TotalEnergies E&P North Sea UK Ltd

Culzean - Floating Offshore Wind Turbine Pilot Project

Environmental Impact Assessment Report – Chapter 4 - Project Description

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REVISIONS & APPROVALS

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GLOSSARY

TERMINOLOGY	DESCRIPTION
Culzean Floating Offshore Wind Pilot Project (the 'Project')	The entire Development including all offshore components and all project phases from pre-construction to decommissioning.
Environmental Impact Assessment (EIA)	The procedure to predict, minimise, measure and, if necessary, correct and compensate the impacts produced by any human action.
EIA Regulations	The Marine Works (Environmental Impact Assessment) Regulations 2007 requires that certain types of projects with the potential to significantly affect the environment have an environmental impact assessment before a marine licence decision is made.
Habitats Regulations Assessment (HRA)	Under the Habitats Regulations, all competent authorities must consider whether any plan or project could affect a European site before it can be authorised or carried out. This includes considering whether it will have a 'Likely Significant Effect' (LSE) on a European site, and if so, they must carry out an 'Appropriate Assessment' (AA). This process is known as Habitats Regulations Appraisal (HRA)
Innovation and Targeted Oil and Gas (INTOG)	The Initial Plan Framework Sectoral Marine Plan for Offshore Wind for INTOG encompasses spatial opportunities and a strategic framework for future offshore wind developments within sustainable and suitable locations that will help deliver the wider United Kingdom (UK) and Scottish Government Net Zero targets. The 'IN' component of INTOG consists of small-scale innovative projects of 100 Megawatts (MW) or less. The aim of the 'TOG' component is to supplying renewable electricity directly to oil and gas infrastructure. The Culzean Floating Wind Pilot Project falls under the TOG component of INTOG.
Marine Licence Application ('the Application')	A Marine Licence is granted under the Marine and Coastal Access Act 2009 for projects between 12-200 Nautical Miles (nm) from shore, or the Marine (Scotland) Act 2010 for projects between Mean High-Water Springs (MHWS) out to 12 nm from shore. The application includes HRA-supporting documentation (where required), an application letter, Marine Licence application form and this EIAR.
Maximum Design Scenario (MDS)	The maximum range of design scenarios for all infrastructure.
Net Zero	Refers to a government commitment to ensure the UK reduces its greenhouse gas emissions by 100% from 1990 levels by 2050 and in Scotland, the same target is set for 2045. If met, this would mean the amount of greenhouse gas emissions produced by the UK would be equal to or less than the emissions removed by the UK from the environment.
Project Design Envelope (PDE)	The maximum range of design parameters of all infrastructure assessed as part of the EIA.
Study Area	Receptor specific area used to characterise the baseline.
Project Area	The extent of the immediate area surrounding the floating Wind Turbine Generator (WTG) and cable route as characterised by the extent of the seabed environmental and habitat surveys. Also referred to as the Survey Area where specifically relating to survey activities.
Survey Area	The area surveyed during site-specific surveys. Also referred to as the Project Area.
Floating Wind Turbine Generator (WTG)	Device that converts the kinetic energy of wind into electrical energy. Can be functionally divided into four parts: wind turbine, tower and transition piece, floating foundation, and mooring system.

ACRONYMS AND ABBREVIATIONS

ACRONYM/ ABBREVIATION	DEFINITION
AHV	Anchor Handling Vessel
AIS	Automatic Identification System
AtoN	Aids to Navigation
BAT	Best Available Technique
BPEO	Best Practicable Environmental Option
BWM	Ballast Water Management
CA	Comparative Assessment
CAA	Civil Aviation Authority
CaP	Cable Plan
CBRA	Cable Burial Risk Assessment
CEMP	Construction Environmental Management Plan
CMS	Construction Method Statement
CNS	Central North Sea
CO_2e	Carbon Dioxide Equivalent
COCP	Code of Construction Practice
COLREGs	International Regulations for the Prevention of Collision at Sea
CPF	Central Processing Facility
DGC	Defence Geographic Centre
DP	Dynamic Positioning
DSLP	Development Specification and Layout Plan
EEZ	European Economic Zone
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Electromagnetic Field
EMP	Environmental Management Plan
EPS	European Protected Species
ERCoP	Emergency Response Cooperation Plan
ERRV	Emergency Rescue and Response Vessel
FLO	Fisheries Liaison Officer
FPV	Fall Pipe Vessel
GHG	Greenhouse Gas
HPHT	High Pressure High Temperature
HSE	Health and Safety Executive

ACRONYM/ ABBREVIATION	DEFINITION
IALA	International Association of Marine Aids to Navigation and Lighthouse Association
IEMA	Institute of Environmental Management and Assessment
IMO	International Maritime Organization
INNS	Invasive Non-Native Species
IPF	Initial Plan Framework
km	kilometre
kV	kilovolt
LCV	Light Construction Vessel
LMP	Lighting and Marking Plan
m	metres
m^2	square metres
m/s	metres per second
MARPOL	International Convention for the Prevention of Pollution from Ships
MCA	Maritime and Coastguard Agency
MD-LOT	Marine Directorate - Licensing Operations Team
MDS	Maximum Design Scenario
MGN	Marine Guidance Note
µT	Microtesla
mm	millimetre
mph	miles per hour
MoD	Ministry of Defence
MSL	Mean Sea Level
MW	Megawatt
MWL	Mean Water Level
NLB	Northern Lighthouse Board
nm	Nautical miles
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notice to Airmen
NSP	Navigational Safety Plan
OEM	Original Equipment Manufacturer
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OREI	Offshore Renewable Energy Installations
PDE	Project Design Envelope
PEMP	Project Environmental Monitoring Programme
ROV	Remotely Operated Vehicle

ACRONYM/ ABBREVIATION	DEFINITION
SAR	Search and Rescue
SCADA	Supervisory Control and Data Acquisition
SF6	Sulphur hexafluoride
SOLAS	Safety of Life at Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
Te	Tonnes
TEPNSUK	TotalEnergies Exploration and Production North Sea UK Limited
TOG	Targeted Oil and Gas
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UKHO	United Kingdom Hydrographic Office
ULQ	Utilities and Living Quarter
UXO	Unexploded Ordnance
WHP	Wellhead Platform
WGS84	World Geodetic System 1984 (coordinate reference frame)
WTG	Wind Turbine Generator
VMC	Visual Meteorological Conditions
VMP	Vessel Management Plan

4 PROJECT DESCRIPTION

4.1 Introduction

This chapter presents a description of the Culzean Floating Offshore Wind Turbine Pilot Project (the 'Project') design carried forward from option selection. It sets out the design and components for the Project infrastructure, as well as the main activities associated with the construction, operation, maintenance, and decommissioning of the Project.

The objectives of the Project design are to:

- Operate with low maintenance and maximum availability.
- Industrialise with minimum redevelopment of existing local infrastructure.
- Base the design on a commercial floating Wind Turbine Generator (WTG) with:
  - Low hull weight;
  - Flexibility for quayside handling; and
  - Quick assembly features for offshore installation.

4.2 Design Envelope Approach

Whilst this Project is not seeking consent under Section 36 of the Electricity Act 1989, TotalEnergies Exploration and Production North Sea United Kingdom (UK) Limited (TEPNSUK) are aligning the approach to Environmental Impact Assessment (EIA) with the Scottish Government (2022a) Guidance for applicants on using the design envelope for applications under Section 36 as best practice.

TEPNSUK recognise that some of the final design details are likely to be unconfirmed at the time of the Application, including:

- The number and length of the mooring lines;
- The anchor dimensions;
- Export cable parameters; and
- The requirement for rock remediation following cable trenching activity.

The Project Design Envelope (PDE) approach presents Environmental Impact Assessment (EIA) topic-specific realistic worst-case scenarios or Maximum Design Scenarios (MDS) for the Project. The PDE parameter values which represent the worst-case scenario for the impact assessments have been determined on a case-by-case basis, depending on the receptor and impact being considered. These are described in each topic-specific EIA chapter. This enables significant effects to be established for each impact pathway and receptor and allows meaningful assessment to be undertaken, while retaining reasonable flexibility for future Project design. Any modifications to the host installation (i.e. the Culzean platform) are not considered in this Environmental Impact Assessment Report (EIAR) and will be applied for under the Energy Act (2008) Consent to Locate requirements as applicable (UK Government, 2013) and the 2003 Pollution Prevention and Control (Scotland) Amendment Regulations (UK Government, 2003).

4.3 Project Location and Components

The Culzean development is an ultra-High Pressure, High Temperature (HPHT) gas condensate oil and gas development located 222 kilometres (km) east of Aberdeen in the UK Continental Shelf (UKCS) Block 22/25a in the Central North Sea (CNS) (Figure 4-1). The aims of the Project are to deploy one floating WTG with a capacity of 3 Megawatt (MW), test floater and mooring system technologies for offshore floating wind and to demonstrate the feasibility of platform electrification in an offshore environment. The facility is a stand-alone development involving three, bridge linked platforms, including:

- Wellhead Platform (WHP);
- Central Processing Facility (CPF) with flare tower; and
- Separate Living Quarters and Utility Platform (ULQ).

The Project does not require a grid connection to shore, and the Development Area will be entirely within the offshore region between 12 nautical miles (nm) and the Exclusive Economic Zone (EEZ) boundary. A floating WTG will be located approximately 2 km west of the Culzean facilities with an approximately 2.5 km long export cable connected to the CPF via an existing J-tube on the platform (Figure 4-2 and Figure 4-2). The key components include:

- One WTG;
- One floating substructure;
- Up to six mooring lines;
- Up to six drag anchors (or an alternative scenario of three drag and three plate anchors);
- One approximately 2.5 km export cable; and
- Associated scour and cable protection (if required).

To comply with the spatial parameters set out at the leasing application stage, all Targeted Oil and Gas (TOG) decarbonisation projects were required to be within designated areas based on Initial Plan Framework (IPF) requirements (see Chapter 3: Site Selection and Consideration of Alternatives for more information). The Project falls within the area E-a. The coordinates of the key infrastructure associated with the Project are provided in Table 4-1.

Table 4-1 Project infrastructure coordinates

KEY INFRASTRUCTURE	LATITUDE (WGS84[1])		LONGITUDE (WGS84)	
	Degrees, minutes, seconds	Decimal degrees	Degrees, minutes, seconds	Decimal degrees
Wind Turbine Generator	57° 11′ 29.3′′ N	57.1914 N	1° 52′ 35.3′′ E	1.8764 E
Central Processing Facility	57° 11′ 39.8′′ N	57.1903 N	1° 54′ 46.0″ E	1.9079 E

[1] *World Geodetic System 1984 (coordinate reference frame).*

The 'Project Area' is referred to throughout this EIAR and can be defined as the immediate area surrounding the floating WTG and cable route and is shown in Figure 4-1. The area has been characterised by the extent of the seabed environmental and habitat surveys, as outlined in Section 1.5.2 of the Introduction.

