CHAPTER 3 – PROJECT DESCRIPTION

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3 PROJECT DESCRIPTION

Summary

3.1 This chapter provides an outline description of the Proposed Development, the Site and surrounding area and the phasing of design. It also details the construction, operational and decommissioning phases of the Proposed Development.

3.2 The Proposed Development will consist of the construction, 25 year operation and subsequent decommissioning of two wind turbines up to a tip height of 125m, and associated infrastructure.

The Site and Its Surroundings

3.3 The Site is located in a sparsely populated area of Carmarthenshire, north of the village of Rhydcymerau, the edge of which is approximately 2.2km from the nearest proposed turbine, 2km west of Wren, 5.5km south-east of Llanybydder and 6.5km south of Lampeter. Outside of these settlements there are other smaller village clusters and farmsteads at varying distances from the Site.

3.4 The Site is generally characterised by upland grazing agricultural land to the north, with a more enclosed valley character to the south closer to the property at Esgairliving.

3.5 The wider area is generally defined by upland grazing agricultural land, consisting of open sheep farming agricultural land within a rural landscape. There are some more enclosed areas within the valleys, where larger settlements are more common. The wider area to the south-east consists of large commercial forestry areas, namely Brechfa Forest.

3.6 There are only 3 properties within 1km of a turbine that are not financially involved in the scheme (distances to nearest turbine);

- Caermalwas Fawr 793m
- Cefnblaenau 951m
- Bwlch Caemalwas Fach 939m

3.7 The nearest financially involved properties are Tanrhiw (679m), and Esgairliving Farm (714m).

3.8 Cefn Blaenau Site of Special Scientific Interest (SSSI) is located approximately 0.7km to the north-east of the Site. Caeau Blaen-Bydernyn SSSI is located 2.5km to the north-west of the Site and Cae Blaen-Dyffryn 4.4km to the north-east. Brecon Beacons National Park (SSSI) is located 18.5km to the south-east.

3.9 There are no Public Rights of Way (PROW) within the Site. The closest PROW to the site crosses the edge of Llwydrissi woodland, 1.3km to the north-west of the Site at the closest point. There are some publicly accessible tracks within Llwydrissi woodland.

Site Selection Methodology

3.10 As part of the Company's European strategy, Energiekontor UK Ltd began an in-house study to identify potential wind farm sites throughout the UK in 2002. The study aimed to identify the locations of land areas where the siting of a wind farm would result in minimal environmental effects and would be viable on an economic basis. This study involved the identification of potential areas for wind farm development involving:

- A review of the planning context for renewable energy in Wales
- A GIS mapping exercise;
- A review of wind speed data;
- A review of the proximity of the electricity supply grid network;
- Evaluation of alternative locations; and
- Potential areas for wind farm development.

GIS Constraints Mapping Exercise

3.11 The geographical Information System (GIS) 'sieve mapping' exercise involved identifying the areas with the most significant development constraints which were subsequently excluded from further consideration. In this instance, the land areas and receptors considered to be potentially highly sensitive to wind farm development included:

- International natural heritage designations, including Ramsar sites (designated under the International Convention on Wetlands of International

Importance, especially regarding Waterfowl Habitats), Special Areas of Conservation (SACs) (designated under the EC Habitats Directive 92/43/EEC), and Special Protection Areas (SPAs) (classified in accordance with Article 4 of the EC Directive on the Conservation of Wild Birds 79/409/EEC);

- National and local natural heritage designations, including National Parks, Sites of Special Scientific Interest (SSSIs), Areas of Outstanding Natural Beauty (AONBs), Heritage Coast, Coastal Conservation Areas, National and Local Nature Reserves (NNR and LNRs), Ancient Woodland and RSPB reserves;
- Cultural heritage assets, including Historic Landscape Areas, World Heritage Sites, Scheduled Monuments, Listed Buildings, Conservation Areas, Registered Parks and Gardens and Battlefield sites; and
- The pattern of settlement, with all areas within 600m of settlements and residential properties in the countryside excluded.

3.12 The GIS also assisted in identifying the location of infrastructure which may be sensitive to wind farm development including:

- Strategic infrastructure, such as telecoms equipment and links, pipelines, military and civilian airports and radar; and
- The location of Public Rights of Way

3.13 The locational approach was to exclude and avoid as far as possible, those areas of constraint as described above.

Wind speed data

3.14 The information on constrained areas was then coupled with data on wind speed (using the Department of Trade and Industry (DTI) wind speed database, NOABL which provides annual mean wind speeds on a kilometre grid square basis) to identify potentially suitable locations for wind farm development.

