Scira offshore energy	**SCIRA PROJECT**	
	DOCUMENT NO: SC-00-NH-F15-00005	**REV:** **03**

SHERINGHAM SHOAL OFFSHORE WIND FARM

DOCUMENT TITLE:

Decommissioning programme

REV	DATE	ISSUE OR REVISION DESCRIPTION	ORIG. BY	CHKD. BY	COMP. COORD	PRJ. MGR.
03	2009-07-03	Issued for consultation	AJR			
02	2009-03-05	Initial draft Issued prior to meeting with DECC				
01	2008-12-x	First draft including input from Company Representatives	AJR			

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1 INTRODUCTION

The Sheringham Shoal Offshore Wind Farm (SSOWF) will comprise 88 wind turbine generators (WTG) and will have a total capacity of 315MW. The wind farm will be located approximately 17km to 23km offshore from the coastal town of Sheringham on the north Norfolk coast, and approximately 5km north of the sand bank known as Sheringham Shoal. The SSOWF project will cover 35km^2. The associated landfall for the onshore works will be located in Weybourne Hope, on the north Norfolk coast.

The owners of Scira Offshore Energy Limited (Scira), are the two Norwegian energy companies StatoilHydro (50%) and Statkraft (50%) To follow-up the installation of the wind farm , StatoilHydro has established an internal project organisation called “Sheringham Shoal Offshore Wind Farm Project”.

The Environmental Statements (ES) for the offshore and onshore elements of the development were approved in August 2008 through the respective consents according to the Energy Act 2004 (Section 36), The Coast Protection Act 1949, the Food and Environmental Protection Act 1985, as well as the Town and Country Planning Act 1990. Elements related to decommissioning were briefly discussed in the Environmental Statements. Upon issue of the Section 36 consent for the SSOWF, a notice under Section 105(2) of the Energy Act 2004 was also issued, regarding the requirement to prepare and seek approval for a decommissioning programme for the project prior to commencement of construction.

This Decommissioning Programme is prepared as a response to Scira’s consent condition relating to the preparation and submission of a Decommissioning Programme prior to the start of offshore installation work and to the corresponding Notice from DECC dated 7th of August 2008. Installation of offshore foundations is scheduled to start March 2010, while the horizontally directional drilling in the landfall area is scheduled to start October 2009.

This Decommissioning Programme has been produced in accordance with the Department of Trade and Industry (DTI) (now the Department for Energy and Climate Change (DECC)) guidance document “Decommissioning of Offshore Renewable Energy Installations under the Energy Act 2004 – Guidance Notes for Industry”.

2 EXECUTIVE SUMMARY

The Sheringham Shoal Offshore Wind Farm (SSOWF) is currently under development and the fabrication and installation Contracts are awarded. The SSOWF consists of 88 wind turbine generators (WTG), two offshore electrical substations, marine infield cables and marine export cables. Production of electricity is planned to start in year 2011/2012. The Crown Estate has given a lease of 40 years. The wind farm has a design life of 20 years, at the end of which the condition of the installation will be evaluated with respect to the possibility for further production lifetime.

The Energy Act 2004 requires that Scira prepares and eventually carries out at the appropriate time a decommissioning programme for the Sheringham Shoal Offshore Wind Farm prior to commencement of construction.

The Environmental Statement and Appropriate Assessment presented during the consenting process provide the current baseline of conditions in the physical, biological and human environment. The full Environmental Statement and Non-Technical Summary can both be found at the website www.statoilhydro.com/en/TechnologyInnovation/NewEnergy/RenewablePowerProduction/Offshore

The scope of the decommissioning works described in this document is determined by the legislation in place at the time of writing and involves all accessible installed components of the wind farm. This includes Offshore Substations (both topsides and foundation structures); all components of the WTGs (i.e. blades, nacelles, towers, transitions pieces and associated components); the WTG foundations and sections of the export cables and inter-array cables close to offshore structures. Cable sections planned to be removed, will be those from the J/I tubes on the WTG structures to the grade-in point of cable burial. The Table 2.1 below summarises the decommissioning proposals for the separate components of the SSOWF.

Table 2.1 Decommissioning proposal

Component	Decommissioning Proposal
Wind Turbine/generating equipment	Complete removal from site
Foundations (wind turbine, met mast, transformer platforms)	Cut off at or below seabed and removed
Cables (inter-array and export)	Left in situ
Anemometry masts	Complete removal of structure
Transformer platforms	Complete removal of topside

Health, Safety and Environment (HSE) performance management will be central to the decommissioning process. HSE risks will be identified and mitigated during the whole process, embedded in the contract philosophy and carried out through evaluation of decommissioning contractors and the planning and execution of the work. Specific evaluation criteria for evaluation of future decommissioning contractors, will be established in due course.

As per the DTI guidance notes (2006) the proposed method of removal for the separate components will have regard to:

- The Best Practicable Environmental Option (BPEO), the option which provides the most benefit or least damage to the environment as a whole, at an acceptable cost, in both the long and short term;
- Safety of surface and subsurface navigation;
- Other uses of the sea; and
- Health and safety conditions

Decommissioned material, such as metal, will be recycled wherever possible. Hydraulic oil will be returned to the supplier for reuse. Unused and/or remaining chemicals will be returned to the supplier for reuse or satisfactory treatment. The need for emptying fluid systems prior to decommissioning will be assessed and planned prior to decommissioning. Equipment such as motors, cranes, transformers etc, may be returned to the supplier for possible re-use and/or recycling.

It will be both appropriate and necessary to review the decommissioning programme throughout the lifetime of the wind farm as legislation, regulatory requirements and current approaches change overtime. Such reviews will also need to reflect advances in knowledge and understanding of the marine environment, changes in working practices and technological advances.

Consultation throughout the decommissioning process will be similar to that undertaken during the Environmental Impact Assessment (EIA) process but will also incorporate changes and amendments made overtime to the requirements within the regulatory consultation process.

Costs and financial security provisions have also been provided within this document as per requirements set out in the DTI guidance notes (2006). These are provided within Appendix 4 and 5.

The following key documents have informed the provisions presented:

- Decommissioning of Offshore Renewable Energy Installations under the Energy Act 2004: Guidance notes for Industry, DTI, December 2006

- Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone, International Maritime Organisation (IMO), 19th October 1989

- Guidance Notes for Industry: Decommissioning of Offshore Installations and Pipelines under the Petroleum Act 1998, DTI, http://www.og.dti.gov.uk/regulation/guidance/decommission.htm

- Review of the Current State of Knowledge on the Environmental Impacts of the Location, Operation and Removal/Disposal of Offshore Wind-Farms, OSPAR, 2006, ISBN 978-1-905859-15-3, www.ospar.org

- Guidelines for Environmental Risk Assessment and Management, Defra, September 2002, http://www.defra.gov.uk/environment/risk/eramguide/08.htm

3 BACKGROUND INFORMATION

3.1 Organisation

The owners of Scira Offshore Energy Limited (Scira), are the two Norwegian energy companies StatoilHydro (50%) and Statkraft (50%). To follow-up the installation of the wind farm, StatoilHydro has established an internal project organisation called “Sheringham Shoal Offshore Wind Farm Project”.

The electrical transmission system will be part of the new OFTO-system. The future appointed OFTO for the Sheringham Shoal project will be responsible for decommissioning of the transmission system. Scira will be responsible for decommissioning of those parts of the Wind Farms that are not part of the transmission system.

3.2 Project status

The SSOWF was consented in August 2008 as part of the Round Two site allocation process. The following consents were awarded at that time:

- Section 36 Electricity Act 1989 (construction and operation of the wind turbines, offshore transformer stations and met masts; granted by DTI);
- Section 5 Food and Environment Protection Act 1985 (installation of foundations of offshore structures, rock armouring, scour protection etc; granted by DEFRA);
- Section 34 Coast Protection Act 1949 (obstruction to navigation works; granted by DEFRA);
- Section 36 Energy Act 2004 (navigation extinguishment declaration; granted by DTI); and
- Planning permission has also been received under Section 57 of the Town and Country Planning Act 1990 for the onshore works at Weybourne Hope.

The project is scheduled to commence construction of offshore foundations at the beginning of 2010. Horizontal directional drilling in the landfall area at Weybourne Hope is planned to start October 2009. Contracts for all elements of the construction process are awarded. The wind farm`s WTGs will gradually been set in production from year 2011 / 2012.

3.3 Project overview

SSOWF covers 35km^2 and is sited approximately 17km to 23km offshore from the coastal town of Sheringham on the north Norfolk coast, and approximately 5km north of the sand bank known as Sheringham Shoal. The depth is 15 – 22 m. The associated landfall for the onshore works is located in Weybourne Hope, on the north Norfolk coast. The electrical connection will be located at an existing electricity substation at Salle near Cawston, which is owned by EDF Energy (EDFE).

The location of the wind farm site and the export cable route corridor is as shown in **Figure 3.1** and **Table 3.1**.

