Triton Knoll Offshore Wind Farm Project

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Decommissioning Programme for Triton Knoll Offshore Wind Farm

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TRITON KNOLL

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01	22 March 2018	Draft submitted to BEIS for consultation	H. Craven (RHDHV)	A. Garry (RHDHV)	A. Meredith (TK)

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Triton Knoll Offshore Wind Farm (TKOWF; the Project) is located off the east coast of England, approximately 32km from the Lincolnshire coast and 50km from the coast of north Norfolk, with the export cable landfall located at Anderby Creek on the Lincolnshire coast. The footprint of the consented development area is approximately 145km2. The Project has progressed through two separate consent applications, Triton Knoll Offshore Wind Farm Array (TK Array) which was granted development consent on 11 July 2013, and Triton Knoll Electrical System (TK Electrical System), which was granted development consent on 6 September 2016. Following consent awards for the TK Array and Electrical System, the Project is being taken forward as a single development by Triton Knoll Offshore Wind Farm Ltd (TKOWFL). The Project is owned by majority shareholder innogy (59%), along with partners J-Power (25%) and Kansai Electric Power (16%); innogy will manage the construction, operation and maintenance works on behalf of the project partners.

The Project was awarded a Contract for Difference (CfD) by the UK Government on 11 September 2017 for a generating capacity of 860MW. TKOWF will consist of 90 (up to 10MW) wind turbine generators (WTGs), delivering a capacity of 855MW.

Onshore construction works commenced in Q3 2018 and offshore construction, excluding the landfall HDD exit pit and seabed preparatory work, will commence in Q1 2020. The Project will be commissioned in 2021. After the operational lifetime of approximately 24 years, the Project will be decommissioned in accordance with the current legislation guiding offshore wind farm development and as required by relevant provisions in some of the obtained licences. A new marine licence will be required for these decommissioning activities. A summary of the proposed decommissioning measures is provided in **Table 1.1**.

Table 1.1 Summary of Proposed Decommissioning Measures

Component	Decommissioning Proposal
90 WTGs	Complete removal by a jack-up crane vessel.
Transition pieces and foundations	Monopiles will be cut below the seabed with the remainder of the structures left *in situ*, below the seabed. Monopiles and transition pieces (WTG and OSP) will be removed by vessel.
Scour protection	To be left *in situ.*
Cables (all)	To be left *in situ.*
Cable protection	To be left *in situ.*
Two offshore substation platform (OSP) topsides	Each to be removed in a single mobilisation, ideally using the same vessel as the WTG sets / foundations.

Please note the decommissioning of the offshore transmission (OFTO) assets, i.e. the two offshore substation platforms and export cables will be the responsibility of the OFTO.

It is estimated that the decommissioning of the Project will take 30 months.

2 INTRODUCTION

Triton Knoll Offshore Wind Farm (TKOWF; the Project) is located off the east coast of England, approximately 32km from the Lincolnshire coast and 50km from the coast of north Norfolk, with the export cable landfall located at Anderby Creek on the Lincolnshire coast. The footprint of the consented development area is approximately 145km^2. The Project has progressed through two separate consent applications, Triton Knoll Offshore Wind Farm Array (TK Array) which was granted development consent on 11 July 2013, and Triton Knoll Electrical System (TK Electrical System), which was granted development consent on 6 September 2016. Following consent awards for the TK Array and Electrical System, the Project is being taken forward as a single development by Triton Knoll Offshore Wind Farm Ltd (TKOWFL). The Project is owned by majority shareholder innogy (59%), along with partners J-Power (25%) and Kansai Electric Power (16%); innogy will manage the construction, operation and maintenance works on behalf of the project partners.

In January 2014, following detailed technical and commercial optimisation studies undertaken by TKOWFL, the generating capacity of the Project was reduced to a maximum of 900MW. Further project optimisation work continued post-consent and the Project was awarded a Contract for Difference (CfD) by the UK Government on 11 September 2017 for a generating capacity of 860MW. TKOWF will consist of 90 (up to 10MW) wind turbine generators (WTGs), delivering a capacity of 855MW.

This Decommissioning Programme provides preliminary information on the approaches to decommissioning the offshore components of the wind farm, including WTGs, offshore substation platforms (OSPs) and all offshore cabling. This programme is informed and supported by the Environmental Statements and associated assessments which were produced in support of the Development Consent Order (DCO) applications.

In considering the Decommissioning Programme, TKOWFL has sought to adhere to the following key principles:

- Safety for all at all times;
- Consideration of the rights and needs of legitimate users of the sea;
- Minimise environmental impact by having regard to the best practicable environmental option;
- Promote sustainable development;
- Adhere to the Polluter Pays Principle;
- Maximise the reuse of materials;
- Commercial viability; and
- Practical integrity.

This Decommissioning Programme is being submitted to the Department of Business, Energy and Industrial Strategy (BEIS) for approval in accordance with Section 105 of the Energy Act 2004. This is in line with the requirements of the DCOs, namely Schedule 1, Part 3, Requirement 22 of The Triton Knoll Offshore Wind Farm Order 2013 and Schedule 1, Part 3, Requirement 4 of The Triton Knoll Electrical System Order 2016. This single Decommissioning Programme is being prepared to discharge both of these DCO requirements.

The expected operational lifetime of the wind farm is 24 years and 8 months which will be dependent on specific conditions arising during operation. At the end of the Project lifetime, the Project will be decommissioned to restore the site to its original conditions in so far as is reasonably practical. This

Decommissioning Programme provides preliminary information on the methods and approaches to how the offshore installations may be decommissioned.

This Decommissioning Programme is informed and supported by the existing environmental assessment for the consented Project, namely the Environmental Statements (ESs) for the generation and transmission assets (RWE npower renewables, 2012 and RWE npower renewables, 2015). The programme will be subject to review and updated, as appropriate, throughout the lifecycle of the Project to reflect changes to regulatory requirements, changing circumstances and to incorporate any improvements in knowledge and understanding of the decommissioning process and impacts on the marine environment. Prior to decommissioning is it expected that a detailed environmental assessment will be undertaken to support the marine licence application for the activities.

It should be noted that cost and financial security information is confidential and therefore is not included within this Decommissioning Programme. Details on the costs and financial securities are provided in a separate document entitled *Appendix C&D*.

Table 2.1: Proposed timescales for the review and approval of the Decommissioning Programme

Process	Timescale	Status
Detailed discussion between TKOWL and BEIS on content of programme	Dec 2017 – Mar 2018	Complete
Informal review of draft Decommissioning Programme by BEIS	May 2018	Complete
Informal review of draft Decommissioning Programme by The Crown Estate	Nov 2018	Complete
Submission of draft Decommissioning Programme to BEIS and The Crown Estate	Dec 2018 – Jan 2019	Ongoing
Notices published and consultation with stakeholders on draft Decommissioning Programme	Dec 2018 – Jan 2019	Ongoing
Update to Decommissioning Programme based on written comments	Jan 2019	-
Formal submission of Decommissioning Programme for approval	Feb 2019	-
SoS approves Decommissioning Programme	June 2019	-

3 BACKGROUND INFORMATION

3.1 Project Description

The TKOWF is being developed in the North Sea in the Greater Wash Strategic Environmental Assessment (SEA) region. The TKOWF will cover an area of approximately 135km^2 and will be located approximately 32km off the Lincolnshire coast and 50km off the North Norfolk coast (see **Figure 3.1**).

TKOWF will consist of:

- Ninety up to 10MW WTGs on transition pieces and monopile foundations with a total generating capacity of 855MW;
- Two OSPs on monopile and transition piece foundations;
- 131km of 66kV inter-array cables linking the WTGs and two OSPs;
- Two 220kV export cables running 52km from the OSPs to landfall north of Anderby Creek;
- Two 58km 220kV onshore circuits connected to a new onshore 220kV substation located next to the current Bicker Fen substation; and
- A connection from the Triton Knoll onshore substation to the National Grid substation in Bicker Fen.

The provisional final layout the TKOWF array, as agreed with the Maritime and Coastguard Agency (MCA) and in line with the Project CfD agreement, is given in **Figure 3.1.**

Offshore construction will start in Q1 2020, with first generation expected to occur in Q1 2021 and for the Project to be fully commissioned in approximately Q4 2021.

3.2 Site Characteristics

This section provides a brief summary of some of the key characteristics of the offshore site, including the wind farm array and export cable route. The information is based on the chapters of the ESs (RWE npower renewables, 2012 and 2015).

3.2.1 Offshore Physical Characteristics

The site has mainly shallow gradients and even bathymetry. There is a gentle east-west gradient, with depths of c.-13m to -18m below Lowest Astronomical Tide (LAT) and c.-16m to -20m (LAT) in the east and west sectors, respectively.

Currents and Tides

The tides in the North Sea rotate anti-clockwise around an amphidromic point centred approximately 350km from the TKOWF site, near the Danish coast. The greatest tidal elevations are to the west and the smallest tidal range is to the east. The spring and neap tidal range increases in a shoreward direction.

There may be mean sea level changes within the development lifetime as it has been indicated that by 2050, relative sea level will have risen between 0.53m and 0.79m above the 2009 levels (Lowe *et al.*, 2009).

According to metocean survey data, peak spring current velocity is between 0.42 and 1.26ms^{-1} as compared to peak neap velocity of 0.15 to 0.52ms^{-1}, with the highest current velocities occurring in the northeast of the site. The flood tide has the greatest current velocities, and there is no period of slack water experienced during the tidal cycle (DHI, 2016).

