2 Design Iteration

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2 Design Iteration

2.1 Executive Summary

2.1.1 This chapter describes the site identification and design iteration process which has been undertaken by the Applicant to determine both the location of the site and the design of the Proposed Development.

2.1.2 Throughout the process the Applicant has considered key environmental receptors and has aimed to remove and reduce environmental effects through design.

2.2 Introduction

2.2.1 The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 state that the EIA Report must include "*A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects*" (Schedule 4.2) (Scottish Government, 2017).

2.2.2 This chapter provides a description of the site selection process and design iterations that were undertaken prior to arriving at the final design of the Proposed Development, which is described in detail in Chapter 3 (Proposed Development).

2.3 Background and Needs Case Considerations

2.3.1 The Proposed Development is one of three under development by the Applicant under Orkney's Community Wind Farm Project. The aims of this project are threefold:

- to generate income to be used for the benefit of the people of Orkney;
- to aid towards a meaningful response to the Climate Emergency and the urgent need to further decarbonise; and
- to build the case for a new transmission connection for Orkney and unlocking wider benefits to the energy sector in Orkney.

2.3.2 In addressing these aims the scale of development is a critical issue. At present, Orkney is not served by a transmission grid connection and the distribution network is at capacity such that there has been a moratorium on new grid connections since 2012 and many operational wind energy projects are experiencing substantial constraint through an Active Network Management system. The lack of grid capacity has driven some innovation locally, but the overall impact has been to heavily impede development of the energy industry.

2.3.3 In September 2019 the electricity market regulator Ofgem published its final decision on the Needs Case for a transmission connection linking Orkney to the Scottish Mainland. It determined that there is a need for a cable. To justify the required spending on a new cable, there is a requirement for Scottish Hydro Electric Transmission (SHE-T) to demonstrate that there will be sufficient generation capacity to connect to the new cable, once operational. Ofgem agreed that in order to trigger a new 220 MW connection, 135 MW of new generation is required to have obtained planning permission, signed up to a grid connection agreement, and passed a financial audit before the end of 2021. Currently less than 40 MW of new wind has gained planning permission. Noting that there are a number of other private projects at different stages of development, it is clear that, without the Proposed Development and the other two wind farms within 'Orkney's Community Wind Farm Project', it is unlikely that the threshold will be met, and a new interconnector will not be built.

2.3.4 Furthermore, there is a need to increase the proportion of energy generated through renewable sources in order to meet the Orkney Sustainable Energy Strategy 2017 – 2025 which strives for 'a

secure, sustainable, low carbon economy'. The provision of a minimum power generation in order to trigger the new 220 MW connection will allow for greater flexibility to further develop renewable energy technologies within Orkney, including the world leading marine energy sector.

2.3.5 Developing all available sites with a realistic chance of contributing towards the Needs Case for a new cable to their realistic maximum capacity is viewed as the best way of ensuring that the aims outlined above are achieved.

Orkney Islands Council as a Developer of Onshore Wind Farms in Orkney

2.3.6 Orkney Islands Council (OIC) has therefore taken a number of choices leading to the decision to become a developer of onshore wind farms in Orkney:

- As early as September 2013 OIC endorsed the principle of the council itself establishing, developing or investing in an onshore wind farm project.
- At the OIC Policy and Resources committee meeting of 21st June 2016 OIC approved the principle of the council assuming the role of a project developer of onshore wind farm projects in Orkney.
- At the general meeting on 4th July 2017 OIC resolved that a process should be undertaken to identify property owners in Orkney with large sites able to accommodate scale wind generation who would wish to sell or lease land for the purpose of a wind development.
- At the OIC Policy and Resources committee meeting of 28th November 2017 it was recommended that OIC proceed to planning consent stage with development of a project on Hoy, at a maximum scale of approximately 108 MW.
- At the general meeting of the OIC of 5th March 2019 it was agreed that OIC should focus on developing all projects which have a realistic chance of contributing to the Needs Case for a new grid connection to Orkney, namely Hoy, Faray, and Quanterness.

