



White Cross Offshore Wind Farm: Outline Offshore Operations and Maintenance Plan

WHX001-FLO-CON-ENV-PLN-0008



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Glossary of Acronyms

Acronym	Definition
ASV	Autonomous Surface Vessels
AUV	Autonomous Underwater Vessels
CEMP	Construction Environmental Management Plan
CTV	Crew Transport Vessel
ECoW	Environmental Clerk of Works
ECT	Environment and Consents Team
ELO	Environmental Liaison Officer
ES	Environmental Statement
HSE	Health and Safety Executive / Health, Safety and Environment
IP	Injured Person
LOLER	Lifting Operations and Lifting Equipment Regulations
MBES	Multibeam-Echo Sounder
MHWS	Mean High Water Springs
MIPCP	Marine and Intertidal Pollution Contingency Plan
MMO	Marine Management Organisation
NE	Natural England
O&M	Operation and Maintenance
OOOMP	Outline Offshore Operation and Maintenance Plan
OOMP	Offshore Operation and Maintenance Plan
OSP	Offshore Substation Platform
PEMMP	Project Environmental Monitoring and Mitigation Plan
PSSR	Pressure System Safety Regulations
ROV	Remotely Operated Vehicles
SSS	Side Scan Sonar
SOV	Service Operation Vessel
WCOW	White Cross Offshore Windfarm
WCOWL	White Cross Offshore Windfarm Limited
WTGs	Wind Turbine Generators

1. Introduction

1. The Outline Offshore Operation and Maintenance Plan (OOOMP) has been produced in response to a request made by the Marine Management Organisation (MMO) following the statutory consultation on Marine Licence application MLA/2023/00113 for White Cross Offshore Windfarm (WCOW). This request was for the provision of further information on the operation and maintenance (O&M) activities for WCOW, and for these activities to be assessed accordingly.
2. Once built, WCOW would have an export capacity of up to 100MW, with the offshore components comprising:
 - Six to eight semi-submersible floating platforms and Wind Turbine Generators (WTGs)
 - One mooring system per substructure comprised of mooring lines (catenary, taught or semi-taught) and seabed anchors (drag embedment anchors or suction, driven pin or drilled piles)
 - Up to ten dynamic inter-array cables and associated cable protection
 - OSP (if required) with a fixed jacket substructure
 - Other associated offshore infrastructure, such as navigational markers
 - Offshore export cable connecting the offshore wind farm to the landfall and associated cable protection.
3. The detailed design of the Project (e.g. number of WTGs, OSP(s), layout configuration, foundation type and requirement for scour protection) will be determined post-consent. **Chapter 5: Project Description** of the **Offshore Environmental Statement** (ES) (Document Reference FLO-WHI-REP-0002-05) provides a description of the key components of the Project, as well as details of how the Project will be constructed, operated, maintained and decommissioned.
4. If MLA/2023/00113 is approved, there are likely to be conditions attached to the subsequent Marine Licence that will formally outline the requirement for an Offshore Operations and Maintenance Plan (OOMP) for the Project. **Appendix A** will provide the Marine Licence conditions that this document seeks to discharge.

2. Purpose and scope of the Outline Offshore Operations and Maintenance Plan

5. The purpose of the OOOMP is to provide an outline of reasonably foreseeable offshore operational and maintenance (O&M) activities and the broad approach to be taken for each activity.

6. For the purposes of this document, “to maintain” is defined as including to inspect, maintain, repair, adjust and alter, and further includes remove, reconstruct and replace any of the ancillary works and any component part of any WTG or OSP and associated cables described in the ES (but not including the alteration, removal or replacement of foundations) to the extent assessed in the ES; and “maintenance” shall be construed accordingly.
7. The final OOMP will be prepared following post-consent detailed design as required by any consent conditions if MLA/2023/00113 is approved. The OOMP will be developed prior to construction in a timescale to be agreed with the MMO. This will include full details of the:
 - O&M requirements of the project including all foreseen O&M activities, equipment, structures and associated infrastructure in accordance with design and manufacturer recommendations and associated vessels
 - Operational health, safety and environment management.
 - Accessibility solutions and constraints
 - Logistical set up and operation of the O&M base & warehousing.
 - O&M staff requirements, including numbers and skills.
 - Supply Chain requirements
 - Spare parts and availability
 - High level maintenance and sparring philosophy
 - Planning of scheduled and unscheduled maintenance.
8. The OOMP is relevant for all offshore works carried out during the Operations Phase of the wind farm (following commissioning).
9. Access to the wind farm for routine inspection, maintenance & repairs will be carried out with a Service Operations Vessel, a Crew Transfer Vessel, or a Helicopter. A combination of the three may also be utilised to maximise access & availability.
10. Non-routine Maintenance & Repairs may require specialist vessels such as cable-lay vessels, anchor-handlers, tugs and heavy-lift vessels.
11. The OOMP aims to maximise safety, minimise environmental impact, maximise asset availability, and maximise efficiencies. Maintenance strategies such as predictive maintenance, risk-based inspection programs, and machine-learning/digital twin will be employed to achieve these goals.
12. Based on current understanding of the operation and maintenance of WCOW, activities will include but are not limited to the following:

a. Planned Maintenance

- i. Geophysical survey for asset integrity purposes, typically using Multibeam-Echo Sounder (MBES) and/or Side Scan Sonar (SSS), potentially using Remotely Operated Vehicles (ROVs), Autonomous Surface Vessels (ASVs) and Autonomous Underwater Vessels (AUVs)
- ii. WTG Annual Service (including function tests, replacement of lubricants, oils, filters, bolt checks, etc.)
- iii. WTG Blade inspection & Testing
- iv. Floating substructure Annual Service & General Inspections (including secondary steel checks/repairs)
- v. Emergency Evacuation & Rescue, Fire System inspections & function tests
- vi. Floating substructure above-water cleaning, repainting, repairs, including removal of bird waste and marine growth
- vii. Painting and applying other coatings to supporting structures, e.g. access ladders, walkways etc.
- viii. Access ladder and boat landing repair / replacement
- ix. Statutory Inspections (Lifting Operations and Lifting Equipment Regulations (LOLER), Pressure System Safety Regulations (PSSR))
- x. Substructure underwater surveys
- xi. Mooring System surveys (ROV)
- xii. Cable surveys (ROV)
- xiii. Cable and Scour Protection replenishment (if relevant)
- xiv. Inspections and surveys for the Offshore Substation, including statutory inspections and fire system checks
- xv. Switchgear and transformer inspection & testing
- xvi. Onshore Substation inspections, maintenance, fire safety checks
- xvii. O&M Base general maintenance & statutory inspections, including waste management.
- xviii. Control Systems function tests & upgrades

xix. Vessel inspections & maintenance as required (to be carried out at a specialist site and managed by the vessel operator)

b. Reactive / Unplanned Maintenance:

- i. Minor WTG failures / faults requiring access with Service Operation Vessel (SOV) / Crew Transport Vessel (CTV)
- ii. Failure of WTG Main Components (including gearbox, generator, blades, yaw & pitch systems), requiring major replacement works. This may be conducted through towing the Floating WTG to a suitable port, or the use of a floating crane vessel or novel up-tower crane technology).
- iii. Blade Leading Edge Protection replacement
- iv. Minor Floating Substructure failures/faults such as Mechanical/Electrical faults on active ballast system, or corrosion protection / painting repairs, marine growth removal
- v. Major Floating Substructure failures, such as cracks, requiring either tow-to-port and dry-docking for repair, or an in-situ repair project
- vi. Mooring line failures requiring mobilisation of vessel spread to replace mooring line
- vii. Repair/replacement of mooring & cable ancillary equipment (clump weights, buoyancy modules, anodes), requiring SOV
- viii. Cable reburials
- ix. Cable failure, requiring mobilisation of specialist cable repair/installation vessel
- x. OSP major failures (including transformer, switchgear) requiring mobilisation of heavy-lift vessel
- xi. OSP minor failures requiring SOV/CTV access to repair

13. Planned Maintenance will be scheduled in order to minimise the number of times the turbine needs to be accessed, through scheduling all tasks to be carried out either consecutively or simultaneously, whichever represents the most efficient process. This will normally be planned around the Annual Service. The subsea survey will be carried out in a single campaign and the frequency will be driven by a Risk Based

Inspection approach. Reactive/unplanned maintenance will be undertaken as and when issues arise and will be planned accordingly.

