Non Technical Summary

Introduction

EDF Energy (Northern Offshore Wind) Ltd (NOWL) is part of EDF Group, one of the world's largest energy companies and a leader in renewable generation. World wide, EDF Group has a hydro generation capacity of over 25,000MW and manages 3,500 wind turbines. EDF Group runs a 240MW tidal power plant in western France and is also involved in projects using geothermal and biomass sources of energy, as well as promoting the development of photovoltaic technologies. NOWL is a subsidiary of EDF Energy, one of the UK's major energy companies, which operates a range of power stations and wind farms in the UK.

This Non-Technical Summary forms part of the Environmental Statement (ES) to accompany an application by NOWL for the consents necessary to construct and operate a 30 turbine wind farm at Redcar, Teesside. The proposed site was allocated under Round 1 of offshore licensing which, when consents are in place, provides a Crown Estate Lease for a period of 22 years to allow for wind farm construction and decommissioning phases, separated by a period of 20 years for electricity generation. The wind farm will produce up to 100MW (megawatts) of clean, green, pollution free electricity equivalent to the typical domestic demand of approximately 70,000 homes. The Environmental Statement reports the findings of the Environmental Impact Assessment undertaken by Entec on behalf of NOWL.

Background

Renewable energy production has increased in response to growing concern about the rise in atmospheric levels of carbon dioxide (CO_2) and other greenhouse gases and their effect on global climate change. Burning fossil fuels (coal, oil and gas) is a major contributor to greenhouse gas emissions, and reducing their use and increasing the proportion of power generated from renewable energy sources is seen as a vital part of reducing these emissions.

The development of offshore wind farms will enable the UK to achieve a number of targets and policy goals relating to reducing greenhouse gas emissions, renewable energy, efficiency, and security and diversity of energy supply. The key policies and targets in the UK include:

- The Renewables Obligation scheme, whereby the Government has set a target of generating 10% of UK electricity energy demand from renewable sources by 2010.
- At the Kyoto Summit, the UK committed to reducing greenhouse gas emissions by 12.5% below 1990 levels by 2008-2012. The Government set

a target beyond that commitment of reducing UK carbon dioxide emissions by 20% below 1990 levels by 2010.

- An ambition in the 2003 Energy White Paper to generate 20% of electricity from renewable sources by 2020 and to reduce current levels of carbon dioxide emissions by 60%, by about 2050.

- Renewable generation will increase energy diversity and security of supply and reduce reliance on imported fuel, with the UK expected to be a net importer of gas by 2006 and oil by 2010.

The Teesside Offshore Wind Farm will contribute towards Government targets by offsetting the annual release of approximately 260,000 tonnes of carbon dioxide, the main greenhouse gas.

Regulatory Consents

Teesside Offshore Wind Farm lies within UK territorial waters, with the elements above mean low water within the jurisdiction of Redcar and Cleveland Borough Council. The offshore wind farm consents process is led by the Department of Trade and Industry's (DTI) Offshore Renewables Consents Unit (ORCU). NOWL is applying for the following consents and licences:

- Consent under Section 36 of the Electricity Act 1989 for the electricity generating facility;

- Consent under Section 34 of the Coastal Protection Act 1949 for construction under or over coastal terrain below Mean High Water Spring (MHWS) tide mark;

- A licence under Section 5 of the Food & Environmental Protection Act (FEPA) 1985 for the placement and deposit of construction materials in the sea below MHWS;

- A PD Teesport Works Licence to construct on under or over tidal waters and tidal lands below the level of high water in the harbour; and

- Planning permission under Section 57 of the Town & Country Planning Act 1990 for the onshore underground electricity cables and the sub-station.

The Environmental Impact Assessment

Environmental Impact Assessment (EIA) is a process by which information about the environmental effects of a project is collected, evaluated, and if consented, details how the project is to be built, operated and decommissioned. The developer presents information on the project and its environmental effects in an Environmental Statement.

Under EC Council Directive No. 85/337/EEC on the Assessment of effects of certain public and private projects on the environment (the EIA Directive), as amended by EC Council Directive No. 97/11/EC, EIA is required for various types of development, which are defined in Annexes to the Directives. An offshore wind farm development is covered in Annex II of the EIA Directive (97/11/EC) as 'installations for the harnessing

of wind power for energy production (wind farms)' and these provisions have been incorporated into UK legislation.

Offshore Electricity generation projects in England requiring Section 36 consent under the Electricity Act (i.e. those with output exceeding 1MW) fall within the remit of the Electricity Works (Environmental Impact Assessment) (England and Wales) Regulations. Thus the proposals are subject to EIA.

Scoping and Consultation

A formal scoping opinion was sought from the DTI in order to ensure that the ES contained all the information required for them to evaluate the environmental effects of the proposed development

Extensive public consultation was carried out and included two public exhibitions in Redcar and Hartlepool in July 2003 and public meetings in Redcar and Hartlepool in late August 2003. Over 150 people attended the Redcar exhibitions and over 40 attended the Hartlepool exhibitions. The exhibitions were held as open forums to inform the public of proposals and seek feedback on key issues of concern, whereas public meetings were held as formal chaired events to give a further opportunity to raise concerns. Feedback received from local people at the exhibitions was largely positive with the main issues raised being potential visual impact and noise, marine recreation and navigation, wildlife particularly ornithology and impacts on fishing activities. A number of exhibition attendees requested a visit to see a wind farm and NOWL organised a trip to High Hedley onshore wind farm as well as to Blyth to view the offshore wind farm, with 92 people attending these visits.