2.3.7 In terms of delivering community benefit to the people of Orkney there are currently substantial challenges around funding service provision in the area which Orkney's Community Wind Farm Project may be able to address provided income from the Project is of the scale required.

2.3.8 In order to maximise the local benefit from the proposed 220 MW cable, it is also considered desirable to ensure that as much of the generation as possible is taken into local or public ownership, thereby ensuring that profits stay within Orkney.

2.4 Site Selection

Broad Site Identification and Selection

2.4.1 In response to the OIC decision to seek landowners with an interest in selling or renting land for wind farm development, an Expressions of Interest (EoI) process was undertaken in August and September 2017 requesting landowners to get in touch with OIC. A number of responses were received, and each was assessed against defined criteria and compared against other sites received, and sites within OIC ownership.

2.4.2 The outcome of this process was the decision to focus on development of a project of up to 108 MW on Hoy.

2.4.3 Initial baseline survey work at a potential large-scale site which would potentially deliver the entire 108 MW capacity was undertaken in 2018 however based on preliminary findings it was considered that a single development of that scale was unlikely to be achievable in Orkney. A process was therefore undertaken in late 2018 to assess the whole of Orkney for the potential for onshore wind farm development at a smaller scale, which could, in combination, provide the required capacity to support the Needs Case.

2.4.4 This was done by buffering address point data and plotting international designated sites on a map and identifying those areas which were of sufficient size to host a wind farm and were not constrained by either of those limitations. Each site was then investigated in further detail to identify any additional potential constraints. A short list of sites was drawn up and a full assessment of suitability was undertaken, the results of which were used to inform a report to OIC.

Hoy Specific Site Identification

2.4.5 The land on Hoy (refer to Figure 2.1) was identified as a potentially suitable development site, and further work was undertaken to establish feasibility of development and the potential scale and capacity of potential wind energy generation at the site.

2.4.6 The Hoy site was therefore considered alongside responses from the 2017 EoI process (refer to paragraph 2.4.1) and subsequent wider work was undertaken in 2018 to identify suitable sites for development.

2.4.7 In conjunction with the OIC decision on 5th March 2019, to focus on developing all projects which have a realistic chance of contributing to the Needs Case for a new grid connection to Orkney, Hoy was selected for progression towards an application for planning permission, alongside sites at Quanterness and Faray.

2.4.8 Numerous surveys were undertaken on-site which have contributed to the various design iterations presented below culminating in the design detailed in Chapter 3 (Proposed Development).

2.5 Opportunities and Constraints

Opportunities

2.5.1 The Proposed Development benefits from a number of opportunities as a wind farm site, including:

- status within planning policy (see below);
- excellent wind resource;
- good access;
- current land use (low quality rough grazing land);
- separation from residential properties;
- the ability to site infrastructure away from watercourses and private water supplies; and
- having an infrastructure footprint located outwith nationally and internationally important designations.

Planning Policy

2.5.2 There are no planning policies which, in principle, preclude wind energy development. The development footprint is partially located within an 'Area with Potential for Wind Farm Development' and partially within an 'Area of Significant Protection' as defined by the Spatial Strategy Framework for windfarm development (OIC, 2017). The 'Area of Significant Protection' relates to the Wild Land Area at the western extent of the development footprint and Class 1 Peat covering large parts of the site. The Supplementary Guidance includes explanation on the meaning of the above terms, as noted below.

2.5.3 'Areas with Potential for Wind Farm Development' represent *"the areas of least constraint to wind energy development. Wind energy development is likely to be supported in principle within these areas…"*

2.5.4 Wind farm developments within an 'Area of Significant Protection' *"may be supported when a proposal complies with the Development Criteria from Supplementary Guidance: Energy and where it can be demonstrated by the applicant that any significant effects on the qualities of these areas can be overcome by siting, design or other mitigation".*

2.5.5 The Proposed Development is **not** within any areas that have been defined within the Spatial Strategy Framework as *"Areas where wind farms are not acceptable"*.