14. For conventional fixed-bottom wind farms, major component replacement of components within the WTG nacelle are carried out using a heavy-lift jack-up vessel at the wind farm site. This is not possible with floating wind due to the depth of water. Existing demonstrators have therefore utilised a 'tow-to-port' strategy whereby the floating WTG is disconnected from the array and the moorings and cable are laid on the sea-bed. The floating WTG is towed into a deep-water port where a quay-side crane is used to replace the broken component. This strategy may be utilised for White Cross, however the Project and the wider industry are working to develop in-situ major component replacement technology, such as an Up-Tower Crane, so that the WTG does not need to be disconnected. This is expected to reduce costs and duration of the replacement task.
15. However, until an in-situ major component replacement technology is available, the Project Team will work to minimise the benthic spatial footprint of the disconnected mooring lines if they are placed on the seabed in a 'tow-to-port' scenario. Where possible, these will be laid within the already disturbed area around the foundations of the mooring anchors (created by the scouring effects of the catenary action of the mooring lines as described in **Section 10.6.2** of FLO-WHI-REP-0002-10 **Chapter 10 Benthic and Intertidal Ecology** of the Offshore ES). Once further information is known on the mooring design, this document and any required assessments will be updated.
16. In the event of an emergency requiring evacuation/rescue, the WTG is equipped with emergency response equipment to enable evacuation of an Injured Person (IP) to the routine service vessels. In an extreme scenario, the coast guard may be involved to ensure fast rescue & response.
17. Operational activity impacts are assessed in the following chapters of the **Offshore ES**:
 - FLO-WHI-REP-0002-08 Chapter 8 Marine and Physical Processes
 - FLO-WHI-REP-0002-09 Chapter 9 Marine Water and Sediment Quality
 - FLO-WHI-REP-0002-10 Chapter 10 Benthic and Intertidal Ecology
 - FLO-WHI-REP-0002-11 Chapter 11 Fish and Shellfish
 - FLO-WHI-REP-0002-12 Chapter 12 Marine Mammal and Marine Turtle Ecology
 - FLO-WHI-REP-0002-13 Chapter 13 Offshore Ornithology
 - FLO-WHI-REP-0002-14 Chapter 14 Commercial Fisheries
 - FLO-WHI-REP-0002-15 Chapter 15 Shipping and Navigation

- FLO-WHI-REP-0002-18 Chapter 18 Infrastructure and Other Users

2.1 Interfacing Plans

18. The final OOMP will comply with the following outline plans:

- Construction Environmental Management Plan (CEMP)
 - At this pre-consent stage, an outline CEMP is provided (WHX001-FLO-CON-ENV-PLN-0010).
- Project Environmental Management and Monitoring Plan (PEMMP)
 - An outline PEMMP is provided (WHX001-FLO-CON-ENV-PLN-0003)
- Marine and Intertidal Pollution Contingency Plan (MIPCP)
 - An outline MIPCP is provided (WHX001-FLO-CON-ENV-PLN-0004)
- Invasive Non-Native Species (INNS) Management Plan
 - An outline INNS Management Plan is provided (WHX001-FLO-CON-ENV-PLN-0009)
- Vessel Management Plan
 - This has not yet been drafted

19. All contractors will ensure that their own emergency response procedures align with the obligations set out therein. Each contractor will provide their own Emergency Response Plan (including proposed monitoring procedures following a spill), which will comply with Flotation Energy Offshore Construction / Activities HSE Minimum Standards (FLO-IMS-PRO-0024).

3. Roles, responsibilities, and personnel

20. The off-site Project Environment and Consents Team (ECT) and the Health and Safety Executive (HSE) team are responsible for:

- Managing consultation on the OOOMP with the relevant consultees.
- Maintaining and updating the OOOMP.
- Ensuring the relevant permissions are in place to carry out certain activities and ensuring the relevant notifications are made to the appropriate organisations when planning/undertaking works.
- Supporting the contractor tendering process to ensure mitigation requirements are efficiently communicated to suppliers performing O&M activities.

21. An on-shore based WCOWL Environmental Liaison Officer (ELO) will be employed during O&M activities to ensure best practice is being followed for any offshore and intertidal works.

4. Activities during the Operations and Maintenance Phase

22. An indicative list of activities that are likely to be undertaken during the O&M phase of WCOV is provided in **Appendix B**. This O&M list is a live document which will be updated and agreed with the MMO as the project design progresses.