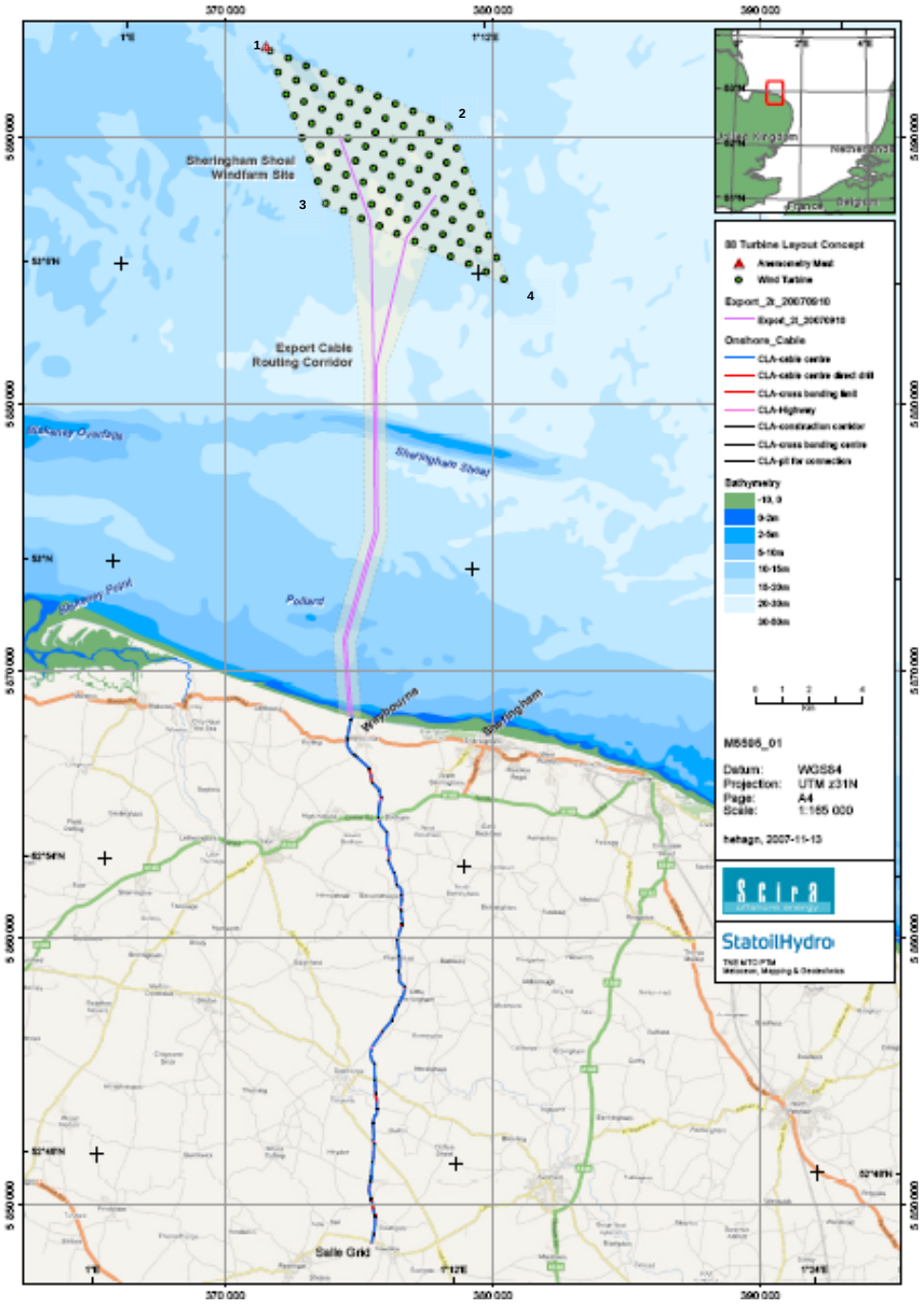


Figure 3.1 **Sheringham Shoal Offshore Wind Farm site lay-out (See Appendix 1 for an A4 version of this figure).**

Table 3.1 **Co-ordinates of Sheringham Shoal Offshore Wind Farm Site**

Point	Latitude (N) degrees	Minutes	Longitude (E) degrees	Minutes
1	53	10.4788	01	4.6665
2	53	8.9810	01	10.9461
3	53	5.7867	01	13.0286
4	53	7.2916	01	6.7490

The wind farm will consist of 88 3.6MW wind turbine generators (WTG). The WTGs will be connected via a network of inter-array cables to two offshore substations. Six strings, connecting 7-8 WTGs in series, will be connected to each substation. The infield cables will have two different sizes, 36 kV 3x400 m^2 and 36 kV 3x185 m^2, where the largest cables are closest to the substations. One fibre optic element will be included to each cable. Each offshore substation is connected to the onshore substation in Salle via a submarine export cable, coming onshore near Weybourne, and underground cables from Weybourne to Salle. The main section of the submarine export cable is a 145 kV 3x1x630 mm^2 cable and the landfall section is a 145 kV 3x1x1000 mm^2. Both sections include one fibre optic element. Cable burial depth is 1m. At the Salle substation the underground export cables will connect the wind farm to the regional distribution network, and further via overhead powerlines connect it to the UK transmission network at Norwich.

The wind turbines themselves will be constructed of steel monopiles with a diameter of 6m which will be driven into the seabed by means of a hydraulic hammer on a jack-up barge. Depending on the outcome of the currently ongoing assessment of the ground conditions, a smaller number of foundations will be drilled. There may be the need for added protection around some of the monopile bases to prevent scour. The scour protection could be made up of rock, gravel or frond mats as deemed appropriate.

3.4 Other human activities in the area

The area adjacent to the SSOWF site has a range of ongoing activities and uses which may change over the lifetime of the wind farm. At present and in the near future they will include:

- Other wind farm operators;
- Oil and gas activities;
- Marine aggregate extraction;
- Disposal of dredged material;
- Outfalls and subsea cables;
- Navigation and shipping; and
- Commercial fisheries.

Due to changes in use over time it will be necessary to review these key activities on a regular basis and eventually reconfirm those still relevant prior to decommissioning taking place. Following confirmation of other activities and uses in the area at the time of decommissioning a programme of consultation and communication with the relevant stakeholders will be developed. Predicted possible activities and uses are outlined below.

3.4.1 Other wind farm operators

It is highly likely that there will be other wind farm operators in the area adjacent to SSOWF over the project lifetime. Currently Scira is aware of a number of other existing and potential wind farms in the vicinity of the SSOWF and these are described in **Table 3.2** and their positions relative to the project are shown in **Figure 3.2**.

Table 3.2 Potential wind farms in the vicinity of SSOWF

Site	Developer	Location	Distance from SSOWF	Status	Capacity	Round of award
Docking Shoal	Centrica Renewable Energy Ltd.	40km off Cromer	32km	Submitted	500 MW	Two
Dudgeon	Dudgeon Offshore Wind Ltd.	22km off Sheringham	3km	Pre-submission	300 MW	Two
Inner Dowsing	Centrica Renewable Energy Ltd.	5km off Ingoldmells	43km	Operational & under construction	97MW	One
Lincs	Centrica Renewable Energy Ltd.	8km of Skegness	39km	Approved	250MW	Two
Lynn	Centrica Renewable Energy Ltd.	5km off Skegness	42km	Operational & under construction	97MW	One
Race Bank	Centrica Renewable Energy Ltd.	30km off Ingoldmells	28km	Submitted	620 MW	Two
Triton Knoll	RWE Npower Renewables	38km off Mablethorpe	40km	Pre-submission	1200MW	Two

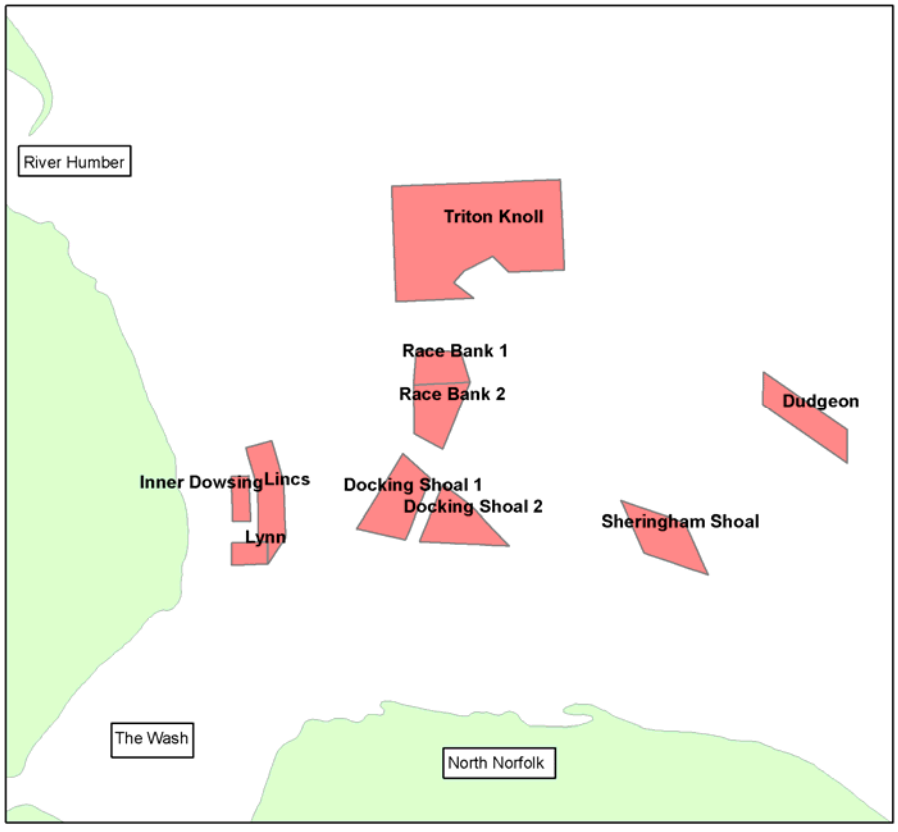


Figure 3.2 Potential and existing wind farms in the vicinity of Sheringham Shoal Offshore wind farm

3.4.2 Oil and gas operations

The southern North Sea is an important area for oil and gas extraction dominated by offshore gas fields. The sector is regulated by the DECC though its licensing process. The SSOWF site falls partially within

block 21 and 27 of quadrant 48. Block 21 is currently under licence to Warwick Energy Exploration Ltd. It is unlikely that the area will be subject to future prospecting or drilling due to the limited prospects.

Block 27 of quadrant 48, located to the west of the proposed site, has been awarded to Bridge E&P at the 23rd licensing round, which closed on 9th June 2005. Other activity includes two wells drilled in 2005, due north of Cromer by Century Oil. Therefore, there is a possibility that seismic surveys and exploratory drilling could take place following lease of the block.

There are no oil or gas pipelines traversing the proposed site or cable routes, at present the nearest pipeline is over 15km away to the north and east, terminating respectively at the gas terminals at Theddlethorpe and Bacton.

3.4.3 Aggregate extraction

Aggregate extraction activities are licensed by The Crown Estate following a positive Government View regulated by DEFRA. There are currently no licensed aggregate extraction areas close to the proposed wind farm site. A number of licensed areas exist to the north-west, the closest being South Inner Dowsing (Area 107) owned by British Dredging Limited (RMC Marine) and Area 440 owned by Westminster Gravels Ltd. Both areas are 25km from the site.