Separate consultations have been held with special interest groups in particular the fishing community. Several meetings have been held with fishermen and an ongoing fisheries liaison group has been established, and it is expected that this group will continue to meet throughout the project life cycle. Presentations to and meetings with the local bird club have also taken place.

Description of the Proposed Development

The Wind Farm Site

The site for the proposed offshore wind farm development is located approximately 1.5km offshore from Coatham Sands, Redcar and Cleveland (Figure 1.1) between the mouth of the River Tees and the town of Redcar, off the coast of Teesside. The seabed where the wind turbines will be located is in UK territorial waters owned and administered by the Crown Estate. The site is also located in the Tees Port Authority area under the jurisdiction of PD Teesport Port.

The mouth of the Tees has extensive areas of open water, mud flat, salt marsh and meadow starkly contrasting with extensive areas of industry including power stations, steel works and refineries. Teesport is the second busiest port in the UK with large vessels usually visible in the bay. The Corus Steel Works are prominent in the coastal zone between Warrenby and South Gare. Cleveland Golf Course and Coatham sandbanks separate Warrenby from the beach. There are also two caravan sites west

of Coatham on areas of coastal grassland. There are industrial properties on Tod Point Road including scrap yards and engineering workshops. There is also a dismantled railway, which runs parallel to Tod Point Road. To the south east of Coatham are the towns of Redcar and Marske-by-the-Sea both having large areas of sandy beaches combined with rugged rocks or scars. Inland to the south the ground rises towards the villages of Kirkleatham, Yearby and then to the steep hilly landscape of Eston Moor, Guisborough and the Cleveland Hills. The industrial town of Billingham lies to the west of the site.

There are several statutorily designated sites, which lie within 3km of the proposed development. South Gare and Coatham Sands SSSI is of interest for its flora, invertebrates and birds. It comprises a range of habitats, including intertidal mud and sand, sand dunes, saltmarsh and freshwater marsh, rocky foreshore and slag banks.

Seaton Dunes and Common SSSI and Seal Sands SSSI lie on the opposite side of the Tees estuary and Redcar Rocks SSSI is located 2.5km from the proposed onshore substation associated with the development. The Teesmouth and Cleveland Coast Special Protection Area (SPA) designated under the Birds Directive is an internationally important site for breeding, passage and wintering waterfowl. The Teesmouth and Cleveland Coast Ramsar site (designated under the 1971 Ramsar Convention) is coincident with the boundary of the SPA.

There is also one non- statutorily designated site known as Coatham Marsh Nature Reserve and Site of Nature Conservation Interest (SNCI). It is a freshwater marsh, which is surrounded by grazed meadows, man-made mounds with areas of grassland and two freshwater lakes.

The Proposed Wind Farm

The Crown Estate lease area occupies a trapezoidal box of 10km^2 plan area of seabed. Within this area NOWL plans to install 30 turbines (3 rows each containing 10 turbines) rated each at between 2.3 to 3.6MW. These turbines will be installed in a pre-determined configuration optimised to prevailing winds and with sufficient separation to minimise wind-wake effects. The spacing between rows is of the order of 600m, and the spacing between adjacent turbines within each row is approximately 300m. The general turbine layout is presented in Figure 8.1.

In addition, three underground cables, laid together in a single trench, will link the turbines to an onshore substation in Warrenby, which will also house the wind farm control room. The cable comes ashore within the sand dunes of South Gare and Coatham Sands SSSI, crosses an area of industrial slag, which supports a sparse vegetation, and then follows the road and the disused mineral railway to the proposed substation on Tod Point Road.

The wind farm will be connected into the local Northern Electric Distribution (NEDL) electrical infrastructure and connect at their Lackenby substation. It is expected that the grid connection from the NOWL Warrenby sub-station to the NEDL connection point at Lackenby will be via underground cables. This cable route will be subject to a separate consenting process and is therefore not assessed in this ES. The wind farm will be maintained from crew vessels operating out of the Port of Tees.

Two turbine foundations are under consideration, monopile and tripod, though monopile foundations are the preferred option. A monopile foundation consists of a steel pipe of up to 5.5m diameter which is driven or drilled (or a combination of the two) into the seabed to a depth of approximately 32m. A tripod foundation consists of three steel piles of 1.7m diameter driven or drilled (or a combination of the two) into the seabed to a maximum depth of 32 m.

A transition piece forms the supporting structure between the foundation and the cylindrical turbine towers and also houses the access ladders and cable entry points. The turbine tower is fixed to the transition piece and this in turn carries the nacelle (which houses the gearbox and generator) and the rotor hub. The rotor blades (usually made of fibreglass-reinforced polyester) attach to the rotor hub.

Turbines have been considered for the purposes of EIA, which comprise a range of parameters including power output, noise and height. The turbines considered would be expected to utilise towers varying from 70 to 80m to hub height and rotor diameters of between 80 to104m, giving a range of tip heights of 110 to 132m. For the purposes of the EIA, the maximum tip height of 130m has been used for visual assessment.

Access to the turbines will be via the Port of Tees, and access to the onshore substation site will be via Tod Point Road in Redcar. Components associated with the turbines and offshore cabling will be brought in by sea, with only construction materials and equipment for the substation and onshore cabling requiring road access.

The Site Selection and Design Process

In order to select an offshore wind farm site numerous issues are taken into account including wind resource, tidal and wave conditions, environment and wildlife, visual amenity, seabed geology, consents & planning, available electrical grid connection and proximity to a port to support construction and operational activity. The Redcar site is considered to offer the best opportunity for the placement of a wind farm in the waters off the north east coastline.