23. For each activity, a 'traffic light system' will be used to provide clarity as to those activities that can be carried out under the marine licence provided through MLA/2023/00113.

- **Green** indicates that an additional marine licence is not required, however notification should be provided to the MMO on works being undertaken.
- **Amber** indicates that an additional marine licence may be required if proposed works exceed those assessed within the Offshore ES or described within the marine licence.
- **Red** indicates that an additional marine licence could be required dependant on the type of works to be undertaken.

Appendix A: Marine Licence conditions associated with operation and maintenance activities

Appendix B: Potential offshore maintenance activities

Potential offshore maintenance activity	Relevant licence	Included in the Offshore ES	Worst case parameters assessed in the Offshore ES ¹	Location in Offshore ES	Additional licence required?	Consultation required with MMO and SNCBs?
Wind turbines (topside)						
Annual wind turbine maintenance	Generation	Yes	<p>At this stage, based on current understanding the operation and maintenance activities will include but not be limited to the following:</p> <ul style="list-style-type: none"> Wide ranging inspections of mooring system, transition pieces, blades, safety equipment, OSP equipment, etc. System performance assessments and fault-finding Replacement of lubricants, oils, filters, etc. Painting and coating application of turbines, etc. Replacement of wind turbine parts including bearings, gearboxes, generators, nacelles, transformers and blades Minor repair and replacements including access ladders, corrosion protection system including anodes and protective coatings, secondary steel, boat landings, cable penetrations and ducting, aids to navigation Removal of marine growth and guano Structural surveys Periodic cable burial surveys, including any crossings and at interfaces at subsurface structures Reburial or other remedial actions of inter-array cables, export cable and crossings array cables 	<p>ES Chapter 5 Project Description. Activities described or covered off in more generalised activities. Vessel numbers calculated considering listed activities.</p> <p>ES Chapter 8 Marine Geology, Oceanography and Physical Processes. Considers disturbance caused by activities that interact with the seabed.</p> <p>ES Chapter 8 Marine Sediment and Water Quality. Considers disturbance caused by activities that interact with the seabed where there is a potential source to affect water quality.</p> <p>ES Chapter 10 Benthic Ecology. Considers disturbance caused by activities that interact with the seabed.</p> <p>ES Chapter 11 Fish and Shellfish Ecology. Considers disturbance caused by activities that interact with the seabed and considers indirect effects to benthic and water quality features.</p> <p>ES Chapter 12 Marine Mammals. Considers disturbance caused by activities that interact with the seabed and considers indirect effects as well as vessel disturbance.</p>	No	No
Wind turbine troubleshooting	Generation	Yes			No	No
Wind turbine repair	Generation	Yes			No	No
Blade inspection	Generation	Yes			No	No
Blade and hub repair	Generation	Yes			No	No
Major Component Replacement	Generation	Yes			No	No
Blade Leading Edge replacement	Generation	Yes			No	No