Design Evolution

3.15 The development design has been optimised to result in a project which balances the use of land available with the overall impact of the development. This is based on the following technical, economic and environmental criteria:

- Ground conditions and existing land use - suitable ground conditions are key to ensure suitability for the installation of wind turbines, access tracks and all

infrastructure such as the substation. Access tracks where possible follow existing field boundaries to minimise existing disruption to existing land use.

- Distance between turbines and proximity to 'obstructions' - to minimise the turbulent interaction between turbines, turbines must be separated both perpendicular to, and in line with, the prevailing wind direction.
- Environmental constraints - Figure 3.0 provides a snapshot of some of the desktop analysis that was undertaken to guide development. The other assessment chapters of this ER assess each of these considerations and issues in depth.
- Proximity to underground and overground services as well as existing telecommunications links running through the site and separation distance to local roads.
- Landscape and Visual Amenity - Chapter 4 covers this in depth. Minimising the impact of the wind farm whilst maximising the energy output was a key consideration in the design process.
- Access to site. The most suitable access location is shown on the site layout plan. The most appropriate access point to this site was chosen to not only ensure safe access but also to minimise disruption to local residents
- The turbine layout has evolved in order to ensure suitable buffer distances from residential properties in order to reduce environmental effects.

Community Engagement

3.16 This section identifies the consultation methods that the Applicant has undertaken for community engagement for wind farm development. The Applicant adheres to the key principle that underpins onshore wind energy developments - that any onshore wind energy projects are developed in a way that is sustainable - economically, environmentally and socially.

3.17 Due to current restrictions on public gatherings due to the COVID-19 crisis, and in line with regulation[1], public engagement and consultation was carried out through other means, including online. Downloadable documents for the project, both at the pre-application and application stage, are hosted on the

[1] The Planning Applications (Temporary Modifications and Disapplication) (Wales) (Coronavirus) Order 2020

following website https://www.energiekontor.co.uk/our-projects/mynydd-pencarreg.

3.18 There is an extensive planning history associated with proposals to develop turbines at the Site. This history has included rounds of public consultation and planning applications, all of which has influenced the design of this Proposed Development. In addition, as part of this Proposed Development the Applicant has undertaken the following consultation activities;

- the launch of the project website, with detailed information on the Proposed Development, contact information, ability to comment or support the proposal; and
- Contact made with Llanybydder and Rhydcymerau Community Council and other key stakeholders notifying them of the exhibition.

The Proposed Development

3.19 The Proposed Development will consist of the erection, 25 year operation, and subsequent decommissioning of up to two wind turbines, each up to 125m in height to blade tip, including the following main components:

- turbine transformers;
- turbine foundations;
- hard-standing areas for erecting cranes at each turbine location;
- on-site track connecting to turbines;
- underground cables linking the turbines to the distribution connection;
- on-site substation; and
- new site access from B4337

3.20 In addition to the above infrastructure components, construction will involve:

- a temporary construction compound; and
- an additional temporary storage/laydown area.

3.21 The wind farm would provide up to a total of 5MW of generating capacity.

3.22 Drawings of the Proposed Development, including the main elements as noted above, are provided as Figures 3.1 to 3.9. The components required will vary at different times within the Proposed Development's lifecycle due to, for example,

the requirement for temporary infrastructure such as the temporary laydown areas during construction.

3.23 The planning application seeks an allowance for potential micro-siting of the wind farm infrastructure as illustrated on Figure 1.2. If planning permission is granted, the Applicant would commission detailed ground investigations and geotechnical surveys to determine the overall ground conditions. It is possible that there may be a requirement for micro-siting of infrastructure following these investigations and any other pre-construction environmental surveys. Consequently, subject to environmental constraints and ground conditions, the planning application boundary seeks a potential micro-siting of wind turbines by up to 25 metres. The planning application site boundary also allows for some minor repositioning of infrastructure and track re-alignment (localised widening etc) within the red-line boundary.