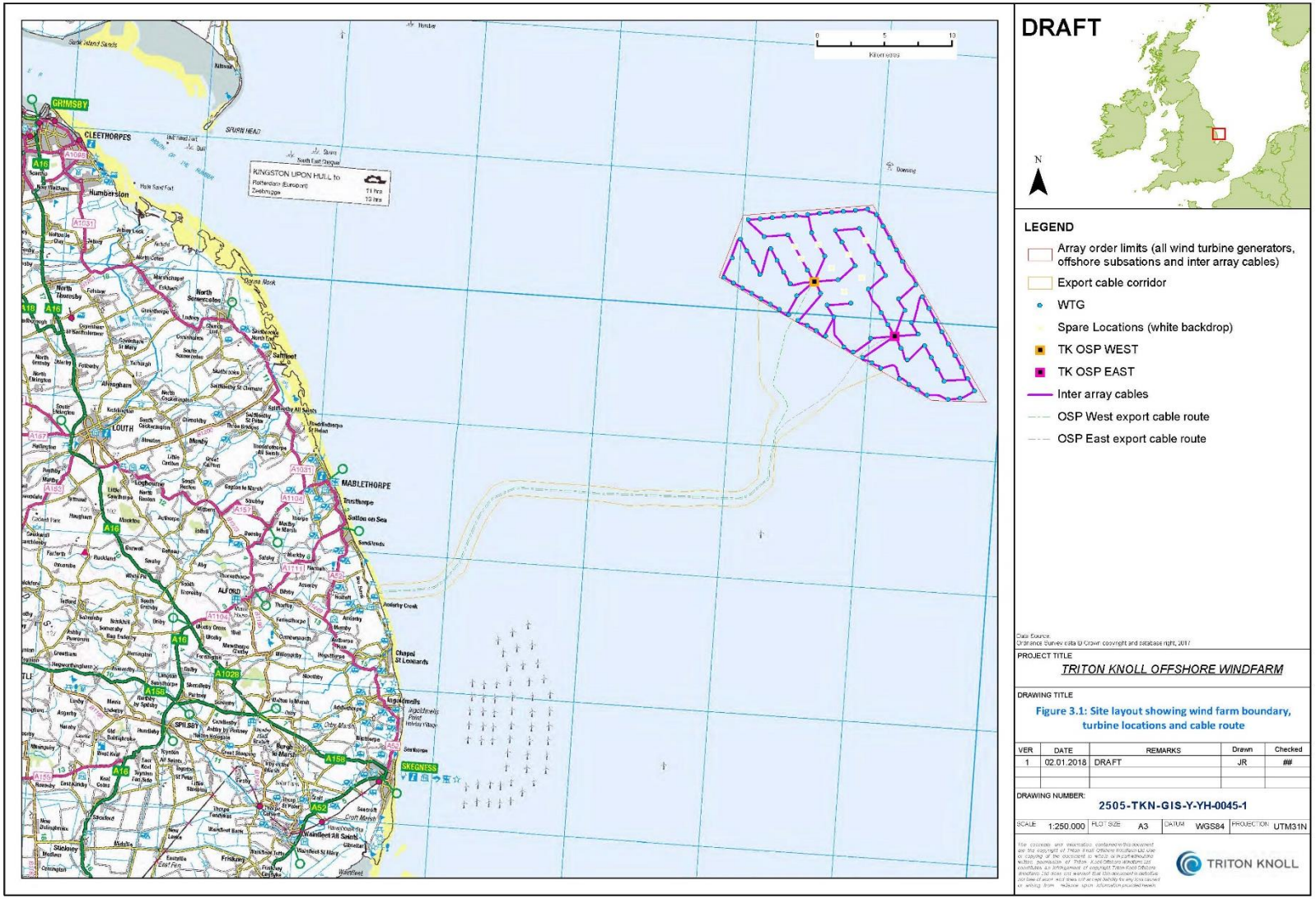


Figure 3.1 Site layout showing wind farm boundary turbine locations and cable route

The most common wave direction and the largest wave height measured within the development site, coincides with the longest fetch rather than the prevailing wind direction (EMU, 2009). The wave regime only influences offshore sediment transport during extreme events.

3.3 Offshore Biological Environment

3.3.1 Nature Conservation

This section provides details on the internationally, nationally, regionally and locally designated sites that are located within the vicinity of the wind farm and export cable route. Details of the sites are listed below.

Special Areas of Conservation (SACs)

- Flamborough Head SAC;
- Humber Estuary SAC;
- Wash and North Norfolk Coast SAC;
- Inner Dowsing, Race Bank and North Ridge SAC;
- North Norfolk Sandbanks and Saturn Reef SAC;
- Haisborough, Hammond and Winterton SAC; and
- Southern North Sea cSAC.

Special Protection Areas (SPAs)

- Humber Estuary SPA;
- The Wash SPA;
- Greater Wash SPA;
- North Norfolk Coast SPA;
- Gibraltar Point SPA; and
- Flamborough and Filey Coast SPA.

National Designations

- Hunstanton Cliffs Site of Special Scientific Interest (SSSI);
- Humber Estuary SSSI;
- The Wash SSSI;
- Saltfleetby and Theddlethorpe National Nature Reserve (NNR);
- Donna Nook NNR;
- Silver Pit Marine Conservation Zone (MCZ);
- Wash Approach MCZ;
- Lincs Belt MCZ; and
- Holderness Offshore MCZ.

Figure 3.2 shows the SAC and SPA sites within 100km of the TKOWF. The ES and Habitats Regulations Assessments concluded that, based on the combination of the type and extent of the impact, the proposed mitigation and the limited extent of potential impact areas, there would be no significant effects on nature conservation interests in the study area from construction, operation and decommissioning of the Project.

Since consent was awarded for the wind farm array and export cables, several new sites have been proposed in the vicinity, including the Southern North Sea candidate SAC. If these sites do become designated, any potential impacts to them will be considered at the time of decommissioning and the management measures in place for the sites would be adhered to.

3.3.2 Benthic Subtidal and Intertidal Ecology

The northern area of the TKOWF site is dominated by sandy gravel with scattered boulders, the infaunal benthic community consists of a species rich community of polychaetes. The epifaunal communities include dense colonies of the bryozoan *Flustra foliacea,* with other bryozoans and colonial ascidians also abundant. The southern part of the site has large areas of sand and gravel, with the habitat being dominated by bivalves. The southern epifaunal communities were less diverse and dominated by species such as the tube worm *Pomatoceros triqueter*, barnacles *Balanus* spp. and bryozoan and coralline algae crusts.

Three areas of *sabellaria spinulosa* reef were recorded along the mid-section of the cable route, at the southern end of the Silver Pit channel. The pre-construction surveys will be carried out in Summer 2018 and an Annex 1 Mitigation Scheme for the Project will be developed to minimise impacts on any areas of reef. This will include an agreed buffer by which the export cable will be microsited around the reef.

3.3.3 Fish and Shellfish Ecology

A review of existing information for the area and surveys of the site showed that the fish and shellfish communities present at the TKOWF site are typical for the southern North Sea region. The studies identified possible spawning and nursery grounds for a variety of species including sole, plaice and herring in the wider region. Shellfish such as crab and lobster were recorded across the site.

3.3.4 Ornithology

The majority of the birds recorded in boat and aerial based surveys undertaken for the ES were 'true' seabirds, with the five most numerous species being kittiwake, gannet, guillemot, fulmar and little gull, with some species being present in regionally (or near regionally) important numbers.

3.3.5 Marine Mammals

The main species sighted at TKOWF were harbour seal, grey seal and harbour porpoise. Other species of marine mammals are sighted only occasionally within this part of the North Sea.

3.4 Offshore Human Environment

3.4.1 Commercial Fisheries

Fishing activity within TKOWF is almost exclusively potting for lobster, edible crab, velvet swimming crab and whelk. There are around eight potting vessels that regularly use and have high dependence on the area. Other fishing sectors, including trawling, seine netting and gill netting operate throughout the wider area but the Project site is not considered to be an important fishing ground for these vessels.

3.4.2 Marine Archaeology

Known wreck sites and features of possible archaeological interest have been identified and described following analysis of the geophysical data. Mitigation has been established to ensure no significant effects would occur. A similar approach would be taken during decommissioning, based on the current guidance at the time of decommissioning, to minimise any potential impacts.

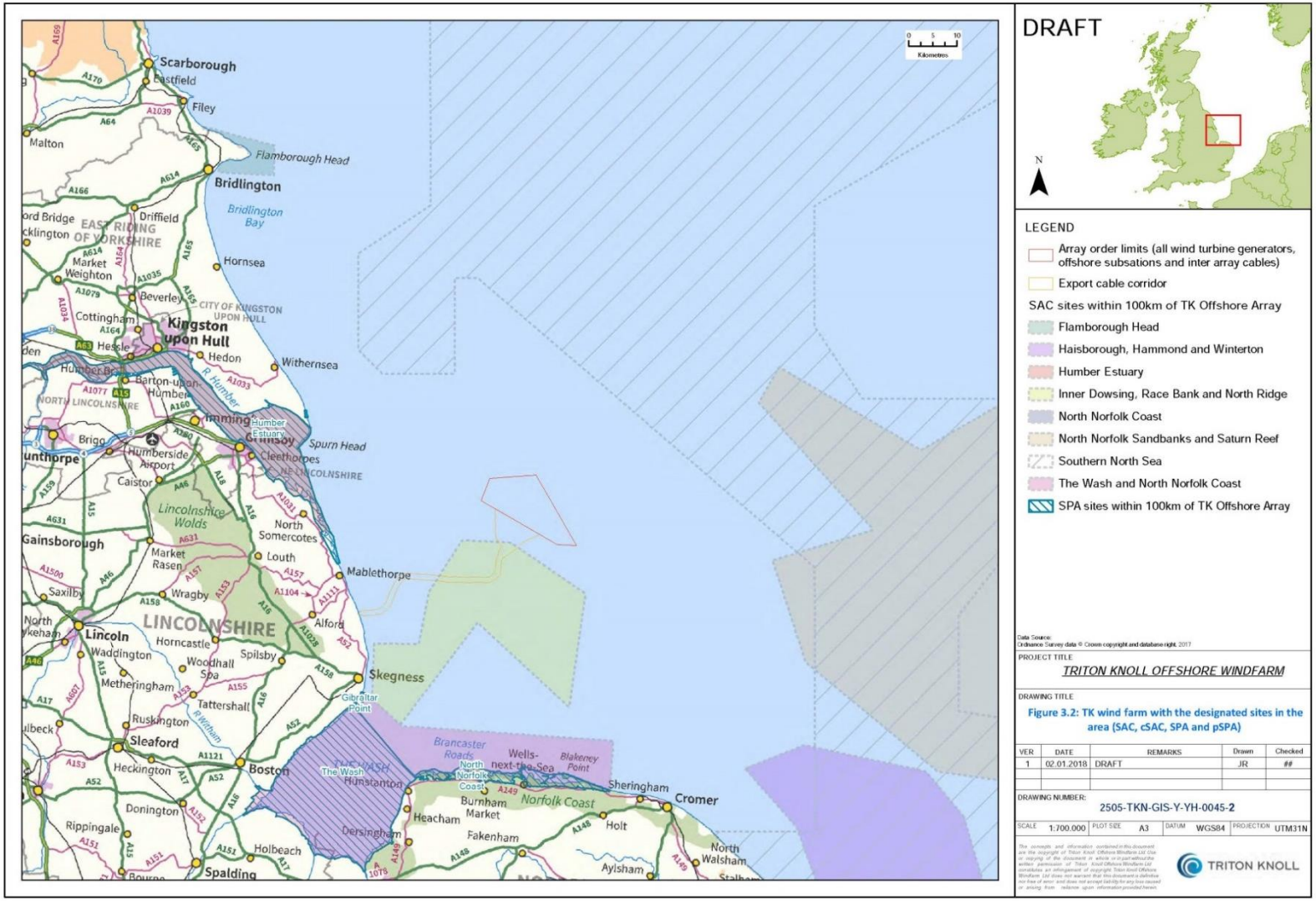


Figure 3.2 TKOWF and designated sites in the area (SAC, cSAC, SPA and pSPA)

3.4.3 Shipping and Navigation

A number of shipping lanes are located around the TKOWF site, due to the proximity to the Humber Estuary. None of these lanes cross the Project site, however a couple do cross the export cable route. Over a 28 day survey period, during the busiest period of the traffic survey, only one vessel transited the Project area (RWE npower renewables, 2012).

