Contents

6 Site Selection and Alternatives

6.1 Introduction

1 This chapter provides details of the alternatives considered for the Project and the selection of the Development Area and the Offshore Export Cable Corridor (see *Section 1.3*). Information in this chapter meets the requirements of Schedule 4 of *The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000* and Schedule 3 of *The Marine Works (Environmental Impact Assessment) Regulations 2007* as described in *Section 3.4.2*. These regulations require that the applicant includes:

> *"the main alternatives studies by the applicant and the main reasons for his choice, taking into account the environmental effects"* (Paragraph 4 of Schedule 4 Part II, *The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000*); and

> *"An outline of the main alternatives studied by the applicant and an indication of the main reasons for the applicant's choice, taking into account the environmental effects of those alternatives and the project as proposed"* (Paragraph 6 Schedule 3, *The Marine Works (Environmental Impact Assessment) Regulations 2007*).

2 A more detailed description of the Project follows in *Chapter 7: Description of Development*.

3 This chapter draws on the findings of *Blue Seas - Green Energy: A Sectoral Marine Plan for Offshore Wind Energy in Scottish Territorial Waters: Part A The Plan* (Marine Scotland, 2011) and is supported by two appendices:

- *Appendix 6A: Export Cable Feasibility Study*; and
- *Appendix 6B: Landfall Feasibility Study*.

6.2 Site Selection

6.2.1 Identification of Inch Cape

4 In 2008, by request of the Scottish Government, The Crown Estate (TCE) invited potential developers to submit proposals for offshore wind farm sites within Scottish Territorial Waters (STW).

5 A broad study of wind resource and water depth data was undertaken to identify a suitable region for offshore wind farm development in STW. This study identified the most suitable physical characteristics existed off the east coast of Scotland. Analysis of other marine users and environmental parameters was used to narrow down the search area to the outer Firths of Forth and Tay.

6 A more detailed analysis of environmental and technical constraints was then undertaken for the outer Firths of Forth and Tay to identify and assess viable sites for a wind farm development. From this analysis, the Inch Cape Development Area was identified as being

the preferred location for development and thus a proposal was made to TCE for this site. Factors considered in this analysis were;

- Potential energy yield;
- Foundation type suitability;
- Seabed and tidal conditions;
- Nature Conservation Designations;
- Marine Ecology;
- Marine Mammals;
- Ornithology;
- Fish Resources and Commercial Fisheries;
- Shipping and Navigation;
- Other marine users;
- Grid connection; and
- Visual amenity.

7 The distance from shore was considered particularly important as initial discussions with local stakeholders (e.g. fisheries and nature conservation bodies) highlighted potential conflicts in inshore coastal locations and potential increased impacts on other human environmental receptors (e.g. visual/seascape issues, tourism and recreation).

8 The key factors which led to the of the Development Area being the preferred site for the Wind Farm, which were set out in the proposal to TCE, are:

- it has an excellent wind resource with the mean wind speed at 90 m then estimated at 9.51 m/s;
- at the closest point, the Development Area is approximately 15 km from the shore which will help minimise its visibility and potential conflicts with inshore uses;
- water depths and ground conditions are suitable for a variety of foundation types;
- there is already electrical infrastructure near the coastline to enable an efficient connection to the national grid;
- there is good access to suitable ports and local supply chain for construction and operations. There are also nearby facilities for fabrication, assembly and maintenance support. The distance to these facilities will be important during operation as they will enable shorter response times for servicing thus improving operational availability and economic feasibility of the Inch Cape Offshore Wind Farm;
- there are no known Annex I habitats in the Development Area and it falls outside any designated conservation area; and
- there are no known active oil, gas or aggregate interests in the Development Area.

9 The proposal was submitted to TCE for their evaluation and in June 2011 TCE awarded an exclusivity agreement for the Development Area, following publication of *Blue Seas - Green Energy: A Sectoral Marine Plan for Offshore Wind Energy in Scottish Territorial Waters: Part A The Plan* (Marine Scotland, 2011).

6.3 Design Alternatives and Decision Making Process

6.3.1 Design Criteria

10 As part of the engineering development process the criteria listed below are central to the selection of design concepts and detailed design:

- **Health and safety:** the inherent safety by design through construction, operation, maintenance and decommissioning.
- **Technical:** the technical suitability of the available alternatives, given the site conditions.
- **Environmental:** the potential for avoiding environmental impact.
- **Project economics:** whole life cost considerations and effect on revenue.
- **Programme:** the impact to delivery of the Project programme.
- **Wind farm performance:** the output and efficiency of the Wind Farm.
- **Technology maturity:** the benefits and risks associated with adopting newer technology over proven technology.