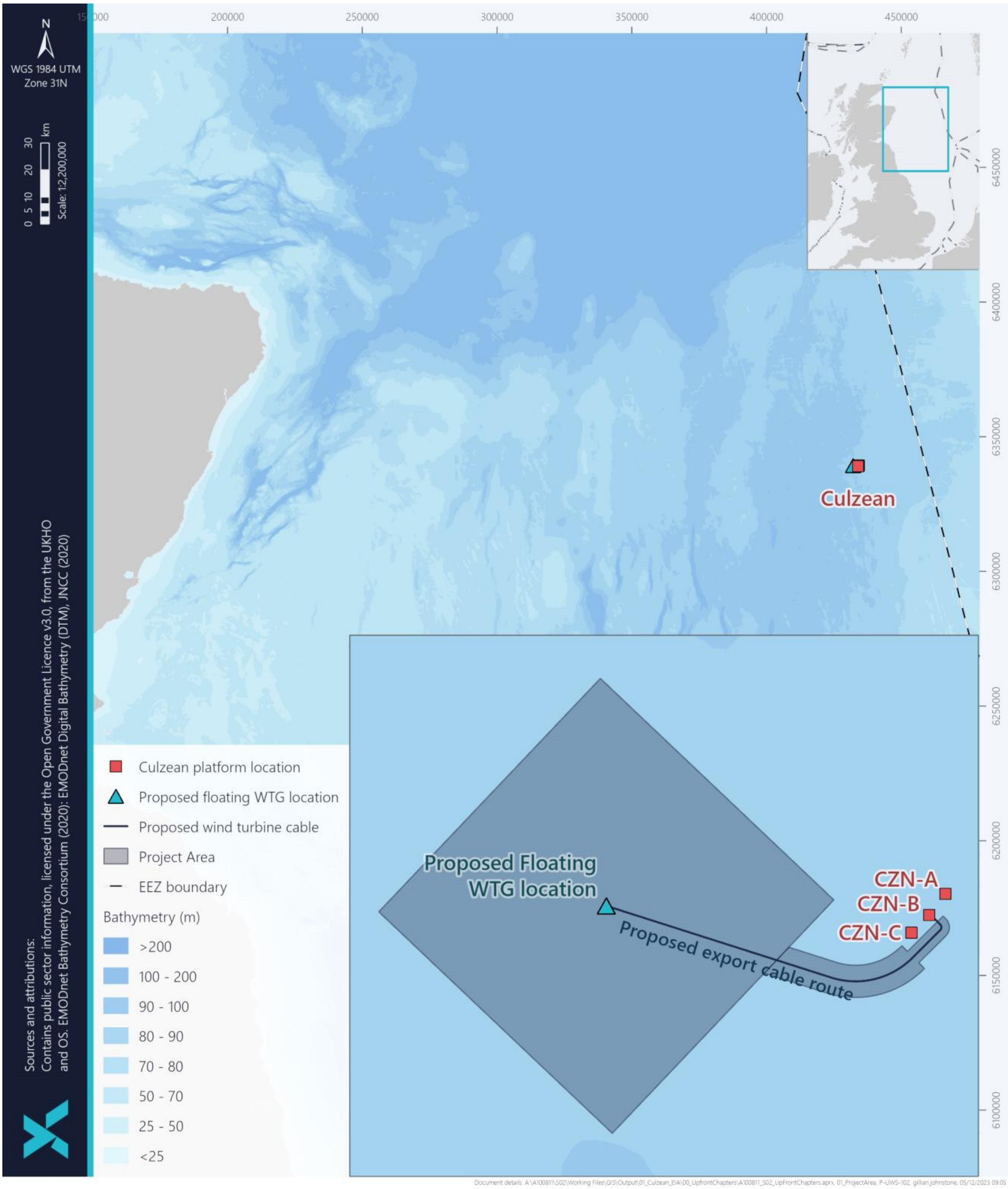


Figure 4-1 The Project Area.

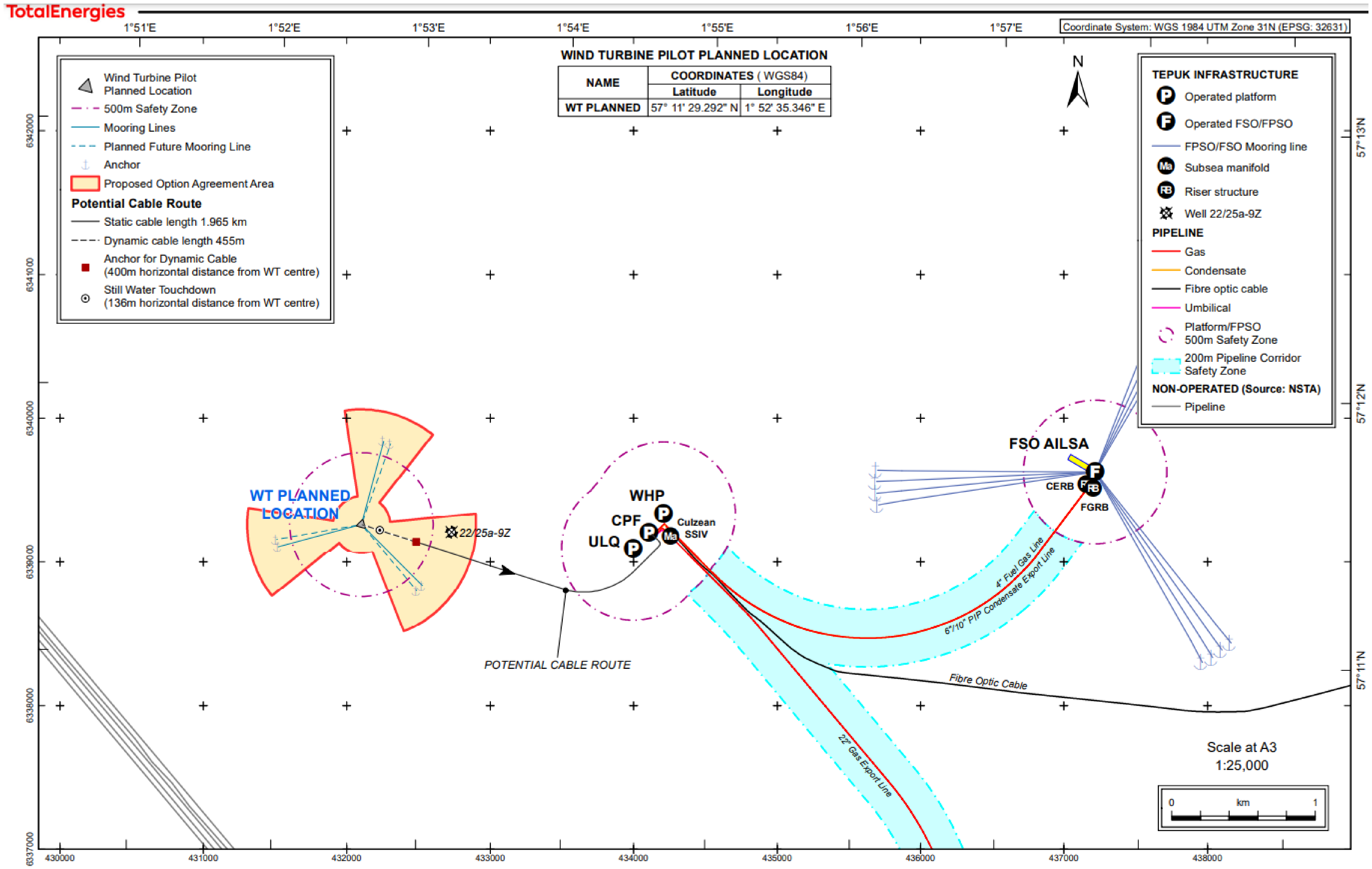


Figure 4-2 Culzean Floating Wind Project planned layout

4.4 Project Infrastructure

4.4.1 Wind turbine generator

TEPNSUK has secured a refurbished Vestas V112 3 MW floating wind turbine (Figure 4-3) which would be expected to last (in offshore conditions) for up to 20 years. Nonetheless, the marine licence is only being sought for a period of 10 years, and this has been the basis for assessments presented within the EIAR. The nacelle and hub are in excellent condition, the blades were manufactured in 2017 and have never been used. A new tower will be built, specifically designed for the Project location, metocean conditions, and the loads induced by the floater motions.

This model has been chosen for the following reasons:

- Immediate availability; and
- Proven track record:
  - The model has been successfully operated onshore since 2013; and
  - More than 385 bottom-fixed offshore units are currently in operation.

Figure 4-3 Vestas V112 3 MW floating wind turbine

Figure 4-4 shows an illustrative WTG, with definitions of the numeric parameters referenced within Table 4-2.

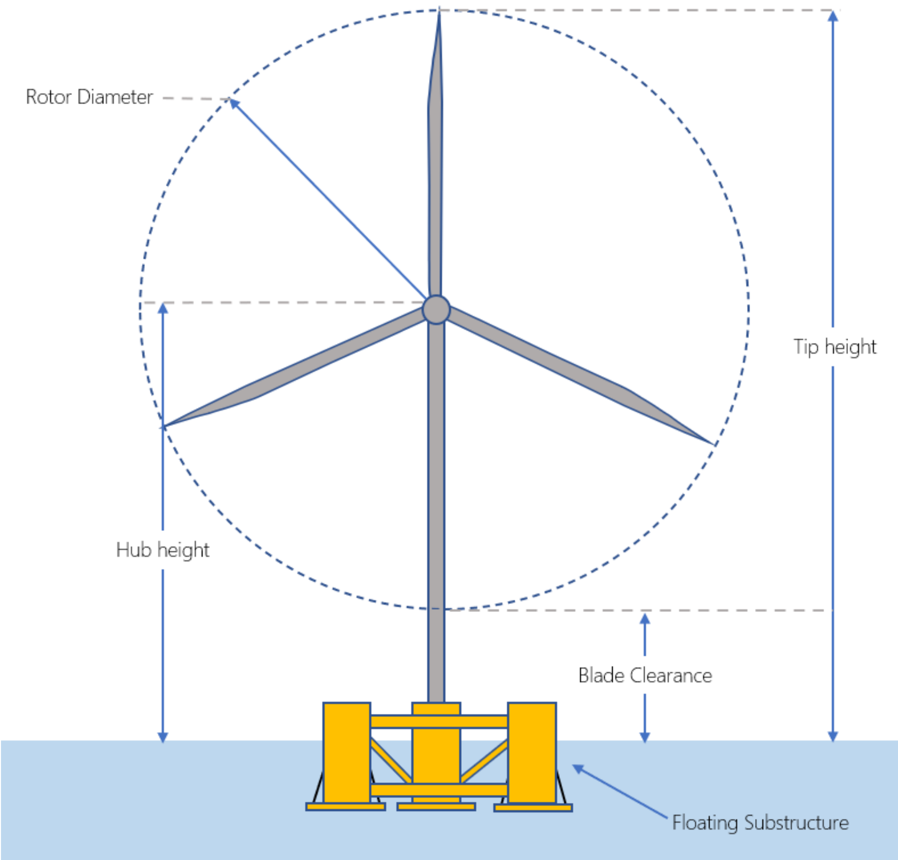


Figure 4-4 Illustration of the design parameter definition for a WTG (not to scale)

Table 4-2 Design parameters for the WTG

DESIGN PARAMETER	MAXIMUM DESIGN SCENARIO
Maximum number of WTGs	1
Total Installation Capacity	3 MW
Minimum blade clearance from sea-level	22 metre (m) above Mean Sea Level (MSL)
Hub height	78 m above MSL
Rotor diameter	112 m
Tip height	134 m above MSL
Turbine light requirements	Not yet fully defined but will be designed and constructed to satisfy the safety requirements of the Maritime and Coastguard Agency (MCA) Civil Aviation Authority (CAA) and the Northern Lighthouse Board (NLB).

The WTG will operate automatically and will yaw (where the nacelle rotates to face the rotor blades into the wind) depending on the predominant wind direction. The rotor blades will also pitch (where the blades can rotate into or out of the wind depending on the wind speed). The WTG is self-starting when the wind speed reaches an average of about 3 metres per second (m/s) to 5 m/s (about 10 miles per hour [mph]). The output increases with the wind speed until the wind speed reaches typically 10 m/s to 13 m/s (about 25 mph). At this point, the power is regulated at rated (maximum) power. When the maximum operational wind speed is reached, typically 25 m/s to 30 m/s (about 60 mph), the WTG will cut-out, either fully or gradually, to limit loading. If the high wind speed cut-out is gradual, the WTG will continue to generate some power through to higher wind speeds. A Supervisory Control and Data Acquisition (SCADA) computer system monitors and controls the output from the WTG. Energy production will be adjusted to the amount of power than can be received by the power management system of the platform. An integrated alarm system will be triggered automatically in the event of a fault. The WTG will also contain components that require lubricating oils, hydraulic oils, and coolants for operation. Examples of these are:

- Grease;
- Synthetic oil / hydraulic oil;
- Nitrogen;
- Sulphur Hexafluoride (SF6); and
- Water / glycerol.

To minimise the impact from an unlikely leak of any of these fluids, the nacelle, tower, and rotor are designed and constructed to contain leaks thereby reducing the risk of spillage into the marine environment.

4.4.2 Floating Substructure

The WTG will be supported by a floating (semi-submersible) substructure, a buoyancy stabilised platform which floats semi-submerged on the surface of the ocean whilst anchored to the seabed. The structure gains its stability through the buoyancy force associated with its large footprint and geometry which ensures the wind loadings on the structure and WTG are countered / dampened by the equivalent buoyancy force on the opposite side of the structure.

