Bellrock Offshore Wind Farm

Wind Farm Development Area

Environmental Impact Assessment Report - Volume II

Chapter 4: Project Description

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Glossary of Terminology

Term	Definition
Air gap	The lowest blade tip point of a wind turbine to sea clearance distance (see individual chapters for the relevant tidal levels).
Applicant	Bellrock Offshore Wind Farm Limited, the legal entity submitting Section 36 Consent and Marine Licence applications for Bellrock Wind Farm Development Area.
Assembly port	A port at which floating substructures are assembled.
Bellrock Offshore Wind Farm (or the Bellrock Project)	An offshore wind farm capable of exporting up to 1.8 GW of renewable energy to the National Electricity Transmission System. The Wind Farm Development Area is located 120 km east of Stonehaven, and will connect to the National Electricity Transmission System at the proposed SSEN Transmission Hurlie substation, west of Stonehaven in Aberdeenshire. The Bellrock Offshore Wind Farm comprises of the following Development Areas: ▪ Wind Farm Development Area; ▪ Offshore Transmission Development Area; and ▪ Onshore Transmission Development Area.
Bollard pull	Maximum static pulling force a vessel can generate when stationary, at zero forward speed and with its engines at full power.
Cable protection	Protective measure to minimise the effects of scour and hazards along the inter-array cables, and protecting these cables at infrastructure crossing points.
Commencement of construction	Commencement of construction to install the Wind Farm Infrastructure as authorised by the Wind Farm Development Area Section 36 Consent and Marine Licence (excluding site preparation works), being the earlier of: ▪ Intrusive pre-installation surveys; ▪ Placement on or installation in the seabed of anchors and associated scour protection, and mooring lines; ▪ Trench excavation for inter-array cables; or ▪ Trenching for, or laying of inter-array cables on or in the seabed.
Commercial Operation Date	The date that the site is fully transferred to the operations team which is likely to be the date of the taking over certificate of the last wind turbine generator to be installed.
Connector	Joint between a dynamic inter-array cable and a static inter-array cable.
Construction port	Port that may be used during the construction of the Wind Farm Infrastructure and includes integration port(s) and assembly port(s).
Construction works	Works to install the Wind Farm Infrastructure as authorised by the Wind Farm Development Area Section 36 Consent/Marine Licence, such as: ▪ Site preparation works undertaken after commencement of construction; ▪ Pre-installation surveys (intrusive and/or non-intrusive); ▪ Placement on or installation in the seabed of anchors and associated scour protection, and mooring lines, and associated scour protection; ▪ Towing or transportation of the floating offshore unit to the Wind Farm Development Area from a port or wet storage facility;

Term	Definition
	▪ Floating offshore unit installation and commissioning, including hooking-up to the pre-installed mooring system; ▪ Trench excavation for inter-array cables; ▪ Laying of inter-array cables in or on the seabed and, associated cable protection; ▪ Installation of subsea cable hubs, including placing of associated foundation; ▪ Final commissioning following cable connections and snagging; and ▪ Post installation surveys.
Development Area	For consenting purposes, the area for which separate consents and/or Marine Licences will be sought by the Applicant, comprising: ▪ Wind Farm Development Area; ▪ Offshore Transmission Development Area; and ▪ Onshore Transmission Development Area.
Dynamic inter-array cable	The section of inter-array cable between the floating substructure and the seabed, which is designed to accommodate the dynamic movement of the floating substructure.
Excursion limit	The maximum horizontal movement of a floating substructure from its design coordinates.
Fixed bottom substructure	A substructure that provides support for the offshore substation or offshore reactive compensation station by transferring loads to the seabed, and provides a conduit for interconnector cables and/or offshore export cables.
Floating offshore unit	The combined wind turbine generator and floating substructure.
Floating substructure	A floating structure which provides buoyancy and, in conjunction with the station keeping system, supports a superstructure (e.g. wind turbine generator or offshore substation), and maintaining its position within the structure’s excursion limit.
Floating to floating	Interaction between two floating objects (e.g. a vessel and a floating offshore unit).
Integration port	A port at which wind turbine generators are integrated with floating substructures.
Inter-array cable	Armoured cable containing electrical and fibre optic cores, which link the wind turbine generators to each other and to the subsea cable hubs and/or the offshore substations and include dynamic inter-array cable and static inter-array cable sections.
Interconnector cable	Armoured cable containing electrical and fibre optic cores which link two or more offshore substations.
Landfall	The area from Mean Low Water Springs to a transition joint bay(s), where the offshore export cables come ashore and the transition joint bays are located.
Lowest Astronomical Tide	The lowest level that can be expected to occur under average meteorological conditions and under any combination of astronomical conditions.
Mean High Water Springs	The average over a year of the heights of two successive high waters during those periods of 24 hours (once every fortnight) when the range of the tide is greatest.
Mean Low Water Springs	The average over a year of the heights of two successive low waters during those periods of 24 hours (once every fortnight) when the range of the tide is greatest.