11 The following sections discuss the evaluation and development of alternatives and decisions made based on these criteria. This led to the Design Envelope used in this ES (see *Section 7.4*).

6.3.2 Wind Turbine Generators

12 There are various Wind Turbine Generators (WTGs) currently commercially available or under development. The range of WTGs considered is defined as part of the description of development in Table 7.3. WTGs smaller than those specified in the Design Envelope (see *Section 4.4.1* and *Chapter 7*) have been discounted as Inch Cape Offshore Limited (ICOL) considers these to be uneconomic for a development of this type. Larger WTGs than those specified in the Design Envelope have been excluded as ICOL does not consider that they will be commercially available.

6.3.3 WTG Layouts

13 The final layout design of the Wind Farm will be dependent on the WTG selection and environmental, technical and economic constraints. The final WTG and Offshore Substation Platform (OSP) locations will be decided at a later stage in the design process (see *Section 7.4*).

14 Initial analysis indicated that up to 286 WTGs could be located within the Development Area however the maximum number of WTGs has been reduced to 213 after consideration of

environmental, technical and economic factors. The minimum down-wind and cross-wind spacing between WTGs is 820 m. This distance could increase depending on the requirements of different WTG models. Spacing will be finalised through layout optimisation, considering the wind resource and WTG performance characteristics, to ensure that the yield is economically maximised.

6.3.4 Foundations and Substructures

15 The substructures and foundations connect and secure the WTGs to the seabed. There are a range of substructure and foundation types that can be used for offshore wind developments.

16 Various novel and proven foundation and substructure alternatives were assessed using the criteria outlined in *Section 6.3.1* for both WTGs and OSPs.

17 The following foundation and substructures types were eliminated following evaluation:

- Monopiles: water depth and WTG size make monopiles technically unsuitable. This includes guyed monopiles which have additional navigational hazards; and
- Floating foundation/substructure: due to water depth and because the technology is not yet sufficiently advanced or proven.

18 The following foundation types are considered to be feasible for the Project in whole or in part (see *Section 7.6*):

- Pin-piled foundations (including driven, drilled and other variations) (see *Section 7.6.3*);
- Suction Piles (see *Section 7.6.3*); and
- Gravity Base (see *Section 7.6.5*).

19 The following substructure types are considered to be feasible for the Project in whole or in part (see *Section 7.6*):

- Steel-framed (including jackets and other variations) (see *Section 7.6.3*); and
- Gravity Base Structures (see *Section 7.6.5*).

20 The foundation and substructure types which are still in consideration are detailed in the Design Envelope. The type which represents the worst case, for each receptor, has been used in the assessments.

6.3.5 Transmission Works

Grid Connection Agreement

21 The onshore grid connection was offered by National Gird Electricity Transmission (NGET) and accepted by ICOL in January 2012. NGET has a statutory duty, as a transmission licence holder, under Section 9(2)(a) of the *Electricity Act 1989* "*to develop and maintain an efficient, co-ordinated and economical system of electricity transmission*". Consideration of

possible connection points included assessment of environmental, technical and economic constraints, grid capacity and proposed connection date. The following grid connection locations were considered by NGET for the Project: Arbroath, Tealing, Branxton, Torness, Cockenzie, Crystal Rig, Blyth (via land), Blyth (via sea) and Hawthorn Pit. Following engagement between ICOL and NGET, a grid connection point was agreed at Cockenzie, East Lothian. This connection was primarily chosen due to its ability to accommodate the capacity of the Wind Farm without the need for significant enhancement works by NGET. It could also be delivered to ensure the electricity generated by the Wind Farm could be transmitted in accordance with the current Project programme.

22 The proposed grid connection location informed the selection of the Offshore Export Cable Corridor and landfall options.

Offshore Export Cable Corridor

23 Various Offshore Export Cable Corridor alternatives were considered in parallel with the assessment of landfall locations, taking account of the potential grid connection location and using constraints mapping and technical analysis techniques to identify potential corridors for the connection. The starting point of the corridors was assumed to be located on the boundary of the Development Area with the end point at the connection at Cockenzie (see Figure 7.1).

24 A report detailing the Offshore Export Cable Corridor assessment process and conclusions is included in *Appendix 6A*.

25 When assessing potential offshore export cable corridors, the objective is to minimise the route from the offshore substation to the landfall site, taking account of engineering, physical and environmental constraints, as well as potential conflicts with third parties. The corridor also needs to be determined considering the need for safe installation and the long term integrity of the cables. Regard must also be given to the location of the grid connection and the likely onshore cabling routes as it may be preferable to increase the offshore route length to decrease the onshore route length, depending on onshore routing constraints which can be complex due to environmental, technical or commercial land factors.