Wind Resource

2.5.6 The Orkney Islands are one of the windiest places in the United Kingdom (Met Office, 2019). The average wind speed across the development footprint is c.8.5 m/s at 45 m elevation (DECC, undated). This is substantially above the UK average of 6.8 m/s (DECC, undated).

Access

2.5.7 The Proposed Development site has good transport links with direct access to a main road and a short transport distance to the port at Lyness.

2.5.8 The road network allows for the delivery of large components, ensuring that the turbines can be of a scale that makes the best use of the excellent wind resource.

Land Use

2.5.9 The site is currently used as low quality rough grazing land. The loss of land to the Proposed Development footprint would not impact upon the agricultural requirements of the landowner.

Separation from Residential Properties

2.5.10 There are **no** residential properties within the site boundary. The closest dwelling is Thurvoe c.950 m east of the nearest proposed turbine.

Separation from Watercourses and Private Water Supplies

2.5.11 Only a single watercourse crossing (Burn of Longigill) is required and there are no Private Water Supplies within 1 km of the Proposed Development.

Designations

2.5.12 Within the site boundary, there are **no** National Parks, National Scenic Areas (NSA), World Heritage Sites (WHS), Natura 2000 and Ramsar sites, Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR), Sites identified in the Inventory of Gardens and Design Landscapes, or Sites identified in the Inventory of Historic Battlefields.

Constraints

2.5.13 It is important to note that the identification of a constraint does not necessarily result in the exclusion of that area from the potential development envelope; rather it means that careful thought and attention was paid to the constraint and the design altered appropriately. The key constraints which were considered during the design process included:

- topography;
- landscape and visual;
- ornithology;
- ecology;
- noise;
- cultural heritage;
- geology, peat, hydrology and hydrogeology;
- shadow flicker; and
- telecommunications.

Topography

2.5.14 Turbines have been located so as to avoid the steepest areas of the site where practical to do so. Slope stability and peat slide risk has been considered throughout the site design process.

Landscape and Visual

2.5.15 The design of the wind farm layout is a vital part of the EIA process, as it is the stage where the biggest contribution can be made to mitigate potential effects. Due to the generally high visibility of wind farms, landscape and visual aspects are particularly important, and as such have played a key role in the design process.

2.5.16 The site is located on the southern margin of the Hoy Wild Land Area (41) (WLA) with five of the six turbines located outside the boundary. The Hoy and West Mainland National Scenic Area (NSA) is located c.5.2 km to the north.

2.5.17 The final turbine layout has been optimised to minimise landscape and visual effects as far as possible.

2.5.18 Further detail, and the full assessment of landscape and visual effects, are presented in Chapter 6.

Ornithology

2.5.19 Ornithology has had a major influence on the site design. In response to surveys that have been undertaken, the number of turbines has been reduced from 30 to 6. In addition, the turbine locations have been optimised as far as possible to minimise potential effects and ensure appropriate separation from any protected nest locations.

2.5.20 The full assessment of effects on ornithological receptors is presented in Chapter 7.

Ecology

2.5.21 An ecological desk study was undertaken to confirm the presence of any statutory and non-statutory nature conservation sites and legally protected species. Field surveys including a National Vegetation Classification (NVC) survey, an otter survey and fishery studies then took place.

2.5.22 The Important Ecological Features identified by the ecological assessment works include: Hoy SAC and SSSI; Hoy and North Walls SSSI; Moorland Fringes LNCS; blanket bog; dry dwarf shrub heath; wet heath; running water; mountain hare and fish. The presence, nature and (where applicable) distribution of these features has been taken into account in design iteration, with a view to minimising impacts on these receptors.

2.5.23 The full assessment of effects on ecological receptors is presented in Chapter 8.

Noise

2.5.24 During 2019 background noise monitoring was undertaken at noise sensitive receptors. These were selected and agreed with OIC Environmental Health Officer as being representative of the noise sensitive receptors located closest to the Proposed Development. Using the background noise measurements and noise characteristics of a suitable candidate turbine model, noise modelling was undertaken to allow consideration of noise impacts on local receptors, in the design iteration process.