3.4.4 Marine disposal sites

There are no marine disposal sites located within the vicinity of the SSOWF or any areas nearby subject to capital or maintenance dredging activities.

3.4.5 Outfalls and sub-sea cables

There are two discharge consent sites within 250m of the landfall site at Weybourne Hope. These are presently operated by Anglian Water Services Ltd and are identified as Sewage Discharges - Final/Treated effluent.

Telecommunications cables have been laid in the southern North Sea at numerous locations. Concentration of cables run from the East Coast directly across to the Netherlands. The SSOWF lies within an area of low density cabling with no active cables passing directly through the site. A marine communications cable passes just to the east of the landfall site, which comes ashore at the Weybourne car park. This cable is not in service but should be treated as live (Openreach Sub-sea Operations Group).

3.4.6 Navigation and shipping

A survey of merchant vessel activity in the vicinity of the SSOWF identified six main routes. Three of the routes pass to the south of the SSOWF and three to the north-west. The routes were further examined for the Closest Points of Approach (CPA) which showed that the route closest to the SSOWF had the lowest number of vessels per day passing by compared to the other five routes.

The maritime traffic survey established that there were low levels of recreational activity during the period of the survey. To establish whether this was accurate, discussions were held with the Royal Yachting Association and the Cruising Association. These discussions confirmed that the SSOWF is outside the main sailing areas and cruising routes but is partially within a racing area.

The survey of dredging vessel activity observed that the vessels mainly passed to the south of the SSOWF, either side of Sheringham Shoal and in avoidance of other shallows in this area such as the Race Bank.

3.4.7 Commercial fisheries

The maritime traffic survey carried out indicated that there is presently limited fishing in the area mainly by small inshore vessels. More detailed studies of fishing activity levels in the area further indicated that the wind farm site does not encompass primary fishing grounds with the main fishing activity within the wind farm area being predominantly by local North Norfolk based boats with occasional activity from Lowestoft long-liners.

The study concluded that based on the available evidence there is little scope for any substantial increase in the numbers of locally based vessels or in their fishing effort or landings. Similarly there is sufficient stability and long term commitment amongst the local potting fleet to suggest that there is unlikely to be any dramatic decline in vessel numbers or effort levels within the foreseeable future.

3.4.8 Military exercise areas and unexploded ordnance

Currently there are no military practice and exercise areas (PEXA) within the vicinity of the SSOWF. The north Norfolk Coast and the adjacent sea area have, however, been subject to considerable military activity in the past, in particular from activities during World War II. Specific activities in the locality include.

- The local Anti Aircraft Gunnery School at Weybourne;
- The coastal defence battery at Sheringham;
- The coastal defence line along the beach minefields of Sheringham, Weybourne and Cromer;
- Naval actions off Sheringham and Cromer;
- Cargoes dispersed from sunken ships;
- British laid minefields to protect Convoy Routes; and
- German mines laid by aircraft, warships and submarines.

The hazardous items likely to be encountered as a result of these activities include:

- Sea mines;
- Naval gun ammunition, depth charges and torpedoes;
- Air delivered bombs;
- Aircraft machine gun ammunition and rockets;
- Land based defence gun ammunition;
- Land and ship based anti aircraft gun ammunition;
- Munitions on wrecks from attacking aircraft, ships and coastal artillery;
- Munitions in the holds of wrecks; and
- Munitions from the holds of wrecks broken up by the sea and weather.

Whilst many of the hazards will have been removed after WWII, ordnance has been washed ashore and dealt with in the past 60 years and unexploded ordnance may still remain buried in the seabed and the beaches.

Prior to the start of offshore installation work, a UXO-survey of the offshore wind farm area will be undertaken. This survey information will also be available to inform the future decommissioning (it is accepted that additional survey, at the time, to ensure the health and safety of all workers may be required).

3.5 Nature Conservation

International nature conservation designations relevant to the SSOWF site include: Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Ramsar sites.

The SSOWF site is not currently within any designated sites but there are designated sites close to the landfall area. The site is however, within an area used by populations for which the site has been designated.

3.5.1 Wash and North Norfolk Coast European marine site

The Wash and North Norfolk European marine site includes:

- The Wash and North Norfolk Coast SAC;
- The Wash SPA;
- The North Norfolk Coast SPA; and
- The Gibraltar Point SPA.

The Wash and North Norfolk Coast SAC and the North Norfolk Coast SPA are the sites of most relevance to the offshore components of the wind farm and are discussed further below (where the habitats and species are of relevance to the project). However, when referring to the European marine site, all the designations that form it are considered as integral.

3.5.2 The Wash and North Norfolk SAC

The Wash and North Norfolk Coast SAC qualifies as a SAC for the following Annex I habitats, as listed in the EU Habitats Directive:

- Large shallow inlets and bays;
- Sandbanks which are slightly covered by seawater all the time (referred to in this document as subtidal sandbanks);
- Mudflats and sandflats not covered by seawater at low tide (referred to in this document as intertidal mudflats and sandflats);
- Reefs (eg: *Sabellaria spinulosa*);
- Samphire (glasswort) *Salicornia* spp. and other annuals colonising mud and sand;
- Atlantic salt meadows (*Glauco-Puccinellietalia*); and
- Mediterranean and thermo-Atlantic halophilous scrubs (*Arthrocnemetalia fructicosae*).

The Wash and North Norfolk Coast also qualifies as a SAC for the following Annex II species, as listed in the EU Habitats Directive:

- Common seal (*Phoca vitulina*).

3.5.3 The North Norfolk Coast SPA

The North Norfolk Coast SPA qualifies under the EU Birds Directive for the following features:

- Internationally important populations of regularly occurring Annex I bird species;
- Internationally important populations of regularly occurring migratory bird species; and
- Internationally important assemblage of waterfowl, including the internationally important populations of regularly occurring migratory bird species.

Ramsar criteria 1,2,5,6 have been applied for the justification of the North Norfolk Coast Ramsar site:

- Relating to Ramsar Criterion 1: The site is one of the largest expanses of undeveloped coastal habitat of its type in Europe. It is a particularly good example of a marshland coast with intertidal sand and mud, saltmarshes, shingle banks and sand dunes. There are a series of brackish water lagoons and extensive areas of freshwater grazing marsh and reed beds.
- Relating to Ramsar criterion 2: Supports at least three British Red Data Book and nine nationally scarce vascular plants, one British Red Data Book Lichen and 38 British Red Data Book invertebrates.
- Relating to Ramsar criterion 5: Assemblages of wildfowl of international importance. Over winter the area regularly supports 91,536 waterfowl (5 year peak mean 1991/92-1995/96).
- Relating to Ramsar criterion 6: Breeding and over wintering bird species of international importance, as identified at designation.

3.6 Site Characteristics

In order to inform the decommissioning programme summaries of the physical characteristics of the site are provided in the following sections and are mainly taken from the Project's Design Basis. As input for the offshore installation activities and design of the offshore parts of the windfarm, further geophysical survey work was carried out in 2008. This survey data will now also go towards informing the decommissioning process in the future.

3.6.1 Normal wind conditions

Wind data is provided in **Table 3.4**. The estimated mean wind speed in the centre of wind farm is 9.2 m/s at 80m.

In summary, the turbulence measurement from Docking Shoal can be used to describe the turbulence intensity at SSOWF. The average ambient turbulence intensity at a wind speed at 15m/s is estimated to 6.1%.

Table 3.3 Summary of measurement results used in the update of wind resource assessment

Station	Period	Mean wind speed [m/s]
Lynn & Inner Dowsing (43 m)	Sept 1999 - Nov 2007	8.2
Race Bank (80 m)	June 2006 - Nov 2007	9.5*
Docking Shoal (80m)	June 2006 - Nov 2007	9.3*
SSOWF (80 m)	Estimated long term	**9.3** (9.2)**

* Corrected values using linear regression with L&ID measurement mast as a reference station. Extrapolated values from 90 m to 80 m using wind shear coefficient α=0.1. These values are not corrected for over speeding effect (1.5% is anticipated here) due to the mounting arrangement of the 90 m top sensors.

** Mean wind speed value for the most exposed turbine is given in bold, while 9.2 refer to the centre of the park.

3.6.2 Extreme wind conditions

The extreme wind conditions given in **Table 3.4** are applied as a basis for wind farm design conditions.

Table 3.4 Summary of extreme wind conditions for SSOW at 80 masl

Design parameters	[m/s]
50-years 10 min wind speed	43
50 years 2 sec gust speed	53

3.6.3 Tidal and extreme water levels

Table 3.5 Key values for tidal and extreme water levels

	West side of wind farm	East side of wind farm
Mean seawater Level (MSL) above LAT	3.1 m	2.9 m
Mean high water springs (MHWS) above LAT	5.2 m	4.9 m
Highest astronomical tide (HAT) above LAT	6.0 m	5.6 m
Mean spring tidal range	4.3 m	4.1 m
50-year atmospheric surge above LAT	2.9 m	2.9 m
50-year atmospheric surge below LAT	1.8 m	1.8 m
50-year SWL above LAT	7.3 m	7.1 m
50-year wave crest elevation above LAT[(1)]	17.2 m	16.9 m

[(1)] Coexist with 1-year extreme still water level

3.6.4 Waves

The 50-year significant wave height is 7.4m.

3.6.5 Currents

The 50-year extreme surface current is 1.5m/s in the NW end of the wind farm area and 1.8m/s in the SE end of the wind farm area.

3.6.6 Seabed conditions and shallow geology.

Seabed conditions and geological interpretation for the wind farm site is found in the Seismic Survey Report. **Table 3.6** presents a geological summary for information.

The model was correlated to the 2006 Borehole campaign and the Site survey from 2005. The model has been further refined following the 2008 borehole campaign leading to an updated distribution of soil units for the turbine and substation locations.