1. Proposed activities outwith these parameters should be discussed with the MMO.

Potential offshore maintenance activity	Relevant licence	Included in the Offshore ES	Worst case parameters assessed in the Offshore ES ¹	Location in Offshore ES	Additional licence required?	Consultation required with MMO and SNCBs?
Floating Substructure repair	Generation	Yes	<ul style="list-style-type: none"> Repair or replacement of offshore export and inter-array cables Replenishment of rock protection as additional cable and scour protection. 	ES Chapter 13 Offshore Ornithology. Considers disturbance caused by activities that interact with the seabed and considers indirect effects as well as vessel disturbance. ES Chapter 14 Commercial Fisheries. Considers indirect effects through disturbance caused by activities that interact with the seabed as well as vessel disturbance. ES Chapter 15 Shipping and Navigation. Considers interactions with vessels. ES Chapter 16 Marine Archaeology and Cultural Heritage. Considers disturbance caused by activities that interact with the seabed. ES Chapter 17 Civil and Military Aviation. Considers helicopter operations during maintenance and cranes. ES Chapter 18 Infrastructure and Other Users. Considers vessel movements ES Chapter 19 Offshore Seascape, Landscape and Visual Amenity. Considers vessel movements. ES Chapter 20 Onshore Ecology and Ornithology. Considers disturbance and habitat alteration ES Chapter 23 Socio-economics, Tourism and Recreation. Considers employment associated with operation activities. ES Chapter 24 Human Health. Considers indirect effects from other chapters.	No	No
Floating Substructure maintenance	Generation	Yes	The onshore operation and maintenance base and port for return-to-shore maintenance of the WTG/floating substructure will be selected during FEED based upon technical and economic constraints. In choosing a suitable port / harbour there will be requirements to ensure sufficient access to a fleet of vessels with the capabilities to complete any required operation and maintenance activities. The overall operation and maintenance strategy will also reflect the technical specification once known, including wind turbine type, electrical transmission design and final project layout.		No	No
Paint and repair	Generation	Yes	Maintenance and inspection activities will be performed after the WTG in question has been shut down. Boarding of the units will most likely be undertaken by Crew Transfer Vessel (CTV) but airlifting via a helicopter could potentially be an option. Access to the substructure will occur from the CTV by docking and using ladders, while the use of airlifting will hoist personnel directly onto the nacelle.		No	No
Statutory Inspections (Pressure Systems & Lifting Equipment)	Generation	Yes	It is assumed that the duration of servicing activities will be up to 4 days per visit. These frequencies cover statutory inspections, maintenance recommended by suppliers and a probabilistic estimate of unplanned maintenance.		No	No
Geophysical / inspection survey	Generation	Yes	Offshore Export Cables, moorings, substructures and the OSP will normally be inspected on an annual basis using vessels with ROVs. This is to allow for adequate inspection and biofouling may also have to be removed from substructures, cables and mooring lines.		No	No
Life Saving Equipment checks & replacement	Generation	No	The frequency of the inspections and maintenance will vary but in total it's expected this could be up		No	No
Fire System inspections & function tests	Generation	No			No	No
Mooring system surveys	Generation	Yes			No	No

Potential offshore maintenance activity	Relevant licence	Included in the Offshore ES	Worst case parameters assessed in the Offshore ES ¹	Location in Offshore ES	Additional licence required?	Consultation required with MMO and SNCBs?
Mooring system ancillary equipment replacement	Generation	Yes	to 15 visits per turbine per year (2,400 visits over the lifespan of the Offshore Project). It is possible that major WTG components (rotor blades, generators, gearbox etc.) may need to be replaced during the life of the project. In these extreme events the WTG would need to be disconnected from their mooring system and array cables and towed to shore where major maintenance would be carried out using an onshore crane or jack-up vessel. The tow to shore would be carried out by tug boat(s) and anchor handling vessel(s). The remaining WTGs will continue to operate when one WTG unit has been removed.	ES Chapter 25 Climate Change. Considers vessel movements.	No	No
Mooring line replacement	Generation	Yes			No	Yes
Marine growth survey and removal of organic material	Generation	No	Marine growth/guano will accumulate on the offshore infrastructure. This must be regularly removed to protect the exterior parts of the WTGs and OSP.	N/A	No	Yes
Addition of anti-fouling devices	Generation	No	Anti-fouling devices such as passive bird scarers and bird spikes can be used on the offshore infrastructure to discourage birds and other animals from establishing themselves on or soiling the external surfaces. Such devices are required to ensure safe access and functionality of the infrastructure. It is important to note that the devices are not designed to actively or passively harm wildlife	N/A	No	No
Inter Array and Export Cables						
Cable inspection including geophysical surveys MBES, magnetometer, SSS and Depth of Burial (DoB) surveys to inspect subsea assets.	Generation / Transmission	Yes	During the life of the Offshore Project, repairs may be required and periodic inspection will be undertaken. Periodic surveys would also be required to ensure the cables remain buried and if they do become exposed, re-burial works would be undertaken.	ES Chapter 5 Project Description. ES Chapter 8 Marine Geology, Oceanography and Physical Processes. ES Chapter 8 Marine Sediment and Water Quality. ES Chapter 10 Benthic Ecology. ES Chapter 11 Fish and Shellfish Ecology.	No (marine licence exemption notification would be required, as necessary)	Yes
Replacement or addition to external cable protection in the same locations as external cable protection installed during construction	Generation / Transmission	Yes	To conduct a cable repair, a section of cable will be recovered either side of the fault of sufficient length to enable a repair. The repair comprises two new joints connecting a new section of cable with the ends of the original cables.		No ²	Yes
Cable ancillary equipment repair/replacement	Generation / Transmission	Yes			No	No