2.5.25 Applying design criteria in respect of turbine locations and potential models ensures that no exceedances of acceptable noise levels (determined based on relevant policy and guidance) will occur for the Proposed Development.

2.5.26 Noise is assessed in Chapter 9.

Cultural Heritage

2.5.27 There are 163 non-designated heritage assets and two Category A Listed Buildings on-site, the majority of which date to military activity from the Second World War. The Proposed Development

has been designed to avoid direct impacts upon these assets where possible, and to minimise the effect on setting of these and other nearby heritage assets.

2.5.28 The full assessment of cultural heritage effects is presented in Chapter 10.

Geology, Peat, Hydrology and Hydrogeology

2.5.29 A 50 m buffer has been applied to surface watercourses, and no turbines or other infrastructure have been sited within that buffer apart from a single water crossing (the Burn of Longigill).

2.5.30 Site geology comprises Upper Old Red Sandstone sedimentary strata. This is overlain by peat across most of the site area, with depth varying from nil to locally over 3 m. In parts of the site, there is evidence of recent and older peat cutting, and other localised disturbance or excavation associated with historical wartime structures.

2.5.31 The site has been designed to avoid the areas of deepest peat and minimise peat slide risk where possible. In addition, a Habitat Management Plan (HMP) will look to utilise excavated peat to restore degraded areas of blanket bog in the local area. Further details are provided in Chapter 8 (Ecology).

2.5.32 An analysis of impacts on peat associated with the Proposed Development is presented in Chapter 11 (Geology, Hydrology, Hydrogeology and Peat) of the EIA Report and Appendices 11.1 and 11.2.

Shadow Flicker

2.5.33 The Update of UK Shadow Flicker Evidence Base (DECC, 2011) reviews international legislation relating to the assessment of shadow flicker for wind turbine development and concludes that the area within 130 degrees either side of north from the turbine, and out to 10 rotor diameters, is for a suitable study area for the assessment of shadow flicker effects, within which significant flicker may be experienced. The potential for flicker to impact local residential receptors has been considered in the design iteration process, and flicker effects have been assessed as non-significant.

2.5.34 Shadow Flicker is assessed in Chapter 15.

Telecommunications

2.5.35 Consultation with OFCOM and BT identified a number of telecommunication links in the vicinity of the Proposed Development. A suitable buffer distance was agreed with BT and adhered to during the design process.

2.5.36 Effects on telecommunications links are assessed in Chapter 16.

2.6 Design Principles

2.6.1 Taking into consideration the above constraints and opportunities, the following principles were adopted during the design iterations undertaken by the Applicant to ensure that the final design of the Proposed Development was the most suitable for the site:

- maximising wind yield and maintaining adequate spacing between turbines;
- avoiding designated and protected sites;
- positioning turbines to minimise impacts on ornithology;
- utilising existing tracks, where possible, in order to reduce the footprint of the Proposed Development;
- maximising the distance as far as possible from potential Groundwater Dependent Terrestrial Ecosystems (GWDTEs);
- avoiding positioning turbines in WLA as far as possible;
- avoiding inconsistent turbine spacing, such as relatively large gaps, outliers or excessive overlapping turbines to minimise visual confusion and ensure a balance / compact array from key views;

- positioning turbines outwith agreed telecommunication link buffers;
- maintaining a suitable separation distance from residential properties to minimise noise, flicker and visual amenity impacts;
- minimising impacts on cultural heritage assets;
- minimising the impacts from traffic and transport;
- maintaining a 50 m buffer from watercourses and keep watercourse crossings to a minimum (one water crossing only);
- avoiding areas of high flood risk; and
- avoiding areas of deepest peat and areas of elevated peat slide risk where possible.