26 When choosing a corridor, the following factors need to be considered and weighed up against each other:

- Cable stability;
- Cable protection;
- Cable separation requirements;
- Ability to utilise existing cable lay construction methods;
- Minimisation of seabed pre-lay intervention requirements;
- Minimisation of seabed and cable post-lay intervention requirements;
- Minimisation of the number of cable and pipeline crossings;

- Minimisation of the environmental impact; and
- Minimisation of interference of all types.

27 When assessing the Offshore Export Cable Corridor options, routing through environmentally sensitive areas was avoided where possible. Seabed zones which are exploited by human activities may increase the risk to other users of the sea and to the cable and were also avoided where possible. Minimising the route length that interacts with known fishing grounds is an important consideration due to the mutual risk that may arise through any interaction.

28 To minimise the complexity of cable installation at a landfall, the angle of the cable at shore approach is chosen having regard to the following objectives:

- Minimisation of the shore pull length across the landing area to minimise the maximum pull load on the cable;
- Minimisation of the distance between the cable landing point and a water depth that would allow suitable vessels to come as close as possible to shore and minimise the length of near-shore trenching required;
- Maximisation of the distance from the coast to the first turn in the cable to simplify marine operations near-shore; and
- Where possible, locating the cable parallel to near-shore wave effects to ease installation and minimise the loads on any exposed part of the cable.

29 Seven routes to shore were analysed and are considered feasible (see *Appendix 6A*). A route to Cockenzie or Seton Sands is considered the most suitable when considering all relevant criteria including cost and the distance from landfall to the onshore grid connection point; these are both included in the Offshore Export Cable Corridor.

<u>Landfall</u>

30 Initial landfall locations were identified using technical and environmental constraints mapping along the East Lothian coast. Based on this assessment, six initial landfall locations were identified (see *Appendix 6B*):

- Cockenzie (west of the power station);
- Prestonpans;
- Seton Sands;
- Gullane;
- Thorntonloch; and
- Pease Bay.

31 These six landfall options were assessed and all were considered feasible on environmental grounds with suitable mitigation measures implemented. Gullane, Thorntonloch and Pease Bay were not considered viable on commercial and engineering grounds (primarily due to

potential onshore cable corridor length and associated constraints). Prestonpans was not considered viable due to lack of available onshore land. The landfall options at Cockenzie and Seton Sands were found to be the preferred landfall locations when considering all factors. Further detail of the landfall appraisal process is included in *Appendix 6B*.

32 This Environmental Statement therefore considers two landfall options; Cockenzie and Seton Sands. A decision on the final location of the landfall will be made once further work has been undertaken to determine the most appropriate location for the onshore infrastructure taking account of environmental, technical and commercial considerations (see *Section 1.3.5*).

6.4 Alternatives to Offshore Wind

6.4.1 The 'No Development' Scenario

33 A 'no development' scenario has been considered. Government policies regarding renewable energy development and climate change reduction, as detailed in *Chapter 2: Policy and Legal Background*, emphasise that:

> *"Securing renewable sources of energy is a key pillar of the UK Government's strategy for a diverse, low carbon energy system alongside nuclear, cleaner coal and gas, and energy efficiency. However, as a relatively new, emerging set of technologies, renewables tend to be more expensive than existing fossil fuel generation. Doing nothing is not necessarily the least cost option given the potential price rises of fossil fuels in the future and the potential impacts on security of supply."* (Extract from the *UK Renewable Energy Roadmap,* Department of Energy and Climate Change, 2011).

34 The development of offshore wind energy is in line with European, United Kingdom and Scottish Government policy. Energy generated from the Inch Cape Offshore Wind Farm could make a significant contribution to the Scottish Government's renewable energy target (see *Chapter 8: Benefits of the Project*). In the 'do nothing' scenario this contribution would have to be provided through other appropriate developments within the same timescale.

References

Department of Energy and Climate Change (2011). *UK Renewable Energy Roadmap*. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48128/2167-uk-renewable-energy-roadmap.pdf [Accessed November 2012].

Great Britain Parliament (1989). *Electricity Act 1989. Available at:* http://www.legislation.gov.uk/ukpga/1989/29/contents

Great Britain Parliament (2007). *The Marine Works (Environmental Impact Assessment) Regulations 2007*. Available at: http://www.legislation.gov.uk/uksi/2007/1518/contents/made

Marine Scotland (2011). *Blue Seas - Green Energy: A Sectoral Marine Plan for Offshore Wind Energy in Scottish Territorial Waters: Part A The Plan*. Available at: http://www.scotland.gov.uk/Resource/Doc/346375/0115264.pdf

Scottish Parliament (2000). *The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000*. Available at: http://www.legislation.gov.uk/ssi/2000/320/contents/made