3.24 The construction and decommissioning of the wind turbines, ancillary equipment and on-site infrastructure are described in more detail in the following sections of this chapter. The principal elements include:

- **Wind turbines** – two wind turbines, each up to 125m to blade tip and with a total generating capacity of up to 5MW (see Figure 3.1) for a typical wind turbine elevation). The underside of the turbine foundations would be located in subsoil at a maximum depth of 3.0 – 3.5 m below ground level.
- **Site access** – a new site entrance at the south of the Site, with suitable agreed visibility and access splays for construction traffic. The entrance would be gated and surfaced in bituminous macadam from the road. The new site entrance would replace the existing farm access.
- **Site tracks** – to provide access for construction and maintenance vehicles from the site access to the substation and wind turbines. These would be upgraded / constructed at the commencement of the construction phase and would remain until the end of the decommissioning phase. They would have a 5.0m running width, with local widening on corners and would be surfaced with coarse aggregate (see Figure 3.2 for typical site track cross sections).
- **Construction compound/storage laydown area** – to provide a secure area for site office facilities and storage of materials and components. A primary

Temporary Construction Compound would be constructed adjacent to the site track on Site, with a 60m x 40m hardcore base. The compound will be surrounded by a security fence and locked gates. The fence and gates would be removed at the end of the construction phase and the hardcore base may be retained but allowed to re-vegetate (see Figure 3.3 for a typical construction compound). An additional storage/laydown area would also be created, approximately 50m x 15m, near the entrance to the site. This area would mainly be used for material and turbine component/blade storage, as well as to assist with site mobilization.

- **Crane hardstandings** and outrigger pads – to provide a level and firm base for the cranes at the location of each turbine. Each would be a maximum of 45m x 25m and surfaced with coarse aggregate (see Figure 3.4 for a typical crane hardstanding layout).
- **Transformer housings** – the transformers to step up the voltage exported from each turbine (from 690V to 11kV) would either be placed within the wind turbines themselves, or in a small secure external transformer housing placed next to each wind turbine tower, depending on the final turbine choice (see Figure 3.5 for a typical transformer housing).
- **High voltage and control cables** – to form power and control circuits linking each turbine to the on-site substation, cables would be placed in trenches (dimensions to be determined by the ground conditions but typically 0.5m x 1m deep) routed alongside the tracks (see Figure 3.6 for typical cable trench construction details).
- **Substation building** – a 16m long x 12m wide single storey building, housing the switchgear and control equipment, plus secure storage space (see Figure 3.7 and Figure 3.8 for a typical substation).
- **Turbine foundations** – The design of the wind turbine foundations will be dependent upon the loads from the turbine and the topographical, geotechnical and hydrological Site conditions. The wind turbine foundations would be subject to a final design, dependent upon ground conditions. A typical foundation for the size of turbine proposed for the Proposed Development is shown on Figure 3.9.

- **Ecology Enhancement Proposals** – if considered necessary, the Applicant would be willing to offer habitat enhancement such as hedge and tree planting which would benefit a number of habitats in the vicinity of the site. These details can be agreed in consultation with the Planning Authority.
- **Regular inspection and maintenance** – of the turbines and equipment.
- **Replacement of any major components** – requiring a crane, heavy transport vehicles and a skilled crew.

Wind Turbines

3.25 It is proposed to erect up to two wind turbines on the Site. The turbines would be of a typical modern design comprising a three bladed rotor hub mounted on a rotatable nacelle (containing a gearbox and a generator), tower, foundation and if required an external transformer.

3.26 Final turbine selection would be made following the award of planning permission, however the assessments have been undertaken on the basis of a candidate turbine design, Vestas V100, consisting of:

- A tubular steel tower;
- a rotor consisting of three blades, with a rotor diameter of 100m;
- hub height of approximately 75m;
- maximum height to vertical blade tip of 125m;
- turbines would generate power for all wind speeds between 2m/s and 22m/s.
- at wind speeds greater than 22m/s the turbines would shut down for self-protection.
- Rated power capacity of 2MW each.

Associated Development

3.27 A grid connection would be required to feed the electricity generated by the wind farm into the distribution network for the operational period of the wind farm. Discussions with the Distribution Network Operator (DNO) have indicated that there is a suitable connection point at Lampeter Substation.

3.28 The final details of the distribution connection including the precise route and an assessment of any impacts on the environment would be determined by the DNO at a later date under a separate consenting regime.