3.4.4 Other Marine Users

The sea around the TKOWF site is subject to use by a variety of other industries and is occupied by existing infrastructure. These are:

i) other offshore wind farms;
ii) oil and gas activity and infrastructure;
iii) existing subsea pipelines;
iv) telecommunications systems;
v) marine aggregate dredging; and
vi) recreational sailing.

Figure 3.3 shows the closest offshore wind farm developments in relation to TKOWF. **Figure 3.4** shows the TKOWF in relation to oil and gas platforms, subsea platforms crossing the site and areas of aggregate application, production and licence option.

Offshore Wind Farms

There are five offshore wind farms within a 30km distance of the TKOWF site as shown in **Table 3.1**, with the three closest in bold:

Table 3.1 Offshore Wind Farms in the vicinity of TKOWF

Site	Operator/Developer	Status	Distance (km) from TKOWF site
Race Bank	**Ørsted**	**Partial Generation/ Under Construction**	**11.0**
Lincs Offshore	**Ørsted**	**Fully Commissioned**	**25.7**
Sheringham Shoal	**Statoil**	**Fully Commissioned**	**26.4**
Dudgeon	Statoil	Fully Commissioned	26.7
Humber Gateway	E.ON UK renewables	Fully Commissioned	28.9

Marine Aggregate Extraction

There are 14 areas of operational marine aggregate extraction within the vicinity of the scheme (between 0-48km distance), with aggregate extraction activities occurring immediately to the south of the TKOWF site.

Subsea Pipelines

There are two active pipelines within 0.5km of the site, and that bisect the site as shown in **Figure 3.4**. There is the PL816/ PL817 24 inch gas pipeline and 3 inch methanol pipeline between Pickerill to Theddlethorpe and the PL929 26 inch gas pipeline and 4 inch methanol pipeline between Theddlethorpe and Murdoch MD.

Oil and Gas

There are 12 oil and gas fields between 6.3km and 18.3km from the site. These are either in exploration, operating or under development, and another with a licence to explore blocks awarded in September 2010.

Telecommunications

There are four operational telecommunications cables which cross the site:

- Pickerill A to Sutton-on-Sea Tower – Perenco UK Ltd;
- Pickerill B to Sutton-on-Sea Tower- Perenco UK Ltd;
- Location A (Carrack North) – Shell UK Exploration and Production Ltd; and
- Location B (Cutter QC) - Shell UK Exploration and Production Ltd.

Table 3.2 Other marine users distance from TKOWF

Activity	Project Details	Developer	Distance (km) from TKOWF
Marine Aggregate Extraction	Area 515/1	Westminster Dredging Ltd	0
	Area 354	Cemex UK Marine	3.4
	Area 105	Cemex UK Marine	4.3
	Area 441 (1)	Westminster Dredging Ltd	5.6
	Area 106 (b)	Hanson Aggregates Marine Ltd	7.7
	Area 441 (2)	Westminster Dredging Ltd	9.1
	Area 106 (a)	Hanson Aggregates Marine Ltd	9.8
	Area 106 (c)	Hanson Aggregates Marine Ltd	10.2
	Area 197	United Marine Dredging	16.2
	Area 481 (1)	Tarmac Marine Dredging Ltd	18.3
	Area 481 (2)	Van Oord Ltd	20.5
	Area 107	Cemex UK Marine	23.1
	Area 102	Cemex UK Marine	24.4
	Area 408 (Coal Pit/ Sole Pit)	Hanson Aggregates Marine Ltd	48
Subsea Pipelines	PL816/PL817: Pickerill to Theddlethorpe 24 inch gas pipeline and 3 inch methanol line	Perenco UK Ltd	0.5
	PL929: Theddlethrope to Murdoch MD 26 inch gas pipeline and 4 inch methanol line	Conoco Phillips	0.5
Oil and Gas	Blocks 47/14c (exploration licence)	GDF Suez E&P UK Ltd	-6.3 (maximum overlap of 6.3 km)
	Block 47/19a	Bridge Resources E&P Ltd	-4.8 (maximum overlap of 4.8 km)

Activity	Project Details	Developer	Distance (km) from TKOWF
	Block 47/15a (Amethyst field)	BP Exploration Operating Company Ltd	-0.5 (maximum overlap of 500m within block 47/15a)
	Block 47/14b	GDF Suez E&P UK Ltd	0
	Juliet well	GDF Suex E&P UK Ltd	2.2
	Amethyst B1D (normally unmanned installation (NUI))	BP Exploration Operating Company Ltd	2.8
	Amethyst A1D (NUI)	BP Exploration Operating Company Ltd	9.3
	Amethyst A2D (NUI)	BP Exploration Operating Company Ltd	9.8
	Pickerill A (NUI)	Perenco UK Ltd	12.6
	Amethyst C1D (NUI)	BP Exploration Operating Company Ltd	15
	Pickerill B (NUI)	Perenco UK Ltd	15.9
	Guinevere	Perenco UK Ltd	18.3
Telecommunications	Pickerill A to Sutton-on-Sea Tower	Perenco UK Ltd	0
	Pickerill B to Sutton-on-Sea Tower	Perenco UK Ltd	0
	Location A (Carrack North)	Shell UK Exploration and Production Ltd	0
	Location B (Cutter QC)	Shell UK Exploration and Production Ltd	0

3.4.5 Aviation

The Greater Wash area and the area around TKOWF support existing civil and military aviation activity. The oil and gas industry in the region uses helicopters to service offshore platforms, whilst the wider area is subject to radar surveillance by civil and military aviation radar.