² Unless the replacement cable protection is outside the as installed footprint

Potential offshore maintenance activity	Relevant licence	Included in the Offshore ES	Worst case parameters assessed in the Offshore ES ¹	Location in Offshore ES	Additional licence required?	Consultation required with MMO and SNCBs?
Cable replacement / repair	Generation / Transmission	Yes	<p>The recovery of the cable will be performed by a suitable Dynamic Positioning vessel or anchor barge if in the nearshore region. A suitable dive spread/platform may also be needed, depending on the operation. The length of cable exposed and recovered to a cable handling vessel will be proportional to 1.5 times the deepest tidal water depth at the location of the fault to ensure sufficient slack in the cable system and prevent unnecessary strain on the component parts during repair and reburial.</p> <p>The total length of cable exposed and replaced in any one repair event is unlikely to exceed 200m. All recovered and redundant cable will be disposed of and recycled as appropriate onshore. Cut and exposed cable ends will be sheathed and buoyed to the surface for the repair operation. The buoyed end will then be recovered onto the cable handling vessel and cable jointing will commence.</p> <p>Once jointed, the cable handling vessel will re-lay the cable to the seabed via lowering from the repair vessel deck. Upon completion and re-laying, the cable will be assessed to ensure it is in the correct position and sufficient slack is available.</p> <p>If mechanical re-burial is required, jetting with a Mass Flow Excavator suspended approximately 1 to 2m above the seabed will be conducted. The target burial depth of 0.5 to 3m will be sought via these operations. These techniques do not permanently add or remove any material from the seabed and take place along the existing Offshore Export Cable route. The operation is not expected to disturb more than 2m width of seabed sediment (maximum 7m if the cable cannot be reburied to the original trench from where it was initially recovered).</p> <p>Where jetting is not feasible, trenching could be undertaken with the use of a backhoe dredger as a last resort. Both methods will occupy a similar</p>	ES Chapter 12 Marine Mammals. ES Chapter 14 Commercial Fisheries. ES Chapter 15 Shipping and Navigation. ES Chapter 16 Marine Archaeology and Cultural Heritage. ES Chapter 18 Infrastructure and Other Users ES Chapter 20 Onshore Ecology and Ornithology.	No	No
Cable reburial	Generation / Transmission	Yes			No	No
Sub-bottom profiling (i.e. chirp or pinger)	Generation / Transmission	No			No (marine licence exemption notification would be required, as necessary)	Yes
Geotechnical survey	Generation / Transmission	No			No (marine licence exemption notification would be required, as necessary)	Yes

Potential offshore maintenance activity	Relevant licence	Included in the Offshore ES	Worst case parameters assessed in the Offshore ES ¹	Location in Offshore ES	Additional licence required?	Consultation required with MMO and SNCBs?
			<p>seabed footprint, however trenching represents the realistic worst-case scenario due to the potential for more seabed sediment to be suspended into the water column. Re-burial via ploughing is not technically feasible in this instance, due to the export cables already being in-situ.</p> <p>Rates of re-burial will vary depending on ground conditions and final tools used. Estimated figures for re-burial range from 100 to 250m/hr. An average length of re-burial from cable repair in this application is expected to take approximately five days. Upon completion of re-burial, a post survey will be conducted to assess whether the cable is at the correct position and depth.</p> <p>For cable remediation, previous as-laid cable data and/or data from recent geophysical surveys will be reviewed to finalise the area requiring remediation. A cable pre-burial survey will follow this using a Multibeam Sonar (pipe/cable tracker) or similar device to confirm the exact location and current cable burial depth/areas of exposure.</p> <p>In terms of the affected areas during operation and maintenance the following identifies the Worst Case:</p> <p>Inter-array cables:</p> <ul style="list-style-type: none"> Total area of protection material: 22,400m² <p>Offshore Export Cables:</p> <ul style="list-style-type: none"> Maximum area cable scour protection material (all sources) = 252,560m² <p>Total number of cable repairs of lifetime: 10 Total number of remediation events (re-burial): 40 Total area of seabed affected by remediation events: 1,500,000m²</p>			
Offshore Substation Platform						
Foundation replacement	Transmission	N/A	Replacement of a failed foundation is considered to be a highly unlikely event. Should such an		Yes	Yes