Anticipated Construction Programme and Timescales

3.29 If planning permission is granted in a timely manner, construction of the Proposed Development could be completed within 12 months of the consent.

3.30 An indicative construction programme (based on vehicular movements) is shown in Appendix 9.2. This takes into account all that is currently known about the Site and Proposed Development. The table present an indicative programme of construction activities and their associated vehicle trips. The precise duration and timing of each activity would be modified, as necessary, to take into account the findings of the pre-construction works and surveys, although for the purposes of this chapter it is considered to be 'worst case' based upon typical assumptions.

Construction Works

3.31 Construction works include:

- temporary and permanent highway modifications to enable vehicles to access the Site from the strategic and local highway network;
- construction of access point from the public highway;
- construction and upgrading of new and existing site tracks required to access the wind turbines by civil engineering plant and construction equipment;
- construction of secure temporary compound / storage area for site office facilities and storage of materials and components;
- construction of an additional temporary storage/laydown area;
- installation of hardstandings and outrigger pads for the cranes that would be used for the erection of the turbines;
- construction of foundations for the turbine structures;
- wind turbine delivery and erection;
- installation of transformers in separate housings alongside each wind turbine (if required);

- installation of on-site High Voltage (HV) cabling, communication cabling and earthing;
- installation of Supervisory Control and Data Acquisition (SCADA) system;
- construction of site substation;
- commissioning of site mechanical and electrical equipment; and
- reinstatement and landscaping, removal of temporary site offices, reseeding verges and areas around turbine bases.

3.32 The works would mainly follow the order detailed above, but many will be carried out concurrently to reduce the overall length of the construction programme. There would be construction phasing, with civil engineering works progressing in some areas of the site whilst turbines are being erected elsewhere. In order to minimise disruption to land use, site restoration would be undertaken as early as possible in development areas.

3.33 A detailed programme of works would be provided by the construction contractors prior to the commencement of works on site. Should planning permission be granted then it is likely that construction hours would be restricted via means of a planning condition imposed by the LPA.

3.34 At this stage it is proposed that construction activities on site shall only take place between the hours of 08:00 to 18:00 on Monday to Friday inclusive and 08:00 to 13:00 hours on Saturday, with no construction works on site on Sundays or Bank Holidays. Outside of these hours, works would be limited to emergency works and dust suppression, unless otherwise agreed in writing by the local planning authority.

3.35 It is proposed that the delivery of any construction materials or equipment, other than turbine blades, nacelles and towers, shall be restricted to the above hours, unless otherwise agreed in writing by the local planning authority.

Pre-Construction Works

3.36 Prior to commencement of construction, detailed site surveys would be undertaken to provide data for the final design of the civil and electrical engineering infrastructure for the project. These would comprise topographical and geotechnical surveys.

3.37 The geotechnical survey will inform the excavation and sampling of trial holes at each turbine location and possibly boreholes to obtain information about the underlying strata.

3.38 All intrusive investigations would be sited at turbine locations to minimise the impact of any exploratory excavations.

Temporary and Permanent Highway Works

3.39 Some enabling works would be required along the access route. The likely locations of these works have been identified and are discussed in Chapter 9: Traffic and Transport. All such work would be undertaken to the standards and approval of the relevant transport body.

Construction Compound

3.40 During the construction phase a temporary construction compound and laydown/storage area would be constructed in the locations shown on Figure 1.2.

3.41 The temporary construction compound would be approximately 60m by 40m. The compounds would have a hardcore base constructed of 200mm depth of crushed stone and be surrounded by a security fence and locked gates. Space would be provided for 'Portacabin' style site offices; welfare and mess facilities; secure containers for tool and equipment storage; an area for the storage of various materials and small components; and car parking for several construction vehicles.

3.42 On completion of construction, the site compound surface structure will be removed and the area fully restored in accordance with an approved method statement. In the experience of the Applicant the site compound base is in some cases left in place for agricultural use, depending on the preference of the landowner or upon any planning condition attached to the permission.

Site Access from the Public Highway

3.43 A new entrance would be constructed at the southern boundary of the Site to allow construction and delivery vehicles safe access to the Site from the public

highway (B4337). This new entrance would replace the existing farm entrance. The location of this entrance is shown on the Figure 1.2.

Construction of New Site Tracks

General Construction Principles

3.44 The proposed Site track layout is shown on Figure 1.2. Use of existing agricultural tracks has been utilised where possible and all new site tracks will be "cut" construction.