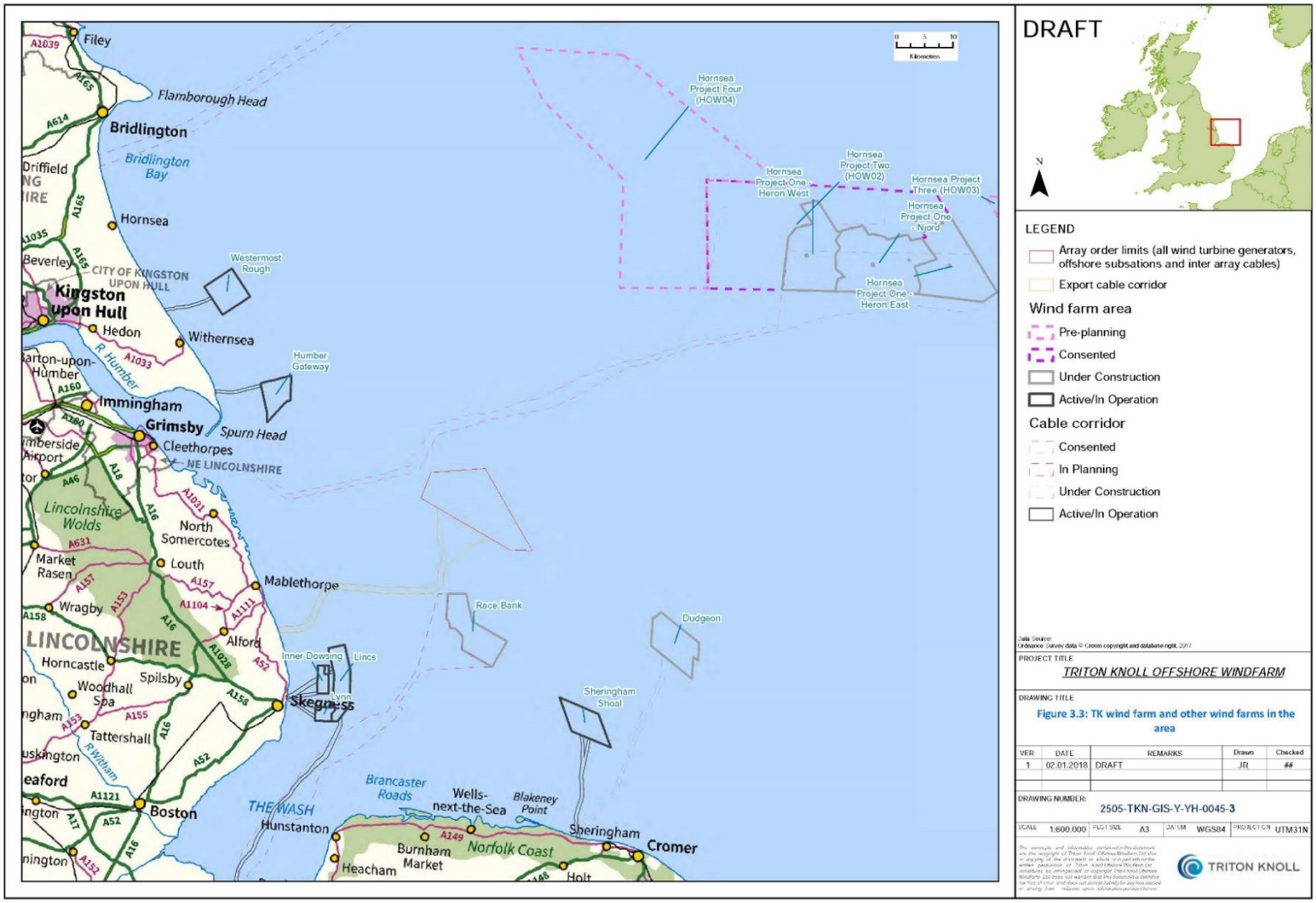


Figure 3.3 TKOWF and other wind farms in the area

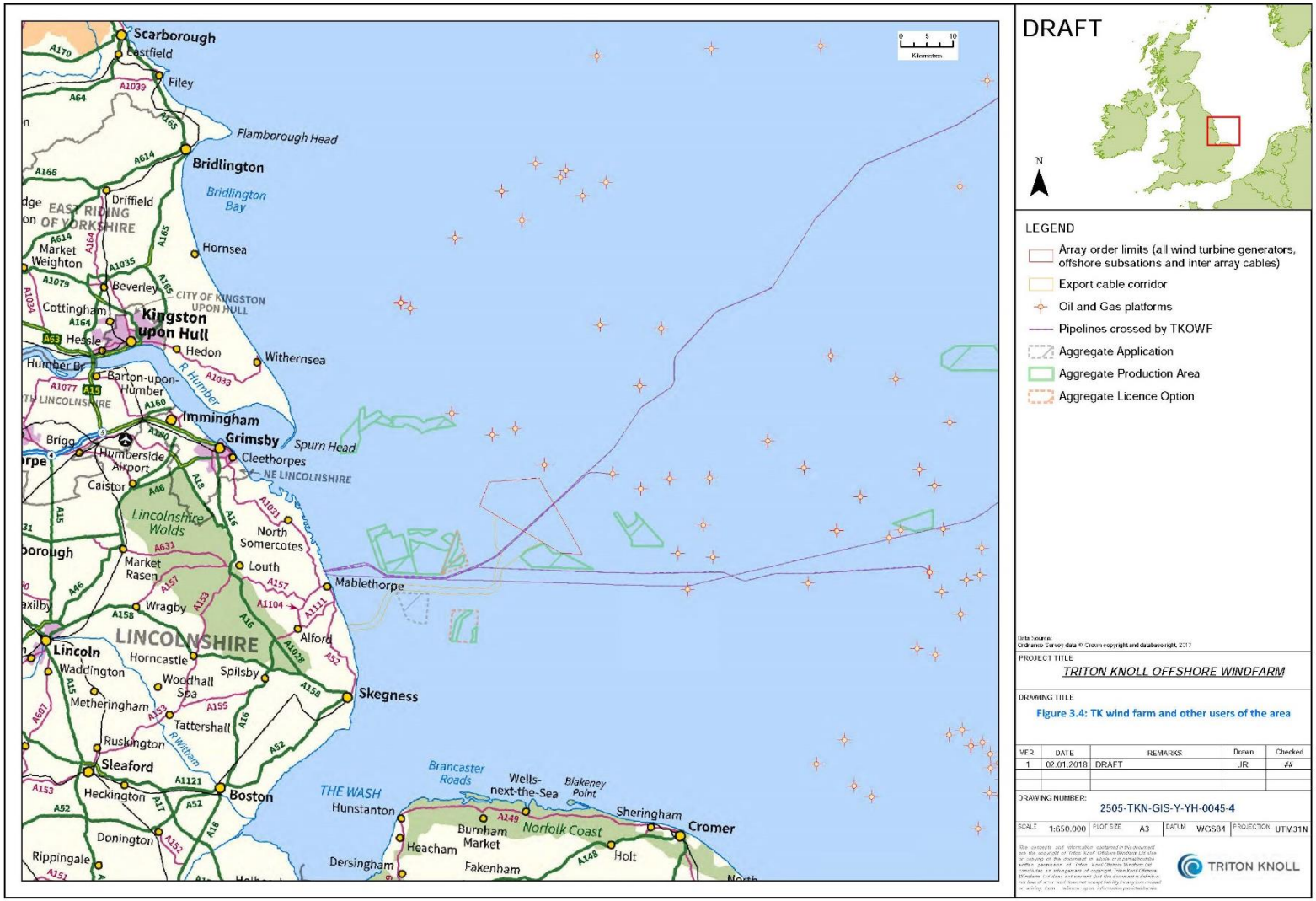


Figure 3.4 TKOWF and other users of the sea

4 ITEMS TO BE DECOMMISSIONED

This section of the Decommissioning Programme contains details of all items which TKOWFL believes will form part of the scope of future offshore decommissioning works at TKOWF, in particular the WTGs, foundations, OSPs, export cables, inter-array cables and scour protection. No meteorological monitoring mast is being erected for TKOWF. At the time of writing, some design details such as final, as built locations of infrastructure (e.g. due to micro-siting to avoid environmental and engineering constraints) are not finalised. These details will be updated in future revisions of this Decommissioning Programme.

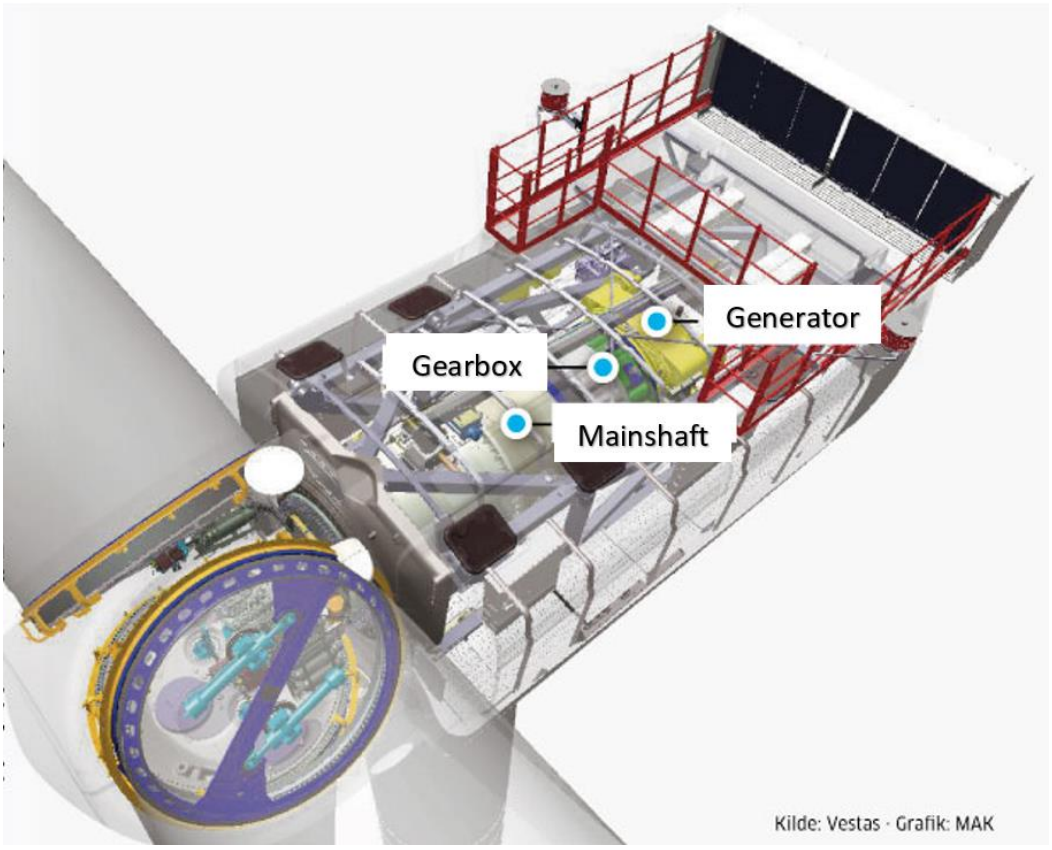
4.1 Generation Assets (Non-OFTO)

Responsibility for the decommissioning of these assets will remain with the generator for the lifetime of the Project.

4.1.1 WTGs

TKOWF will comprise of 90 up to 10MW WTGs, as shown in **Figure 4.1**. The towers will be constructed from three sections bolted together, with internal service platforms and ladders. The rotor diameter will be up to 164m with blades made from glass reinforced epoxy with balsa wood. The nacelle contains a generator, transformers and other equipment. There will be a heli-hoist platform on top of the nacelle for maintenance and emergency access. Each turbine consists of the following components:

- A tubular steel tower;
- A nacelle on top of the tower;
- A three blade rotor with an approximate diameter of 164m; and
- A maximum blade tip height of 220m LAT.

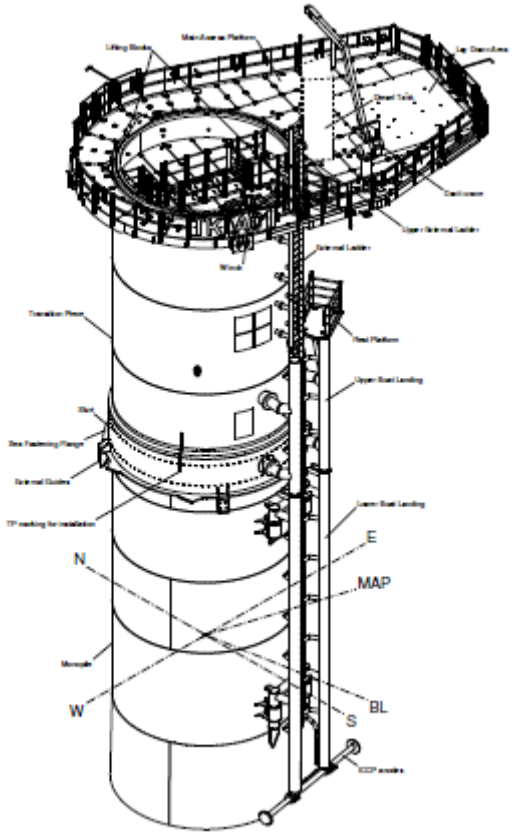


Source: Ingeniøren Newspaper 30. August 2013 – V164 Nacelle Layout

Figure 4.1 Offshore Wind Turbine Generator

4.1.2 Foundations

Each WTG will be installed using a monopile foundation. A transition piece, fixed to the top of the monopile will allow personnel to access the turbine for maintenance. Dimensions of the monopile are provided below in **Table 4.1**.



Mini-FEED Foundation Concept

Table 4.1 Monopile dimensions

Dimension	Approximate measurement
Top diameter	6.5m
Bottom diameter	6.9m
Seabed penetration	20 – 30m

4.1.3 Scour Protection

The final approach to scour protection has not yet been finalised but the base case is that scour protection will be applied to up to 40% of the turbine locations. This will consist of two layers – an armour layer and a filter layer as shown in **Figure 4.2**. The piles will be driven through the scour protection material, which means there will be some rock material infill within the lower section of the pile.