The proposed Teesside offshore wind farm layout has evolved from that originally anticipated in response to a number of constraints and as a result of consultation feedback on the initial plans. These include PD Teesport requesting that some turbines nearest to the entry channel to the River Tees be re-positioned further south to provide a movement area for ships who missed the entry to the dredged channel. The turbines nearest to South Gare re-positioned to maintain the minimum recommended distance of 800m to avoid disturbance to birds and turbines rows moved to avoid interference with PD Teesport navigation sector marking lights.

Construction

The turbines, towers and foundations will be delivered by boat to the Port of Tees for storage and pre-assembly to avoid road traffic problems in the area. The foundations to support the turbine towers will be installed by a jack-up barge or jack up vessel. Scour protection, most probably in the form of rock armouring or mattressing will be placed around the foundations once the transition section is in place.

The transition section , tower, nacelle and rotor are installed onto the foundation using either a jack-up barge with lifting crane and a component delivery barge or a purpose built offshore windfarm vessel, such as the Mayflower Resolution. The Mayflower can carry multiple turbine towers and blades to minimise loading time in port. It has six legs to provide a stable working platform and a heavy lift crane.

Interconnecting 33kV subsea electrical cables are laid between each of the turbine rows. These cables will be installed by specialist cable laying surface vessels or remotely operated subsea vehicles, or a combination of both. Cables will be laid below the seabed and enter each turbine via a steel "J" shaped tube.

Three 33kV subsea cable circuits will be laid from the wind farm towards the beach by a specialist cable-laying vessel. Several techniques are available for preparing the seabed including a trenching machine, or specialist cable plough. A cable plough consists of a blade at the front of the device, which cuts through the seabed or beach and lays the cable behind. The trench created by the plough is refilled by blades located at the rear of the device.

The Cable laying vessel will approach the beach and the cable will be pulled, by winch, from the vessel onto the beach to a joining pit and be temporarily terminated. Winching may be achieved by a winch located on the beach or on the vessel.

The onshore works will consist of cables from the beach joining pit to the sub-station at Warrenby. Cables will be installed under the sand dunes and slag by means of sub-surface directional drilling. Once at the private South Gare access road, behind the Corus steel plant, they will continue underground to the proposed onshore electrical sub-station at Warrenby, via the dismantled railway line.

The substation will comprise a hard standing area containing the main equipment (isolators, circuit breakers, transformers), and a two storey building approximately the size of a house. The sub-station will house transformers to increase the voltage from 33kV to 66kV and a control building. All of the substation structures will be located within a fenced compound of approximately dimension 67 m by 55 m, with an access road off Tod Point Road.

Operation

Wind turbines start to generate electricity at a windspeed of approximately 3.5m/s, their output increasing up to their maximum rated power at a windspeed of approximately 14m/s. As the wind speed increases further, the output is limited to the maximum until the wind speed reaches 25m/s when the wind turbine automatically shuts down.

A single planned maintenance visit is expected annually and will cover items such as visual inspection of all major turbine components including blades, towers, gearbox, bearings and lifting systems. Gearbox oil changes will be based on condition monitoring with maintenance carried out by service staff transported to the turbines by boat from Tees Port.

Decommissioning

Removal of the wind farm is expected following the completion of the 22 year Crown Estate Lease period allowed for construction, operation and decommissioning. The

extent of decommissioning of the wind farm will be subject to discussions between NOWL and The Crown Estate, landowner of the seabed in UK territorial waters. The Crown Estate Lease requires that the site is reinstated and that the developer "remove the Works and Supply Cables…and restores the site…to a safe and proper condition…".

Therefore, following expiry of the Lease the site will revert back to its original condition, although retention of rock armour around the turbine bases may be considered beneficial for marine life. Disposal of the components of the wind farm will be in accordance with the appropriate regulations at the time. However, where possible, items will be re-used or recycled into further developments.

Environmental Effects

The following sections provide a brief summary of the main findings of the EIA as set out in the technical sections within the full Environmental Statement.

Marine Ecology

Intertidal biotope surveys were carried out along the intertidal section of the cable route and a zone 500m either side. Benthic infaunal and epifaunal surveys were carried out to investigate the baseline marine ecology using grab samples and trawls. Surface sediment samples were taken for contaminant analysis.

The intertidal area is predominantly sand characterised by low benthic species diversity and bedrock outcrops and breakwaters with higher species diversity dominated by dense beds of mussels and algae. The inshore subtidal environment of Tees Bay is predominantly sand, with common fauna present. The mouth of the Tees estuary and the area north of Redcar is mostly muddy sand and benthic communities are less diverse than inshore sandy sites or areas of offshore muddy gravel. Small areas of shelving bedrock and of boulders and cobbles are located at Longscar, in the northern part of Tees Bay and east of West Scar at Redcar dominated by common benthic and epibenthic species.

Harbour porpoise are found in the Tees Bay region and a colony of common seals has been established in the mouth of the river Tees since 1994. Grey seals are also regularly observed but in lower numbers and do not breed in the area. Both common and grey seals haul out on mudflats in the Tees estuary at Seal Sands.

Heavy metal contaminants usually bind to silty/clay materials and these sediments do not prevail in the wind farm area due to the mobile nature of the seabed. Surface contaminant samples revealed that Arsenic levels were elevated at two proposed turbine locations with one further (non turbine) sample site within the wind farm having elevated levels of Copper and Lead. However, levels of surface sediment contaminants were not found to be above the probable effect levels which could affect marine ecology and therefore if localised contaminants are released during construction they are not expected to affect marine life. However, *subsurface* contamination may exist and this will be investigated during pre-construction geotechnical investigations.