Table 3.6 Geological summary. All depths are approximate and refer to metres below seabed (BSB) /10/

Unit	Formation	Description	Distribution
1a	Holocene sands	Loose fine to medium sand with shell fragments	In the centre and to the southeast of the survey area
1b	Holocene sands and gravels	Slightly clayey, gravelly, shelly sand	Veneer on the seabed over remainder of survey area
2	Botney Cut	Laminated clays with silts, peats and fine sands infilling channels that cut into the underlying unit	Two north/south trending channels through the centre with a smaller northwest/southeast trending channel in the north of the survey area
3	Bolders Bank	Firm to stiff slightly gravelly sandy sand with pockets of sand and gravel. Occasional boulders may be expected.	Blanket deposit seen throughout the survey area to a maximum depth of 14m BSB
4	Egmond Ground	Dense to very dense slightly gravelly silty fine to medium sand with occasional flint gravel with some stiff gravelly clay bands	Expected over the entire survey area to a maximum depth of 19m BSB
5	Swarte Bank	Hard sandy gravelly clay, with some layers of gravel and very dense sand.	Infills channels cut into the chalk running NNW/SSE and east/west, up to 1.2km wide and 150m deep.
6a	Weathered Chalk	Weak structureless chalk composed of sandy silty fine to coarse gravel with a clayey sandy silty matrix (Grade Dm/Cm Chalk)	Underlies the whole survey area
6b	Chalk	Weak, low to medium density (Grade B5 to B3 chalk)	Underlies the whole survey area

3.6.7 Geotechnical conditions

Geotechnical conditions are identified based on among other laboratory test based on performed borehole campaign and survey. Key strength and stiffness characteristics of the soil unit are identified.

Figure 3.3 presents the expected layer thicknesses at each individual turbine location. The locations are grouped into three characteristic profiles for illustration ; (1) turbine locations at infill channels with thickness of soft clay larger than 1.5m, (2) turbine locations in areas with top of chalk above anticipated depth of pile penetration and/or influence depth for foundation resistance and (3) turbine locations where chalk material is not present within influence depth of the foundation.

The basis for Figure 3.3 is the interpretation of the geophysical survey at each turbine location and the 5 existing boreholes from 2006. When the 7 new boreholes from 2008 are tied in with the same model some adjustments should be expected, particularly with respect to the top of chalk interface. Field results suggest that this interface is deeper at the edge of the erosion channels cutting into the chalk plateau.

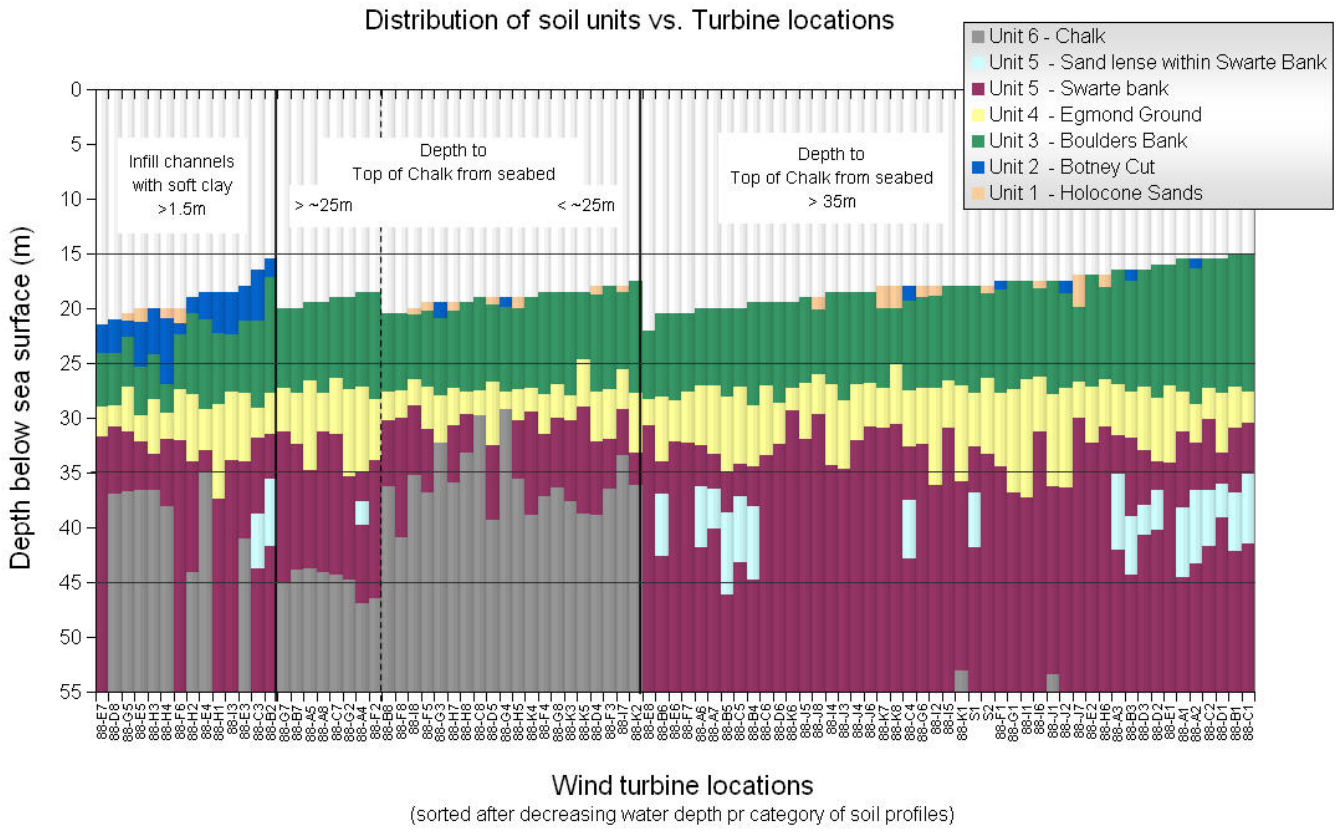


Figure 3.3 Sequence of soil Units for all wind turbine locations

Where the backshore is low, the shingle beach forms a barrier ridge and is the main defence against backshore flooding.

4 DESCRIPTION OF ITEMS TO BE DECOMMISSIONED AND PROPOSED DECOMMISSIONING MEASURES

4.1 Proposed decommissioning programme

At the end of the SSOWF's economic lifetime, decommissioning will take place. Towards the end of the initial lifetime, of 20 years, an assessment of the technical conditions of the installation and its continuing economic potential will be made. The lease period from The Crown Estate is 40 years and within this time, it is possible that the project could be re-powered. Scira is considering to apply for an extension of the lease period from 40 to 50 years.

When planning the decommissioning of the wind farm, the possibility of recycling material and/or reuse of plant elements will be considered. Prior to decommissioning a contract strategy will be established, defining number of contracts and scope of work for each contract. Through the contractual process, reuse and or recycle of plant items, handling of Health, Safety and Environment (HSE) during working operations, principles described in the decommissioning program and applicable laws and regulations at the time of decommissioning will be assessed.

Decommissioning will need to be performed in accordance with applicable laws and regulations current at that time. In the following the expected decommissioning is described based on requirements, guidelines and practices at the time of writing.

Effective management of HSE issues is central to the owners of Scira and, as such, prior to the start of decommissioning, detailed plans including HSE risk assessments and mitigation will be developed.

The onshore and offshore Environmental Statements described the environmental impacts related to construction, operation and eventual decommissioning of the SSOWF. The environmental impacts of the decommissioning are considered to be temporary and either within or of lower magnitude and significance than those described for the construction and operation of the SSOWF. (See website www.statoilhydro.com/en/TechnologyInnovation/NewEnergy/RenewablePowerProduction

4.2 Decommissioning sequence

Decommissioning will generally be a reverse of the order of installation. **Figure 2.1** illustrates the decommissioning process. Prior to decommissioning, the power will be cut off and disconnection from the grid system will occur. The electrical transmission system will be part of the new OFTO-system. The appointed OFTO for Scira project will be responsible for decommissioning of the transmission system. In the following sub-chapters decommissioning activities for the different offshore part of the wind farm are discussed. In addition, appendix 3, contain a rough preliminary evaluation (pros and cons) of decommissioning activities made for some criteria

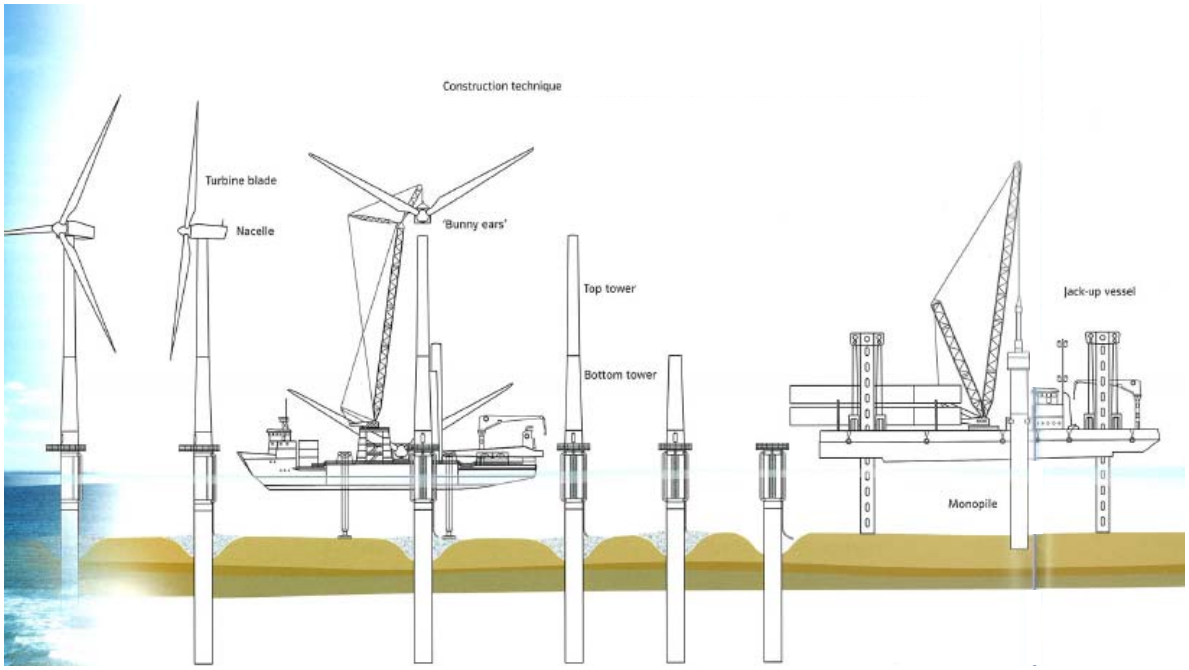


Figure 4.1 Possible decommissioning sequence of WTG, tower and foundation

4.3 Towers and Wind Turbine Generators (WTG)

The wind farm consists of 88 Siemens SWT-3.6-107 WTGs including towers, which gives a hub height of 81.75m, each of the three rotor blades are 52 m long and weigh 20 tonnes

Prior to the start of decommissioning of the WTGs, the system will be de-energised. Liquids like gear oil and motor oil and possible other chemicals present, will be collected and removed from the structures and subsequently returned to the relevant supplier or recycled / disposed of in an appropriate and satisfactory way. Any loose items will be also be removed. Cables will be cut at the grade-in point between the J/I tubes at the base of the WTGs and the point of burial.