3.45 The minimum width of the tracks is normally specified by the turbine supplier. For the Proposed Development a 5m wide running surface, with local widening where necessary, would be sufficient for all of the Site tracks.

3.46 The construction of the tracks would involve the stripping and storage of topsoil followed by installation of geotextile. The crushed stone track would be laid to a nominal depth of up to 370mm and aggregates required for the access tracks would be obtained from local suppliers, where possible. The tracks would incorporate swales to attenuate surface water flow in accordance with sustainable drainage principles.

3.47 Interaction with existing water courses is discussed in more detail in Chapter 10: Geology, Hydrology and Hydrogeology. All drainage details would be agreed with Natural Resources Wales and the LPA prior to construction.

Cut Tracks

3.48 Cut tracks would be formed by first stripping any topsoil / subsoil using conventional construction equipment in order to expose the underlying subsoil. Mineral soil and subsoil excavated during cut track construction would be set aside for re-use in Site reinstatement at a later date.

3.49 In order to prevent any fine, in-situ clayey, subsoil material from migrating into the free draining granular fill of the Site track, a geotextile layer would be laid on the underlying subsoil beneath the Site tracks. General ungraded, granular fill would then be placed on top of the geotextile layer.

3.50 Cut track construction would typically incorporate a thickness of granular fill of up to 370mm, the depth to be determined by the nature and depth of the

underlying subsoil. The fill is likely to be imported from locally sourced, off-site quarries. Any drainage required would also be installed at this stage.

3.51 The fill would be placed to a depth corresponding with original ground level. This would be levelled and compacted by compaction equipment and by the construction traffic that uses the track for access to the various parts of the Site. A layer of geo-grid may be incorporated into the stone fill in highly trafficked areas.

3.52 The application proposal has been assessed on a 'worst case scenario' i.e. on the basis that all materials required for the build will be imported. However, it is expected that some amount of stone will be extracted as part of the cut process and re-used to form part of the access track.

3.53 On completion of the construction, the general fill layer may be capped with a permeable aggregate to form the running surface for operations and maintenance vehicles.

3.54 Cross drains would be designed to divert surface water along the track alignment and transfer to a subsurface flow. As far as practicably possible, any water collected would be re-distributed to replicate the original surface / subsurface flows.

3.55 On completion of construction the remaining excavated mineral soil and subsoil would be levelled alongside the access tracks to a depth of no more than 150mm.

3.56 The access tracks, will be retained throughout the operational life of the Proposed Development to allow access for maintenance of the turbines.

Crane Hardstandings and Outrigger Pads

3.57 At the location of each turbine foundation a hardstanding would be constructed to provide support for the cranes which will be used for erection of turbines. These hardstandings could also be used for storing turbine components, such as the nacelle, until they are installed; although it is normal practice to avoid such double handling. When not being used for the erection of turbines, the crane hardstanding may also be used as a passing place at each turbine location where appropriate.

3.58 Each hardstanding covers an area of maximum dimensions approximately 25m x 45m.

3.59 The hardstandings would be constructed using the same criteria and methods as those used for the Site tracks. The depth of stone fill in these areas is similar to the site track construction, but may be increased due to the axle loading from the cranes. This would depend on the characteristics of the vehicles used for the erection of the turbines.

3.60 The precise design of the crane hardstandings would be determined by the ground conditions at each of the turbine locations in a similar way to the design of the site tracks described above. The crane hardstanding would be of cut design, typically incorporating a thickness of granular fill of up to 370mm, although the actual depth would be determined by the nature and depth of the underlying subsoil. The fill may be imported from locally sourced, off-site quarries. Any drainage required would also be installed at this stage.

3.61 On completion of construction the hardstanding areas at each turbine location would be retained but allowed to re-vegetate naturally. Their retention is required in order that they are available in the event of a major component replacement during the operation of the wind farm and for decommissioning.

Wind Turbine Foundations

Design Principles

3.62 The design of the wind turbine foundations will be dependent upon the loads from the turbine and the topographical, geotechnical and hydrological Site conditions. The wind turbine foundations would be subject to a final design, dependent upon ground conditions. A typical foundation for the size of turbine proposed for the Proposed Development is shown on Figure 3.9.