Installation of turbine foundations and associated cable laying include a direct loss of sedimentary habitat and creation of hard substrate habitat in the form of scour

protection and turbine foundations. These will be colonised by marine life and positive effects will occur during the operational phase. The installation process will also cause mechanical/physical disturbance (including abrasion, smothering, compression) due to jack up barge legs and cable installation. This will inevitably lead to some localised mortalities of benthos and epibenthos. These activities are likely to change suspended sediment loads only at the local level. The development of scour around the turbine foundations will cause release of sediments over a duration of 8-25 days (depending on foundation used and wave conditions at the time) which will disperse mainly in the wind farm area with finer materials transported offsite. Therefore it is proposed that scour protection is installed prior to the development of scour, thus removing the potential for sediment release.

Noise disturbance during piling activities has the potential to cause physiological trauma to the hearing mechanisms of marine mammals and fish species, though data on the subject is limited. As a precautionary measure the developer has to agreed to soft start procedures for construction which will cause sensitive marine life to avoid the construction area thus avoiding damaging effects. Noise habituation is expected for other construction activities in what is an existing busy marine traffic area subject to regular dredging.

Once operational a number of effects may occur. The creation of hard substrate habitat is regarded as beneficial in terms of biodiversity enhancement, and support for fisheries enhancement - particularly lobster. The inclusion of a trawling ban is also expected to reduce trawling related disturbance and mortality in the sedimentary areas between the turbines. This is likely to have a beneficial effect on benthic and epibenthic population structures and species abundance.

Coastal processes studies have not identified significant alterations to current flows and wave climate at anything other than local (individual turbine) scale for monopiles. However, tripod foundations have a greater impact both on wave height reduction and in potential reductions for littoral drift. Any change in sediment distribution patterns (and subsequently on marine benthos) are not likely to be greater than those, which occur naturally, and would be reversible, once the wind farm is decommissioned.

Terrestrial Ecology and Nature Conservation

The ecological assessment was carried out with reference to a desk study to identify existing biological data relating to the site and the surrounding area, and surveys of vegetation and mammals. A Phase 1 Habitat Survey was undertaken across the whole site, whilst areas within 500m of the cable route were subjected to more detailed surveys to National Vegetation Classification (NVC) level. Specific surveys for water voles, great crested newts and invertebrates were also undertaken.

The proposed cable route comes onshore within the sand dunes of South Gare and Coatham Sands SSSI, crosses an area of industrial slag, which supports sparse vegetation, and then follows the road and the disused mineral railway to the proposed substation on Tod Point Road.

The cable route has been selected, in consultation with Tees Valley Wildlife Trust and English Nature, to limit its extent through sensitive dune habitats. Damage to vegetation along the disused railway will be caused during trenching, but the soil profile

will be replaced and the vegetation, which is generally characteristic of open ground and disturbance, is expected to recover rapidly.

One statutorily and one non-statutorily designated site are located within 2km of the cable route. There are not considered to be any potential impacts on Coatham Marsh SNCI and the impacts of cable laying on Coatham Sands SSSI will be mitigated by employing directional drilling underground, rather than by excavating a trench through the dunes. There are not predicted to be any negative impacts on protected species such as water vole or great crested newt, or on the rare invertebrates found on the dune system.

Ornithology

The proposed wind farm site is located just under 1km from the Teesmouth and Cleveland Coast SPA at its nearest point. This SPA is an internationally important site for breeding, passage and wintering waterfowl. The key SPA interest includes wintering knot, redshank, passage ringed plover, post-breeding Sandwich terns, breeding little terns and a wintering bird assemblage of more than 20,000 waterfowl/seabirds.

A comprehensive programme of boat, shore-based and aerial surveys were undertaken during July 2002-July 2003 in order to provide the main baseline data set for the ornithological impact assessment. These data were put into a longer term context using additional data from the Tees Estuary and Hartlepool Bay Wetland Bird Survey (WeBS) counts and from Teesmouth Bird Club .

The overall study area included the potential impact zone of the wind farm, plus a substantial buffer around this to enable the local context of the bird populations using the potential impact zone to be better defined and also to provide a reference area for a post-construction monitoring programme. One species, Sandwich tern, was found within the study area in internationally important numbers. This species is also a qualifying feature of the SPA. Four species were recorded in nationally important numbers: cormorant, sanderling, common tern and kittiwake. A range of species were found in regionally important numbers. These included several SPA species (oystercatcher, ringed plover, grey plover, knot, purple sandpiper, dunlin, bar-tailed godwit, redshank, turnstone and little tern) and a range of non-SPA species too (red-throated diver, great crested grebe, Manx shearwater, gannet, common scoter, red-breasted merganser, arctic skua, little gull, black-headed gull, herring gull, great black-backed gull, guillemot and razorbill). Other SPA species present in locally important numbers included shelduck, wigeon, teal, shoveler, golden plover, whimbrel and curlew.

Examination of the longer-term data from the WeBS counts and the Teesmouth Bird Club data identified a range of further potential ornithological issues including seabird migration through the area (including sooty shearwaters, skuas, little gulls and little auks), goose migration and landbird migrants.

The proposed wind farm site itself and its surrounds held relatively low bird numbers, and the composition is also typical of the species and numbers found at similar distances from the shore elsewhere in the study area. Birds flying through the site comprised mainly herring and great black-backed gulls and kittiwakes, with smaller

numbers of divers, cormorants, gannets, common and sandwich terns, auks and waders. Collision risks would be highest for the larger gulls, through the combination of their higher numbers and higher proportion of flights at rotor height. Many of the other species flew mainly well below rotor height. No collision risks were predicted that would result in a significant impact occurring for any species.