A jack-up barge/vessel will be used for the decommissioning work. The capacity and reach of the crane will be such that it can lift the nacelle including the hub in one lift from the top of the tower, weight of unit including rigging is 205 tonnes.

If the vessel is of self-propelled type and with a good deck carrying capacity, the vessel may store units on own deck and return to agreed harbour for dismantling of the units. A smaller jack-up may be used together with a barge or vessel for transportation to shore.

The decommissioning programme for the WTGs will be in the reverse order of the installation:

1. Jack up at first location.
2. Disconnect cables between tower and foundation;
3. Disconnect each blade and lower to deck using same lifting tool as for installation;
4. Disconnect and lower nacelle to deck and secure;
5. Disconnect upper tower section, lower to deck and secure;
6. Disconnect lower tower section, lower to deck and secure; and
7. Move to next location and repeat.

The decommissioning of the 88 WTGs is expected to take approximately 200 days.

There will be one vessel involved in the decommissioning operation of the WTG. In addition there may be vessels involved in transportation of the decommissioned WTGs. **Figures 4.2** and **4.3** illustrate installation and transportation of WTGs.

Figure 4.2 **Example of a possible installation / decommissioning Vessel**

Figure 4.3 **Example of possible transportation of WTGs**

4.4 Offshore foundations

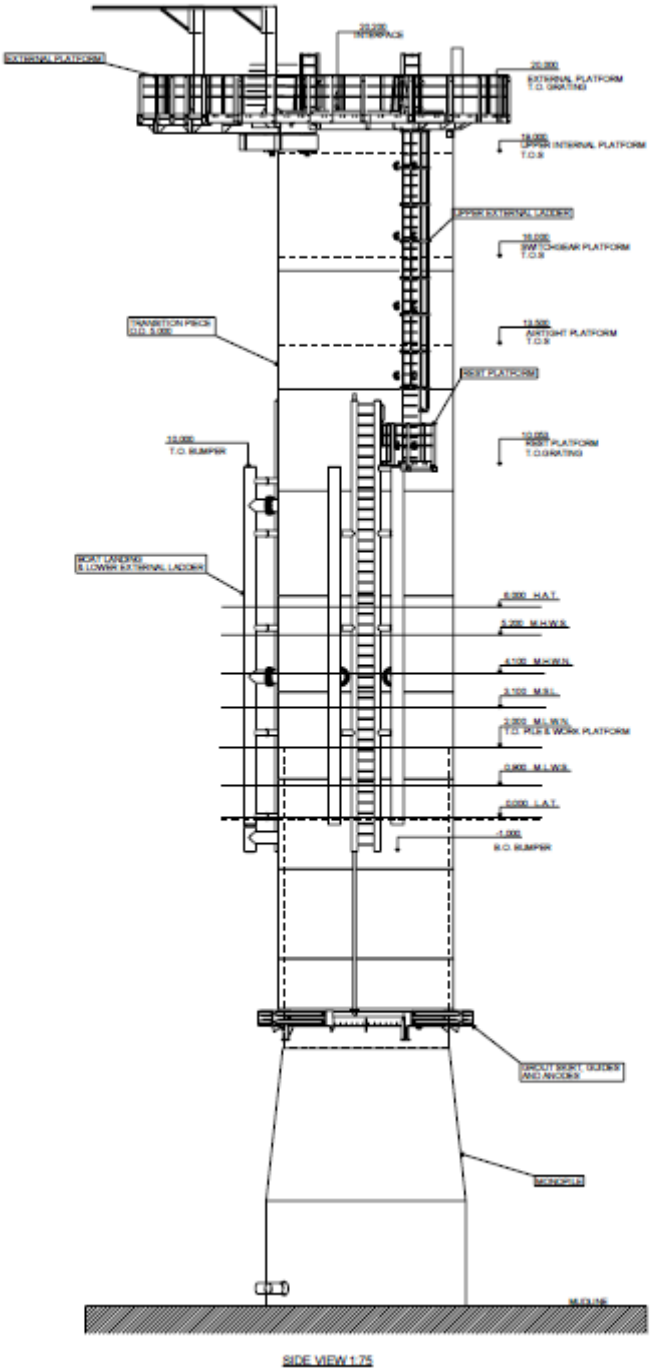
The 90 foundation structures, which are made of steel, will be removed (see **Figures 4.4** and **4.5**). The proposed decommissioning procedure is based on the general principle of removing all parts of the WTG foundation above seabed level. Consequently the mono-pile and the cable connections will be cut off directly beneath the mud-line and the loose foundation part will be lifted off and subsequently transported to the base harbour for demolition, re-use and/or deposition. It is anticipated that the small hollow in the seabed left after the foundation automatically will be filled up by natural deposition of sand materials. The type of crane vessel to be used for the decommissioning work can be a floating crane type, a standard jack-up vessel or a special type offshore unit with stabilising legs.

The possible sequence for decommissioning of the offshore foundations is presented in **Table 4.1** and is discussed in greater detail below.

Table 4.1 Possible sequence for decommissioning of the offshore foundations

Activity no	Main Activities	Detailed Action to be taken
1	Mobilise supply vessel with ROV spread and required equipment	
2	Excavation at cable pit / interface between cable and seabed.	Sea Jet Trencher (or equivalent) and obs-ROV are required
3	Cutting of cables	Cable to be cut at 1-2 meters below seabed
4	Removal of the cable up to switchgear platform	
5	Removal of bend restrictor / chute from seabed to bellmouth	
6	Possible excavation around pile depending upon removal of pile at 1 meter below seabed.	
7	Removal of Brattberg gaskets between J-tube and TP	
8	Removing J-tubes	
9	Preparation for cutting to be carried out. Mounting of cutting tool on pile underneath TP. Carried out by use of divers or ROV.	
10	Demobilisation of supply vessel	
11	Mobilising of heavy lift vessel with ROV spread	
12	Perform Rigging of TP	
13	Cutting of pile underneath TP Cutting tool to be clarified.	
14	Removal of the TP – lift to vessel	
15	Possible Clamping on to pile	
16	Possible Cutting of pile 1 meter below seabed.	
17	Possible Removal of pile	
18	Demobilisation of heavy lift vessel	

Figure 4.4 Foundation structure



Removal of the WTG and the tower

Before the demolition of the foundation can be initiated the cable connections from the foundation to the WTG tower must be disconnected at the bolted flange between the tower and the transition piece in level +21.00 and the tower and the individual WTG elements must be removed. Subsequently the switch gear and other electrical equipment located in the top part of the foundation structure must be removed.

Preparations for foundation removal

After having exposed the cables/J-tubes in the vicinity of the foundation the cables will be cut off immediately outside the bell mouth of the external J-tube elements. Subsequently the external Jtube elements will be disconnected and lifted out of the water for removal. Divers using water jet abrasive cleaning equipment will simultaneously remove the marine growth on the external surfaces of the piles.

The internal platforms will be removed giving access to the interior part of the mono-pile foundation. Following the necessary excavation inside the pile (approx. to 4 m below the seabed level), a tailor made support/cutting tool will be installed for cutting the pile approx. 2 m below mud-line. The tool will be fixed in the correct level inside the pile activating a system of hydraulic cylinders.

The cutting will be executed using a mechanical water jet abrasive system remote controlled and guided by horizontal rails following the internal circumference of the pile.

Removal of the foundation

Before activating the cutting tool the foundation structure will be suspended loosely in the hook of the crane vessel using a set of preinstalled lifting eyes bolted to the top flange in level +21.00.

After cutting the crane will be able to lift off the loose part weighing approx. 400T. During and immediately after the cutting process the cutting tool will support and stabilize the pile horizontally at the cutting level.

The loose part of the foundation will now be lifted out of the water, the cutting tool will be disconnected ready for reuse and the foundation part will be sea-fastened to allow for the subsequent transport to the base harbour.

Demolition works on shore

At the base harbour the foundation element must be cut into minor transportable pieces ready for deposition and/or re-use.

The grout material used in the connection between the mono-pile and the transition piece will be demolished into minor parts to be transported to a dumping ground for deposition. Likewise the steel structures will be cut into transportable units to be scrapped.

Figure 4.5 Foundation Transport

4.5 Scour protection

Due to expected erosion at some of the J-tubes at the foundations, it is expected to be need for scour protection like rock dumping. The requirements set for stones are typically that they shall have a high density and also have a certain strength (in order to not later get pulverized). The scour protection is in accordance with what is described in the Environmental Statement.

Generally the Project during its assessments want to minimize the need for scour protection and rock dumping to a minimum, but it is concluded that there is a need for scour protection at some of the foundations. The requirement for scour protection and where it would be needed is currently being assessed by the Project and its contractors, taking into account the different seabed conditions and tidal flows in the area. Assessments will reveal which of the foundations will be in need of “scour protection” and the extent of it. The assessment will also discuss if there are a need for checking of the installed foundations and method for this.

The scour protection is planned to be left in-situ.

