Hornsea Project Four

Outline Offshore Operations and Maintenance Plan

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Revision Summary

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01	29 March 2022	Hannah Towner-Roethe, Orsted	Keith Lynch, Orsted	Julian Carolan, Orsted
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Revision Change Log

Rev	*Page*	*Section*	*Description*
01	N/A	N/A	Submitted at Deadline 2.
02	8	Table 3	Further detail added to cable protection replacement
02	6-11	Table 3	Formatting error corrected
03	3-12	Section 3	Updated to reflect red throated diver best practice protocols

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Glossary

Term	Definition
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
Hornsea Project Four offshore wind farm	The term covers all elements of the project (i.e. both the offshore and onshore). Hornsea Four infrastructure will include offshore generating stations (wind turbines), electrical export cables to landfall, and connection to the electricity transmission network. Hereafter referred to as Hornsea Four.
Maximum Design Scenario (MDS)	The maximum design parameters of each Hornsea Four asset (both on and offshore) considered to be a worst case for any given assessment.
Scour protection	Protective materials to avoid sediment being eroded away from the base of the offshore foundations as a result of the flow of water.
Wind turbine generator	All the components of a wind turbine, including the tower, nacelle, and rotor.

Acronyms

Term	Definition
CTV	Crew Transport Vessel
DCO	Development Consent Order
JUV	Jack Up Vessel
ROV	Remotely Operated Vechicle
RTD	Red Throated Diver
SOV	Service Operation Vessel
WTG	Wind Turbine Generator

1 Introduction

1.1.1.1 This document provides a description of the reasonably foreseeable maintenance activities at Hornsea Four. This information is taken from the document **A1.4 Project Description** and will subsequently inform the Operation and Maintenance Plan for Hornsea Four which shall be developed post-Consent. Maintenance activities can be categorised into two levels: preventive and corrective maintenance:

- Preventative maintenance will be undertaken in accordance with scheduled services; and
- Corrective maintenance covers unexpected repairs, component replacements, retrofit campaigns and breakdowns.

1.1.1.2 A full definition of maintain is provided in **C1.1 draft DCO including DML,** Interpretations. Maintain includes inspect, upkeep, repair, adjust, and alter and further includes remove, reconstruct and replace, to the extent assessed in the respective receptor chapter of the ES or HRA.

1.1.1.3 Details of licensed marine activities are set out in Schedule 11 and Schedule 12 of **C1.1**.

1.1.1.4 Some activities which could be needed in the operation and maintenance phase of Hornsea Four have not been included in this application as it is considered that these would be best applied for later, if needed, once specific details of the requirements are understood. These activities are not included here as they are currently not reasonably foreseeable.

1.1.1.5 This document also secures the Applicant's commitment to a best practice protocol for red throated diver and common scoter during the operation and maintenance of Hornsea Four.

2 Offshore Operations and Maintenance Activities

2.1.1.1 The overall operation and maintenance strategy will be finalised once the operation and maintenance base location and technical specification of Hornsea Four are known. The offshore operation and maintenance will be both preventive and corrective. However, as more knowledge has been gained in operation and maintenance over the last years, the industry is developing and improving monitoring and preventive maintenance of operational windfarms.

2.1.1.2 The general operation and maintenance strategy may rely on an onshore (harbour based) operation and maintenance base, Crew Transport Vessels (CTVs), Service Operation Vessels (SOVs), offshore accommodation, supply vessels, cable and remedial protection vessels, vessels and helicopters for the operation and maintenance services that will be performed at the project. The final operational and maintenance strategy chosen may be a combination of the above solutions.

2.1.1.3 The maximum design parameters for general operation and maintenance activities are presented in Table 1. The total operational vessel and helicopter requirements for Hornsea Four are presented in **Table 2**.

Table 1: Maximum design parameters for general offshore operation and maintenance activities.