A worst-case analysis of disturbance risk identified four species that could potentially be at risk of a significant disturbance impact: cormorant, kittiwake, Sandwich tern and little tern. Further analysis, including an assessment of the availability of alternative resources and information from existing wind farms, would suggest however that the risk of such impacts would be very low for any of these species, and in fact disturbance impacts on them would be very unlikely to be significant.

Disturbance during the construction phase of the wind farm is likely to be greater, so mitigation measures will be implemented to ensure that these are minimised. NOWL will where practical, avoid potentially disturbing activities during the most important period of bird activity in the area and will not pile turbine bases during the July-mid September period. The same mitigation would also be applied during the decommissioning phase.

Other potential impacts were also considered, including possible barrier effects of the wind farm, direct habitat loss through the construction process and effects of the grid connection cable construction. None were considered to pose a risk of a significant impact.

Coastal Processes

The effect of the Teesside Offshore Wind Farm on the existing coastal processes regime has been assessed by undertaking a comprehensive investigation that has involved a combination of: qualitative assessment of site data; use of empirical calculations; detailed numerical modelling; and application of engineering judgement to define the magnitude and significance of any changes to the existing coastal processes regime.

The development has been demonstrated to have no significant effect on water levels, and the effect on tidal flows is largely contained within the footprint of the development site. Consequently, there are not envisaged to be any significant impacts on the tidal regime due to the scheme.

Wave modelling has demonstrated that the scheme will have a moderate effect on the wave climate in both the development footprint area and coastal area surrounding the site, and that this effect is greatest under the tripod foundation option. The proximity of the scheme to the shoreline means that local wake effects are apparently still present when the waves reach the nearshore seabed, to the lee of the development area.

The principal consequence of this change is that there could be alterations in littoral drift potential along the Coatham Sands shoreline. The general pattern of littoral drift remains unaffected, but the magnitude of potential drift, generally, is reduced by the presence of the scheme. Consequently, should the scheme proceed, there will be a requirement to monitor beach levels along adjacent shoreline frontages

Other sediment modelling approaches have revealed that there is not anticipated to be a significant adverse effect associated with drilling spoil, scour dispersion and the transport pathway of sediments across Tees Bay under suspension in the water column.

Geophysical

A desk based study of geophysical considerations for both onshore and offshore aspects of the development, including a review of historical borehole logs, was undertaken alongside a geophysical survey of the offshore parts of the site.

The geophysicial surveys comprised bathymetric, side scan sonar, and magnetic and marine seismic reflection surveys. The Bathymetric Survey shows that the seabed slopes gently from the beach in a north-north-east direction to a maximum depth of around 20m at the offshore extent of the site. Extending from the entrance to Teesport in the west of the site is a deeper shipping channel. The Side Scan Sonar suggested that the majority of the site is covered with silty sand, with a large area of gravelly clay (or exposed weathered bedrock) in the north. A further similar area of possible gravel/weathered bedrock was detected in the centre-west near shore area.

The results of the geological assessment indicate that excavations for the cable route will be through Made Ground (slag), fine and medium sand and, locally, soft sandy clay. The borehole logs close to the wind farm area have revealed superficial sand and gravel deposits, and glacial clays, overlying bedrock. The anticipated depth to bedrock at the turbine locations will typically be between 5m and 20m. Pre-construction geo-technical investigations will be carried out to input into final engineering designs.

Land Quality

Issues relating to the construction and operation of the proposed electrical cable route, with regard to land quality (ground contamination) and impacts on receptors (such as construction workers) have been assessed. An initial desk study was carried out to collate all available information regarding the proposed cable route in order to establish the environmental and geo-technical setting of the site, followed by site visits. Contractors will use appropriate personal protective equipment and work in accordance with Health and Safety and procedures and control measures.

Hydrology and Hydrogeology

An assessment of the likely impacts of the proposed offshore wind farm development on hydrology, hydrogeology and soils has been made. The study was mainly concerned with the water environment onshore, however, where necessary a wider area has been studied, up to approximately 2km inland.

The on-shore section of the proposed Teesside Offshore Wind Farm is situated in a low-lying and flat coastal area to the west of Redcar. There are a number of small surface water bodies present on site, forming part of the South Gare and Coatham SSSI and and Coatham Marsh Nature Reserve. Groundwater levels beneath the site are also quite high, the area being underlain by two apparently unexploited Minor Aquifers. Another important feature of the site is the large amount of steelworks slag overlying the in-situ drift.

The impact of the onshore elements of the proposed windfarm comprising the proposed cable route and on-shore substation, have been assessed with respect to these baseline water conditions. The main potential impacts comprise site dewatering, the entry of sediment loaded runoff into surface water drains and watercourses and the entry of pollutants in the form of chemical, fuels, drilling fluid and concrete into the surface and groundwater environments. Proposed mitigation measures including construction and environmental procedures have been identified which will minimise the impact of this development on the water environment.

Landscape and Visual

The Teesside Offshore Wind Farm has the potential to affect the landscape and seascape resource of its surroundings, and the purpose of the assessment is to evaluate and assess the potential landscape and visual effects during the construction, operational and the decommissioning phases of the wind farm. For the purposes of this assessment the term 'landscape' includes both townscape (views of built up landscapes that include towns and settlements and industrial areas) and seascape landscapes (views of the coast and sea areas).

An overall study area of 25km radius was selected in consultation with Redcar and Cleveland Borough Council and on the basis of comparable experience of wind farm assessment in the area. For the *landscape assessment* the study area was restricted to the land based application site and includes the substation site, cable route and immediate vicinity relating to the landscape and seascape character types for these areas. For the *visual assessment* the study area was restricted to the potential Zone of Visual Influence (ZVI) from where there may be a view of the wind farm within the 25 km radius study area. The ZVI was calculated using specialist software to produce an area of potential visibility of the proposed turbines. The ZVI however, does not take account of built development and vegetation, which can significantly reduce the area and extent of actual visibility in the field. Cumulative visual assessment has considered existing wind farms and approved, but as yet un-built, wind farm application sites within a 50km radius of the study area.