The substructure for this Project will be a triangular OCG-WIND substructure, designed and commercialised by Ocergy, a company formed to develop new competitive floating substructure designs. OCG-WIND is a semi-submersible design with four columns (Figure 4-5). The WTG is installed on the centre column. The three outer columns are connected to the central column through a frame composed of top and bottom tubular beams interconnected by V-shaped braces. The outer columns contribute to the stability of the unit and are linked by tendons, which are designed to stiffen the structure, reduce the fatigue, and optimise the structural weight. The modules are assembled using mechanical connections based on compact flanges.

The connection point for all mooring line types will be located at the base of the substructure. The floating substructure may offset from its design coordinate (excursion) depending on the magnitude and direction of wind, sea swell and current conditions as illustrated in Figure 4-5. The extent of excursion differs depending on several design factors but predominantly mooring configuration and type. Under normal operation (i.e. a fully intact mooring system), substructure excursions will be up to a maximum of 34 m. Table 4-3 outlines the MDS parameters for the floating structure.

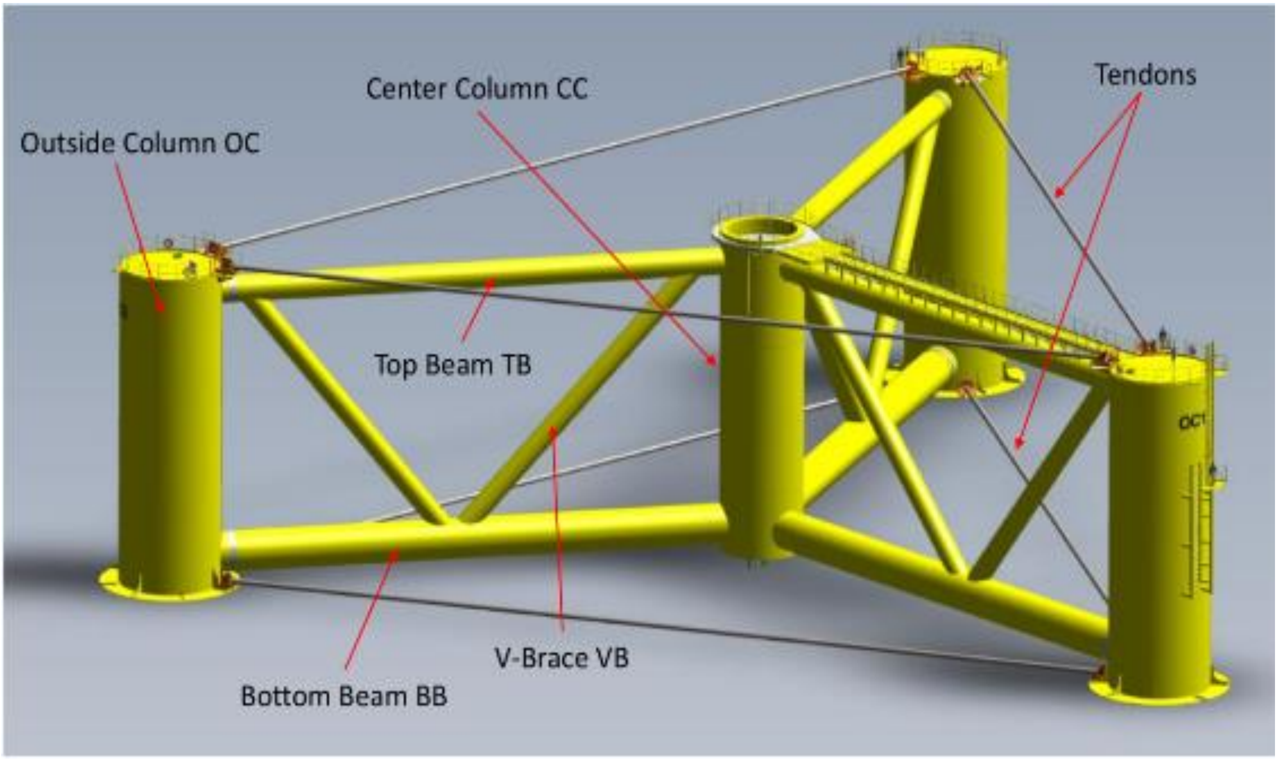


Figure 4-5 OCG-WIND substructure design

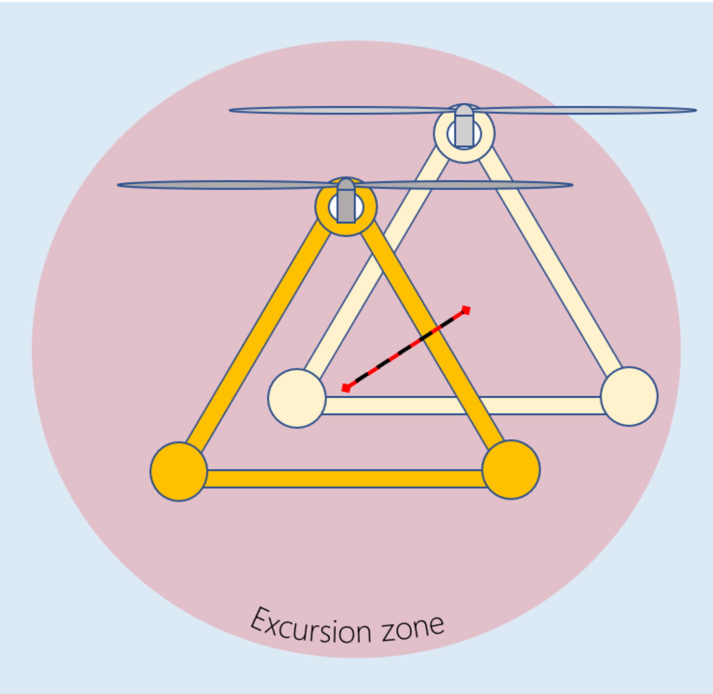


Figure 4-6 Illustration showing potential substructure excursion

Table 4-3 Design parameters for the OCG-WIND substructure.

DESIGN PARAMETER	MAXIMUM DESIGN SCENARIO (MDS)
Floating substructure type	Semi-Submersible – Ocergy OCG-WIND design
Floating substructure height	Maximum 23 m height of outer columns
Floating substructure area	~ 2,500 m^2
Hull weight	975 Tonnes (Te)
Maximum height above MWL	Maximum 9.4 m freeboard above Mean Water Level (MWL) + Idling draft of 13.6 m
Extent of excursion	34 m

4.4.3 Mooring systems

Floating offshore WTGs need to maintain their position even during the most extreme events or storms. The mooring and anchoring systems are responsible for the station-keeping of the floating structure.

The final mooring system design is still under consideration owing to the need to consider new technologies under development by TEPNSUK. As such, the Project will initially utilise a typical catenary mooring design as shown in Figure 4-7. This system will comprise of steel chains, polyester rope, and mooring connectors whose weight in the water column provides the restoring force that holds the floating platform in place. A large section of the mooring chain rests on the seafloor removing any vertical load to the anchors and enabling conventional and more cost-effective anchor types (i.e., drag anchors) to be used. The maximum length encountering the seabed will be 490 m per line (approximately 80% of the line length). These systems typically have large footprints but can be reduced through the attachment of clump weight and/or heavy chain sections to the sections of chain that rest on the seabed. It is anticipated that the maximum average lateral chain movement will be 10 m.

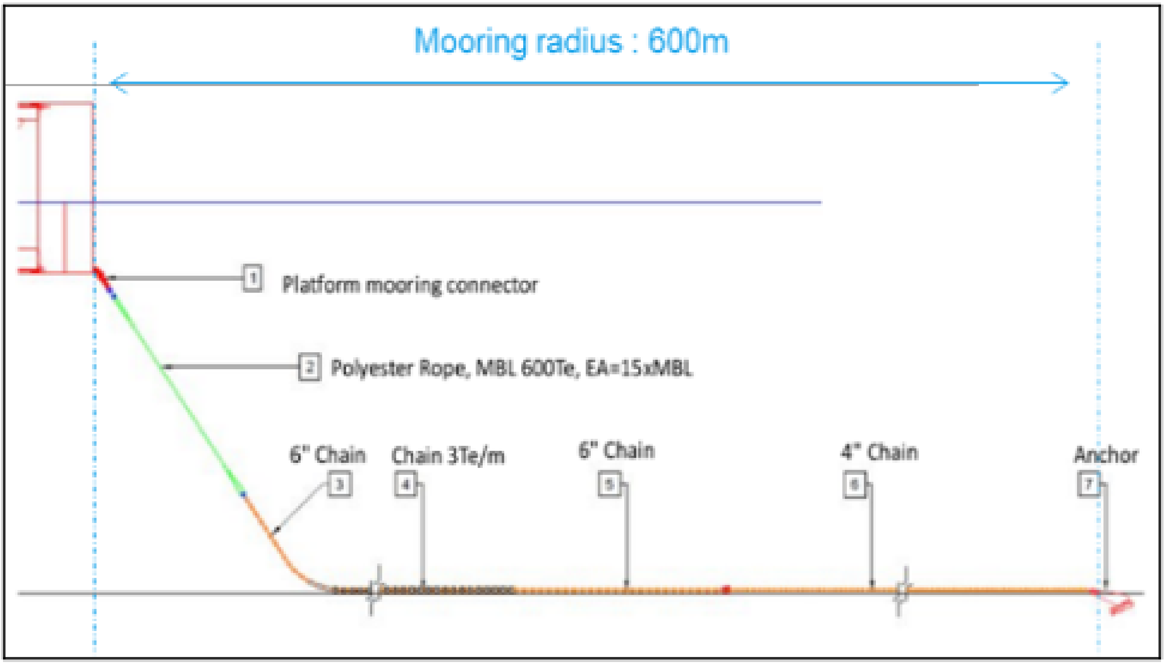


Figure 4-7 Culzean Wind Pilot project initial catenary mooring system overview

Approximately one year into the Project, TEPNSUK plan to install one of the following additional mooring systems to trial new, innovative and low-impact mooring techniques with the aim to assess their feasibility for future electrification projects:

- A taut mooring system utilising synthetic segment (Dyneema, polyester or nylon), elastomer inserts and steel wires or chain segments. The restoring force brought by this mooring system comes from the taut mooring line elasticity. The maximum length of each mooring line would be approximately 205 m whilst under tension with a maximum of 20 m of steel chain in contact with the seabed. It is anticipated that the maximum average lateral movement will be 10 m. This mooring system would be secured with either drag or plate anchor options (Figure 4-8); or
- A semi-taut mooring system utilising a combination of synthetic (nylon) segments and steel wire or chain segments, Where the nylon segment elasticity provides the restoring and wire/chain section is used for anchor connection. The maximum length of each mooring line would be approximately 610 m with a maximum of 110 m of steel chain in contact with the seabed. It is anticipated that the maximum average lateral movement will be 10 m. This mooring system would be secured with either drag or plate anchor options (Figure 4-8).

Either option would reduce the seabed impact of a mooring system in comparison to the more traditional catenary mooring systems. One of the options (either the taut or semi-taut mooring option represented by the red lines in Figure 4-8) will be installed within 5° of the original catenary mooring lines (shown in black in Figure 4-8).

The MDS, based on the three-line mooring system options under consideration is provided in Table 4-4 (catenary system) and Table 4-5 (additional taut or semi-taut systems). Table 4-6 summarises the total MDS and seabed impact for both mooring systems.

Table 4-4 Maximum design scenario for catenary mooring system.

DESIGN PARAMETER	MAXIMUM DESIGN SCENARIO (MDS) PER MOORING LINE	TOTAL MDS
Number of catenary mooring line(s)		3
Length catenary mooring line(s) (m)	600	1,800
Length of mooring line(s) on the seabed (m)	490	1,470
Length of clump weights on seabed (m)	100	300
Material of mooring lines	Steel chains / polyester rope	

Table 4-5 Maximum design scenario for additional taut / semi taut mooring system.