In relation to the circumstances set out in the DTI guidance where non-removal may be considered acceptable, it is considered that “the installation or structure will serve a new use … through the enhancement of a living resource”. It is also stated that entire removal would involve an unacceptable risk to personnel.

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4.6 Offshore electrical substations

The decommissioning of the two offshore electrical substations may be carried out by a jack-up vessel. (See **Figure 4.6** for example of typical substation). Prior to the start of the decommissioning, the system will be de-energised, any liquids chemicals present will be emptied and removed and loose items will be removed. The marine infield and marine export cables will be cut at the grade-in point of burial. When this step is finalised, preparation for rigging and lifting of each of the two substations will take place. The substations are then expected to be transported from the wind farm area to a yard for recycling and/or possible re-use of components. Prior to commencement of operations, special procedures for the work including checklists will be developed and followed-up.

Figure 4.6 Typical substation

4.7 Submarine cables

4.7.1 Marine export cables

The two marine export cables (outer diameter, approx. 205mm) will each be approximately 20km long (see **Figure 4.7**). Close to the point of landfall the two marine export cables will be installed within two casings, pre-installed by a horizontal directional drilling (HDD) rig as part of the onshore transmission works. The marine export cables will be joined to the onshore cables in a transition pit, located within the Muckleburgh Collection on the north Norfolk coast, to the north of the village of Weybourne.

From the landfall, the marine export cables will be laid and buried in a route towards their respective offshore substation in the area of the wind farm. Cable burial will proceed via a simultaneous laying and ploughing technique. Target burial depth is 1m below the level of the seabed. Leaving cables in-situ beneath the seabed may be considered to be the best practical environmental option in order to minimise disturbance to the marine habitats and species that may have substantially colonised the areas. The buried cables will pose no threat to navigation or commercial fisheries.

4.7.2 Marine infield cables

The infield cables consist of Type 1 (OD approx. 132mm), Type 2 (OD approx. 105mm), with a total length of 25km and 57km, respectively. The infield cables comprise unit lengths between 400m and 1400m and

are laid and buried between the WTGs, see **Figure 4.8**. The cables will be buried by a mechanical trenching device, with a target burial depth of 1m.

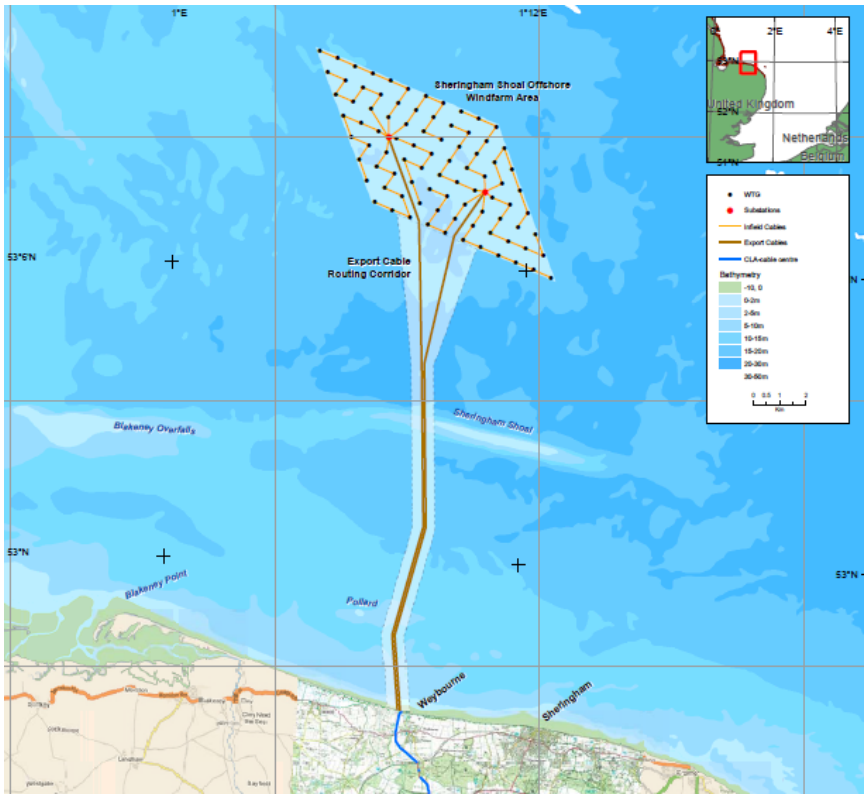

Figure 4.7 **Route of the marine export with corresponding landfall drill and junction pit**

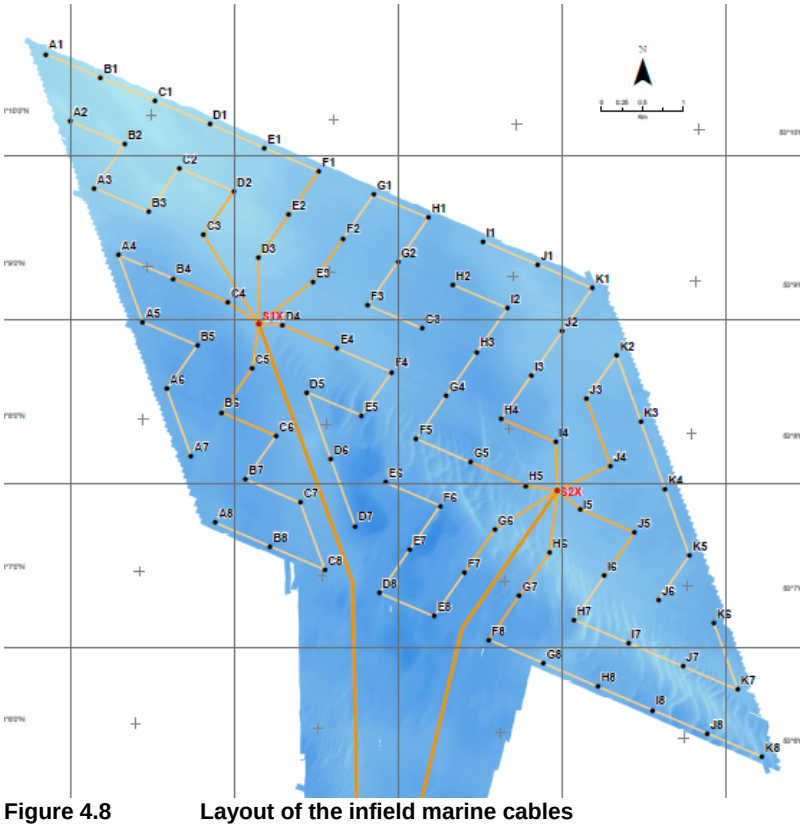

Figure 4.8 **Layout of the infield marine cables**

4.7.3 Decommissioning of submarine cables

The submarine cables, export cables and infield cables will be buried during installation, and the intention is that they are left in-situ. At the time of decommissioning, the cables will be left in their trench but will have to be cut at the grade in point of cable burial. No cables will be left on the seabed surface. The cables themselves consist of three power cores (copper conductors) with water blocking compound and insulation, and armouring. The cut sections will be removed with minimal disruption of the seabed.

The sediment along the submarine export cable routes consists mainly of sand and sand waves with a mixture of other sediments (locally gravelly, with occasional whole shells, and gravelly shelly sand underlain by stiff clay, which can also be silty or slightly sandy). The methodology and tools for the installation/burial of the submarine export cables have been selected based on knowledge of the seabed and subsurface geology and to ensure burial protection over the life of the project. The infield cables will be trenched down to approximately 1m.

When the target burial depth of 1.0 m, the submarine cables will not be visible on the seabed. The cables may be even further protected by moving sand waves generated over the lifetime of the wind farm. Removal of submarine cables will disturb the seabed as it has to be pulled out of the trench, jetted and/or excavated. This will leave deeper seabed sediments on the seafloor, and is considered to be detrimental to the seabed. Other technical challenges and unforeseen problems may be involved with work associated with excavating the sandbank.

Further, leaving the well protected cables in buried conditions is not considered to have any new environmental or pollution impacts. And it is not considered to pose safety risks to mariners.

4.8 Lighting and Marking

In accordance with Clauses 4f and 5a of the Sheringham Shoal consent under Section 36 of the Electricity Act 1989, Scira will ensure that the appropriate marks and lighting are displayed during the decommissioning of the wind farm. Navigational marking in the construction phase has been discussed and agreed with the authorities. In the decommissioning phase, a similar navigational marking and lighting as for the construction phase, is expected.

With regards to aviation safety, the shape, colour and character of the lighting will be compliant with the Air Navigation Order 2005 (or as otherwise directed by the Civil Aviation Authority).

For navigational safety, lights and marks will be agreed with Trinity House, in consultation with the Maritime and Coastguard Agency. Trinity House will be, consulted prior to decommissioning to specify any obstruction marking that may be required during the removal operations. Should any obstruction be left on site that could be considered to present a hazard to navigation Scira will provide the necessary markings specified.

4.9 Authority handling

Prior to start planning for decommissioning an authority plan will need to be prepared addressing the applications and notifications needed to be performed prior to the stopping of electricity production and during the decommissioning. Reference is made to the authority plan prepared for the installation project. Consultation will be carried out with the relevant regulatory authorities at the time of decommissioning. Some of the notifications will include notification to Mariners and fishermen. Further to ensure safety for third parties at sea, temporary safety zones around the installations during decommissioning will be applied for.

4.9.1 Marine archaeology

A draft Written Scheme of Investigation (WSI) has been prepared and initially discussed with English Heritage. For the construction phase, some archaeological construction exclusion zones are suggested. It is expected that these also may be relevant for the decommissioning, and information about these will then be communicated to a future decommissioning contractor and followed-up by Company

4.10 Construction safety

Decommissioning involves heavy lifting activities, electrical work, offshore working, entering of the WTGs and offshore substations from the sea, offshore transportation etc. As already pointed out thoroughly planning will be carried out prior to the commencement of decommissioning. Risk activities will be identified and mitigating measures will be addressed and followed-up. This relates both to the Contract requirements, mechanical and electrical checking prior to lifting, decommissioning activities offshore and at possible yard.