Parameter	Maximum Design Parameters
Operation and maintenance vessels - CTVs:	10
Operation and maintenance vessels - SOVs	2
Operation and maintenance vessels - supply vessels	Ad hoc
JUVs	Ad hoc
Operational hours	24 hours, seven days a week

2.1.1.4 Two scenarios for personnel visits options are currently envisaged, either Scenarios [A] (operation and maintenance from onshore helicopter base) or [B] (wind turbine generator operation and maintenance from offshore base or vessel with helicopter personnel transfer).

Table 2: Maximum design parameters for total offshore operation and maintenance activities.

A single visit comprises a return trip to and from the Hornsea Four array area.

Parameter	Maximum Design Parameters
Wind turbine Visits (included in Scenario [A] only) (per year	2,580
Wind turbine Foundation Visits (included in Scenarios [A] and [B]) (per year	780
Platform Visits - Structural Scope (included in Scenarios [A] and [B]) (per year)	65
Platform Visits - Electrical Scope (included in Scenarios [A] and [B]) (per year)	100
Crew Shift Transfer (included in Scenarios [B] only) (per year)	260
Total Trips (worst case of Scenarios [A] or [B]) (per year)	3,525
Jack-up wind turbine visits (per year)	36
Jack-up foundation visits (per year)	82
Jack-up platform visits - (per year)	6
Jack-up total trips (per year)	124
Crew vessels wind turbine visits (per year)	1,205 visits per year
Supply vessels accommodation platform visits (per year)	104 visits per year

Operation and maintenance activities

2.1.1.5 The following section describes the processes and methods Hornsea Four would undertake for those activities for which a licence is required and for which consent is sought. This includes regular and scheduled operation and maintenance as well as unscheduled maintenance that is likely to occur.

2.1.1.6 Maintenance due to failures that cannot be anticipated are not described here and cannot be included within the application for Development Consent. It should be noted that the application does include typical unscheduled, emergency or reactive maintenance, i.e. the types of faults that offshore windfarms have the potential to experience, as well as scheduled or routine maintenance.

2.1.1.7 During the operational life of Hornsea Four (anticipated 35 years), there can be a total of up to 16 vessels in the Hornsea Four array area on any given day. Descriptions of offshore operation and maintenance activities are provided in **Table 3**. Numbers are provided per visit. A single visit comprises a return trip to and from the Hornsea Four array and export cable area.

Table 3: Maximum design parameters for total offshore operation and maintenance activities.

Activity	Rationale	Parameter	Maximum Design Parameter
Seabed surveys	Seabed surveys will be required to ensure that cables remain buried and that the scour protection remains intact. Typically, this will be undertaken more frequently in early years, hence the assessment is based on twice yearly for first three years; followed by yearly thereafter.	Maximum number in lifetime	38
Component replacement	This activity allows for the replacement of major wind turbine components, for example blades,	Maximum number of exchange	1260 (7)