2.7 Proposed Development Design Iterations

2.7.1 Following the selection of the site location (refer to Section 2.4 above) the Applicant has undertaken multiple design iterations of all aspects of the Proposed Development including the turbine layout and the infrastructure layout. This Section describes the principal design iterations that have been undertaken as the Applicant has sought to achieve a viable design that maximises the renewable electricity generation from the site, whilst minimising the environmental effects related to the constraints identified above.

Turbine Layout

Layout A (EIA Scoping)

2.7.2 The initial site layout which was submitted with the EIA Scoping Report (Appendix 4.1) consisted of up to 30 wind turbines of approximately 125 m to blade tip (Figure 2.2). This layout was based on preliminary high-level assessments.

Layout B

2.7.3 Feedback during the first season of ornithological surveys indicated that the southern half of the site (as defined at that time (Figure 2.2)) was less suitable than the north and that it would be necessary to reduce the number of turbines being proposed in order to avoid potentially unacceptable effects on ornithological receptors. Consequently, the site boundary was extended to the north, and the number of turbines was reduced from 30 to seven (Figure 2.3). At the same time, it was identified that the scale of turbines (tip height and rotor diameter) for the majority of wind energy projects being proposed and progressed in the UK was increasing. Turbine models limited to 125 m tip height were becoming rarer, as larger turbines were being proposed to optimise generation and ensure financial viability of developments following changes to government support mechanisms for onshore wind. The Applicant recognised that, by the time the Proposed Development would be ready for construction, it may be difficult to obtain 125 m turbines and the availability of turbine models could be highly restrictive. In addition, with the changes to government support mechanisms and the additional costs associated with developing in a remote location, it was essential to maximise the generation capacity. Consideration was therefore given to an increased tip height, of up to 149.9 m, remaining below the threshold requiring aviation lighting, but providing greater flexibility in turbine choice, and greater renewable energy generation potential.

2.7.4 Whilst the primary driver from Layout A to Layout B was ornithology, the change brought the following additional benefits:

- Consultation on Layout A had identified eight turbines that had been in close proximity to telecommunication links. All eight of these turbines were removed for Layout B;
- Five turbines in Layout A were within 50 m of watercourses. All five of these turbines were removed for Layout B;

- Two turbines in Layout A were located within basic flushes (sensitive habitat identified during field surveys). All of the Layout B turbines were outwith the basic flushes; and
- The number of turbines located within the WLA was reduced from 12 to three.

Layout C (Application)

2.7.5 A number of alternative seven turbine layouts were considered that represented improvements to Layout B. However, ultimately it was decided based on the analysis of the extensive bird survey data, that a further reduction in turbine numbers would help to further reduce impacts on ornithological receptors. Therefore, the layout was optimised based on six 149.9 m turbines (Figure 2.4).

2.7.6 The turbines were positioned to ensure suitable separation distances are maintained from protected nests and to minimise collision risks. Details relating to protected species are provided in Confidential Appendix 7.2.

2.7.7 The application layout was designed to ensure that it appears as a compact and well-contained feature in surrounding views, with care taken to avoid any turbines appearing as outliers. The number of turbines within the WLA was reduced as far as possible, within the confines of other constraints (from 12 in Layout A, down to one in Layout C).

2.7.8 Care was taken to ensure the application layout respected the agreed telecommunication buffers.

2.7.9 The turbines were positioned with due consideration of the two A Listed Buildings and the various non-designated world war assets on-site.

2.7.10 The locations where deepest peat was recorded were avoided wherever possible, within the confines of other constraints noted above. It was not however, possible to entirely avoid areas of deep peat (>1 m depth) given its distribution across the site and the presence of numerous other constraints. However, siting of turbines on deep peat has been avoided or minimised as far as practically possible, and peat slide risk has been minimised.

Infrastructure Layout

2.7.11 Following confirmation of the turbine locations the design of the accompanying infrastructure was considered. This included access tracks, hardstandings, substation compound and building, temporary construction compound, met mast and the borrow pit search area.