Prior to decommissioning and during decommissioning several safety mitigating measures will need to be addressed. Such safety mitigating measures may include the following:

- Evaluation of decommissioning procedures;
- Establishing contract philosophy and nominating well experienced and suited Contractors;
- Safety assessments of the plans and activities;
- HSE-follow up of the activities;
- Perform safety risk assessments and compare the risk with the project's safety acceptance criteria;
- Notifying 3rd parties;
- Notifying relevant authorities and fishery; and
- Temporary safety zone around the WTGs and the offshore electrical substations during decommissioning.

5 ENVIRONMENTAL IMPACT ASSESSMENT

The intention of the decommissioning process will be to remove the wind turbines and the monopile foundations to either sea bed level or 1m below sea bed level. If scour protection has been used then this will need to be assessed with regard to its removal or its retention in-situ. It is intended that the cabling will remain buried in-situ. It is currently estimated that the decommissioning process will take approximately six months.

The SSOWF ES and subsequent studies undertaken to inform pre-construction baseline represents Scira's current understanding of the site and impacts. Both the ES and the further studies undertaken would be used in the preparation of applications to decommission the SSOWF. It is further anticipated that a full EIA will be required prior to the decommissioning of the wind farm and this will focus heavily on the same list of of key criteria as the original EIA together with any issues that may have arisen in the interim. Those key criteria are expected to be:

- Identification and assessment of potential impacts on the environment;
- Identification of surveys to inform the assessment process;
- A review of nature conservation designations
- The potential interference with other legitimate users of the sea
- Identification and assessment of potential impacts on amenities, communities and future uses of the environment; and
- Identification and assessment of potential impacts on the historic environment.

Some of these key criteria may change in emphasis over time and the EIA will need to recognise and examine such changes.

6 CONSULTATIONS WITH INTERESTED PARTIES

During the EIA and consenting process consultation took place with statutory and non-statutory bodies representing key interests and user groups in the north Norfolk area and the wider area during the Scoping Study. Initial consultation included a description of the project proposals and invited comments and requested relevant data or information. Detailed formal and informal consultation has continued throughout the EIA via correspondence and meetings. All comments received were taken into consideration during the EIA.

The statutory consultees and non-statutory organisations involved in the EIA and consenting process will also be involved in the decommissioning process. The list of consultees may develop and change overtime, but at present the key consultees are anticipated to be *inter alia*:

- The National Federation of Fishermen's Organisations;
- The local Sea Fisheries Committee;
- Chamber of Shipping;
- Royal Yachting Association;
- Joint Nature Conservation Committee;
- Natural England;
- The Environment Agency;
- English Heritage;
- Maritime and Coastguard Agency;
- Trinity House Lighthouse Service;
- The relevant harbour authority; and
- British Marine Aggregate Producers Association (BMAPA).

The consultation process for the decommissioning phase will be scheduled to begin early enough so that initial responses can be adequately assessed and any concerns or queries addressed and/or mitigated in advance of the proposed timing of the decommissioning.

Once decommissioning is due to begin a Notice to Mariners will be issued as well as other navigational warnings as per Clauses 5c and 5d of the Sheringham Shoal consent under Section 36 of the Electricity Act 1989. Appropriate notification on the progress and completion of the works will be supplied to the UK Hydrographic Office.

7 COSTS

Only an estimate of the decommissioning costs can be made at this stage. This cost estimate is given in Appendix 4. The estimate is of course provided at a very early stage. Prior to decommissioning, the estimate will be updated to reflect the decommissioning contract strategy.

8 FINANCIAL SECURITY

See appendix 5.

9 SCHEDULE

In approximately 20 years time the wind farm will be approaching the end of its design lifetime. However, the actual technical status will be regularly assessed and a operation and maintenance system is expected to be in place, in order to prolong the lifetime of the plant. Further since the lease period with the Crown Estate at time being is 40 years, there is also the possibility for re-powering of the wind farm. The possibility to extend the lifetime of the wind farm is in a lifetime perspective positive with respect to the environment.

Scira plan to undertake internal reviews of the decommissioning programme. It is proposed that DECC is consulted at the following times:

- After 10 years of operation
- After 18 years of operation
- 2- 5 years prior to decommissioning

A final decommissioning programme will be prepared prior to decommissioning, 2 - 5 years prior to closing down the wind farm. The final decommissioning programme is expected to include references to relevant surveys performed during the construction phase and during the operational phase.

Prior to decommissioning, Scira will establish a project that will execute and follow-up the following main activities with the following roughly anticipated duration:

- Decommissioning EIA and consultation phase: 12 months
- Project management, planning, procurement and contract follow-up: 36 months
- Offshore decommissioning: 6 – 12 months

10 PROJECT MANAGEMENT AND VERIFICATION

It is understood that information pertaining to project management and verification will only be required to be included when the final review of the programme takes place towards the end of the installation's life.

Guidance provided by DECC suggests that at that time the programme should provide information on how the Operator will manage the implementation of the decommissioning programme and provide verification to Government concerning progress and compliance. This should include a commitment to submit a report, detailing how the programme was carried out. The guidance suggests that this report should generally be submitted within four months of completion of the decommissioning work.

11 SEA-BED CLEARANCE

Following the completion of the decommissioning of the wind farm, surveys will be carried out to check that the site has been cleared. The purpose of the surveys will be to identify any debris located on the sea-bed which may be associated with the wind farm's construction, operation, maintenance or decommissioning and that may pose a risk to navigation, other users of the sea or the marine environment. The type of surveys to be carried out (side scan etc) and the technical requirements will be specified in due course prior to decommissioning.

The area to be covered by the survey will be determined prior to decommissioning taking into account the results of the "as-laid" surveys and other surveys performed in the operation phase.

The decommissioning surveys may be part of the scope of work for the future decommissioning contractor(s) or as separate contracts. Scira also understands that DECC will expect to see an element of independent third party involvement in providing evidence that the site has been cleared and therefore propose that the survey reports can be made available to the authorities as necessary.

12 RESTORATION OF THE SITE

Post decommissioning the intention is to return the site, as far as possible and desirable, to the condition that it was in prior to construction of the installation. The key areas of work will be in relation to:

- Cutting the foundations to below the seabed and ensuring that they are made safe and adequately covered; and
- Ensuring that cables and cable ends are adequately buried

No active restoration which would rely on intervention with equipment is proposed as it is considered that this present unnecessary and unacceptable risks to personnel. Rather, it is considered that allowing the seabed to “self-settle” is sufficient and is proportaion to the limited environmental impact of the proposed decommissioning.

13 POST DECOMMISSIONING MONITORING, MAINTENANCE AND MANAGEMENT OF THE SITE

As cables and foundations are proposed to remain at the site post-decommissioning there will be a need for some further work so that any possible unexpected risks to navigation or to other users of the sea can be identified and mitigated to an appropriate level. The assessment of the level of risk and appropriate mitigation will be dependent on the nature and scale of those items remaining, the likelihood of the remaining items becoming exposed and the degree of risk to other users of the sea.

Based on present day conditions and knowledge the following assessments have been made:

- The risk of exposure of the foundations (the part of foundation located below seabed) or cabling is assessed to be low due to the depth to which the foundations will be cut and also the burial depth of the cable coupled with the relative stability of the sea bed in the area;
- The risk of debris falling overboard at any time is relatively low as offshore work associated with operations and maintenance is low and contained within the turbine structure;
- The risk to legitimate users of the sea is considered to be low as the area is not heavily fished and recreational use of the area is low.

The parameters used in the above assessment may change overtime and so will need to be re-visited closer to decommissioning and therefore any possible monitoring survey strategy will need to be confirmed at that time.

14 SUPPORTING STUDIES

At present the supporting studies used for this decommissioning plan are the studies already carried out in connection with the Sheringham Shoal Offshore Windfarm Environmental Statement (May 2006). In addition to these studies there are geological surveys performed by the Project (2007/2008), pre-construction, during construction and post-construction monitoring programmes either already underway or scheduled to be undertaken at the appropriate time. These monitoring studies will also feed into the assessment and final form of the decommissioning plan.

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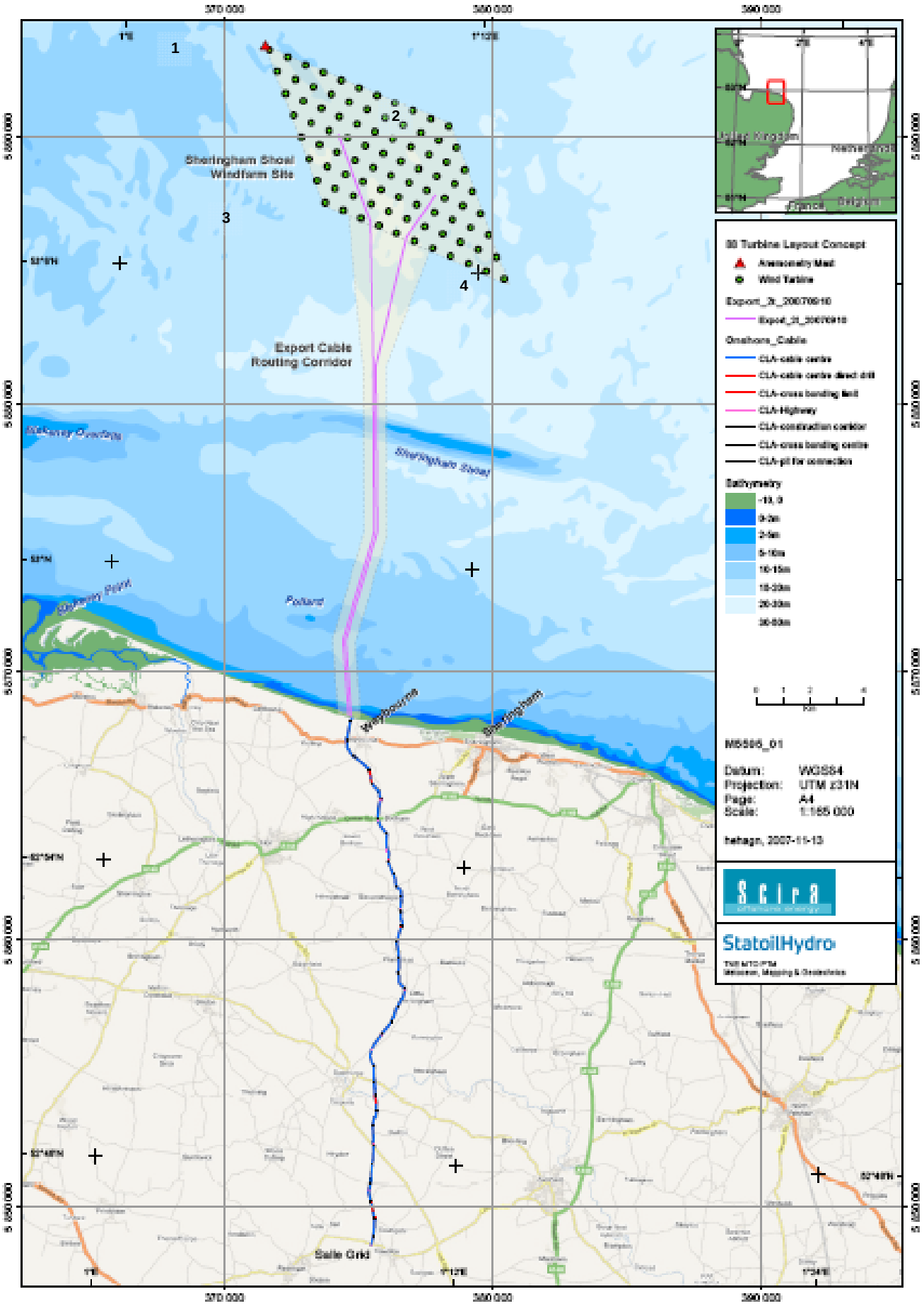
Appendices

