limekiln Wind Farm access junction and existing internal track.

3.4.20. Cut and fill earthworks across the compound areas would be carried out at an early stage of the construction process to create a suitable level development platform. The earthworks would be designed to minimise the need for fill material to be brought to the site or for excess material to be removed from site, as far as practicable.

Outdoor Switchgear and Transformer

3.4.21. To connect the BESS development to the Grid, an outdoor switchgear and 132/33 kV transformer is required at the Substation Extension.

Grid Connection

3.4.22. The BESS project is designed to utilise spare capacity on the existing overhead line to Limekiln Wind Farm; thus no infrastructure works are required from SSEN to connect the BESS project, and the cable corridor to Dounreay is therefore not assessed as part of the application.

Fencing

3.4.23. The BESS compound and Substation Extension would be enclosed by 3 m high steel palisade fence, which would also be installed around the outer perimeter of the compound.

3.4.24. The exact colour of the fences would be agreed post consent but they are likely to be either dark green or brown. The position of the fences are shown in Figures 'Indicative BESS Layout' and 'Indicative Substation Extension Layout', and the details of the fences are shown in Figure 'Indicative Fence Detail'.

Lighting

3.4.25. There would be no permanent visible lighting within the BESS compound or Substation area. The visible lighting within the main compound would solely consist of motion-sensitive lighting at the entrances, which would only be activated during occasional visits by maintenance personnel. This will be designed to be downward facing to minimise any light-spill beyond the enclosure.

3.4.26. There would also be invisible infra-red lighting which will be detectable by security cameras. It is proposed that a condition be attached to the planning permission requiring the submission and approval of a lighting scheme for the BESS. The indicative lighting scheme is shown in Figure 'Indicative Lighting and CCTV Column Details'.

Closed Circuit Television Masts

3.4.27. CCTV cameras would be installed on 4 m high columns; the cameras would be mounted on the 3 m high palisade security fencing at each corner and at strategic intervals along the BESS compound and Substation Extension perimeter.

3.4.28. The masts would accommodate infrared night-time cameras, as well as standard cameras, to maintain security surveillance during hours of darkness.

3.4.29. The detailed design of the CCTV masts and equipment would be submitted at a later stage to satisfy a planning condition. Figure 'Indicative Lighting and CCTV Column Details' shows the indicative CCTV column details.

Site Access and Internal Access Tracks

3.4.30. Access to the BESS compound and Substation Extension would utilise the existing wind farm tracks. Therefore no new tracks are proposed outside of the confines of the compounds. An internal access track is proposed within the BESS compound and Substation Extension; the access is required for future maintenance and repair if required.

Forestry Felling

3.4.31. The proposed BESS would be situated within a large commercial conifer plantation on the reinstated temporary construction compound used for the construction of Limekiln Wind Farm. This area was felled during the construction phase and was due to be replanted under the Limekiln Wind Farm's Long-Term Forestry Plan.

3.4.32. The Substation Extension also lies within the plantation, in an area that has already been felled as part of the Limekiln Wind Farm construction. Some additional felling would be required but would be minimal.

3.4.33. The route of the underground cable between the BESS and Substation Extension has been designed to minimise impact on forestry. Minimal tree felling would be required to install the underground cable alongside the core path.

3.4.34. If the Proposed Development is consented, compensatory planting would be undertaken to mitigate any permanent woodland loss. See Chapter 4 Forestry for further information.

Educational Signs

3.4.35. No landscaping has been proposed for the Proposed Development due to being situated within the proximity of Limekiln Wind Farm and a large forestry plantation.

3.4.36. The Landscape Officer at the Highland Council major developments pre-application meeting suggesting the BESS could be made a point of interest along the core path. Educational signs have been proposed along the core path to help inform the public about the Proposed Development and its purpose.

3.5. Construction of the Proposed Development

3.5.1. The start of construction would depend on the planning process, and the procurement stage.

3.5.2. The on-site construction period is estimated to be approximately 6 - 12 months, however, this could be longer if there is a delay between the ground works and the installation stage due to the lead in time for the delivery of the battery units and inverters.