DESIGN PARAMETER	MDS PER MOORING LINE	TOTAL MDS
Number of additional mooring line(s)		3
Length mooring line(s) (m)	610	1,830
Length of mooring line(s) on the seabed (m)	110	330
Material of mooring lines	Synthetic fibres (Dyneema, polyester or nylon), elastomer inserts and steel wires or chain segments (taut system) Synthetic fibres (nylon) / steel wire or chain (semi-taut system)	

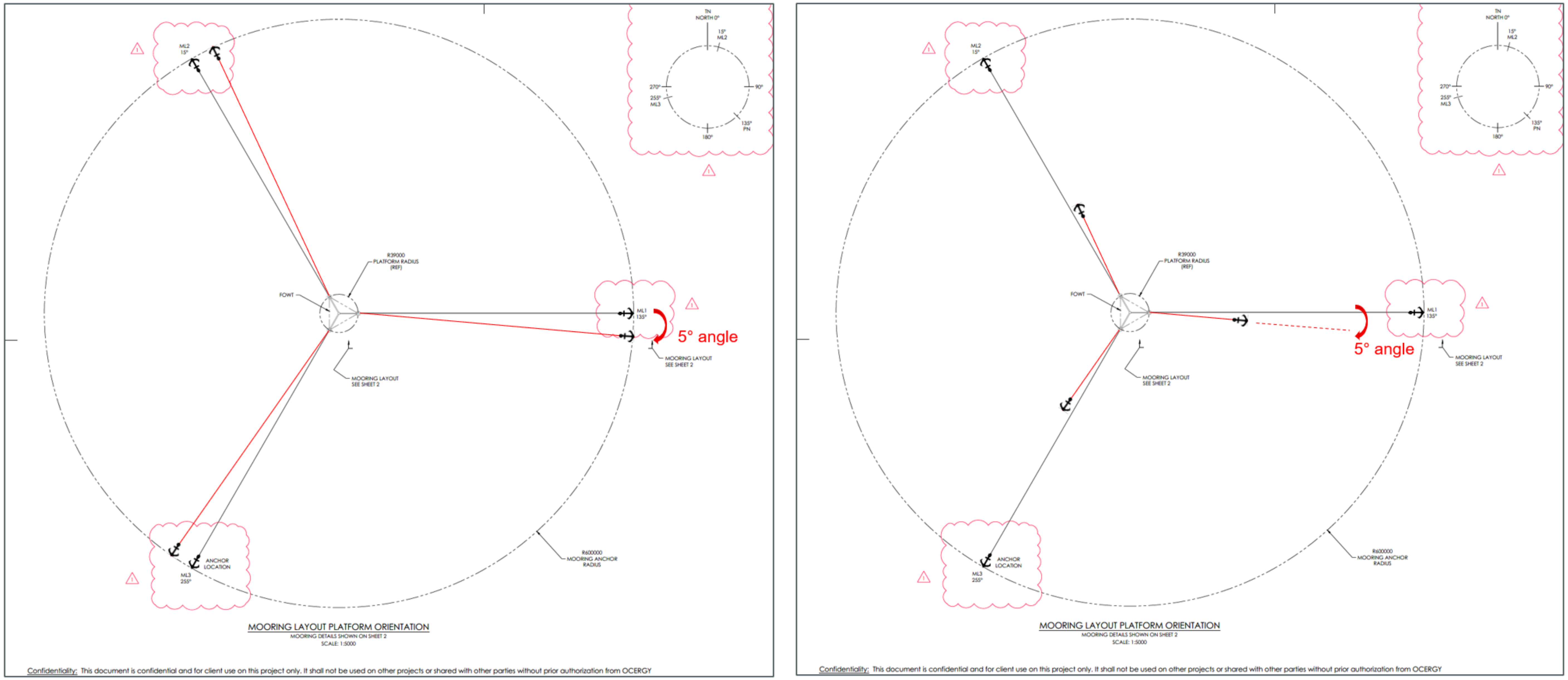


Figure 4-8 Taut (left) and semi-taut (right) mooring system layouts

Table 4-6 MDS for the catenary and additional taut/semi taut mooring system

DESIGN PARAMETER	CATENARY MOORING SYSTEM MDS	ADDITIONAL SEMI TAUT/TAUT MOORING SYSTEM MDS	TOTAL MDS
Number of mooring line(s)	3	3	6
Mooring line length per line (m)	600	610	610
Mooring line length total (m)	1,800	1,830	3,630
Length mooring line(s) on the seabed per line (m)	490	110	490
Length of mooring line on seabed total (m)	1,470	330	1,800
Area of impact total (m^2) based on 10 m corridor	14,700	3,300	18,000
Material of mooring lines	• Steel chains / polyester rope (catenary system); • Synthetic fibres (Dyneema, polyester or nylon), elastomer inserts and steel wires or chain segments (taut system); and/or • Synthetic fibres (nylon) / steel wire or chain (semi-taut system).		

Clump weights are likely to be required to add mass to the catenary mooring line and dampen the lateral movement of the floating WTG and reduce the seabed impact of the mooring lines. These weights would be attached to each of the mooring lines and will be in the form of a casing around the mooring line where it meets the seabed (Figure 4-7) with further clump weights spread out along the grounded portion of the mooring chain. The maximum length of the casing with clump weights is expected to be 100 m per mooring line with up to 11 clump weights spread evenly along the casing, resulting in one clump weight approximately every 9 m. The clump weight footprint will be within the 10 m seabed footprint corridor which accounts for the lateral movement of the mooring lines. This also accounts for any lateral movement during the installation of the clump weights.

4.4.4 Anchoring

The mooring options under consideration include catenary, taut and semi-taut options, as discussed above. Should catenary be used, drag anchors are the preferred option to handle the horizontal loading. Should the taut or semi-taut option be used, either drag or plate anchors will be utilised.

In line with the mooring systems, it is anticipated that the WTG and substructure will require six anchors. The size of a drag anchor can vary, with larger and heavier anchors able to generate a greater holding capacity. Again, this approach might be required to withstand the extreme environmental conditions in the Project Area. For the purposes of this EIAR, calculations have been based on Stevpris Mk5 drag anchors with maximum dimensions of approximately 11.2 m long by 11.2 m wide by 6 m high (based on a worst case 65 Te anchor). The maximum seabed footprint immediately following installation would be 125 m^2 per anchor, not accounting for the impacts of subsequent drag which would be expected to extend for 50 m and cover an area of 3,360 m^2.

There may also be a requirement to install scour protection for the drag anchors (most likely rock) post-installation to prevent the anchors from being undermined by seabed erosion. The requirement for scour protection may be included in reaction to the identification of an issue as part of a post-installation survey or following periodic inspections undertaken during operation and maintenance as outlined in Section 4.6.4. The maximum seabed footprint of rock per anchor would be 70 m^2, protruding approximately 1 m above the seabed. Based on a worst-case quantity of 1.6 Te per m^3, for the stipulated seabed footprint and height of the rock, this would represent a total of 112 Te of rock per anchor.

Plate anchors are designed to allow uplift at the anchor point, which is required in semi-taut or taut leg mooring systems. Plate anchors would be installed into the seabed, without need for preparation or scour protection. Anchors would be installed using a follower such as a suction pile. which is used to set the anchor at target penetration depth and removed after installation of the anchor (Figure 4-10, item 1). A support structure would be laid on the seabed, to which the mooring cables would be attached (Figure 4-10, Items 2 and 3). The sub seabed anchor would then be pulled into position as the mooring lines are connected to the floating substructure (Figure 4-10, Item 4).

Plate anchor dimensions have been based on 20 m^2 surface guide and a suction pile with dimensions of 20 m (length) by a maximum of 6 m diameter (area of 28 m^2). The worst- case direct seabed footprint for each plate anchor installation would be 48 m^2 (20 m^2 for the surface support and 28 m^2 for the suction pile).

As the drag anchors represent the worst-case scenario in terms of seabed disturbance, these parameters have been used to define the MDS for anchors, as shown below in Table 4-7.

Table 4-7 Maximum design scenario for anchoring system.

DESIGN PARAMETER	ANCHOR MDS	TOTAL MDS
Number of anchors		6
Anchor type	Drag anchor	
Anchor dimensions	11.2 m long by 11.2 m wide by 6 m high	
Direct area of impact (m^2)	125	750
Area of drag (m^2)	560	3,360
Scour protection area (m^2)	70	420
Scour protection weight (Te)	112	672

Figure 4-9 Example of a Stevpris Mk5 drag anchor

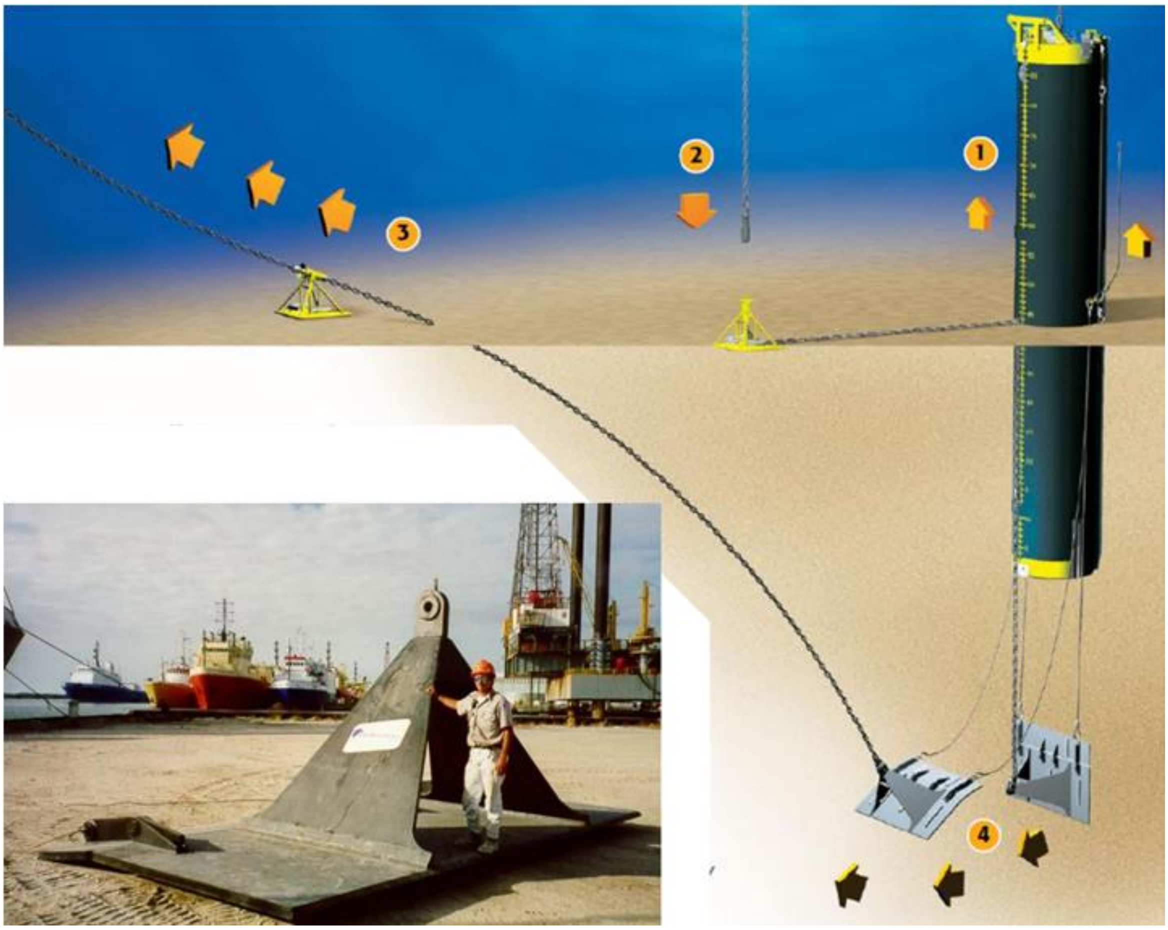


Figure 4-10 Plate anchor installation process

4.4.5 Export cable

The export cable will collect the power from the WTG and connect to the CPF via an existing J-tube on the platform (Figure 4-2). The key design parameters for the cable are listed in Table 4-8.

One of the key design differences between cables for a fixed-bottom wind farm development and those for floating WTGs is the dynamic nature of the cables. The cable system must be able to accommodate the movement of the floating substructure without imparting any direct loads on the cables (i.e., acting as a form of mooring). As such, the cable design often adopts a 'lazy-s' configuration using buoyancy modules attached to a portion / midpoint of the cable. Although other configurations may be adopted for the same purpose, the 'lazy-s' allows the cable configuration to expand and contract in shape, in response to the movements of the floating substructure. An illustration of a typical dynamic cable arrangement is provided in Figure 4-11.

From the point where no movement in the cable is expected on the seabed (the static cable) the cable will be trenched and buried to a minimum target depth of 0.6 m. Burial is expected to be achievable within the seabed conditions between the key Project locations (Figure 4-2), and a target of 100% burial will be aimed for. In the unlikely instance that burial is not achievable, remedial protection, likely in the form of rock placement, will overlay the top of the cable. Immediately following installation, post-installation surveys will be conducted to confirm target burial depths have been achieved and identify where remedial protection measures may be required.