It is anticipated that all of the scour protection at the turbine positions will be left *in situ* unless otherwise agreed with the authorities.

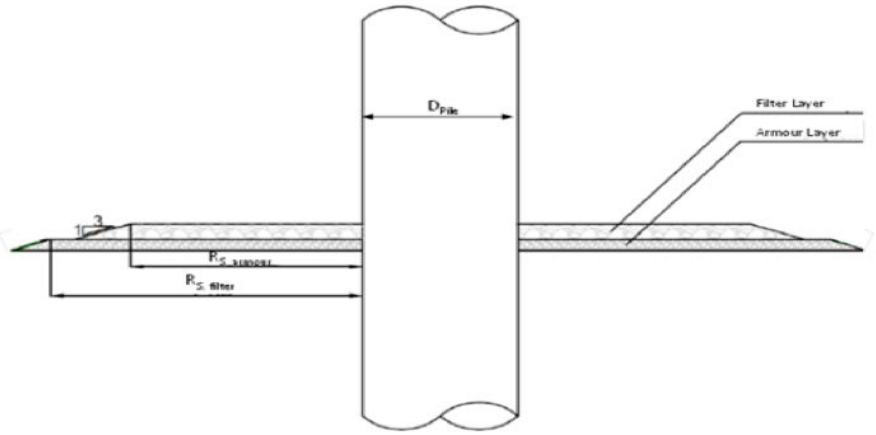
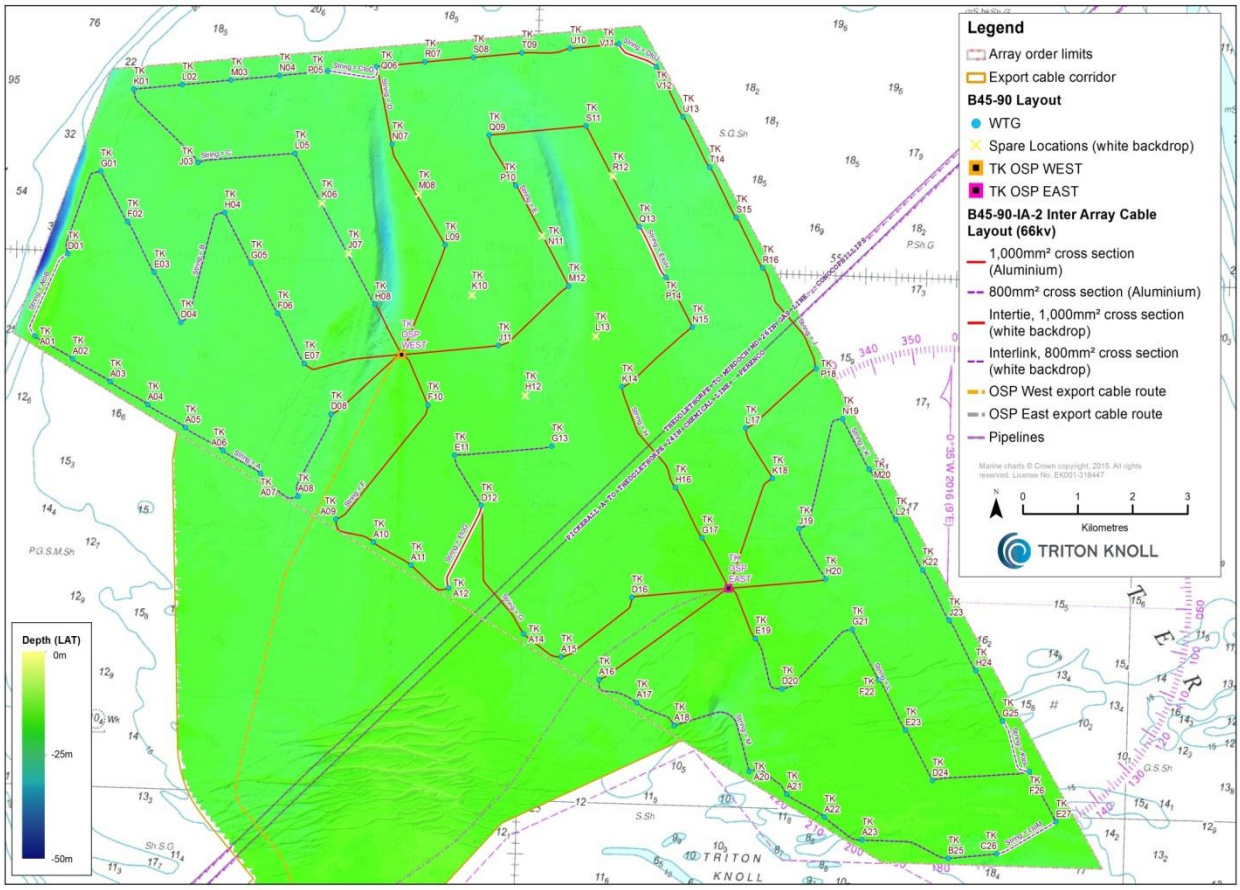


Figure 4.2 Scour Protection Profile

4.1.4 Inter-Array Cables

There will be 131km of 66kV inter-array cables to link the WTGs and the OSPs, with five or six turbines per string. An inter-array cable may have a crossing over a high pressure gas pipeline that exports to Theddlethorpe Gas Terminal, although there is the potential that this pipeline will be decommissioned prior to the TKOWF construction.



Source: Electrical Inputs for Layout B45-90 Yield Analysis from Sgurr Energy, December 2017

4.2 Offshore Transmission Assets

These assets will be transferred to the OFTO along with the responsibility for decommissioning.

4.2.1 Offshore Substation Platforms

The wind farm comprises two OSPs, which will be installed upon monopile foundations. Each offshore substation is equipped with a single 420 MVA offshore 2-winding transformer to step up the 66kV offshore voltage from the array cable to 220kV voltage level. Other equipment includes 175kVA Auxiliary transformer, 66kV and 220kV GIS switchgear, 43MVA Reactor and temporary diesel generator (**Figure 4.3**).

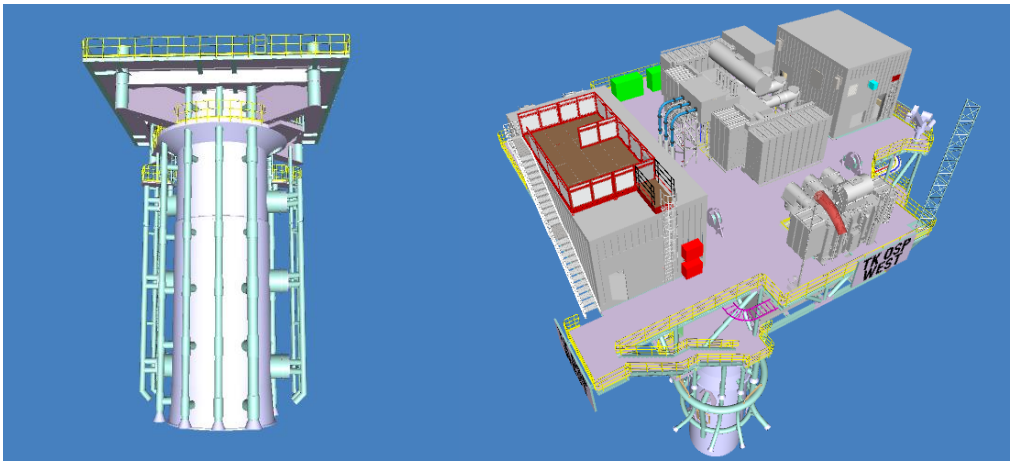


Figure 4.3 OSP Schematic

4.2.2 Export Cables and Pipeline Crossing

Two 220kV offshore export cables consisting of three copper cores and with a diameter of 1000mm^2 will run approximately 50km to the landfall north of Anderby Creek, Lincolnshire (Figure 4.4).

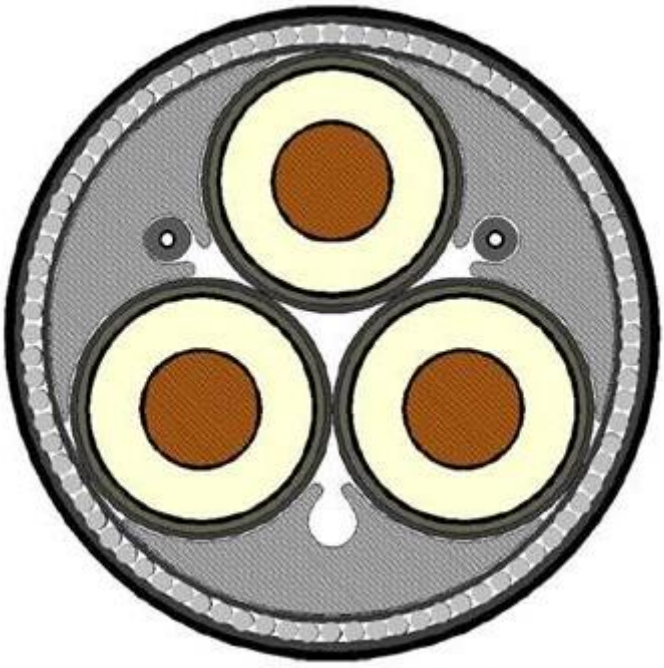


Figure 4.4 Submarine cable design with aluminium armouring (not to scale)

Both export cables will cross the gas pipeline (see **Section 3.4.4** and **Figure 3.4)**. The crossing is assumed to be partially embedded into the seabed, with 125 concrete mattresses overlaying the pipeline area in up to four layers.

5 PROPOSED DECOMMISSIONING MEASURES

This section of the report describes the proposed measures that will be taken to decommission the component elements of TKOWF. Given the construction of TKOWF has yet to take place, some detail is subject to final design, for example confirmation of the built locations of cables and where scour protection has been placed. Nevertheless, the following sections of this report set out the general principles that are anticipated toward decommissioning of the TKOWF components. Future iterations of this report will provide further detail when available. The decommissioning techniques outlined in this section are those which are currently available. Should future decommissioning techniques not currently foreseen become available, TKOWF could propose these alternative means rather than the methods outlined below.