1 Map of the location of the Sheringham Shoal Offshore Wind Farm devlopment
2 List of abbreviations
3 Preliminary evaluation (pros and cons) of decommissioning activities made for some criteria
4 Decommissioning costs – Not attached
5 Financial security – Not attached

Appendix 1 A4 version of Figure 1-1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Sheringham Shoal
Pollard
Weybourne
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Appendix 2 List of abbreviations

AONB	Area of Outstanding Natural Beauty
BPEO	Best Practicable Environmental Option
CD	Chart Datum
DECC	Department of Energy and Climate Change
Defra	Department for Environment, Fisheries and Rural Affairs
DTI	Department for Transport and Industry
EDFE	EDF Energy
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ES	Environmental Statement
FEPA	Food and Environmental Protection Act
HDD	Horizontal Directional Drilling
HSE	Health, Safety and Environment
kV	kiloVolt
LME	London Metal Exchange
MHWN	Mean High Water Neaps
MHWN	Mean High Water Springs
MLWN	Mean Low Water Neaps
MLWS	Mean Low Water Springs
mODN	Mean Ordnance Datum Newlyn
MSL	Mean Sea Level
MW	Mega Watts
NNR	National Nature Reserve
OD	Ordnance Datum
OFTO	Offshore Transmission Owner
OSPAR	Oslo Paris Agreement
PEXA	military Practice and Exercise Areas
Project	The Sheringham (Shoal Offshore Wind Farm) Project
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SPA	Special Protected Area
SSSI	Site of Special Scientific Interest
SSOWF	Sheringham Shoal Offshore Wind Farm
TP	Transition Piece
UXO	Unexploded Ordnance
WSI	Written Scheme of Investigation
WTG	Wind Turbine Generator

Appendix 3 Preliminary table listing of pros and cons of possible decommissioning activities

The following appendices list a rough preliminary evaluation (pros and cons) of decommissioning activities made for some criteria.

Appendix 3.1 Wind Turbine Generators

For the Wind Turbine Generators, complete removal is the planned decommissioning activity.

Wind Turbine Generators	
Criterion	**Complete removal**
No harm to people	Prior to decommissioning a risk assessment has to be performed addressing the mitigating measures that need to be in place prior to start this decommissioning activity. Removal of the offshore substations at the end of the operational life time, is considered to be accordance with applicable guidances.
Consideration of the rights and needs of legitimate users of the sea	Complete removal of structures best long term solution. Appropriate notification and consultation will be carried out during the decommissioning work. Further to ensure safety for third parties at sea, safety zones around the installations during decommissioning will be applied for.
Minimise environmental impact	Materials will be completely removed from site. Materials are expected to be reused as much as possible.
Commercial viability	Most commercial viable solution. Optimization of the method and the associated costs, will be further assessed in due time prior to decommissioning.
Practical integrity	The decommissioning is expected to re reverse of the construction.

Appendix 3.2 Foundations

For the foundations, cutting below seabed is the planned decommissioning activity.

Foundations		
Criterion	**Complete removal**	**Cutting below seabed**
No harm to people	This alternative is assessed to represent a much higher risk towards personnel.	Fewer activities to be undertaken over a shorter time period offshore, minimising the risk to personnel.
Consideration of the rights and needs of legitimate users of the sea	Disadvantages to other users of the marine environment include disruption over a longer time period whilst the works are undertaken and remaining scour holes associated with excavation.	No risk presented providing cutting is at sufficient depth and site is monitoring post decommissioning.
Minimise environmental impact	Excavation pits over a wide area causing significant impact to marine environment. Associated dumping of excessive volume of waste material also required. Disturbance would take place over long time period. Some artificial reef habitat may be lost, but long term risk of decay and pollution will be eliminated.	Considerable reduced works footprint relative to complete removal. Works would take place over reduced time period and involve less equipment. Seabed recovery time shorter than complete removal scenario. Some artificial reef habitat may be lost, but long term risk of decay and pollution will be eliminated.
Commercial viability	Not commercial viable. Excavation and extreme lifting involves major equipment requirements over longer periods of time.	Less expensive alternative to complete removal, involving minimal excavation.
Practical integrity	Not a practical solution as the following are expected: High risk associated with heavy lift, considerable excavation needed with possible associated storage of disposal of large volumes of waste	Expected to be more standard procedures and equipment. The decommissioning is expected to re reverse of the construction.

Appendix 3.3 Offshore substations (platforms)

For the offshore substations (platforms), removal is the planned decommissioning activity.

Offshore substations (platforms)	
Criterion	**Complete removal**
No harm to people	Prior to decommissioning a more detailed method evaluation and risk assessment has to be performed addressing the mitigating measures that need to be in place prior to start this decommissioning activity. (Standard) for our activities). Removal of the offshore substations at the end of the operational life time, is considered to be accordance with applicable guidances.
Consideration of the rights and needs of legitimate users of the sea	Complete removal of structures is considered the best long term solution. Appropriate notification and consultation will be carried out prior to and during the decommissioning work. Further to ensure safety for third parties at sea, safety zones around the installations during decommissioning will be applied for.
Minimise environmental impact	Materials will be completely removed from site. Materials are expected to be reused as much as possible.
Commercial viability	Most commercial viable solution. Optimization of the method and the associated costs, will be further assessed in due time prior to decommissioning.
Practical integrity	The decommissioning is expected to re reverse of the construction.

Appendix 3.4 Marine cables

For the marine cables, leave in-situ is the planned decommissioning activity.

Marine cables		
Criterion	**Complete removal**	**Leave in-situ**
No harm to people	Some risk to personnel as all possible decommissioning activities represent a HSE risk	No decommissioning activity, hence no risk to personnel
Consideration of the rights and needs of legitimate users of the sea	No risk assumed, except temporarily during possible removal operation	No risk assumed from leaving buried cables in-situ. The situation is expected to be unchanged from what will be experienced in the future operational phase.
Minimise environmental impact	Given the considerable length of cable and the need for jetting techniques, removal would cause considerable damage and disruption to the seabed and established communities. These impacts could be considered large relative to the environmental gains from removal.	Benign – no environmental impact associated with long term disintegration of buried cables
Commercial viability	Extensive operation, offset to some extent by copper re-sale value	Costs limited
Practical integrity	Possible to undertake. Likely to cause disturbance to the marine environment.	N/A

Appendix 3.4 Scour material

For scour material, leave in-situ is the planned decommissioning activity.

Scour material		
Criterion	**Complete removal**	**Leave in-situ**
No harm to people	Removal is labour intensive and involves a risk to personnel involved in operation	Reduced risk for contractor personnel
Consideration of the rights and needs of legitimate users of the sea		
Minimise environmental impact	Removal will cause considerable damage and disruption to the seabed and established communities. Associated equipment and vessels will generate disturbance and additional noise. Materials gathered would need to be dumped elsewhere.	Habitat for established communities retained, no short or long term detrimental effects on marine environment anticipated.
Commercial viability	Expensive, labour intensive, high volume of operation	Costs limited
Practical integrity	High reliance on manual work, labour intensive. Possible, but not practical	N/A

For scour material, leave in-situ is the planned decommissioning activity.

Appendix 4 Decommissioning costs

The purpose of the decommissioning cost analysis for the SSOWF is to find the estimated net cost of the removal of the offshore structures that will be removed as a part of the decommissioning of SSOWF. As a basis for the cost of removal of the offshore items of the SSOWF the following assumptions is used as a basis:

- The items that have to be removed are 88 WTG's including towers, 90 mono piles plus 2 offshore substations.
- The cost level is based on 2008 autumn rates under the assumption that the salvation rates and vessels rates follows each other since they both are related to the general economic climate and this was the basis for the vessel rates.
- Since these items mostly consist of steel the salvage value is based on the LME steel index. To account for that the steel structures in not standard steel billet only 90% of the LME index value is used.
- The actual value of the scrap metal is actually higher since some of the elements such as the transformers consist of large quantities of copper which higher salvage value than steel since the relative value of copper is higher than that of steel. The additional value this material is assumed to outweigh the cleaning cost of the steel items.
- With regards to decommissioning vessels it is assumed that similar vessels to what is used for installation will be used. The norm for removing each unit is set to be 80% of the installation norm. Since there is not time critical issue here the vessel rate was set top be 90% of the installation rate as a consequence of greater ability to time the operations.

Cost estimate not attached

Appendix 5 Financial Security

Not attached