As a worst-case scenario, it is estimated that up to 50% of the cable length on the seabed (approximately 1,000 m) may require additional remedial cable protection in the form of rock placement. It should be noted that this is a worst-case estimate and during detailed design the requirement for cable protection will be reviewed, to reduce cable protection volumes where possible. The maximum width of cable protection along the cable route will be 7 m, which equates to a worst-case maximum seabed footprint of 7,000 m^2. The height above the seabed that this protection may protrude is approximately 1 m. Based on a worst-case quantity of 1.6 Te per m^3, for the stipulated seabed footprint and height of the rock, this would represent a total of 11,200 Te of rock. Table 4-9 provides details of the specific design elements of the Project export cable.

Table 4-8 MDS parameters for export cable.

DESIGN PARAMETER	MAXIMUM DESIGN SCENARIO
Export cable voltage (kilovolt (kV))	52.5
Export cable diameter (millimetre (mm))	107 ± 2
Length of export cable (m)	2,500
Length of export cable in the water column (m)	455
Length of export cable on the seabed/ trenching corridor (m)	2,045
Cable trenching corridor width (m)	15
Cable protection	Rock covered over 1000 m (~50 % of seabed cable length)
Cable protection width (m)	7
Cable protection height (m)	1
Total cable protection seabed footprint (m^2)	7,000
Total cable protection weight (Te)	11,200

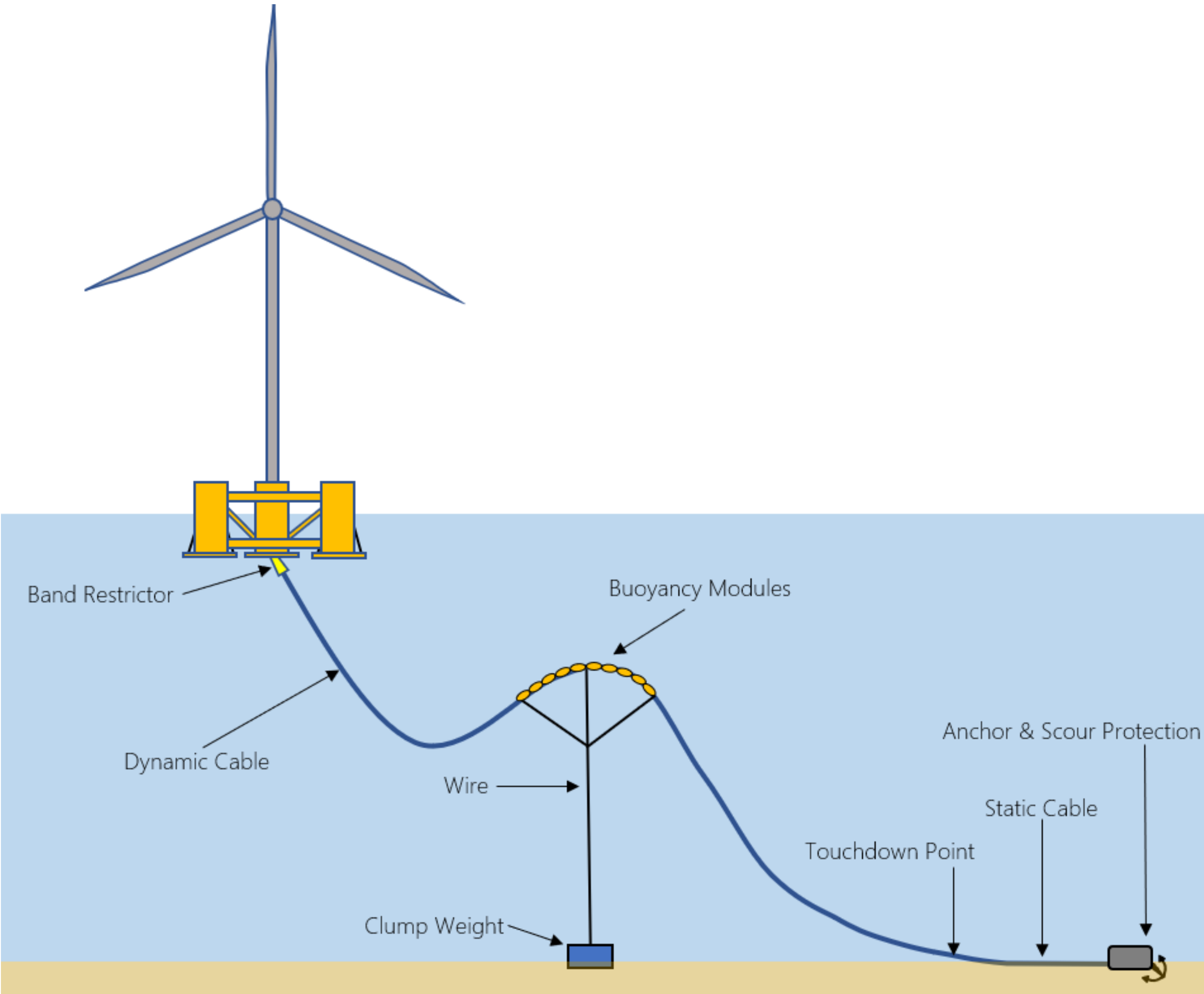
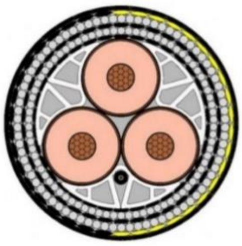
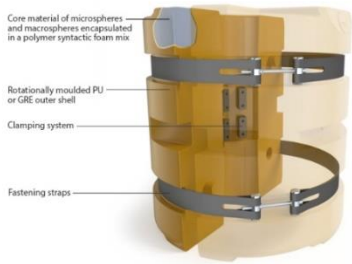


Figure 4-11 Example dynamic cable Lazy-S arrangement (not to scale)

4.4.5.1 Electromagnetic Fields

The Earth has its own geomagnetic field, meaning that Electromagnetic Field (EMF) effects are always naturally present, and this is known to vary between 25 microtesla (µT) and 65 µT (National Oceanic and Atmospheric Administration (NOAA), 2021). Cables used for power transfer are known sources of additional EMF, creating a highly localised change in electric and magnetic fields. The voltage, size, and operational characteristics of the export cable differ between offshore wind energy project designs, and these all influence the level of additional EMF locally. Potential magnetic fields generated are proportional to cable current and higher cable voltage results in a smaller cable current, whilst lower cable voltages result in larger currents and therefore higher levels of EMF and thermal loads. EMF levels dissipate rapidly from the source for both buried and dynamic cables. Due to the dynamic nature of these cables, it is highly unlikely that receptors will come within, or remain in, proximity to the cables. To this end, and as agreed within the Scoping Opinion (Marine Directorate - Licensing Operations Team (MD-LOT), 2023), impacts from EMF have been scoped out of the EIA, and as such are not considered further within the EIAR.

Table 4-9 Dynamic cable features

CABLE FEATURE	DESCRIPTION	IMAGE
Dynamic Cable	• Three-phase conductor (copper); • Conductor insulation; • Conductor sheath; • Filler; • Two optical fibres; • Inner sheath (bedding); • Armour wire (two layers of galvanised steel wire); and • Outer jacket (high density polyethylene).	
Buoyancy Module	The buoyancy modules are typically clamped to the cable during installation and serve to support the weight of the cable in the water column and are positioned to provide the 'lazy-s' configuration in the water column. The number of modules required will be driven by a combination of factors such as: • Water depth; • Desired configuration; • Environmental conditions; • Metocean conditions; • Dynamic cable specification amongst other drivers; and • Floating sub-structure movement.	 (Image from Balmoral Offshore)
Bend Restrictor	Bend restrictors are used to reduce the fatigue in the export cable at pinch points within the system's physical design. This is particularly pertinent in the case of the floating WTG design as there are two moving components, the cable systems and the floating structure, as opposed to just the cable system in the case of the fixed-bottom WTG arrangement. For the dynamic cable design, a bend restrictor may be used at the exit point of the cable from the floating structure and at the touchdown / tie-down point of the cable on the seabed, although this is designed on a project-by-project basis. The bend restrictor material type is typically non-toxic polymers.	 (Image from Balmoral Offshore)

4.5 Offshore Pre-Installation, Installation and Commissioning

4.5.1 Schedule and timescales

It will take approximately one month for the pre-construction, construction and installation of the WTG, moorings and cable installation activities which are proposed to take place in Q3, 2025. Timescales are subject to the Project securing all relevant permits and licences, as well as the finalisation of procurement and supply chain contracts.

TEPNSUK will be applying for a 10-year Marine Licence to cover the life of the Project.

4.5.2 Safety zones

To minimise disruption to navigation by users of the sea, safety zones are expected to be established around areas that have relevant activities taking place at a given time. The floating WTG is being treated as a supplementary unit under the Health and Safety Executive (HSE) Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995 and as such, TEPNSUK are applying for a 500 m safety exclusion zone centred around the WTG for the duration of installation and operations and maintenance activities (Figure 4-2). It should be noted that there is an existing 500 m safety zone around the Culzean platform that is always present.

It is also standard safe working practice to establish advisory minimum safe passing distances around areas of vessel activity that present a navigational safety risk to marine users. This includes providing information of planned works and a requested safe clearance distance. These advisory safety zones are generally 500 m and move with the vessel during its operation.

Safety zones, and/or any other exclusions required, will be discussed and agreed with relevant stakeholders and implemented and communicated through standard protocol (e.g. Notice to Mariners) and will be supported by risk-based justification.

4.5.3 Construction vessels

It is anticipated during the construction of the Project, that a variety of vessels and vehicles will be used for installation, support and transport of equipment and infrastructure to the Project Area. The vessel requirements will be determined by the installation contractor post-consent, and this will depend on vessel availability. To account for uncertainly (including weather constraints), conservative assumptions have been made on the vessel activities for the construction period and these are presented in Table 4-10. It is expected that several vessels may work in parallel during various construction phases, with a maximum of four vessels on site at the same time during mooring line hook-up (Table 4-10). All vessels will use Dynamic Positioning (DP).

4.5.4 Surveys

Site-specific geophysical and geotechnical surveys were undertaken in Spring 2023 to inform detailed design and layout. Additionally, no Unexploded Ordnance (UXO) were detected during site-specific surveys with a magnetometer or during any other surveys undertaken within the Culzean Field over the last 15 years. The 2023 surveys also confirmed that that boulder movement will not be required prior to anchor installation.

Pre-installation surveys will be undertaken in 2024/25. These will consist of visual inspections (using Remotely Operated Vehicle (ROVs)) of the mooring locations and cable routes to confirm the exact routing and determine the need for any seabed preparation. These surveys are likely to take up to a day. All survey equipment will utilise ultra-short baseline positioning equipment to ensure precise subsea locations.

Table 4-10 Estimated vessel requirements during the construction period

CONSTRUCTION PHASE	ACTIVITIES	VESSEL(S)	NUMBER OF VESSELS	DURATION (DAYS)		
				Mob / Demob	Transit	Working
Pre-lay surveys	Check for hazards and obstacles potentially missed in initial survey	ROV loaded onto Light Construction Vessel (LCV)	1	2	2	1
Mooring line pre-lay	ROV surveys, Anchor and mooring line deployment	Anchor Handling Vessel (AHV) with ROV capability	1	1	1	12
Mooring line hook up to floating substructure	ROV Surveys, connection of mooring lines to floating substructure	AHV with ROV capability	1	1	1	10
		2 Anchor Handling Tugs	2	4	4	10
Export cable hook up to floating substructure and initial cable lay	ROV Surveys, hook up and cable lay	LCV with installation cable reel and ROV capability	1	1	1	5
Completion of cable lay and hook up at Culzean J-Tube.	ROV Surveys, hook up and cable lay	LCV with installation cable reel and ROV capability	1	1	1	5
Cable trenching and remediation	Trenches and burial of the cable	Trenching vessel	1	2	2	8
	Installation of rock or gravel to protect and ensure a firm installation of the cable.	Fall Pipe Vessel (FPV)	1	2	2	2
Post - installation survey	Check if cable is buried correctly	ROV Loaded onto LCV	1	2	2	1
Total				**16**	**16**	**54**

4.5.5 Mooring line and anchor installation activities

To ensure efficient installations and avoid any simultaneous vessel operations, the mooring system will be pre-installed and wet-stored prior to the floating assembly arriving in the Project Area and will be marked by the Culzean platform's dual purpose Emergency Rescue and Response Vessel (ERRV). Any wet storage will be location-specific and within the footprints assigned to seabed impact by the MDS outlined in Section 4.4.3. A general installation sequence will involve anchor installation prior to mooring installation. The location of the anchors on the seabed will be informed by detailed analysis of the site-specific geophysical and geotechnical surveys undertaken in the 2013 and 2023 surveys.