5.1 Guiding Principles

The wind farm will be built in a way that enables it to be decommissioned at the end of its operational lifetime. The proposed approach is that all structures above the seabed i.e. wind turbines and offshore substations will be completely removed. The cables and the lower part of the monopiles beneath the seabed are assumed to be left *in situ,* pending the outcome of the necessary consultation and assessments as may be required at the time of decommissioning and the risk of the cables becoming exposed is minimal. This approach has been chosen to minimise disturbance of the seabed from decommissioning whilst ensuring there is no risk to the safety of other users or that the materials will become exposed at any future time.

The following decommissioning measures have been proposed based on the known technology available today and have been proposed with regard to:

- The Best Practicable Environmental Option (BPEO);
- Safety of surface and subsurface navigation;
- Other users of the sea; and
- Health and safety considerations.

Components to be left *in situ* following decommissioning will be in accordance with the standards set out by the International Maritime Organisation (IMO), which consider the following matters:

- Any potential effect on the safety of surface or subsurface navigation, or of other uses of the sea;
- The rate of deterioration of the material and its present and possible future effect on the marine environment;
- The potential effect on the marine environment, including living resources;
- The risk that the material will shift from its position at some future time;
- The costs, technical feasibility, and risks of injury to personnel associated with removal of the installation or structure; and
- The determination of a new use or other reasonable justification for allowing the installation or structure or parts thereof to remain on the sea-bed.

In addition to the guidance set out above, the decommissioning will be undertaken in accordance with the following legislation and guidance:

- Decommissioning of Offshore Renewable Energy Installations under the Energy Act 2004: Guidance notes for Industry, DECC, January 2011;
- 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, DECC;
- OSPAR guidance documents on offshore wind farms;
- Guidelines for Environmental Risk Assessment and Management, Defra, September 2002;
- United Nations Convention on the Law of the Sea (UNCLOS), 1982;
- Hazardous Waste Regulations 2005;
- Marine and Coastal Access Act 2009;
- The Water Resources Act 1991;
- The Conservation of Habitats and Species Regulations 2010;
- The disposal or recovery of waste on land, principally under Part II of the Environmental Protection Act 1990, other legislation relating to the carriage and transfer of waste and, where appropriate, the Hazardous Waste Regulations 2005; and relevant health and safety legislation;
- London Convention 1972 and the 1996 Protocol, relating to the prevention of marine pollution by dumping of wastes;
- Construction (Design and Management) Regulations (CDM) 2015; and
- Appropriate H&S Regulations.

5.2 Pre-Decommissioning

Prior to starting decommissioning, reviews of the regulations and Environmental Impact Assessment (EIA) requirements will be undertaken, consultations carried out with local and statutory bodies and relevant consents and a marine licence will be obtained. Discussions will be held to ensure interfaces are addressed, in particular with the TKOWF OFTO. Where practicable, synergies will be identified, such as sharing of onshore facilities and guard vessels. Disposal facilities will be identified and developed if necessary in collaboration with specialist industrial recyclers.

5.2.1 Asset Shut-Down

There will be a progressive shut down of WTGs, working on a 'string by string' basis. Some turbines may continue to generate while others are being decommissioned.

The structural integrity management programme will ensure that the asset structures are fit for their intended purposes at all times. A full visual/ drone inspection of all WTG and OSP structures will be undertaken at the end of the Operations and Maintenance phase, to identify and correct any gross damage, deformation or other factors that could impact their capacity in lifting and transportation.

It is likely that shut-down will include:

- Orientation of the blades to the preferred position for removal;
- Electrical isolation and disconnection of cable terminations;
- Severing cables at pre-determined positions; and
- Removal or bracing of loose items.

In order to minimise the time on site for the crane vessel, the OSPs will be shut-down by:

- Electrical isolation;
- Removal of loose objects;
- Separation of monopile cabling;
- Internal sea-fastening;

- Inspection and renovation of lift points; and
- Preparation of access platforms for rigging and cutting operations.

5.2.2 Subsea Survey

Any exposed or other cable issues will be identified and rectified in the regular, through-life, inspection and maintenance programme. A full baseline seabed survey along all cable routes and around each monopile will be undertaken during the pre-decommissioning phase to identify:

- Exposed cable sections; and
- Seabed level changes around monopiles.

The survey will be undertaken with multi-beam transponders towed from a survey boat. An inspection-class ROV can be deployed to inspect any high criticality areas, for which visual information would be beneficial.

Based on the outcomes of these surveys, the final methodology for decommissioning will be agreed.

5.2.3 Ports, Logistics and Disposal/ Recycling Facilities

Arrangements will be made with ports, yards and recycling companies, for mobilising personnel and equipment to the offshore operations, and for receiving removed equipment and structures. Current possibilities include the following East Coast English ports:

- Port of Blyth;
- Port of Tyne;
- Teesside;
- Seaton;
- Grimsby;
- Humber;
- Lowestoft;
- Great Yarmouth; and
- Harwich.

There are also plans for the Port of Hull to develop a dedicated renewables facility (“Green Port”), which would be well positioned to support the decommissioning works.

5.3 Decommissioning

5.3.1 Generation Assets (Non-OFTO)

Responsibility for the decommissioning of these assets will remain with the generator for the lifetime of the Project.

5.3.1.1 Wind Turbine Generators

Overview

Dismantling of the 90 WTGs will be undertaken as a reverse of the installation process. Blades, nacelles and towers will be disassembled using a jack-up crane vessel and set down on the vessel’s back deck to be shuttled to the onshore disposal facility. Between each shore-to-shore rotation of the crane vessel, multiple WTGs will be dismantled.

The WTGs will be shut down, electrically isolated and made ready for dismantling prior to arrival of the crane vessel on site. Cables will be pre-cut at selected positions to allow the WTG components to be separated. Lubricant oil will be left contained in the gearboxes for processing onshore.

Bolted connections will either be loosened manually or cut. The blades and turbines will be sea-fastened on re-usable grillages on the back deck of the crane vessel.

To minimise the need to shuttle the crane vessel to the disposal yard, maximum use will be made of the vessel's back deck. Welding work will be minimised offshore as sea-fastening arrangements will be designed to be adaptable to varying geometrics.

The following operational sequence in Table 5.1 is estimated.

Table 5.1 Estimated Operational Sequence

No.	Activity
1	WTG prepared in advance
2	Vessel arrives on location
3	Transfer personnel to WTG for operations Start unbolting blades Final preparations for lifting Prepare blade tool Jack unit to work height
4	Rig up blade 1, complete unbolting. Lift and set down, sea-fasten and rotate blade 2 into position
5	Rig up blade 2, unbolt, lift set down, sea-fasten and rotate blade 3 into position
6	Rotate blade 3. Rig up, unbolt, lift, set down, sea fasten
7	Rig up nacelle, unbolt, lift, set down, sea fasten
8	Rig up tower, unbolt from transition piece, lift, set down, sea fasten
9	Inspect flanges Install navigation aids onto transition piece
10	Transfer personnel and materials to jack-up
11	Jack down

Crane Vessel

A jack-up crane vessel will be used to provide the required hook stability at height when removing the blades and nacelles. The unit will shuttle remove WTG to shore for offloading.

The estimated hook height will be 132m above LAT, which is required for the nacelles, with a factored lift force of up to 520 tonnes for the towers. The jack-up crane vessel is also required to include:

Self-propelled, dynamically positioned;
Able to approach and position in water depths of 15m;
Able to jack to required air gap in up to 22m of water, with an allowance for soil penetration; and
Space and capacity on back deck to carry dismantled WTG sets for shipment to shore.

A required deck space of 445m^2 is estimated per set of WTG components, if the towers and blades can be carried vertically. There will also be allowance for working areas, bracings and other stowed items.

Materials and equipment will be collected from shore between rotations.

Offshore Spread

Rigging

A lifting frame will be used for each blade to allow them to be held before cutting the bolts. The frame needs to attach to the blades in various orientations and be able to adapt to deviations from the expected centre of gravity, as shown in **Figure 5.1**.

Figure 5.1 Illustrative Blade Frame (source: Siemens Website)

Nacelles and towers will be lifted from existing lift points with four and two-point sling arrangements, respectively.

Grillage and Sea-fastening

A re-usable, variable grillage design is needed for set down and transit. In order to reduce excursions to the shore, maximum use will be made of the deck space and carrying capacity.

Key features of the grillage include:

- Blades will be stored in a racking arrangement;
- Nacelles will be set down into steel cradles and chain lashed. Their flanges may be used to sea-fasten the bases, either with clamps or by bolting; and
- Towers will be docked vertically into a grillage structure, which provides bearing support and horizontal restraint at the footings. The towers will be clamped and/or bolted through the base flanges.

5.3.2 Monopiles and Transition Pieces

Overview

Transition pieces and monopiles will be removed in combined lifts with the two parts connected. The proposed method requires the monopiles to be cut in two places. The first section is cut 3m above the mudline, and the transition pieces and monopile will then be lifted off. A second cut is made at such a

depth below the surface of the seabed that the remaining parts do not pose a danger for shipping or fishing vessels, even if sediments should become relocated, and the section removed. The level of this cut will be determined following the seabed surveys (**Section 5.2.2**). The remaining sections of monopiles below the cut will be left *in situ* as there is no appropriate technology for their removal and is likely to involve extreme costs to attempt to remove them. In addition, this will avoid unnecessary disruption of the seabed. The second cut line may vary between WTGs, as there is the potential for sand wave mobility. Following the surveys, a risk assessment will be carried out to determine the level of the cut, to ensure the likelihood of exposure of any remaining infrastructure to be negligible.

A specialist lift tool, e.g. an electro-hydraulic lifting tool, will engage the flange at the top of the monopile.

Flanges must be preserved through the life of the asset and during WTG removal, as they are primary structural connections.

Before lifting, cables will need to be separated from the structure, if necessary by cutting inside the transition piece. Once the allowable number of monopile and transition piece sections have been removed, the crane vessel will transit to the disposal yard for offloading.

The following operational sequence in **Table 5.2** is estimated.

Table 5.2 Estimated Operational Sequence

No.	Activity
1	Unit arrives on location
2	Transfer personnel to transition piece for operations Jacking unit to work height Removal of navigational aids Prepare lift tool
3	Deploy external cutting spread (3 heads)
4	Deploy lift tool and engage into monopile/transition piece flange
5	Cut monopile above seabed
6	Lift transition piece + monopile, set down
7	Retrieve cutting spreads Commence sea-fastening of monopile + transition piece
8	Deploy excavation kit Ongoing monopile + transition piece sea-fastening
9	Extract seabed materials from monopile Machine slots for lift points on monopile stub Complete monopile + transition piece Sea-fastening Prepare stub lift tooling
10	Deploy internal cutting spread (3 heads)
11	Cutting, engage lift rigging, lift and set down stub
12	Retrieve cutting spread Stub sea-fastening
13	ROV inspection
14	Jack-down Complete sea-fastening

Monopile Cutting
For the external cut, a guide band manipulator will be used to move the cutting head(s) around the circumference of the pile; and for the internal cut, the tool(s) will be lowered into the pile with a centralising tool, deployed by Remotely Operated Vehicle (ROV).