3.63 The loads from the turbine, combined with the ground and hydrological conditions at each of the turbine locations would determine the overall size of the support structure. The underside of the foundations would be located in subsoil at a maximum depth of between 3.0 – 3.5m below ground level.

3.64 Where the groundwater is below the bottom of the foundation, then the structure would be designed for dry and drained conditions, i.e. with no water

pressure on the bottom of the foundation. Where there is a high groundwater table (above the underside of the foundation) the foundation would be designed for buoyant conditions arising from water pressure acting upwards on the underside of the structure.

3.65 In all situations, the foundation design would be optimised to provide a minimum volume of concrete, thereby reducing the environmental footprint of the turbine.

Construction Methods

3.66 The first task in constructing each wind turbine foundation would be to remove any mineral soil to the perimeter of the proposed foundation excavation. The underlying subsoil would then be excavated to the required foundation depth, by conventional construction equipment. Excavated materials would be set aside for reuse as backfill around the foundation following completion of construction. Detailed method statements for materials handling would be prepared in accordance with conditions imposed by the LPA on the granting of a planning consent.

3.67 The foundation formation would then be prepared to receive concrete blinding by placing timber shuttering around the edge of the excavation. Concrete blinding would be poured on the foundation formation to level the area in preparation for fixing the steel reinforcement bars. The blinding would be a weak mix of concrete with low slump and would normally be placed fairly dry. Little if any loss of cement would, therefore, occur during placement of the lean-mix levelling layer.

3.68 A bottom mat of reinforcement would be placed on the weak mix concrete blinding. Additional reinforcement would be fixed to the bottom mat to form the main reinforcement cage for the foundation. Starter bars would then be fixed to the main cage to form the up stand, which would support the bottom tower section. Temporary shuttering would be placed on the reinforcement cage to ensure that there would be sufficient concrete cover to the top layer of steel. Side shuttering would also be positioned around the cage to form the sides of the concrete slab and to prevent loss of concrete and cement paste into the ground.

3.69 Concrete would then be poured to form the main slab either by a concrete pump or by being placed in small hoppers / skips that would be lifted over the area being concreted and then tipped. Conventional concrete lorries of approximately 8m³ capacity or an on-site batch plant would be used for each foundation. During the pour, the concrete would be compacted using poker vibrators. As the concrete placement is completed, the temporary shuttering on the top steel would be removed, and the concrete tamped and floated to a smooth finish.

3.70 A curing compound is often used to stop the concrete drying out too quickly (which can lead to hairline cracking of the top surface). This is sprayed onto the surface concrete. Plastic sheeting or hessian may also be used to assist with curing of the concrete, if it is considered appropriate. This reduces evaporation of water at the surface of the concrete and also assists in preventing shrinkage of cracking material.

Turbine Delivery and Erection

3.71 Mechanical installation would comprise the delivery and erection of turbine components. Delivery of the turbine components would be undertaken by specialist contractors using purpose built vehicles, as described in more detail in Chapter 9: Traffic and Transport. Erection of the turbine components will be undertaken by the turbine supplier using specialist heavy lifting subcontractors and cranes.

3.72 The connection of the tower to the foundation would be made by using holding down bolts or with a short cylindrical steel section embedded in the foundation slab. The choice of holding down system would depend on the wind turbine supplier. The sequence of construction of the connection between the tower and foundation depends on which system is used.

3.73 For a holding down bolt solution, the up-stand foundation anchor bolt assembly would be placed, along with additional reinforcement in the up-stand following completion of the base slab. At this stage, partial backfilling of the foundation would be undertaken to aid access to the turbine location during the rest of the foundation construction. Once the up-stand reinforcement and anchor bolt assembly is complete, timer or steel shutters would be placed to form the up-stand of the turbine foundation.

3.74 If the tower is connected to the foundation by a steel cylindrical section then the up-stand reinforcement and holding down bolts would not be required. For this holding down solution, there would be only one phase of concrete pour because the embedded section would form a permanent shuttering for the mass concrete inside it.

3.75 Electrical ducts would then be placed through the shuttering and reinforcement (for the holding down bolt solution), or the steel cylinder. These would include conduits for the high and low voltage cables and earthing tapes. The configuration of the ducts and the earthing tape would depend on the turbine model being used and the nature of the electrical layouts. The holding down bolts are held in place within the shuttering by a template which would be fixed to the shuttering. Concrete would then be poured to form the foundation up-stand. The up-stand concrete would be compacted with poker vibrators in a similar way to that described for the base slab.