Drag embedment anchors are designed to penetrate approximately 10 m to 15 m into the seabed, subject to seabed conditions. The anchors will be installed by an AHV (Table 4-10), which will lower the anchor to the seabed and then drag it into the required position and depth. The installation process for plate anchor installation is outlined in Section 4.4.4. Vessel activity for this additional installation is also anticipated to be carried out by AHV and is included within the vessel scope in Table 4-10. Moorings will then be hooked to these pre-installed anchors and if required, hooked up to buoys which will act as future installation aids for the floating substructure and WTG hook-up. The impacts of the mooring lines on the seabed have been quantified (as a worst-case) in Section 4.4.3.

There may also be a requirement to install scour protection post-installation for some anchor solutions to prevent the structure from being undermined by seabed erosion. This is achieved either through a fall-pipe from a rock placement vessel (most efficient method and generally used in water depths greater than 10 m). Graded rock is used with grain sizes being tailored to achieve the necessary protection. The impacts of anchoring and scour protection on the seabed have been quantified (as a worst-case) in Section 4.4.4.

4.5.6 Floating substructure and WTG installation activities

The WTG will be installed on the substructure at the quayside in Aberdeen using a crane. Quayside pre-commissioning will take place to reduce offshore operations to a minimum. The WTG and floating substructure will be transported by sea from Aberdeen harbour. The same port is likely to be used for marshalling the other Project components such as the anchors and cables.

Upon the arrival of the floating assembly in the Project Area, the substructure will be manoeuvred into the correct location using tugboats to steer the substructure into position / orientation whilst the previously installed mooring lines are connected to the floating substructure.

4.5.7 Export cable installation

Installation of the export cable will take place once the floating substructures and WTG have been installed, using a LCV (Table 4-10).

A pre-lay grapnel run (2 m wide along the length of the cable route) would be undertaken to hook any linear debris; if any debris is hooked, it will be recovered to the vessel for onwards disposal / recycling ashore. The LCV will transit to the site of the pre-installed floating structure where the cable is pulled into the floating structure and secured. The cable (with buoyancy modules) is then deployed into the water column. The second end of the cable will then be deployed and pulled and secured into the J-tube at the Culzean CPF.

Several different approaches are available for installation of the export cables laid on the seabed and these include:

- Pre-lay trenching using a displacement plough to create a pre-lay trench which the cable is then installed into. A separate backfill plough may then be used to push the spoil heaps created by trenching over the cable, thus creating the required cable cover;
- Post-lay trenching using a variety of tools including:
  - Jet trenchers (either self-propelled or mounted as skids onto ROVs) which inject water at high pressure into the sediment surrounding the cable. The seabed is temporarily fluidised and the cable is lowered to the required depth. Displaced material is suspended in the water and then resettles over the cable. This process is controlled, to ensure that sediment is not displaced too far from the cable;

- Mechanical trenchers which bury the cable by lifting the laid cable whilst excavating a trench below, and then replacing the cable at the base of the trench and allowing the soil to naturally backfill behind the trencher;
- Non-displacement ploughs which simultaneously lift a share of seabed whilst depressing the cable into the bottom of the trench. As the plough progresses, the share of the seabed is replaced on top of the cable; and
- Simultaneous cable lay and burial, using a jet trencher or non-displacement plough.

A combination of the above methods may be used for export cable installation, depending on the ground conditions.

Cables which have not been adequately protected by burial generally need some form of remedial protection to reduce the risk of damage to the cable. Immediately following installation, post-installation surveys will be conducted to confirm target burial depths (0.6 m) have been achieved and identify where remedial protection measures (e.g., rock placement, concrete mattresses or sand / grout bags) will be required. Cable protection, either by burial or placing of external protection over the cables (if required), will take place after cable laying. The potential impacts of cable lay and protection have been quantified (as a worst-case) in Section 4.4.5. Once the required cable protection has been added, the cable will be commissioned.

4.6 Operation and Maintenance

4.6.1 Overview

Once commissioned, the Project is expected to remain in operation for up to 10 years. During the operations period, the following classifications of maintenance may be required:

- Routine maintenance: activities that are carried out on a regular basis based on the Original Equipment Manufacturer (OEM) recommendations and good industry practice, for example inspections, testing investigation of minor faults;
- Unscheduled maintenance: activities that may be required to carry out repairs or remedial works to return the asset to serviceable condition possibly requiring tow back to shore; and
- Major component replacement / repair: Faults that could trigger repairs requiring large component replacements and extensive remedial works, likely requiring tow back to shore.

4.6.2 Operation and Maintenance Vessel Requirement

The overall in-service inspection, maintenance, and monitoring of the WTG will be carried out in accordance with the service requirements provided by the WTG manufacturer. This schedule will to a large extent follow normal seabed fixed WTGs, however, on a few central elements there will be a significant difference. This will relate to major component replacements and below-water inspections.

The access strategy anticipates the use of a dual-purpose ERRV rigged with a compensated gangway for personnel transfer. The ERRV will support Culzean operations and will be used for transferring personnel between Culzean and the WTG. Given the proximity of the Culzean platforms and the WTG, the use of a dual-purpose ERRV has been confirmed acceptable provided adaptation of procedures and final vessel requirements will be agreed as per the Project Navigational Safety Plan (NSP) and/or Vessel Management Plan (VMP). The ERRV will deploy its compensated gangway on landing points on Culzean ULQ platform and on the WTG.

It is anticipated that an additional 24 days per year of supply vessel activity will be required over the duration of the Project operations. This is to account for an extended stay on site of approximately 2 days per month to account for ongoing maintenance activity required for the WTG.

The accessibility criteria for the floating substructures are expected to be the same as that of fixed-bottom installations. This consideration has been evaluated with numerical simulation. However, offshore weather conditions in the Project Area may limit access to the WTG. Unmanned, remotely operated or autonomous vessels and drones may also be used for inspection.

4.6.3 Floating substructure and WTG maintenance

It is expected that the floating substructures will be painted in a low-toxicity anti-fouling paint and will also be fitted with cathodic (anode) protection to reduce the risk of corrosion of the steel structures. The substructure will be designed to accommodate marine growth; however, growth levels will be inspected regularly, and subsequent removal of this growth will be undertaken using water jetting tools (or other suitable means) if substantial accumulation is in evidence.

For repairs that cannot reasonably be completed onsite, towing to port or shallower water where a jack-up vessel can be used for repair, may be required. The floating substructure, mooring, and cable arrangements will be designed to enable the safe and efficient disconnection of the structure from its moored position. The structure will also be designed to allow for towing with conventional tugs between the Project Area and port. The following sequence is envisaged for a major component changeout:

- The WTG is shut down and is isolated from the export cable;
- The power cable is disconnected from the WTG and the cable end is suitably wet stored;
- The mooring system is disconnected from the WTG, with the moorings laid safely on the seabed;
- The complete WTG and structure assembly is towed to the operations and maintenance port / shallow waters for repair; and
- Following quayside repair, a repeat of the relevant steps of the installation sequence will be completed to bring the WTG back into operation.

4.6.4 Mooring line maintenance

Protection from corrosion will be provided by cathodic (anodes) protection of the polyurethane cover at the synthetic termination[2]. Any section of the mooring lines that rest on the seabed will not be protected in these ways as the lines will be in constant movement against the seabed.

The mooring monitoring, inspection and maintenance will be in line with expectations laid out by the HSE and MCA for floating wind (HSE & MCA, 2017). The overall operation and maintenance strategy will be developed post-consent; however, it is anticipated that the inspections will follow the inspection scheme stipulated by the mooring line OEM. Later, a risk-based approach might be adopted. The inspections will be undertaken via conventional periodic visual (ROV) inspections. Inspections would be undertaken to check the following:

[2] *For steel mooring chains, no corrosion protections is required as corrosion allowance is accounted for within design.*

- Anchor condition (specific inspection informed by selected technology) for evidence of displacement and scour;
- Mooring line condition, including corrosion (particularly at the point of touch down on the seabed), amongst other technology-specific considerations;
- Connection points for wear, corrosion, and functionality (i.e. free rotation in case of swivel connector);
- Marine growth levels, and subsequent removal of this using water jetting tools, if substantial accumulation is in evidence; and
- Collection and removal of debris (such as abandoned fishing nets, pots, and other marine rubbish) amongst the mooring lines.

4.6.5 Export cable maintenance

Within the lifetime of the Project, there should be no need for scheduled repair or replacement of the subsea cables; however, reactive or proactive repairs may be required. Periodic ROV inspection surveys will be performed to ensure the cables remain buried and undamaged. If cables do become exposed, re-burial works, or remedial cable protection works would be undertaken. Maintenance activities expected to take place on the cables during the operational phase include but are not limited to:

- Cable route inspection, both seabed and water column;
- Cable repair by recovering the cable from its trench / water column and making the necessary repairs;
- Reburial of sections of cable which have become exposed;
- Remedial protection over sections of the cable identified as in need of protection; and
- Periodical removal of marine growth from the submarine cable and relevant accessories.

4.7 Decommissioning

Under Section 105 of the Energy Act 2004 (as amended) (UK Government, 2004), developers of offshore renewable energy projects are required to prepare a Decommissioning Programme for approval by Scottish Ministers. A Section 105 notice is normally issued to developers by the regulator after consent / marine licence has been issued for the given development. Developers are then required to submit a detailed plan for the decommissioning works, including anticipated costs and financial securities; this is then consulted on by MD-LOT prior to seeking ministerial approval.

The overarching principles that will be followed when developing an appropriate Decommissioning Programme are derived from Decommissioning of Offshore Renewable Energy Installations in Scottish Waters under The Energy Act 2004 Guidance notes for Industry (in Scotland) (Scottish Government, 2022b), and will consider:

- The Best Practicable Environmental Option (BPEO), which is the option that delivers the most benefit or least damage to the environment at an acceptable cost, both in the short and long term. This involves balancing the reduction in environmental risk with practicability and the cost of reducing the risk;
- Safety of surface and subsurface navigation;
- Other uses of the sea; and
- Health and safety considerations.

In addition, the Project will adhere to the principles of:

- Sustainable development, and will seek to ensure that, as far as reasonably practicable, future generations do not suffer from a diminished environment, or from a compromised ability to make use of marine resources; and
- Polluter pays principle, which acknowledges the Project's responsibility to incur the costs associated with its impact on the environment.

In developing a Decommissioning Programme, TEPNSUK will seek to maximise the re-use of materials and will pay full regard to the 'waste-hierarchy'. To ensure that commercial viability is maintained, the Best Available Technique (BAT) will be used and cost-effective decommissioning solutions will be sought. In achieving the above objectives, TEPNSUK will ensure practical integrity. When decommissioning the Project, TEPNSUK will seek to minimise the influence on land transportation and where practicable, will plan transportation between the coast and respective waste management facilities to reduce safety issues and disturbance to traffic.

In line with the Scottish Government's default position for the Decommissioning of Offshore Renewable Energy Installations (OREI), the starting presumption is that at the end of the Project's operation and maintenance phase, there will be a requirement for all offshore components (above and below seabed) to be completely removed to shore for re-use, recycling, incineration with energy recovery, or disposal at a licensed site. As the Project's anticipated lifetime is up to 10 years from full commissioning, there may have been advances in technological capabilities for decommissioning and/or changes to legislation by this time, therefore decommissioning best practices and legislation will be applied at that time. Under international standards such as those published by the International Maritime Organization (IMO), there is the potential to consider decommissioning components *in situ*, however, it is understood that this would require a robust and compelling justification to be presented to Scottish Ministers to be granted approval. In this instance, a Comparative Assessment (CA) would be undertaken to provide a recommendation, based on the performance against five main criteria: Safety, Environmental, Societal, Technical Feasibility and Economic.

Throughout the Project's life cycle, the Decommissioning Programme will be reviewed and updated every five years. Consultee bodies listed in the S105 Notice, and any additional consultees identified by MD-LOT or TEPNSUK, will be provided with the opportunity to comment on the final decommissioning strategy prior to it being finalised. It is anticipated that the final revision process will commence two years prior to the initiation of decommissioning activities.