Term	Definition
Onshore export cables	Electrical and fibre optic cables between the transition joint bay(s) and the onshore substation which may be laid directly within a trench or laid within cable ducts or protective covers.
Onshore substation	Onshore substation which will be fenced and house electrical equipment (such as transformers, switchgear, and protection and control systems), thereby enabling renewable electricity from the wind farm to be received via the onshore export cables and exported to the National Electricity Transmission System.
Onshore Transmission Development Area	The boundary within which the Onshore Transmission Infrastructure will be constructed, operated and maintained, and decommissioned.
Operations and maintenance port	Port that may be used in the operations and maintenance phase of the Wind Farm Development Area and mainly comprises of a day-to-day operation and maintenance port and other port(s) required for major maintenance.
Operational life	The expected operational life of the Wind Farm Infrastructure from the Commercial Operation Date to the first floating offshore unit being decommissioned.
Project design envelope	Includes all relevant technical, spatial and temporal elements of the Wind Farm Infrastructure, and the proposed methodology to be employed for construction, operations and maintenance, and decommissioning.
Safety Zone	An area of water around or adjacent to a floating offshore unit which is to be constructed, extended, operated or decommissioned, from which certain or all classes of vessels are excluded and within which activities can be regulated for the purpose of securing safety of the floating offshore unit or vessel in that vicinity, and individuals on the floating offshore unit and vessel, in line with Section 95 of the Energy Act 2004.
Scour protection	Protective material positioned around anchors to avoid sediment being eroded as a result of the flow of water.
Site preparation works	Preparatory activities undertaken within the Wind Farm Development Area prior to the commencement of construction of the Wind Farm Infrastructure, which may comprise (and which may require separate consents): ▪ Geophysical surveys, geotechnical surveys and diver/remotely operated vehicle surveys; ▪ Seabed preparation including sand wave levelling, slope levelling for gravity based anchors (if selected), boulder clearance, and pre-lay grapnel runs; ▪ Unexploded ordnance survey and/or clearance; ▪ Debris clearance; and ▪ Out of service cable/pipeline removal.
SSEN Transmission Hurlie substation	The onshore substation to be developed by SSEN Transmission, which will receive renewable electricity from the Bellrock Project onshore substation and allow supply of renewable electricity from the wind farm to the National Electricity Transmission System.
Static inter-array cable	The section of inter-array cable that is not designed to move.
Station keeping system	The system (including mooring lines and anchors) used to hold a floating offshore unit within its excursion limit and maintain the intended orientation of the floating offshore unit.
Subsea cable hub	A subsea device, with a gravel pad foundation, which allows the connection of multiple inter-array cables.