The effects on the landscape will be limited to the land based activities of cable laying, substation construction, and operation. There will be no significant adverse effects on landscape elements such as mature trees and woodland and the overall effects on landscape character will be of a low level and will not be significant. The wind farm design presents a simple and positive composition that may be accommodated within the existing *seascape* character. It may be speculated that the wind farm could be viewed as a new point of interest or attraction to the area, but this cannot be proved or disproved by the assessment.

For the *visual assessment*, potential visibility would be limited to the coastal areas of Tees Mouth, Teesside / Redcar and the Cleveland coast, and areas of high ground within the Tees Valley and National Park. There would be potential significant effects in connection with the coastal settlements of Redcar, Coatham and Seaton Carew and the Tees Bay seascape or local, coastal landscape character. This is due to the extent of the wind farm that would be visible from the seafront areas of these towns when viewing out to sea. There are however many existing industrial and urban

elements also visible when viewing along the coastline to Tees Mouth. There would be no significant effects on other settlements within the study area.

The assessment has also concluded that there would be no significant effects on The North Yorkshire Moors National Park, Heritage Coast, Coastal Special Landscape Areas, inland Special Landscape Areas, Areas of High Landscape Value, Historic Parks and Gardens, Long Distance Routes and main transport routes through the area.

Potential cumulative visibility of wind farms in the area would be concentrated in the Tees Valley, which has high levels of screening and is characterised by existing built and industrial development. The proposed wind farm on the Corus steelworks site is the closest to the offshore wind farm. Most of the other onshore wind farms are located at over ~10km distance to the north east and cumulative effects with these would not be significant. Sequential visibility of the wind farms from the main routes of transport has also been considered as part of the assessment and these effects would also be limited, viewed in different directions at distance, and viewed in the context of a developed landscape.

In conclusion the wind farm would be visible along the coastal areas with the greatest visibility and magnitude of change affecting the views along the coastline between Redcar and Seaton Carew.

Noise

The noise assessment aims to determine the impact of airborne noise at the nearest properties to the proposed windfarm site and the impact of underwater noise on marine ecology in the vicinity of the site and to identify how any negative noise effects can be mitigated. This assessment therefore considers the impact of noise arising from the construction, operation, and decommissioning of both the offshore and onshore components of the development.

In general terms, the assessment procedure involves determining noise levels likely to be generated by the proposed development, comparing these with measured or assumed baseline conditions, and with other sources of existing noise impact in the area, and assessing the effects in the context of the likely impact on sensitive receptors, such as humans and wildlife.

Noise source information has been sought from turbine and construction equipment manufacturers wherever possible. Published data and references in British Standards have been used for some elements of the construction phase and for underwater levels. Noise propagation calculations, both above and below sea level have been carried out using standard acoustic calculation methodologies, with worst case assumptions made in any areas of uncertainty or ambiguity. The assessment of operational noise from wind farm developments was undertaken in accordance with the DTI Noise Working Group assessment procedure.

The results of the assessment show that piling of turbine foundation structures during construction is the most likely activity to result in noise impacts. Utilising drilling techniques rather than conventional piling will reduce the noise levels experienced by humans and will be less intrusive to wildlife in the area. Soft-start procedures for offshore construction equipment will also reduce disturbance to marine life by either

causing them to move away or enabling marine life to habituate to the noise. 'Soft start' is the process by which the intensity of construction activity is increased gradually and inherently noisy activities,–such as piling, will start quietly gradually increasing in noise level.

Compliance with recommended operational noise guidance levels will be achieved through the selection of a turbine model, which does not exceed the noise criteria identified in the assessment. In terms of operational underwater noise and marine fauna, there may be a period of avoidance in the immediate area around the turbines followed by habituation or tolerance to the continuous noise generated by the turbines and the attraction of the habitat benefits offered by the turbine structures and rock armour around the bases.

Traffic and Transport

This assessment examined the road transportation impacts related to the proposed offshore wind farm. The main transportation impacts will be associated with the movements of commercial vehicles to and from the site during the construction phase of the development. It is anticipated that most of the wind farm components will arrive by sea to Teesport where they will be offloaded to the dock before transfer to construction vessels and barges.

Cabling operations in the private access road (which runs behind the Corus steel plant), and along Tod Point Road will be managed through a traffic light system, thus delays to other road users is likely to be negligible. A Traffic Management Plan will be implemented to manage construction traffic during construction of the substation and during onshore cabling operations. The scale of the construction works and the time period over which they will occur is limited and therefore no impacts resulting from the construction traffic are expected.

Cultural Heritage

The cultural heritage assessment considered the potential for the proposed wind farm to affect features and deposits of cultural heritage interest both on and offshore. Consideration was also given to the potential for significant effects on the settings of designated features of cultural heritage (e.g. listed buildings and scheduled monuments).

A review of existing information on archaeology within the site has identified the known or potential presence of a Site of Medieval Church and associated cemetery; Eighteenth and nineteenth century settlement; Twentieth century anti-invasion defences; Nineteenth and twentieth century wrecks; and offshore deposits which may be of some archaeological interest. It is possible that remains of the church and cemetery could be of regional importance but other known onshore and coastal features are considered to be of local importance only.

There are known wrecks within the site and the immediate vicinity. A protocol will be agreed in order to ensure avoidance of known sites, and the reporting of any new discoveries to English Heritage and Tees Archaeology.