4.7.1 Decommissioning the WTGs and floating substructures

The removal of WTG components, including blades, nacelle, and tower, will largely be a reversal of the installation process and will likely be undertaken following repositioning to shore. The general methodology for carrying out WTG decommissioning will be:

- De-energise WTG and isolate them from the power source;
- Disconnect the dynamic cable and recover or lay down for later recovery; and
- Disconnect the floating foundation from its moorings and tow complete foundation with WTG to port / onshore facility for dismantling and processing.

Once onshore, the components are likely to be processed as follows:

- All hazardous substances and fluids will be removed from the WTG (such as oil reservoirs and any hazardous materials and components) and will be disposed of in accordance with relevant regulations at the time of disposal;
- All steel components and any other salvageable components will be recycled;

- Electrical components will be disassembled and handled in accordance with the newest International Electrotechnical Commission 61400 at the time of decommissioning; and
- The WTG blades (fibreglass) will be disposed of in accordance with the relevant regulations in force at the time of decommissioning.

4.7.2 Decommissioning the anchoring systems

The removal and dismantling of the anchoring systems will largely be a reversal of the installation process and subject to the same constraints. Decommissioning will be undertaken in the same controlled manner as the installation process and in accordance with a risk management plan, to ensure the same level of safety and pollution control measures. The post-decommissioning state will be to leave the site with a clear seabed surface, free from obstruction to other seabed traffic such as fishing gear. Components will be re-used or recycled, wherever possible.

4.7.3 Decommissioning the export cable

It is anticipated that full removal of both the dynamic and seabed laid static cable section (buried and protected) will be required unless there is compelling evidence to decommission the buried sections *in situ*. The sequence for removal of the cable is anticipated to be:

- Locate the cable using a grapnel and lift it from the water column or seabed. Alternatively, or in addition, it may be necessary to use an ROV to cut and/or attach a lifting attachment to the cable so that it can be recovered to the vessel;
- For dynamic cable removal the buoyancy modules along with all other associated accessories will be removed as the cable is recovered to deck;
- Seabed material may need to be removed to locate the cable (excluding dynamic cable sections). This is likely to be carried out using a water jetting tool similar to that used during cable installation;
- The recovery vessel will either ‘peel out’ the cable as it moves backwards along the cable route whilst picking it up on the winch or cable engines, or, if the seabed is very stiff, it may first under-run the cable with a suspended sheave block to lift the cable from the seabed. The use of a suspended sheave block may be carried out by a separate vessel, such as a tug, prior to the recovery vessel ‘peeling out’ the cable;
- The recovery vessel will either spool the recovered cable into a carousel or cut into lengths as it is brought aboard before transport to shore; and
- The cable will be recycled onshore.

If through consultation and assessment, a decision to leave cables *in situ* was deemed the most suitable approach, any application for this would be supported by a CA process (in line with Scottish Government (2022b) Guidance) and a suitable body of evidence. If approval was granted, the ends of the cable will be cut as close to the seabed as possible and will be weighted down and buried (probably using an ROV) to ensure they do not interfere with trawling and other rights and needs of legitimate users of the sea.

4.7.4 Removal of scour / cable protection

It may be preferable to leave the scour or cable remedial protection in situ to preserve any marine habitat that may have developed over the life of the Project; this is particularly the case for rock placement / boulders as these are generally quite small in grade size so not practical to recover. Relevant stakeholders and regulators will be consulted to establish the most appropriate approach at the time of final decommissioning decision-making.

4.7.5 Seabed clearance and restoration

TEPNSUK is committed to restoring the Project Area, as far as is reasonably practicable, to the condition that it was in prior to construction. In line with the details provided above, TEPNSUK is also committed to ensuring the Project is safely and effectively decommissioned.

4.7.6 Post-decommissioning monitoring, maintenance, and management

Should any infrastructure be left *in situ*, post-decommissioning activities may be required to identify and mitigate any unexpected risks to navigation or other users of the sea. This includes the cable becoming exposed through natural sediment movement. The requirement for monitoring and the extent and approach taken will be determined based on the scale of the remaining infrastructure, the risk of exposure and the risk to marine users. The requirement will be agreed upon with MD-LOT in subsequent revisions of the Decommissioning Programme as the Project progresses.

Where considered necessary, post-decommissioning monitoring surveys (using non-intrusive survey techniques where possible) of the seabed will be carried out following the completion of the decommissioning works. Surveys are expected to comprise geophysical surveys (such as swathe bathymetry, side scan sonar, and magnetometer). Surveys will be undertaken in line with the final Decommissioning Programme, and in line with the survey scopes consulted on with MD-LOT and relevant stakeholders. Compliance will be verified through an independent third-party survey upon completion of the works. The results of these surveys will be issued to MD-LOT for record-keeping purposes. Any post decommissioning hydrographic surveys will be undertaken in accordance with the requirements set out in the relevant guidance in place at the time.

4.8 Residues, Emissions and Waste

4.8.1 Hazardous substances

The key potential sources of hazard substances associated with the Project include:

- Oils, fuels and effluence necessary for the operation of the WTG; and
- Accidental releases of hazardous substances from vessels associated with the Project.

Measures will be adopted to reduce any potential discharge of hazardous substances associated with the Project. Oils, fuels and effluents will be necessary for the operation of the WTG. These will be stored and managed in line with best practice to reduce any potential spillage into the marine environment. Anti-corrosion paints on steelwork vulnerable to corrosion will follow relevant best practice measures and regulations (e.g. ISO 12944 and ISO 8501-3).

Vessels associated with the construction, operation and maintenance and decommissioning of the Project will also contain hazardous materials. However, the risk and impact of accidental releases of hazardous substances will be reduced through the implementation of the Construction Environmental Management Plans (CEMP), including measures for compliance with international requirements of the International Convention for the Prevention of Pollution from Ships (MARPOL) Convention and best practice for works in the marine environment (e.g. preparation of Shipboard Oil Pollution Emergency Plans (SOPEP)).

4.8.2 Underwater noise

Since the Scoping Report was submitted in April 2023, pin piling has now been removed from the design envelope of this Project and this is therefore not considered as a potential noise source. The Project Area and surrounding area of seabed is well known to the developer, with multiple years of survey data. One UXO was discovered and detonated in 2017 under a Marine Licence issued by the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED). No further UXOs were discovered during the 2013 or 2023 geophysical surveys (Appendix J: Geophysical Survey Report and Appendix K: Archaeological Assessment of Geophysical Data). Other noise sources will also be associated with the pre-construction, construction, operation, maintenance and decommissioning of the Project. These sources may include cable laying, trenching, rock placement for seabed preparation, vessel movements (including acoustic positioning systems) and operational WTG noise. The potential impacts of underwater noise are assessed in Chapter 10: Marine Mammals and Other Megafauna. Should further noisy operations be required at any time following installation, these will be subject to a separate marine licence and associated European Protected Species (EPS) licence application.

4.8.3 Lighting and marking

The WTG and floating substructure will be designed and constructed to satisfy the safety requirements of the MCA including the OREI Requirements, (MCA, 2021) and the International Association of Marine Aids to Navigation and Lighthouse Association (IALA) Guidance G1162 and G1065 (IALA, 2021a; 2021b) as well as the marking, lighting, and fog-horn specifications of the CAA, NLB and MCA. The use of Automatic Identification System (AIS) Aids to Navigation (AtoN) will be discussed with the NLB. Indicative information is provided below, however, the specific requirements for marking and lighting the Project will be determined post consent in consultation with the relevant stakeholders.

At present, whilst not a regulatory requirement it is industry best practice that the WTG is marked with lights that are visible from 3 km (2 nautical miles) and from all angles during activities at the offshore site. When in operation, the floating substructure will be marked and visible from all sides and comply with applicable requirements of Marine Guidance Note (MGN) 654 (MCA, 2021). For aviation purposes, any unique identification characters will be visible from the air in accordance with the CAA CAP 764 - CAA Policy and Guidelines on Wind Turbines (CAA, 2016). Lighting requirements will be finalised as part of detailed design within the Lighting and Marking Plan (LMP).

4.8.4 Waste

All wastes (e.g. oil wastes and wastewater) will be contained and recovered for disposal onshore by an approved waste management company. Waste management procedures will also be developed for contractors and personnel working at the offshore Project. All vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to MARPOL Annex IV Prevention of Pollution from Ships standards. Ballast water discharges from vessels will be managed under International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (Ballast Water Management (BWM) Convention).

4.9 Project Emissions

A Carbon Assessment for the Project has been carried out, as requested by consultees during Scoping (Table 4-11), to estimate:

- The carbon lifecycle emissions which will result from the Project in terms of Carbon Dioxide Equivalent (CO_2e) emissions; and
- The CO_2e emissions which will be avoided because of the Project.

The emissions assessment methodology and results are presented in detail in Appendix A: Carbon Assessment.

Table 4-11 Scoping Opinion responses relevant to Emissions

CONSULTEE/ SCOPING OPINION REFERENCE	COMMENT	RESPONSE
Scottish Ministers (via MD-LOT)	The Scottish Ministers acknowledge the data sources included with the Scoping Report and highlight the Institute of Environmental Management and Assessment (IEMA) EIA Guide "Assessing Greenhouse Gas Emissions And Evaluating Their Significance" ("IEMA GHG Guidance") (2022), which states that "GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit, as a such any GHG emissions or reductions from a project might be considered significant." The Scottish Ministers have considered this together with the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 and the requirement of the EIA Regulations to assess the significant effects from the Proposed Development on climate. The Scottish Ministers are content that the GHG Assessment included within the EIAR is to be based on a Life Cycle Assessment approach and note that the IEMA GHG Guidance provides further insight on this matter. The Scottish Ministers highlight that this Assessment should consist of the pre-construction, construction, operation, and decommissioning phases, as well as benefits beyond the life cycle of the Proposed Development.	Appendix A: Carbon Assessment has been produced to understand the effects of the Project on climate, using a Life Cycle Assessment Approach in line with IEMA's Greenhouse Gas (GHG) Guidance to describe the total carbon emissions associated with all phases of the Project. The potential benefit of the Project, in terms of avoided emissions, is also presented.

All industries produce GHGs. The aim of the Project is to replace a proportion of the electricity generated from gas via the gas turbines on the Culzean platform with electricity generated from renewable energy via the WTG. Power generation for the Culzean Field would therefore be partly from the gas turbines and partly from the WTG.

Two scenarios were utilised to estimate the high and low-emission scenarios associated with the Project. Estimates were made of the following:

- Pre-construction emissions from vessels associated with surveys;
- Embodied carbon of the components of the Project, their transport to site and installation, including:
  - WTG;
  - Floating substructure;
  - Mooring and anchor systems;
  - Export cable; and
  - Associated scour and cable protection (if required).
- Operation and maintenance: emissions from vessels required to maintain offshore components during the 10-year operational period of the Project; and
- Decommissioning: emissions from vessels removing and transporting components to shore, following the operational period of the Project.

Solely based on fuel gas saving, Appendix A: Carbon Assessment estimates that the Project will avoid 60,838 tCO_2e over a 10-year operational lifetime. Considering a high-emissions scenario, it is estimated that 33,536 tCO_2e will be avoided as a minimum. This is a clear demonstration of progress towards the Project aim, i.e., realising a reduction in CO_2e emissions associated with electricity generation at this demonstration scale.

4.10 Consideration of Major Accidents and/or Disasters

The EIA regulations (as defined in Chapter 2: Legislation and Policy) require an EIA to consider "any expected effects deriving from the vulnerability of the works to risks, so far as relevant to the works, of major accidents and disasters."

The EIA regulations go on further to state that the EIAR should include "*A description of the expected significant adverse effects of the development on the environment deriving from the vulnerability of the development to risks of major accidents and/or disasters which are relevant to the project concerned. Relevant information available and obtained through risk assessments pursuant to EU law such as any law that implemented Directive 2012/18/EU of the European Parliament and of the Council or Council Directive 2009/71/Euratom or UK environmental assessments may be used for this purpose provided that the requirements of any law that implemented this Directive are met. Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies.*"

The Scoping Opinion also provides the advice in Table 4-12 for the selection of a consideration of major accidents and/or disasters. An assessment of the potential vulnerability of various aspects of the project is provided in Appendix B: Major Accident and Disasters.

Table 4-12 Scoping Opinion responses relevant to consideration of major accidents and/ or disasters.