3.5.3. The construction activities are listed below in the approximate order that they would take place, albeit that the duration of some activities will overlap.

Ground Works

- Formation of the construction compound (potential future augmentation area) immediately to the west of the main BESS compound.
- Levelling and preparation of the main BESS platform.
- Formation, levelling and preparation of the Substation Extension platform and preparation of foundation footings.
- Preparation of battery unit and other foundation footings within the BESS compound.
- Preparation of the transformer and other electrical components within the Substation Extension.
- Trenching and laying of cables.
- Formation of compounds with imported aggregate.
- Construction and electrical fit out of buildings and enclosures.
- Erection of the palisade fences around perimeters.

Installation

3.5.4. Delivery of the battery units, inverters and transformers using heavy goods vehicles, while the 132/33 kV transformer, which constitutes an abnormal load due to its size and weight, will be transported using a specialist low-loader. All components will be offloaded and installed on-site using a mobile crane.

Temporary Core Path Diversion

3.5.5. During the installation of the underground cable, it is proposed to temporarily divert the core path CA11.03 route from the Substation Extension area through the wind farm to rejoin at the BESS compound. The Highland Council has been consulted on this temporary diversion and have indicated that no significant impacts are predicted.

Commissioning

- Installation of underground electrical cable to the Substation Extension.
- Setting, testing and monitoring initial operation of the battery facility.

Proposed Site Re-instatement and Enhancement

- Forestry replanting onsite with productive conifer species matching the Long Term Forestry Plan (LTFP) Restocking Plan;
- Offsite compensatory planting for the remaining felled area;
- Restoration and enhancement of plantation woodland edge habitats following felling;
- Restoration of remaining area around Substation Extension to manage heathland and associated habitats;
- Hedgerow planting around the BESS compound;
- Allow heathland to expand into open areas around the BESS compound and underground cable route areas;
- Bird boxes (including owl boxes) and bat boxes; and
- Refugia piles for reptiles and amphibians.

3.5.6. The typical construction plant to be used would include: excavators, graders and haulage vehicles, mobile and tower cranes, heavy and light goods vehicles.

3.5.7. The crushed rock used to form the BESS compound and Substation Extension hardstandings will be imported from local quarries. The material for the foundations will be imported ready mixed concrete. Material excavated during the ground works phase will be reused within the site.

3.5.8. Normal construction working hours would be Monday to Friday 08:00-18:00 and Saturday 08:00-13:00. No Sunday, bank holiday or night working is proposed except as described below. Up to an hour before and after the normal construction working hours, the following activities may be undertaken:

- arrival and departure of the workforce at the site and movement around the project site that does not require the use of plant;
- site inspections and safety checks; and
- site housekeeping that does not require the use of plant.

3.5.9. Non-noisy activities such as fit-out within buildings may be undertaken outside of those hours where these would not cause disturbance off-site. It is possible that certain construction activities that cannot be interrupted, such as a continuous concrete pour, may be required for the foundation slabs of the development platforms.

3.5.10. Directional task lighting may be required during normal construction hours in winter. Outside normal construction working hours, motion-activated directional security lighting may be used at the site.

3.5.11. A Construction Environmental Management Plan (CEMP) will be prepared and agreed prior to any work commencing on site. A Construction Traffic Management Plan (CTMP) will also be produced prior to the commencement of construction.

3.6. Operation of the Proposed Development

3.6.1. The BESS is likely to operate intermittently on a 24-hour, seven day a week basis, although operation during the middle of the night would be less likely to occur, as electricity demand is lower at this time.

3.6.2. The BESS or Substation Extension would not require a permanent manned presence. Maintenance would be overseen by suitably qualified personnel who would visit the development as required. This would typically be less than twice per month. Online monitoring of performance and identification of issues would be provided on a 24-hour basis.

3.6.3. Typical traffic to the site would be up to two vans per month. During the normal course of operations, no heavy good vehicles (HGV) are anticipated to be required. There would, however, be some additional HGV movements if any part of the BESS required replacement during the operational life of the development.