Term	Definition
Switchgear	Electrical equipment used to control, protect, and isolate electrical circuits and equipment.
Temporary construction compound	Area within the Onshore Transmission Development Area used temporarily to support the construction and commissioning, which may include (but not limited to) office, welfare and workshop facilities; vehicle parking; spoil, material and equipment laydown and/or storage; drainage infrastructure; wheel washing facilities; and lighting, fencing and security.
Towing	Transportation of a floating offshore unit or floating substructure between a port, and/or wet storage facility and/or the Wind Farm Development Area.
Transition joint bay	An underground structure at the landfall accessed by manhole or other means which accommodates the jointing of the offshore export cables and the onshore export cables. A fence may be installed around the access manhole for protection.
Wet storage	The temporary storage/anchorage of floating substructures and/or floating offshore units prior to their transportation to the Wind Farm Development Area.
Wind Farm Development Area	The boundary within which the Wind Farm Infrastructure will be constructed, operated and maintained, and decommissioned.
Wind Farm Infrastructure	Infrastructure located within the Wind Farm Development Area including wind turbine generators; floating substructures, station keeping systems and associated scour protection; inter-array cables and associated cable protection; subsea cable hubs; and ancillary infrastructure including buoys (including activities associated with the Wind Farm Infrastructure construction, operation and maintenance, and decommissioning).
Wind turbine generator	A wind turbine generator converts wind energy into electrical energy. The main components include rotor assembly (composed of three blades and a hub); nacelle (containing the generator, shaft and gearbox, power electronic converter and transformer); and a tower (containing lifting equipment and switchgear).

Glossary of Abbreviations

Term	Definition
AIS	Automatic identification system
AtoN	Aids to navigation
BGS	British Geological Survey
CAA	Civil Aviation Authority
CBRA	Cable Burial Risk Assessment
CCTV	Closed-circuit television
CEA	Cumulative effects assessment
CLV	Cable laying vessel
CSV	Construction service vessel
CTV	Crew transfer vessel
DDD	Drive-drill-drive
DEA	Drag embedment anchor
DSLP	Development Specification and Layout Plan
EIA	Environmental impact assessment
EIA Report	Environmental Impact Assessment Report
FOU	Floating offshore unit
FSS	Floating substructure
GBA	Gravity based anchor
HAZCON	Construction Hazard Study
HAZID	Hazard Identification
HAZOP	Hazard and Operability Study
HDD	Horizontal directional drilling
HLV	Heavy lift vessel
HTV	Heavy transport vessel
HVAC	High voltage alternating current (>1,000 volts)
HVDC	High voltage direct current
IAC	Inter-array cable

Term	Definition
ICPC	International Cable Protection Committee
LAT	Lowest astronomical tide
LiDAR	Light detection and ranging
LMP	Lighting and Marking Plan
MCA	Maritime and Coastguard Agency
MD-LOT	Marine Directorate-Licencing and Operations Team
MOD	Ministry of Defence
MPCP	Marine Pollution and Contingency Plan
NESO	National Energy System Operator *(formally ESO)*
NLB	Northern Lighthouse Board
NtMs	Notice to Mariners
O&M	Operation and maintenance
OEM	Original equipment manufacturer
OfRCS	Offshore reactive compensation station
OfSS	Offshore substation
OfTDA	Offshore Transmission Development Area
OMP	Operation and Maintenance Plan
OnSS	Onshore substation
OnTDA	Onshore Transmission Development Area
OREI	Offshore Renewable Energy Installations
PLGR	Pre-lay Grapnel Run
ROV	Remotely operated vehicle
SCADA	Supervisory control and data acquisition
SKS	Station keeping system
SOV	Service operation vessel
SWMP	Site Waste Management Plan
SSEN	Scottish and Southern Electricity Networks
TLP	Tension leg platform

Term	Definition
UK	United Kingdom
USV	Uncrewed service vessel
UXO	Unexploded ordnance
WFDA	Wind Farm Development Area
WTG	Wind turbine generator

4 Project Description

4.1 Introduction

4.1.1 Purpose of Chapter

1. This Chapter provides an overview of the Bellrock Wind Farm Development Area (WFDA) and describes the Wind Farm Infrastructure included within the Bellrock WFDA Section 36 (s.36) Consent and Marine Licence applications. It also provides an overview of the main activities that will be undertaken during construction, operations and maintenance (O&M), and decommissioning of the Wind Farm Infrastructure. The Project Description provides the basis for the technical assessments provided in **Chapters 6 to 19 (Volume II)** of this Bellrock WFDA Environmental Impact Assessment (EIA) Report.