CONSULTEE/ SCOPING OPINION REFERENCE	COMMENT	RESPONSE
Scottish Ministers (via MD-LOT) 3.4.1	The EIAR must include a description and assessment of the likely significant effects deriving from the vulnerability of the Proposed Development to major accidents and disasters. The Developer should make use of appropriate guidance, including the recent IEMA 'Major Accidents and Disasters in EIA: A Primer', as noted within Section 5.6.2 of the Scoping Report, to better understand the likelihood of an occurrence and the Proposed Development susceptibility to potential major accidents and hazards. The description and assessment should consider the vulnerability of the Proposed Development to a potential accident or disaster and also the Proposed Development potential to cause an accident or disaster.	As described in the IEMA (2020) 'Major Accidents and Disasters in EIA: A Primer guidance', major accidents refer to low likelihood high consequence events that threaten immediate or delayed serious environmental effects to human health, welfare and/or the environment and requires the use of resources beyond those of the client or its appointed representatives (i.e. contractors) to manage. In line with IEMA Guidance on Major Accidents and Disasters in EIA, Appendix B: Major Accidents and Disasters provides a summary of the likelihood of an occurrence and the Project susceptibility and vulnerability to potential major accidents and hazards as well as the potential of the Project to cause an accident or disaster.
Scottish Ministers (via MD-LOT) 3.4.2	The Scottish Ministers advise that existing sources of risk assessment or other relevant studies should be used to establish the baseline rather than collecting survey data and note the IEMA Primer provides further advice on this. This should include the review of the identified hazards from your baseline assessment, the level of risk attributed to the identified hazards and the relevant receptors to be considered.	The Project has been designed to operate within the marine environment and relevant extreme environmental conditions (e.g. storm events) for the lifetime of the offshore Project have been considered in the Project design. The offshore Project will not include any large inventories of hazardous material that could be released in the event of a natural disaster.
Scottish Ministers (via MD-LOT) 3.4.3	The assessment must detail how significance has been defined and detail the inclusions and exclusions within the assessment. Any mitigation measures that will be employed to prevent, reduce, or control significant effects should be included in the EIAR.	Risk reduction will continue to be refined during detailed engineering design, to ensure that a hierarchy of controls are in place through the various management plans and method statements.

4.11 Embedded Mitigation and Management Plans

The PDE includes embedded mitigation measures and various management plans that will further mitigate potential impacts. These management plans will form conditions to the marine licence, should it be granted. This includes all embedded mitigation and if required, identifies additional mitigation which will be in place during the relevant phases of construction, operation and maintenance, and decommissioning.

Embedded mitigation is that which has been recognised as having benefits in reducing impact significance and is contained within the design of the Project. These mitigations form part of the application for development consent and will be described in detail during the condition discharge stage, should the marine licence be granted. A summary of the embedded mitigations and management plans for the Project is presented in Table 4-13.

Table 4-13 Embedded mitigation and management plans

EMBEDDED MITIGATION	DESCRIPTION
Minimum air gap	Minimum air gap from mean sea level will be equal to or greater than the minimum 22 m required to comply with Search and Rescue (SAR) requirements. This is to reduce potential risks to ornithological receptors.
Micro-siting of WTG and associated offshore infrastructure including cable route	The final Project layout will be presented within the Cable Plan (CaP) and Development Specification and Layout Plan (DSLP) and conditions of the marine licence. The final placement of anchors and export cable will be informed through micro siting based on available site survey data to ensure avoidance of sensitive habitats, archaeological and other structures where possible. Where this is not possible, the route will take the shortest distance possible through the sensitive areas to reduce environmental effects.
Reducing localised habitat loss	Best practice will be followed to ensure that potential habitat loss is minimised throughout the proposed works (e.g. Micro-siting and minimising the benthic footprint of the Project). The amount of rock used to protect the offshore export cable or as scour protection will be kept to a minimum where possible.
Removal of marine growth	The substructure will be designed to accommodate marine growth; however, to manage weight / drag-induced fatigue, growth levels will be inspected regularly, and subsequent removal of this growth will be undertaken using water jetting tools if substantial accumulation is in evidence. A separate Marine Licence application may be required for removal of marine growth.
Removal of debris from floating lines and cables	Mooring lines and the floating cable will be inspected with a risk-based frequency during the operational life cycle of the Project, starting at a higher frequency and likely declining after several years, based on evidence gathered during inspections. Any inspected or detected debris on the floating lines and cable will be recovered based on a risk assessment which considers impact on environment, risk to asset integrity and cost of intervention.

EMBEDDED MITIGATION	DESCRIPTION
Application of scour protection	The PDE includes the installation of scour protection around the anchors. This will therefore negate the introduction of scour during the Project operation stage. The potential scale and requirement for scour protection will be informed by ongoing inspection surveys and the selected anchor solution.
Charting requirements	Prior to construction, the position and final height of the WTG will be provided to the UK Hydrographic Office (UKHO), Ministry of Defence (MoD), and Defence Geographic Centre (DGC) for aviation and nautical charting purposes. The height will be charted on aeronautical charts and reported to the DGC, which maintains the UK's database of tall structures (digital vertical obstruction file) at least ten weeks prior to construction. The Project infrastructure, including the cable, mooring lines, anchoring points, as well as the WTG and floating substructure, will be plotted and provided to other sea users to be uploaded on their charts.
Promulgation of information as per marine licence requirements and standard industry practice.	As per required marine licence conditions, the details of the Project's activities will be promulgated in advance of, and during, construction via channels such as notices to mariners and kingfisher bulletins to ensure shipping and navigation users are informed about ongoing and upcoming works.
Fisheries Liaison Officer (FLO)	A TEPNSUK FLO will be appointed to establish effective communications surrounding the Project with local fishermen and other sea users. The FLO will distribute information on the safe operations of fishing activities at the site and will be a contact for fishermen and other sea users during the lifetime of the Project.
Target depth of lowering	Static cables will be trenched and buried to a minimum target depth of 0.6 m. Where this cannot be achieved, remedial cable protection will be applied. The cable burial target depth will be informed by a Cable Burial Risk Assessment (CBRA) and implemented through the CaP produced post-consent.
Nacelle, tower, and rotor design	The nacelle, tower, and rotor are designed and constructed to contain leaks thereby reducing the risk of spillage into the marine environment.
MGN 654 compliance	The Project will comply with MGN 654 and its annexes as per its marine licence conditions to ensure that impacts on navigational safety and emergency response are considered, assessed, and mitigated where necessary. This includes post-consent completion of the search and rescue checklist which includes the completion of an Emergency Response Cooperation Plan (ERCoP).
Any temporary obstacles associated with wind farms which are of more than 91.4 m in height are to be alerted to aircrews through the Notice to Airmen (NOTAM) system.	Consultation with the CAA will be required to ensure that temporary obstacles of more than 91.4 m are identified to aircrews by NOTAM. Notification of temporary obstacles will be a condition of the marine licence. Measures will be adopted to ensure that the potential risk of aircraft collision with construction, operation and maintenance, and decommissioning infrastructure is minimised.

EMBEDDED MITIGATION	DESCRIPTION
Post-consent application for safety zones	The floating WTG is being treated as a supplementary unit under the HSE Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995 and as such, Total are applying for a 500 m safety exclusion zone centred around the WTG. In addition, a 500-m advisory safety zone will also be requested around project vessels (e.g., During cable-laying).
Adherence with the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (Ballast Water Management (BWM) convention)	Ballast water discharges from vessels will be managed under the BWM Convention which aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ships' ballast water and sediments. Measures will be adopted to ensure that the risk of invasive non-native species introduction during construction, operation and maintenance, and decommissioning is minimised.
Procedures for dropped objects and claim processes for loss / damage to fishing gear / vessels.	Protocols and procedures for dropped objects will be adhered to in order to minimise the risk to navigation from large, dropped objects associated with the Project.
International Regulations for the Prevention of Collision at Sea (ColRegs) and the International Regulations for the Safety of Life at Sea (SOLAS).	All vessels will comply with the provisions of the ColRegs and the SOLAS, including the display of appropriate lights and shapes such as when vessels are restricted in their ability to manoeuvre.
Adherence to MARPOL	All vessels will operate in adherence with MARPOL requirements. Accordance with this will help to ensure that the potential for release of pollutants is minimised during operations.
Review and Revise Helicopter Landing Certificates for the Culzean platform and Ailsa FSO facility.	Revision of Helicopter Landing Certificates will ensure that low-visibility procedures into the Culzean and Ailsa helicopter platforms continue to be carried out safely, or, if needed, be restricted to Visual Meteorological Conditions (VMC) only.
MANAGEMENT PLANS	
Environmental Management Plan (EMP)	The EMP will provide the over-arching framework for on-site environmental management during the phases of development as follows: • All construction as required to be undertaken before the commissioning of the Project • The operational lifespan of the Project from Commissioning until the cessation of electricity generation (environmental management during decommissioning is addressed by the Decommissioning Programme). The EMP will be in accordance with the Application insofar as it relates to environmental management measures. The EMP will set out the roles, responsibilities and chain of command in respect of environmental management for the protection of environmental interests during the construction and operation of the Project. It will

EMBEDDED MITIGATION	DESCRIPTION
	address (but not be limited to) the following overarching requirements for environmental management during construction: • Mitigation measures as identified in the Application, pre-consent and pre-construction monitoring or data collection • A pollution prevention and control method statement, including contingency plans; • Management measures to prevent the introduction of Invasive Non-Native Species (INNS); • A site waste management plan (dealing with all aspects of waste produced during the construction period), including details of contingency planning in the event of accidental release of materials which could cause harm to the environment. Wherever possible the waste hierarchy of reduce, reuse and recycle will be referred to; and • The reporting mechanisms that will be used to provide the Scottish Ministers and relevant stakeholders with regular updates on construction activity, including any environmental issues that have been encountered and how these have been addressed. The EMP will be regularly reviewed by the Company at intervals agreed by the Scottish Ministers and will be updated based on current information on construction methods and operations. The EMP will be informed, so far as is reasonably practicable, by the baseline monitoring or data collection undertaken as part of the Application and the Project Environmental Monitoring Programme (PEMP) to ensure that all construction and operation activities are carried out in a manner that minimises their impact on the environment, and that mitigation measures contained in the Application, or as otherwise agreed are fully implemented.
Project Environmental Monitoring Programme (PEMP)	A PEMP will be developed to provide further evidence to support these conclusions of the EIA and to provide information on the environmental research initiatives for the Project to allow information to be obtained for future offshore wind farm developments.
Construction Method Statement (CMS)	A CMS will be developed in accordance with the EMP and detail how project activities and plans identified within the EMP will be carried out, whilst also highlighting any possible dangers / risks associated with specific Project activities. The CMS will include the Code of Construction Practice (CoCP) which will set out the approach to how construction activities will be managed and controlled in order to deliver the commitments and mitigation arising from Project.
ERCoP	An ERCoP will be in place for the Project. The ERCoP will detail the key roles and responsibilities and protocols to be established in the event of an emergency during the lifetime of Project related activities.
CaP and CBRA	A CaP will be provided for the Project which will detail the location, duration / route and cable laying techniques of export cable and detail the methods for cable surveys during its operational life. This will be supported by survey results from the

EMBEDDED MITIGATION	DESCRIPTION
	geotechnical, geophysical, and benthic surveys. The CaP will also detail the electromagnetic fields of the cables deployed. A CBRA will also be undertaken and included within the CaP which will detail cable specifications, cable installation, cable protection, target burial depths / depth of lowering and any hazards the cable will present during the lifetime of the cable.
VMP	A VMP will be prepared for the Project which will detail the number, type and specification of vessels utilised during construction and operation. This will also detail how vessel management is coordinated and the ports and transit corridors proposed.
NSP	A NSP will be developed for the Project which will detail all navigational safety measures, construction exclusion zones if required, notices to mariners and radio navigation warnings, anchoring areas, lighting and marking requirements and emergency response procedures during all phases of the project.
LMP	A LMP will be developed for the Project. This will provide that the WTG be lit and marked in accordance with the current CAA and MoD aviation lighting policy and guidance. The LMP will also detail the navigational lighting requirements detailed in IALA R139 and G1162.
Decommissioning Programme	A Decommissioning Programme will be provided pre-construction to address the principal decommissioning measures for the Project, this will be written in accordance with applicable guidance and detail the management, environmental management, and schedule for decommissioning.

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