2.7.12 The design was carried out to balance cut and fill where practical. This minimises the requirement for both imported material and on-site borrow.

2.7.13 Numerous adjustments were considered, and various iterations of hardstanding orientations were assessed before the infrastructure layout was finalised. This iterative design process allowed the effects of different wind farm layouts to be assessed then modified to prevent, reduce or offset effects.

2.7.14 Principal adjustments included, inter alia:

- Adjustments around T1 and T2 to maintain suitable separation from the A-Listed underground tanks and taking into account factors such as contours, cut and fill balance, peat depth and peat slide risk;
- Minor adjustments to the placement and orientation of the infrastructure around T4 to minimise the interaction with the 50 m watercourse buffer and to avoid the deepest peat;
- The substation building and compound were relocated from their earlier location (in close proximity to the OS viewpoint), to its final and less prominent location to the north of T1;
- The orientation of the temporary construction compound was adjusted to avoid directly impacting on a visible component of non-designated WWII heritage remains; and

- The borrow pit search area was moved further west from its initially proposed position, to ensure it would not impact on key views from the A-Listed Naval Headquarters and Communication Centre.

Conclusion

2.7.15 The turbine and infrastructure layout illustrated in Figure 1.2 has been taken forward as the design for the Proposed Development within this EIA Report. Further micro-siting and detailed design work may be required following the detailed ground investigations which will take place post-consent. In this regard, there will be a micro-siting allowance of up to 50 m in all directions[1] in respect of each turbine and its associated infrastructure in order to address any potential localised difficulties which may arise in the event that pre-construction surveys identify unsuitable ground conditions or environmental constraints that could be avoided. The assessments within this EIA report have included the considerations of this 50 m micro-siting and it does not alter the conclusions formed as to likely effects.

2.8 Do-Nothing Scenario

2.8.1 Should the Proposed Development as described in Chapter 3 (Proposed Development) not be consented (the "do-nothing scenario"), it is anticipated that the Proposed Development site will not alter from the current baseline described above and in Chapters 6-16.

2.9 Summary

2.9.1 The initial site layout consisted of up to 30 wind turbines of approximately 125 m to blade tip (Figure 2.2). This layout was based on preliminary high-level assessments.

2.9.2 The final layout has been informed by a robust environmental assessment and design iteration process, taking into account physical constraints, potential environmental, landscape and visual impacts and their effects. The information used to inform the design iteration process included consultation responses received, baseline data and the impact assessment undertaken.

2.9.3 The final layout comprises six turbines of up to 149.9 m tip height, and their associated infrastructure, as shown in Figure 1.2.

2.9.4 The Proposed Development layout is considered to represent the most appropriate design, taking into account potential environmental impacts and physical constraints, while maximising the renewable energy generating capability of the site.

2.10 References

DECC (undated), Windspeed Database, https://webarchive.nationalarchives.gov.uk/20121217154048/http://www.decc.gov.uk/en/content/cms/meeting_energy/wind/onshore/deploy_data/windsp_databas/windsp_databas.aspx

Met Officer (2019). *Windiest Parts of the UK*. Available at: https://www.metoffice.gov.uk/weather/learn-about/weather/types-of-weather/wind/windiest-place-in-uk

Orkney Islands Council (2017). *Local Development Plan – Supplementary Guidance: Energy*. Available at: https://www.orkney.gov.uk/Files/Planning/Development-and-Marine-Planning/Adopted_PPA_and_SG/Guidance_for_the_Plan/Energy_Supplementary_Guidance.pdf

[1] Should micro-siting be required, the turbine locations will not be moved within the accepted telecommunications buffer (75 m clearance from the blade tip) unless otherwise agreed with BT. In addition, the separation distance from the closest turbine to the closest residential property (Thurvoe) will not be reduced.

Scottish Government (2014). *Scottish Planning Policy*. Available at: https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2014/06/scottish-planning-policy/documents/00453827-pdf/00453827-pdf/govscot%3Adocument/00453827.pdf