3.76 The wind turbine earthing rods and tails would then be placed within the backfill. In some cases, earthing rods would be needed around the foundations. The need for these would depend on the ground conditions at the wind farm site. If required, they would be installed as self-boring rods, drilled into the ground, in contact with the weathered rock. The depth of the rods would depend on the electrical characteristics of the ground. Once the earthing ring is completed, the cable ducts would be extended to the edge of the foundation and backfilling to the top of the up-stand would commence.

3.77 The wind turbine foundation would then be backfilled. Weathered rock material from the foundation excavation would be used for the bulk of the backfill. It would then be placed in thin layers and compacted mechanically.

3.78 The bottom section of the wind turbine tower would be placed over the foundation bolts and fixed to the foundation. Cementitious grout would be placed between the bottom flange of the tower and the foundation. The grout would be retained in position by temporary formwork, which would prevent it from spilling outside the foundation. The material would be allowed to cure and the ends would be tightened to pre-tension the bolts.

3.79 The area around each turbine tower and over the turbine foundations would be reinstated by using topsoil stripped during the foundation construction excavation and other surplus excavated material.

Wind Turbine Transformers

3.80 In order to carry the power generated to the local electricity network each turbine may require a transformer. Turbine transformers can be located within the nacelle or adjacent to the base of each tower, depending on the wind turbine model selected and the supplier's specification.

High Voltage Cabling

3.81 The turbines would be interconnected using armoured underground cables placed in trenches forming a power circuit within the Site. The underground cables would be taken into the on-site substation where the electrical control equipment would interface with the local distribution network.

3.82 The design of the high voltage (HV) cable trenches would be a function of the electrical rating of the cables, the ground conditions and the depth of protection required for the cables. The electrical rating and the ground conditions would provide data to assess the thermal performance of the cables. This would determine the likely spacing between each electrical circuit and therefore the width of the trench. Typical cable trench construction details are shown in Figure 3.6 for the single and double circuits which would be used for the Proposed Development.

3.83 Cable trenches would be excavated using conventional construction equipment. The mineral soil would be dug out and set aside for re-use in the reinstatement of the trenches. The trench would then be excavated to the required overall depth. Subsoil material from the excavation would be temporarily stockpiled alongside the trench, but kept separate from any mineral soil. Detailed method statements for materials handling would be prepared in accordance with a Restoration and Management Plan.

3.84 The cable would be placed on a bed of previously dug stone free excavated material soil. The trench would then be backfilled with excavate subsoil taken from the temporary stockpile alongside the trench and the top of the

excavation reinstate with topsoil. Cable tiles or a warning marker tape would be laid in the trench during backfilling at a pre-specified depth. Any surplus excavated material would be stockpiled at an agreed location and used later in the reinstatement of the Site.

Supervisory Control and Data Acquisition System (Turbine Monitoring and Control)

3.85 Monitoring and controlling the performance of the wind turbines would be achieved by way of a sophisticated Supervisory Control and Data Acquisition (SCADA) system. The SCADA system would gather data from all of the turbines and provide the facility to control them from a remote location. Communications cables connecting to each turbine would be buried in the electrical cable trenches (described above) to facilitate this.

Site Substation

3.86 Wind farm substation buildings are typically of conventional masonry construction, on concrete foundations with a pitched roof constructed of trussed rafters finished in slates or tiles. A security slab of reinforced concrete can be incorporated into the roof construction. In most cases, cable ducts and trenches are formed in the slab of the building. The trenches can be up to 1.5m deep depending on the electrical requirements and the layout of the site, and also on whether the switchgear in the control building utilises top or bottom entry cables.

3.87 The substation would be a single storey building, a maximum of 16m long x 12m wide, with a standard ridge height. Where possible, the substation would be constructed using locally sourced materials in a style to complement the local vernacular. The external finishes to the substation building would be subject to the approval of the LPA prior to construction. The substation would house the switchgear and control equipment needed for the distribution connection and would also provide some secure storage space that may occasionally be required for the Proposed Development. The building would not be permanently manned as the Proposed Development would be controlled remotely from a central control facility.