Cable Cutting
The cabling will need to be cut in the region of the interface with the monopile, prior to the second lift. A diamond wire rig can be deployed, using the ROV.

5.3.3 Inter-Array Cables

Overview
It is expected that after 24 years, it will be the most practicable environmental option to leave cables *in situ*, except where they are exposed by the removal of monopiles or the mobility of the seabed. Where the cables have been buried, over the 24 year lifetime of the Project, the seabed would have recovered to its condition prior to work starting. Where the cable has remained buried, the potential impact to the marine environment and costs of removing the cable are minimal and therefore represent the best option for decommissioning.

Studies and inspections will be undertaken towards the end of life, in order to identify the sections that are exposed, or at risk of exposure, and so require to be removed. Removal of the cables will be carried out should they be exposed and present a danger to navigation or fishing vessels. On decommissioning there will be exposure of cable ends at the foundation locations and OSP. These cable ends will be weighted and deposited on the seabed where natural processes will bury them over time.

5.3.4 OFTO Assets

These assets will be transferred to the OFTO along with the responsibility for decommissioning.

5.3.4.1 Offshore Substation Platforms – Topsides

Overview
The OSPs will be installed onto a monopile and transition piece of comparable dimensions to the turbine foundations, with 'cow horn' interfacing structures on the top of the transition piece (see Figure 4.3). The two topside structures will be removed in one mobilisation using a suitable crane vessel. If a vertical lift strategy is adopted using the pad-eyes on the upper topside deck (as per construction) a temporary steel structure to support the lifting spreader frame may need to be constructed in order to rig the spreader frame safely to the topside. The topside structure will be lifted using the spreader frame onto a specially designed grillage on vessel barge, before shipping to the offloading port. Following topside removal, the OSP monopiles and transition pieces will be removed in the same way as the removal of the WTG foundations.

The topside and cable deck will be separated from the transition piece at the interface which comprises four welded cow horn structures. As the cable deck is an integral part of the transition piece; this will be removed during foundation decommissioning after the topside lift.

Main offshore substation components will be removed at the quayside or yard for disposal.

The offshore sequence for topside removal is below in Table 5.3.

Table 5.3 Estimated Offshore Sequence

No.	Activity
1	Topsides prepared in advance
2	Transit to field
3	Unit arrives on location, sets up on DP
4	Transfer personnel to first OSP
5	Deploy & install 4 sets of diamond cutting rigs Rig up lift points
6	Cut 4 supporting cowhorn structures
7	Break out topside, lift and set down
8	Start sea-fastening Install navigation marks Inspect lift points on cow horns
9	Retrieve cutting equipment Transfer personnel to crane vessel Ongoing sea-fastening
10	Transit second OSP Set up on DP Complete sea-fastening OSP1
11	Transfer personnel to second OSP
12	Deploy & install 4 sets of diamond cutting rigs Rig up lift points
13	Cut 4 supporting cowhorn structures
14	Break out topside, lift and set down
15	Start sea-fastening OSP2 Install navigation marks Inspect lift points on cow horns
16	Retrieve cutting equipment Transfer personnel to crane vessel Ongoing sea-fastening
17	Complete sea-fastening
18	Transit Offloading Port

As an alternative, the topside and cable deck may be separated from the TP below the Cable Deck level. In this scenario the topsides and cable decks will be separated from the TP at the interface with the cow horn structures. This combined Topside/cable deck structure will be lifted onto a barge. The TP will then be un-bolted or cut to allow removal of the TP. The TP and monopile may be removed using either the vessel used for topside removal or the vessel used for WTG foundation removal.

The connection between the OSP topsides and the cable decks would need to be reinforced, prior to removal, to allow the two parts to be lifted together.

Crane Vessel

With a single mobilisation, separate grillage and rigging arrangements will be required, and therefore a separate vessel would need to be selected. Whereas the piecemeal approach would utilise the WTG or foundation removal vessels.

The requirements of the crane vessel are:

- Self-propelled, dynamically positioned;
- Able to approach and position in water depths of 15m;
- Lift capacity of 1500 tonnes at height of 40m above grillage top and
- Space and capacity on back deck to carry two OSP topsides for shipment to shore. Estimated requirement of 1000m^2.

5.3.4.2 Offshore Substation Platforms – Monopiles and Transition Pieces

As the monopiles for the OSPs will have similar dimensions to the WTG foundations, broadly the same removal process will be adapted. This will involve cutting the monopiles below the seabed level and leaving the foundations in place. However, conventional rigging and lifting arrangement will be used for the cow horn structures, rather than the electro-hydraulic lift tool deployed for the WTG transition pieces.

Another difference is that the monopiles will have 14 J-tubes (7 per OSP) and associated J-tube cages, rather than the two cable entry points for the WTG foundations. |The J tube cage rests on trunnions on the monopile. The cables will be severed prior to the removal of the transition piece. There may need to be some modifications to sea-fastening to accommodate the OSP transition pieces and J-tube cages. The J-tube cages will either be removed as a separate lift or secured to the monopile during lifting.

5.3.4.3 Export Cables and Pipeline Crossing

The export cables will be larger in diameter than the inter-array cables, otherwise their treatment will be the same. If cables are shown to be adequately buried by the surveys described in **Section 5.2.2**, they will be left *in situ*. This will minimise the impact on the marine environment as it is expected that the seabed will have recovered in the 24 year period following installation, and removal of the buried cable will cause unnecessary impacts. If required, cutting operations for the 220kV cables can be expected to take longer than for the 66kV sections.

There is a high-pressure gas pipeline that exports to Theddlethorpe Gas Terminal which crosses the export cable route. If this pipeline is still live in 24 years, then it is likely that the cable protection will be left *in situ* whilst the pipeline is operational but this will be dependent on the cable crossing agreements that are made between TWOFL and the pipeline owners.

During the lifetime of the Project, it is expected that the mattresses will have been colonised by a variety of marine organisms, which would be disturbed by the removal operations. Therefore, it may be environmentally preferable to leave them *in situ* or to reduce them to rubble and remove only the other materials. Surveys will be undertaken prior to decommissioning and discussions held with stakeholders to agree the most appropriate approach at the time of decommissioning.

5.4 Waste Management

Waste management will be carried out in accordance with the relevant legislation at the time of decommissioning and will have regard to the waste hierarchy which suggests that reuse should be considered first, followed by recycling, incineration with energy recovery and lastly disposal. TKOWFL expects significant scrap value arising from sale of steel and copper, reducing the net decommissioning costs and therefore sale of scrap material will be prioritised.

After offloading from the crane vessel, the materials will be trailered to a processing area, where they will be broken down into suitable sizes for recycling or disposal. It is assumed that:

- Carbon steel would be reduced to manageable sizes and sold as scrap;

- Copper wire would be removed from the WTGs and cables and sold as scrap; and
- Glass reinforced plastic would be recycled. It is anticipated that the current practice of disposing to landfill will not be acceptable at the time that the TKOWF is decommissioned.

A waste management plan will be drawn up prior to commencement of decommissioning.

6 ENVIRONMENTAL IMPACT ASSESSMENT

Two Environmental Impact Assessments (EIAs) were undertaken for the Project at the time of consent, one for the generating assets and the other for the transmission assets, with the results published in Environmental Statements (ESs) in 2013 and 2016, respectively. These EIAs included high level assessments of the potential environmental impacts of the Project during the construction, operational and decommissioning phases. A summary of the impacts from the decommissioning phase is provided in **Table 6.1**.

Table 6.1 Summary of decommissioning impact assessment

Topic	Magnitude of Impact	Significance of effect including designed in measures
Marine Physical Environment	Negligible to Minor	Minor/ Negligible – Not significant
Marine Ornithology	Minor (common scoter). Negligible (cormorant, guillemot and razorbill).	Minor (common scoter). Negligible (cormorant, guillemot and razorbill) – Not significant
Subtidal and Intertidal Ecology	Negligible	Negligible - Not significant
Fish and Shellfish	Negligible	Negligible - Not significant
Marine Mammals	Negligible	Negligible - Not significant
Offshore Nature Conservation	Negligible	Negligible - Not significant
Commercial Fisheries	Negligible	Negligible - Not significant
Shipping and Navigation	Tolerable to Unacceptable	Tolerable – Not significant
Other Marine Users	Negligible	Negligible - Not significant
Marine Historic Environment	Negligible to Minor	Negligible to Minor – Not significant

Overall, the majority of the impacts are reduced when leaving cabling *in situ*, rather than full removal.

TKOWFL will commission environmental studies as part of the decommissioning consenting process. The TKOWF decommissioning ES (or other similar environmental report) produced will supersede and replace the assessments presented in the original TKOWF ES and will take into account up to date information of both the environment in and around TKOWF and the decommissioning proposals.

As set out in DECC (2011) guidance, the decommissioning EIA should aim to:

- Identify and assess potential impacts on the environment, including exposure of biota to contaminants associated with component removals, other biological impacts arising from physical effects, conflicts with the conservation of species, with the protection of their habitats, or with mariculture, and interference with other legitimate uses of the sea;
- Identify and assess potential impacts on amenities, the activities of communities and on future uses of the environment; and

- Describe the measures envisaged to avoid, reduce and, if possible, remedy any significant adverse effects indicated.

The TKOWF decommissioning ES will ultimately identify potential impacts arising from the programme and, where these are considered significant, will propose appropriate mitigation measures. In addition, pre, during and post decommissioning monitoring programmes may also be considered appropriate and, where these are identified, will be developed in partnership with the appropriate regulatory bodies.

7 CONSULTATION WITH INTERESTED PARTIES

The opinions of the following organisations (or their equivalent) will be sought for drafting and reviewing the final decommissioning programme prior to decommissioning:

- Marine Management Organisation (MMO);
- Natural England;
- The Environment Agency;
- Historic England;
- Maritime and Coastguard Agency;
- Trinity House;
- The Crown Estate;
- National Federation of Fishermen's Organisation (NFFO);
- Eastern Inshore Fisheries Conservation Agency;
- Chamber of Shipping;
- Joint Nature Conservation Committee;
- National British Marine Aggregate Producers Association (BMAPA);
- Association of British Ports;
- Royal Yacht Association;
- Trinity House Lighthouse Service;
- East Riding of Yorkshire Council;
- Lincolnshire County Council; and
- Norfolk County Council.