Activity	Rationale	Parameter	Maximum Design Parameter
	blade bearings, hub generators, yaw rings or nacelles (like-for-like or as within the project envelope). Works conducted under this activity would likely require a JUV supported by at least one CTV. There would be up to Seven visits on average for exchange events per turbine over the Hornsea Four lifetime.	events – lifetime (per WTG)	
		Footprint of seabed disturbance per event (m2)	300
Painting of transition pieces	This activity includes the application of paint or other coatings to protect from corrosion (internal/external). Technicians and equipment – largely hand tools - will be deployed from a CTV or similar vessel. Surface preparation is required to break down existing surface coatings and any associated corrosion. There will be one full paint job per turbine every 10 years, and one touch-up paint job per turbine every three years	Maximum number of full painting events – lifetime quantity (per WTG)	630 (4)
Marine growth / bird waste removal	Marine growth and bird waste will be physically brushed off turbines by hand, using a brush to break down the marine growth/organic waste (where required) followed by high-pressure jet wash (sea water or potable water). Technicians and equipment will be deployed from a CTV or similar vessel. Up to five cleaning events per turbine per year are planned	Maximum number of cleaning events – lifetime quantity (per WTG)	31,500 (175)
Access ladder replacement	This includes the replacement of access ladders to wind turbine transition pieces due to damage or corrosion. Access ladder replacement is likely to require a CTV or small JUV. Technicians and equipment will be deployed from a CTV or similar vessel. One ladder replacement event is planned per turbine every five years	Maximum number of ladder replacement events – lifetime quantity (per WTG)	1260 (7)
		Footprint of seabed disturbance per event (m2)	300
Foundation anode replacement	This includes the removal and replacement of anodes, which are required for corrosion protection (internal and external to the foundation). These sacrificial anodes, usually zinc, are fastened to an external structure. The metal erodes away preferentially and so protects the erosion of the turbine (foundation) steel. Anode replacement works are likely to be undertaken via divers from a dive support vessel. One turbine anode replacement event is planned per turbine every five years.	Maximum number of anode replacement events – lifetime quantity (per WTG)	1260 (7)
		Footprint of seabed disturbance per event (m2)	300
J-Tube repair/ replacement	The turbine foundation J-tubes occasionally require modifications or corrective maintenance, including alterations to the bell mouth of the Jtubes during a cable repair or replacement (e.g.	Maximum number of turbine foundation Jtube replacement	360 (2)

Activity	Rationale	Parameter	Maximum Design Parameter
	cutting, re-welding). This work will be undertaken either by ROV or divers from a dive support vessel or using a jack-up barge. It is expected that the frequency will be two J-tubes over the lifetime of the Offshore substation	events – lifetime quantity (per WTG)	
		Footprint of seabed disturbance per event (m2)	300
Array Cables			
Cable remedial burial	This activity provides remedial burial of array cables that may have become exposed via natural sediment transport processes. As-laid cable data will be reviewed to identify priority areas possibly requiring remediation. A multibeam sonar (or similar) will then be used to confirm the exact location and current cable burial depth and/or areas of exposure. Should any areas of exposed or insufficiently buried cables be identified, jetting equipment (i.e. Flow tool or similar) operated from a vessel, or diver or ROV operated injector, will be powered up and manoeuvred along the exposed cable at a steady rate until the desired burial depth is achieved. Once complete, a seabed survey will be conducted to determine the success of the operation. If necessary, another pass may be required to achieve the specified depth. As-buried data will be documented and only once all remedial works have been agreed will the vessel and associated equipment transit from the field to port for demobilisation.	Lifetime quantity of cable (km)	42
		Maximum length of cable subject to jetting (remediation re-burial) per event (m)	2,000
		Maximum width of disturbed seabed per event (m)	100
		Maximum footprint of (temporary) seabed disturbance per event (m2)	200,000
Cable protection replacement	Where rock protection has been employed during the construction phase, this may be replenished/ maintained during operation. This operational rock placement would not exceed 25% of the estimated rock volume and would occur in areas already disturbed by rock placement (i.e. rock replenishment will occur exclusively where cable protection is already in place and no new areas of the seabed will be affected).	Up to 25% of the volume of cable protection presented in **Table 4.26** of **A1.4 Project Description** will be replenished.	
Array cable repairs	Where a fault is detected it may be necessary to expose the cable prior to recovery where testing will be conducted to establish the extent and type of repair required. The maximum design scenario (in terms of potential environmental impact) for Hornsea Four has been calculated based on full de-burial always being required. In some instances, cable replacement may be required. The same tools used for construction will be utilised for re-burial. Upon completion of re-burial, a post-burial survey will be carried out	Maximum number of array cable repairs – lifetime quantity	10
		Maximum footprint of seabed disturbance per event (m2)	363,736
		Predicted duration of each cable repair event	Approximately three months