Effects on onshore and coastal cultural heritage can be expected to be minor, and would be adequately off-set by provision of a watching brief during construction. Some effects of minor significance on the setting of listed buildings and conservation areas will occur during the operation of the wind farm. Whilst the wind farm will be visible and prominent from these features, it is not anticipated that this would affect an appreciation of their architectural or historic interest.

Recreation

Recreational activities (marine, intertidal, and foreshore) take place in various areas along the Redcar sea front, Coatham Sands, and South Gare breakwater. They include but are not limited to dog walking, horse riding, beach use, scuba diving, sailing, kayaking, wind and kite surfing, fishing (shoreline and from boats), swimming and bird watching.

Disturbance to beach, sand dune and SSSI areas has been reduced by installing the cable by directional drilling which means cable installation will not disturb ground level users. There will be temporary access restrictions to a relatively small area of Coatham beach during cable installation and traffic on the South Gare access road will be controlled with a temporary traffic light.

Birdwatching at Coatham Marsh is unlikely to be significantly affected by either the construction or operation of the wind farm. There may, however, be some effect on the numbers of birds observed while seawatching at South Gare, as some birds may avoid the wind farm, resulting in them passing the breakwater further out to sea.

During construction there will be a moving safety zone of approximately 500m around the immediate construction site, thus navigation will be partially restricted. A safety zone of 50m around each turbine is proposed during wind farm operation. The distance between the three turbine rows is approximately 600m and spacing within rows approximately 300m meaning that recreational craft will be able to safely navigate between the turbines. For comparison, the width of the dredged channel into the River Tees used by container and tanker vessels is less than 300m.

A potential for VHF interference when the transmitter or receiver is within 40m of a turbine tower has been identified, but if proved necessary following construction, NOWL has agreed to install a VHF repeater station on one of the towers which will remove interference. Turbines will be marked and lit in order to aid visibility to mariners during both day and night-time navigation. Therefore, night-time navigation is not considered to be more hazardous than presently.

Kite surfing activity in Tees Bay is concentrated close to the shore between the inshore row of turbines and the waters edge, with only the southern corner of the wind farm area (nearest Coatham rocks) currently used for kite surfing. NOWL are seeking a 50m safety zone around all turbines during operation and to agree a code of practice with kite surfers to avoid any potential for interaction between the turbines and kite surfers.

Modelling of impacts on wind resource available to kite and wind surfers using Tees Bay has showed that the turbulence intensity directly behind the turbines would be approximately 20% (compared to a natural turbulence intensity of 15%). The prevailing wind is offshore and so effects would mostly occur seaward of the turbines, in areas

not presently surfed. There may be minor and localised increases in turbulence when the wind is onshore and only in the immediate vicinity of the turbines. This is not expected to alter kite or windsurfing activities in the area.

Coastal processes investigations have modelled the effect of turbines on wave regimes in the turbine array and shoreward of the turbines using both monopile and tripod foundations. Minor reductions in typical wave heights at specific water depths are predicted for monopile foundations with wave height reductions for tripod foundations predicted to be slightly higher. These changes are considered unlikely to have an overall noticeable effect on wind or kite surfing activities, when compared to the natural variation in sea state.

Commercial Fisheries

A desk study and series of consultations were carried out to determine the extent and economic significance of commercial fisheries both within the proposed boundary of the wind farm site, and regionally. The official landings data are not representative of landings recorded from within the proposed site as the majority of boats working the site are less than 10m in length and boats of this size do not have to report their landings. Therefore, extensive consultation with the fishermen has taken place and a Fisheries Liaison Group has been established and a Fisheries Liaison Officer appointed to act as the main point of contact between fishery stakeholders and NOWL.

The main fisheries of local importance are for shellfish; particularly lobster and edible crab. However, there is an emergent fishery for velvet crab to supply European markets. Tees Bay is noted as an important spawning and nursery ground for some finfish species, especially lemon sole that is commercially valuable. The overall value of fisheries from the proposed wind farm site in 2003 was in the region of £75,500, with approximately 28% of this from the local lobster fishery.

NOWL has offered financial support to the North East Sea Fisheries Committee (NESFC) and local fishermen to instigate a lobster reseeding programme which could release several thousand juvenile lobsters per year into the fishery. This will make best use of the artificial reef habitat that will result from rock used for scour protection around the turbine foundations.

Potential significant impacts include proposed trawling restrictions within the wind farm and habitat creation, which will benefit the shellfish fisheries. In addition, the turbine bases and the surrounding scour protection are likely to attract fish to the site and will enhance trawl fisheries around the edge of the proposed wind farm site.

Underwater noise from construction could have a short-term negative impact on fish distribution. Cumulative impacts of underwater noise during operation of the wind farm are not likely to have a negative effect on fish distribution as the area is already subject to relatively high levels of background noise from port operations.

Based on this assessment, the construction and operation of the proposed wind farm is not likely to have significant negative effect on commercial fisheries.

Socio-economics and Public Attitude

The development of the wind farm may give rise to a number of socio-economic and community impacts which have been assessed through desk study. The proposed wind farm would involve a significant investment by NOWL and will in turn bring the opportunity for direct economic benefits within Teesside. The wind farm will require significant amounts of steel for foundations, piles, and towers, as well as the fabrication and installation capability for these items. In addition, the development will need onshore construction and lay-down facilities with river frontage, as well as offshore lifting vessels, tugs, transport and support boats. The Tees has a good skill base within the offshore, steel and construction industry and local firms will be encouraged to bid for work when tendered. The development will also maintain or create a small number of jobs through the ongoing maintenance of the wind farm.