The Decommissioning Programme will be made available to the general public though the website.

Following consultation, a summary of the comments and actions taken following receipt of any comments will be provided as an Appendix to this document. This will be updated as necessary following any reviews and updates to the Decommissioning Programme through the lifetime of the Project.

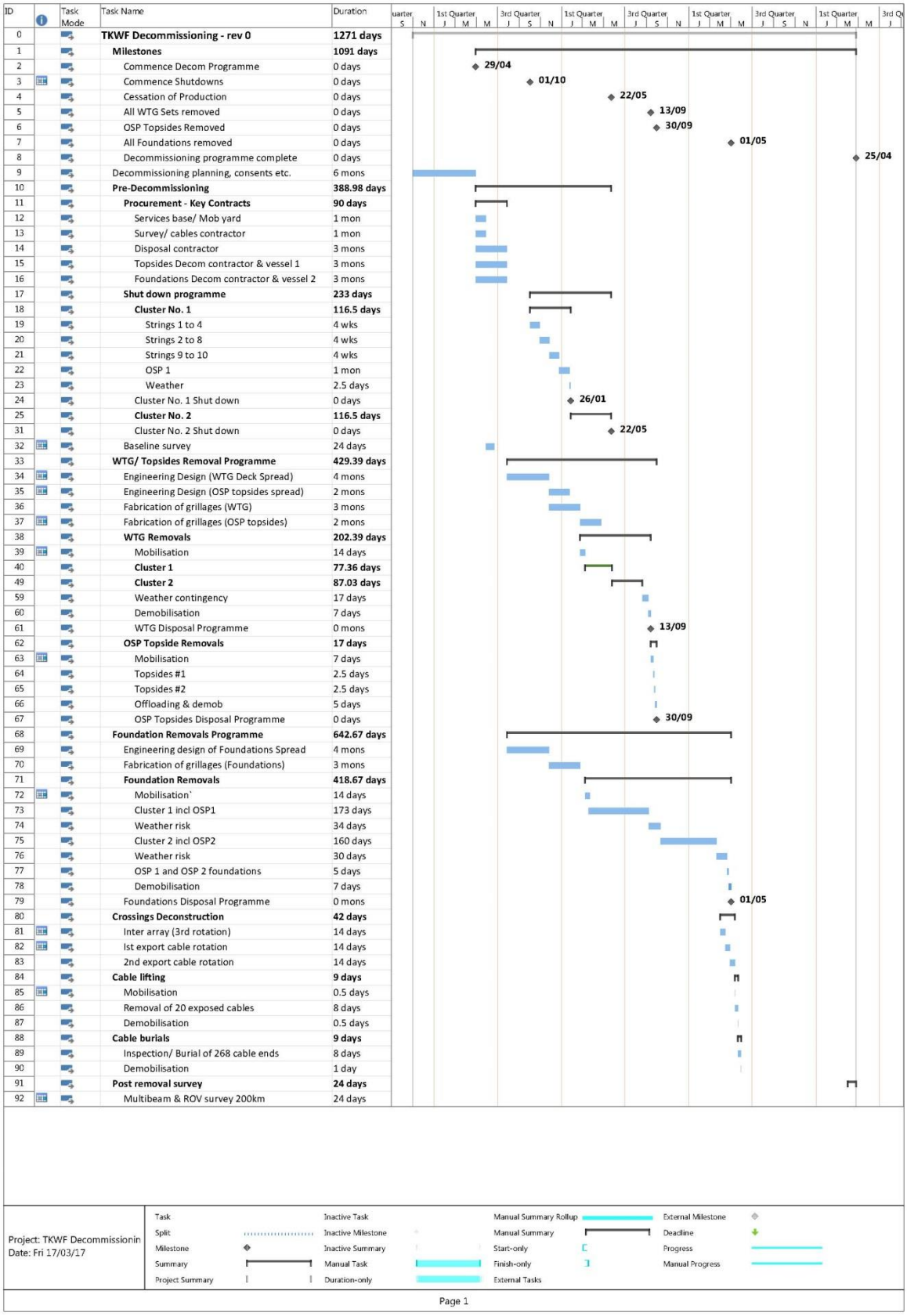
Regarding the local marine industry, Notices to Mariners will be issued before the start of the decommissioning phase.

8 COSTS AND FINANCIAL SECURITY

Cost and financial security information is confidential and has therefore been provided to BEIS as a separate document entitled Appendix C & D.

9 SCHEDULE

An indicative schedule showing possible timescales for decommissioning is provided below. Due to the fact that no large scale offshore wind farms have been decommissioned to date, it is difficult to anticipate the operational challenges, costs and precise timings of the work. When further details are available on the timings, costs and technology available this schedule will be updated to reflect the proposed decommissioning approach.



ID	Task Mode	Task Name	Duration
0		**TKWF Decommissioning - rev 0**	**1271 days**
1		**Milestones**	**1091 days**
2		Commence Decom Programme	0 days
3		Commence Shutdowns	0 days
4		Cessation of Production	0 days
5		All WTG Sets removed	0 days
6		OSP Topsides Removed	0 days
7		All Foundations removed	0 days
8		Decommissioning programme complete	0 days
9		Decommissioning planning, consents etc.	6 mons
10		**Pre-Decommissioning**	**388.98 days**
11		**Procurement - Key Contracts**	**90 days**
12		Services base/ Mob yard	1 mon
13		Survey/ cables contractor	1 mon
14		Disposal contractor	3 mons
15		Topsides Decom contractor & vessel 1	3 mons
16		Foundations Decom contractor & vessel 2	3 mons
17		**Shut down programme**	**233 days**
18		**Cluster No. 1**	**116.5 days**
19		Strings 1 to 4	4 wks
20		Strings 2 to 8	4 wks
21		Strings 9 to 10	4 wks
22		OSP 1	1 mon
23		Weather	2.5 days
24		Cluster No. 1 Shut down	0 days
25		**Cluster No. 2**	**116.5 days**
31		Cluster No. 2 Shut down	0 days
32		Baseline survey	24 days
33		**WTG/ Topsides Removal Programme**	**429.39 days**
34		Engineering Design (WTG Deck Spread)	4 mons
35		Engineering Design (OSP topsides spread)	2 mons
36		Fabrication of grillages (WTG)	3 mons
37		Fabrication of grillages (OSP topsides)	2 mons
38		**WTG Removals**	**202.39 days**
39		Mobilisation	14 days
40		**Cluster 1**	**77.36 days**
49		**Cluster 2**	**87.03 days**
59		Weather contingency	17 days
60		Demobilisation	7 days
61		WTG Disposal Programme	0 mons
62		**OSP Topside Removals**	**17 days**
63		Mobilisation	7 days
64		Topsides #1	2.5 days
65		Topsides #2	2.5 days
66		Offloading & demob	5 days
67		OSP Topsides Disposal Programme	0 days
68		**Foundation Removals Programme**	**642.67 days**
69		Engineering design of Foundations Spread	4 mons
70		Fabrication of grillages (Foundations)	3 mons
71		**Foundation Removals**	**418.67 days**
72		Mobilisation`	14 days
73		Cluster 1 incl OSP1	173 days
74		Weather risk	34 days
75		Cluster 2 incl OSP2	160 days
76		Weather risk	30 days
77		OSP 1 and OSP 2 foundations	5 days
78		Demobilisation	7 days
79		Foundations Disposal Programme	0 mons
80		**Crossings Deconstruction**	**42 days**
81		Inter array (3rd rotation)	14 days
82		Ist export cable rotation	14 days
83		2nd export cable rotation	14 days
84		**Cable lifting**	**9 days**
85		Mobilisation	0.5 days
86		Removal of 20 exposed cables	8 days
87		Demobilisation	0.5 days
88		**Cable burials**	**9 days**
89		Inspection/ Burial of 268 cable ends	8 days
90		Demobilisation	1 day
91		**Post removal survey**	**24 days**
92		Multibeam & ROV survey 200km	24 days

10 PROJECT MANAGEMENT AND VERIFICATION

Once consultation is complete, the Decommissioning Programme will be finalised and submitted to the Secretary of State (SOS) before construction below Mean Low Water commences. However, this will be reviewed again towards the end of the operational phase, which will produce a Decommissioning Programme of Works including current knowledge of decommissioning methods, measures and timing. This will be made available for public comment. In addition, during the operational phase of the Project, the Decommissioning Programme will be reviewed at regular intervals to ensure it is still appropriate and reflects current guidance.

Following decommissioning, a Decommissioning Report, summarising how the Programme has been carried out will then be issued for approval from the appropriate regulatory authorities. This report should include:

- Confirmation that the approved Decommissioning Programme has been adhered to during the decommissioning works; otherwise, an explanation of any major variances from the programme; this includes information of actual costs of the works and an explanation of any major variances from the forecast costs;
- Information on the outcome of the decommissioning phase, including seabed clearance;
- Confirmation that relevant authorities have been notified, in case any elements of the development remain protruding from the seabed, of existence of such remains; and,
- Information of any appropriate aids to navigation have been installed, where required, to overcome risks posed by such remains.

Full details on the approach to project management and verifications will be provided prior to decommissioning occurring.

11 RESTORATION OF THE SITE

Evidence will be provided to confirm that the seabed at the TKOWF site has been restored to a state that is reasonably acceptable for the long term following decommissioning. Although the majority of the cables will remain *in situ*, any exposed areas will be removed and cable ends buried. Part of the monopiles from the WTGs and the OSPs will also be left *in situ*, to minimise seabed disruption.

Further details on how the site will be restored will be provided in the updated Decommissioning Programme towards the end of the Project's life.

12 POST-DECOMMISSIONING MONITORING, MAINTENANCE AND MANAGEMENT OF THE SITE

The requirement for post-decommissioning monitoring will be agreed in advance with the relevant authorities at the time of decommissioning based on the latest guidance. It should be noted that TKOWFL is required to apply to the MMO closer to the time for a Marine Licence for decommissioning activities, which are not consented under the Project's current consents and licences. It is at this stage that the specific details of the methods and details of any monitoring will be agreed with the relevant authorities and their consultees.

13 REFERENCES

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