Potential offshore maintenance activity	Relevant licence	Included in the Offshore ES	Worst case parameters assessed in the Offshore ES ¹	Location in Offshore ES	Additional licence required?	Consultation required with MMO and SNCBs?
			occurrence take place then consent for the replacement of the failed foundation would be obtained from the MMO prior to commencement.			
Foundation inspection Foundation repair	Transmission Transmission	Yes Yes	Within the assumed maintenance activities per annum for scheduled and unscheduled maintenance as described above	ES Chapter 5 Project Description. ES Chapter 8 Marine Geology, Oceanography and Physical Processes. ES Chapter 8 Marine Sediment and Water Quality. ES Chapter 10 Benthic Ecology. ES Chapter 11 Fish and Shellfish Ecology. ES Chapter 12 Marine Mammals. ES Chapter 14 Commercial Fisheries. ES Chapter 15 Shipping and Navigation. ES Chapter 16 Marine Archaeology and Cultural Heritage. ES Chapter 18 Infrastructure and Other Users ES Chapter 20 Onshore Ecology and Ornithology.	No	Yes
Replacement or addition to scour protection installed during construction around foundations ³	Transmission	Yes	Within the assumed maintenance activities per annum for scheduled and unscheduled maintenance as described above.	ES Chapter 5 Project Description. ES Chapter 8 Marine Geology, Oceanography and Physical Processes. ES Chapter 8 Marine Sediment and Water Quality. ES Chapter 10 Benthic Ecology. ES Chapter 11 Fish and Shellfish Ecology. ES Chapter 12 Marine Mammals.	No	No
Inspections including geophysical surveys MBES, magnetometer, SSS) surveys to inspect subsea assets.	Transmission	Yes	OSP(s) could typically require an average of 2 visits per week although this may be more during unscheduled maintenance.	ES Chapter 5 Project Description. ES Chapter 8 Marine Geology, Oceanography and Physical Processes. ES Chapter 8 Marine Sediment and Water Quality. ES Chapter 10 Benthic Ecology. ES Chapter 11 Fish and Shellfish Ecology. ES Chapter 12 Marine Mammals.	No	No
Sub-bottom profiling (i.e. chirp or pinger)	Transmission	Yes		ES Chapter 11 Fish and Shellfish Ecology. ES Chapter 12 Marine Mammals.	No (marine licence exemption notification would be required, as necessary)	No

³ The scour protection placed during operation cannot exceed the seabed footprint of the scour protection laid at that location during construction

Potential offshore maintenance activity	Relevant licence	Included in the Offshore ES	Worst case parameters assessed in the Offshore ES ¹	Location in Offshore ES	Additional licence required?	Consultation required with MMO and SNCBs?
General maintenance work, e.g. oil replacement, mechanical works, external surface preparation and protective coating repair/re-painting	Transmission	Yes		ES Chapter 14 Commercial Fisheries. ES Chapter 15 Shipping and Navigation. ES Chapter 16 Marine Archaeology and Cultural Heritage. ES Chapter 18 Infrastructure and Other Users ES Chapter 20 Onshore Ecology and Ornithology.	No	No
Switchgear replacement	Transmission	Yes			No	No
Marine growth survey and removal of organic material	Transmission	No	Marine growth/guano will accumulate on the offshore infrastructure. This must be regularly removed to protect the exterior parts of the WTGs and OSP.	N/A	No	Yes
Addition of anti-fouling devices	Transmission	No	Anti-fouling devices such as passive bird scarers and bird spikes can be used on the offshore infrastructure to discourage birds and other animals from establishing themselves on or soiling the external surfaces. Such devices are required to ensure safe access and functionality of the infrastructure. It is important to note that the devices are not designed to actively or passively harm wildlife	N/A	No	No
Other						
Davit crane inspection	Generation	Yes	Within the assumed maintenance activities per annum as described above.	ES Chapter 5 Project Description. ES Chapter 8 Marine Geology, Oceanography and Physical Processes. ES Chapter 9 Marine Sediment and Water Quality. ES Chapter 10 Benthic Ecology. ES Chapter 11 Fish and Shellfish Ecology. ES Chapter 12 Marine Mammals. ES Chapter 14 Commercial Fisheries. ES Chapter 15 Shipping and Navigation.	No	No
Fuel replenishment to crew transfer vessel (CTV)	Generation	Yes			No	No
Re-fuelling of generator on the OSP	Generation	Yes			No	No
Grout and corrosion works (including cathodic protection inspection, grouting core samples and re-grouting)	Transmission	Yes			No	No
Retro-fitting of cathodic protection	Generation / Transmission	Yes			No	No
Crane transfers of equipment from vessel to either WTGs or to quayside O&M building or vice-versa	Generation	Yes			No	No