Commissioning of Mechanical and Electrical Equipment

3.88 The testing and commissioning of a wind farm is normally undertaken by the turbine supplier. It involves a series of tests on the high voltage electrical network, the electrical equipment in the turbines and control building and the SCADA system. No construction activities are required and only infrequent access would be required for domestic scale vehicles.

Reinstatement and Removal of Temporary Works

3.89 On completion of construction, all temporary fencing, the temporary construction compound and temporary turning heads would be removed from the Site and all areas disturbed by the works would be reinstated.

Construction Materials

Stone / Aggregate for Site Tracks

3.90 The Environmental Report has been produced based on the assumption that all material would be sourced off-site and from local supplies where possible i.e. a worst case scenario in terms of traffic and vehicle generation. The exact quantity of materials needed would depend on the actual ground conditions revealed by the pre-construction geotechnical survey and encountered during construction. The construction of the new on-site access tracks, turning heads, temporary compounds / storage areas and crane hardstandings would incorporate geogrid to strengthen the material and geotextile to prevent fines from migrating into the granular fill from beneath. The exact amounts would depend on the final designs, which would be adapted to suit local ground conditions as necessary.

Concrete and Steel Reinforcement

3.91 Each wind turbine foundation would require approximately 350m³ of concrete, which would amount to a total of 700m³. Each foundation would also require a quantity of plastic ducting, shuttering, and drainage materials. Copper earthing cables would be laid beneath a layer of binding cement under each foundation. Concrete for the Proposed Development would be obtained from a ready mixed concrete plant.

Electrical Materials

3.92 The wind turbines would be connected together with several electrical circuits. Each circuit would incorporate three high voltage cables, laid in trenches about 1m deep, with the circuits being connected to the new substation building. For protection, the cables would be laid on a bed of stone free previously dug material.

Wind Farm Decommissioning

Decommissioning Works

3.93 At the end of the Operational Period the wind farm would be decommissioned. This would involve the complete removal of the wind turbines, transformers, substation, switchgear and other equipment over a period of up to 6 months. The removal of the wind farm components would essentially be the reverse of the construction process.

Decommissioning Bond

3.94 The Applicant would provide a decommissioning bank guarantee or insurance bond to ensure that sufficient funds are available at any time during the lifetime of the wind farm to enable all decommissioning works to take place.

Dismantling of Turbines

3.95 The removal of the wind turbines at the end of the operating life of the wind farm would be the reverse of the erection process, involving similar cranes and procedures. The components would be removed off-site for them to be re-used elsewhere, dismantled and recycled or disposed of as appropriate.

3.96 Turbine components would be loaded directly onto vehicles for transportation to storage, recycling or disposal sites. It is possible that smaller vehicles may be used for component such as the blades, which may be split into smaller sections on-site.

Turbine Foundations

3.97 The decommissioning of the turbine foundations would involve removing the upper part of the reinforced concrete foundation. This could be achieved by

conventional construction equipment (excavator mounted pneumatic hammers etc.).

3.98 In order to achieve the removal of the upper section, which is up to 1.2m deep, a 600mm wide trench would need to be excavated around the approximately 4m diameter up-stand to facilitate access for removal of the concrete. All other parts of the foundation would remain in place and no other disturbance of the ground around the turbine would be required.

3.99 Once the upstand has been removed, the disturbed area would be reinstated by backfilling with site-derived materials to an agreed method statement, leaving the remaining portion of the foundation approximately 1.2m below ground level.

Crane Hardstandings

3.100 Crane hardstandings would be removed following dismantling of the wind turbines. Any crane outrigger pads would also be removed.

HV Cables

3.101 It is proposed to leave all HV cables in the ground on decommissioning of the wind farm. Where the cables run up through the foundation up-stand, they would be cut back to the top of the remaining concrete foundation.

Substation, Transformers and Grid Connection

3.102 The substation building would be removed in its entirety. Similarly, the ground floor slabs would be broken up and removed and the area would be reinstated to the original ground level. The transformers would be removed and the ground reinstated to the original ground level. All electrical cable would be cut back to below original ground level and rendered safe and nuisance free. The distribution connection would be the responsibility of the DNO and may be decommissioned or retained, depending on the configuration and the needs of the local distribution network at the time of decommissioning.

Site Tracks

3.103 The site tracks would be left in place for agricultural use or removed depending on the preference of the landowner or upon any condition attached to the permission.