Whilst some local residents may currently have reservations about the proposed development, previous surveys at operational wind farms show that the majority of residents who live near a wind farm are in favour of generating power from wind and are comfortable with a wind farm in their area.

Similarly, studies of tourists' perceptions of wind farms within an area show that they would only be put off from visiting an area where a wind farm might spoil the experience they were anticipating enjoying. Furthermore the wind farm provides an additional tourist attraction with increased requirements for services and increased flow of money in the area with additional visitors. As such the economic effects of the proposed wind farm will be long-term and on the whole positive. Overall it is perceived that the proposed wind farm will have positive socio-economic effects.

Marine Navigation Risk Assessment

The Marine Navigation Risk Assessment has adopted a standard approach to risk assessment within the context of a risk management process. This seeks to identify hazards, as sources of risk, then examine how the hazards might give rise to accidents. The accidents are categorised both in terms of the severity of their effects (i.e. consequences in terms of harm to people or the environment, damage to assets and other economic losses) and the likelihood of the harm occurring.

By using Worst Credible Scenarios the greatest risks have been identified and these are tolerable. Several risk reduction measures have been identified and together they reduce the navigational risks of the project to a fully acceptable low level. The principal risk reduction measures include:

- Clearly marking the towers with paint, lights, photo-luminescent safety markings and fog signals in accordance with the Trinity House and Maritime and Coastguard Agency guidelines.
- Ensuring that a safe navigational channel is maintained between the wind farm and the shore for yachts, motor boats and fishing vessels.
- If required by Trinity House installing a general navigational light to supplement South Gare Light, which may be partially obscured by the wind farm's towers.

- Appropriate distribution of Navigational Warnings and Notice to Mariners thereby ensuring that the wind farm is properly marked on navigational charts.
- Formulation and testing of a marine emergency plan with MRSC Humber Coastguards and with the Tees Harbourmaster which should include a system to allow a turbine to be stopped to prevent its rotors striking a drifting vessel or yacht.
- Burying the offshore cables, including the shore link and inter row connector cables
- Port advising its Pilots and vessels visiting the port to navigate well clear of the wind farm

Fishing with pots and static nets can safely continue within the wind farm, although the developers are seeking to exclude trawling within the turbine array and the vicinity of cables to shore.

The direct track from the Salt Scar buoy to/from Tees Approach Channel Buoy No 4 passes through the corner of the proposed site of the wind farm. However, with the wind farm in place it is anticipated that vessels will pass to the north of the wind farm. Their courses are likely to be slightly longer and different, although as the increase in sailing time is only minutes, it is unlikely that the wind farm will have any demonstrable impact on a vessel's operation.

Existing Infrastructure, Shadow Flicker, Public Safety, Telecommunications and Television, and Aviation

An assessment of the likely impacts of the development on existing infrastructure (such as utility services), shadow flicker, public safety, telecommunications and television, and aviation issues has been undertaken.

Service providers (such as water, electricity and gas) have been consulted and design solutions to enable the cable route to cross services have been identified. Under certain combinations of geographical position, time of day and year, the sun may pass behind moving rotor blades and cast a flickering shadow. It occurs only within buildings where the flicker appears through a narrow window opening. A detailed investigation into shadow flicker has shown that no houses will fall within the right distance or angle to experience shadow flicker.

There may be an effect on potential telecommunications links but the link operators have not been identified despite extensive searches and liaison with the appropriate authorities. These links may no longer be operational, although if they are, a suitable solution will be agreed.

The Ministry of Defence (MOD) and Civil Aviation Authority (CAA) were consulted about the development. Assessment of air safety and defence interests, through evaluation of the possible effects on air traffic systems, defence systems and military low flying activities has been made. NOWL also consulted with Teesside International Airport Ltd and a study into potential impacts on the radar systems was carried out by

NOWL. Subsequent to these studies, aviation lighting on the turbines has been agreed with the CAA and there are no objections on the grounds of aviation.

Overall Conclusions

The very purpose of power generation from renewable energy resources is to reduce the production of greenhouse gases and their effect on global climate change and improve air quality via a reduction in the consumption of fossil fuels. As part of the UK Government's commitment to reducing carbon dioxide emissions, the Teesside offshore wind farm will play a positive role in this process. The Teesside offshore wind farm has the potential to contribute 5.9% (100MW) of the expected total power output (1700MW) from Round 1 of the UK's offshore wind programme and will contribute towards the Government's target of 10% of electricity being produced from renewable resources by 2010.

The EIA of the proposed Teesside Offshore Wind Farm has addressed a wide range of potential impacts on different aspects of the environment. The emerging findings of the assessment process have been integral to the iterative site design process and the final wind farm site layout. Environmentally led site design changes combined with the incorporation of appropriate mitigation will reduce potential negative impacts to effects which are not deemed significant.

The incorporation of the mitigation, enhancement and offsetting measures into the scheme will result in effects being 'minor' or 'not significant'. Landscape and visual effects have been assessed in a different manner to other assessments in that impacts are classed as either 'not significant' or 'significant' (rather than of minor or major significance). From Redcar and Seaton Carew landscape and visual effects have been classed as 'significant'. However, a range of independent surveys demonstrate that a significant majority residents who live near a wind farm are in favour of generating power from wind and are comfortable with a wind farm in their area, although the acceptability of a visual effect is an individual and subjective issue.

In conclusion, the Teeside Offshore Wind Farm is not envisaged to have significant adverse effects on the biological, physical or human environments and has the potential to bring positive effects to the area. In addition, the development of Teesside Offshore Wind Farm will produce clean, green, pollution free electricity equivalent to the typical domestic demand of approximately 70, 000 homes.