Potential offshore maintenance activity	Relevant licence	Included in the Offshore ES	Worst case parameters assessed in the Offshore ES ¹	Location in Offshore ES	Additional licence required?	Consultation required with MMO and SNCBs?
				ES Chapter 16 Marine Archaeology and Cultural Heritage. ES Chapter 18 Infrastructure and Other Users ES Chapter 20 Onshore Ecology and Ornithology.		
Unexploded Ordnance (UXO) clearance via detonation	Generation / Transmission	No	No UXO clearance events assessed during the O&M period given that UXO would likely be identified during the construction period.	N/A	Yes	Yes
Marine archaeology	Generation / Transmission	Yes	<p>It is assumed that given the pre-construction survey requirement it is unlikely that any new archaeology would be found during operation. All archaeology would have been identified at that stage.</p> <p>There is potential that some identified features avoided during construction may be affected during maintenance activities if the footprint of works is larger (for example, isolated features which have potential to be relocated). In this case, the Applicant will consult with Historic England and agree any action with the MMO.</p>	ES Chapter 16 Marine Archaeology and Cultural Heritage.	No	Yes
Offshore visual inspections	Generation / Transmission	No	The use of video recording equipment and photography to record the condition of the subsea assets. Equipment may be mounted to a ROV/AUV or held by a diver.	N/A	No	No
Use of artificial lighting	Generation / Transmission	Yes	When natural light is inadequate or not available artificial lighting will be provided to ensure health and safety of work personnel and other site users. Artificial lighting will not impact the visibility or apparent colour of any safety signs or other safety-related items such as fire extinguishers. Artificial lighting also relates to the artificial illumination of emergency escape routes.	ES Chapter 13 Offshore Ornithology.	No	No
Transport and transfer of individuals and load by air	Generation / Transmission	No	Helicopters are not envisaged as the primary means of access for offshore operations and maintenance activities, however their use during heavy maintenance periods, or for fault clearance is possible.	ES Chapter 5 Project Description. ES Chapter 17 Civil and Military Aviation ES Chapter 18 Infrastructure and Other Users.	No	No
Recovery of dropped objects	Generation / Transmission	N/A	Dropped objects will be reported to the MMO using the Dropped Object Procedure Form. On receipt of	ES Chapter 14 Commercial Fisheries.	No	Yes

Potential offshore maintenance activity	Relevant licence	Included in the Offshore ES	Worst case parameters assessed in the Offshore ES ¹	Location in Offshore ES	Additional licence required?	Consultation required with MMO and SNCBs?
			the Dropped Object Procedure Form, the MMO may require relevant surveys to be carried out if reasonable to do so and the MMO may require obstructions to be removed from the seabed if reasonable to do so.			
Rope access	Generation / Transmission	N/A	Rope access work could be required to provide access for both routine and extra ordinary operations	N/A	No	No
Use of drones for offshore inspection	Generation / Transmission	N/A	The use of drones for inspections of blades, transition pieces and the splash zone. Drone operation will require permission under the jurisdiction of the Civil Aviation Authority (CAA).	N/A	No	No
Seabed preparation activities as a result of jack-up operations	Generation / Transmission	No	Up to one jack-up vessel visit every other year for the Project resulting in a maximum 1,500m ² of disturbance every other year	N/A	Yes	Yes
Water use and discharge	Generation / Transmission	No	Cleaning of the WTGs and OSP(s) and their internal surfaces will be required for general maintenance where controls can be put in place to collect runoff. Run-off water will be collected and will be handled in compliance with the local legislation and site requirements. Any cleaning operations will be compliant with the Outline PEMMP.	Activity to be included in the final PEMMP.	No	No