Activity	Rationale	Parameter	Maximum Design Parameter
	to assess whether the cable is at the correct position and required burial depth. During all the works, an advisory exclusion zone of 50 m around the cable and 500 m around all vessels involved in the works will be notified via Notice to Mariners	Rock-berm Area (m2)	6,180
		Rock-berm Volume m3	6,750
Offshore Substations and Accommodation Platform Activities			
Offshore substation component replacement	This includes the replacement of major components, for example transformers (like-forlike or as within consented envelope). These works would likely require a JUV supported by at least one CTV. It is expected that two major components will require replacement per offshore substation over the lifetime.	Maximum number of exchange events – lifetime quantity	20
		Footprint of seabed disturbance per event (m2)	300
Offshore substation and accommodation platform foundation painting	This includes the application of paint or other coatings to protect the offshore substation and accommodation platform foundations from corrosion (internal/external). Technicians and equipment will be deployed from a helicopter, SOV, CTV or similar vessel. Surface preparation is required to break down existing surface coatings and any associated corrosion	Maximum number of painting events – lifetime quantity	10
Marine growth / bird waste removal	As per wind turbine generators	Maximum number of cleaning events – lifetime quantity	1750
Access ladder replacement	As per wind turbine generators	Maximum number of ladder replacement events – lifetime quantity	300
Foundation anode replacement	As per wind turbine generators	Maximum number of anode replacement events – lifetime quantity	70
		Footprint of seabed disturbance per event (m2)	300
J-Tube repair/ replacement	As per wind turbine generators	Maximum number of turbine foundation Jtube replacement events – lifetime quantity	20
		Footprint of seabed disturbance per event (m2)	300

Activity	Rationale	Parameter	Maximum Design Parameter
Offshore export cable activities			
Cable remedial burial	As per array cables	Lifetime quantity of cable (km)	14
		Maximum length of cable subject to jetting (remediation re-burial) per event (m)	2,000
		Maximum width of disturbed seabed per event (m)	100
		Maximum footprint of (temporary) seabed disturbance per event (m2)	200,000
Cable protection replacement	As per array cables	Up to 25% of the volume of cable protection presented in **Table 4.26** in **A1.4 Project Description** will be replenished.	
Export cable repairs	As per array cables	Maximum number of export cable repairs – lifetime quantity	23
		Maximum footprint of seabed disturbance per event (m2)	6,676
		Predicted duration of each cable repair event	Approximately three months
		Rock-berm Area (m2)	6,180
		Rock-berm Volume m3	6,750
Interconnector cable activities			
Cable remedial burial	As per array cables	Lifetime quantity of cable (km)	7
		Maximum length of cable subject to jetting (remediation re-burial) per event (m)	2,000

Activity	Rationale	Parameter	Maximum Design Parameter
		Maximum width of disturbed seabed per event (m)	100m
		Maximum footprint of (temporary) seabed disturbance per event (m2)	200,000
Cable protection replacement	As per array cables	Up to 25% of the volume of cable protection presented Table 4.26 in A1.4 Project Description will be replenished	
Interconnector repairs	As per array cables	Maximum number of array cable repairs – lifetime quantity	3
		Maximum footprint of seabed disturbance per event (m2)	6,676
		Predicted duration of each cable repair event	Approximately three months
		Rock-berm Area (m2)	6,180
		Rock-berm Volume m3	6,750

3 Red Throated Diver Best Practice Protocols

3.1.1.1 Vessel disturbance: using best practice in the management of vessel traffic a significant disturbance to red throated diver (RTD) and common scoter can be avoided. The Applicant will have regard to best practice during the operation and maintenance of Hornsea Four in accordance with this section. Example of relevant best practice include where reasonably practicable:

- avoid works within or within 2km of a Special Protection Area designed for RTD during the over winter period 1st Nov – 31st March inclusive
- selecting routes that avoid known aggregations of birds;
- restricting (to the extent reasonably possible) vessel movements to existing navigation routes (where the densities of divers are typically relatively low);
- maintaining direct transit routes (to minimise transit distances through areas used by divers);
- avoidance of over-revving of engines (to minimise noise disturbance); and,
- briefing of vessel crew on the purpose and implications of these vessel management practices (through, for example, tool-box talks).