4.1.2 Project Design Envelope and Need for Flexibility

2. As the Bellrock WFDA is not yet at the detailed design phase, it is necessary for the project design envelope on which this Bellrock WFDA EIA Report is based, to have sufficient flexibility to accommodate the future design development of the Wind Farm Infrastructure. A parameter-based design envelope approach has therefore been adopted within this Bellrock WFDA EIA Report. The project design envelope sets out a minimum (where relevant) and maximum design scenarios for each design parameter within which the final Wind Farm Infrastructure design will fall within.

3. The project design envelope includes all relevant technical, spatial and temporal elements of the Wind Farm Infrastructure, and the proposed methodology that has been adopted for construction, O&M and decommissioning.

4. In each of the technical chapters of the Bellrock WFDA EIA Report, the receptor specific worst-case scenario has been determined from the project design envelope parameters and then assessed. This is a standard approach and is widely accepted by stakeholders and regulators and is necessary to maintain design flexibility at this early stage of project development. Further detail on the use of the project design envelope is provided in **Chapter 5: EIA Methodology (Volume II)**.

5. The information presented in this Chapter outlines the options and flexibility required by the Applicant and the range of potential design, location and activity parameters upon which the assessment of impacts is based. The final design of the Wind Farm Infrastructure will be within the parameters of the project design envelope and subsequent consents, enabling detailed design and procurement to be undertaken post-consent whilst retaining the validity of the Bellrock WFDA EIA Report and consents.

6. The need for flexibility in the consent is a key aspect of any large development but is particularly necessary for floating offshore wind farm projects where technology is expected to evolve over long project development timescales. The project design envelope must therefore provide sufficient flexibility to allow the Applicant and their supply chain to use the most efficient and economical technology and techniques in the construction, O&M and decommissioning of the Wind Farm

Infrastructure, without giving rise to any greater environmental effects than those for the worst-case scenarios assessed within this Bellrock WFDA EIA Report.

7. The project design envelope has been refined following the submission of the Bellrock WFDA Scoping Report (see **Appendix 1.1: Bellrock WFDA Scoping Report (Volume IV)**), and the Bellrock WFDA Scoping Opinion, which was received from Marine Directorate-Licencing and Operations Team (MD-LOT) in August 2024 (**Appendix 1.2: Bellrock WFDA Scoping Opinion (Volume IV)**) to reflect design developments and where possible to reduce potential environmental impacts. These post-scoping design refinements, described in **Chapter 3: Site Selection and Alternatives (Volume II)**, are reflected in this Bellrock WFDA EIA Report, and are summarised as follows:

- Increase in the number of floating offshore units (FOU) installed within the WFDA boundary (see **Table 4.1** below);
- Reduction in the maximum blade tip height (m) from 400 m above lowest astronomical tide (LAT) to 335 m above sea surface;
- Removal of fixed bottom substructures (i.e. piled jacket, suction caisson and cable supported monopile options) from the wind turbine generator (WTG) foundation design envelope;
- Removal of semi-spar from the WTG floating substructures (FSS) design envelope;
- Removal of vertical loaded anchor, suction embedded plate anchor, and drilled and grouted piles from the anchor design envelope;
- Addition of gravity based anchors (GBA) to the anchor design envelope[1];
- Removal of the shared mooring line configuration from the station keeping system (SKS) design envelope. The shared anchor configuration remains in the project design envelope; and
- Removal of the mass flow excavator as an inter-array cable (IAC) trenching techniques.

8. Guidance prepared by Marine Scotland (now MD-LOT) and the Scottish Government's Energy Consents Unit on using the design envelope approach for applications under s.36 of the Electricity Act 1989 where flexibility is required in applications (Scottish Government, 2022) has been considered when refining the design envelope to inform the EIA.

9. As detailed in the **Chapter 3: Site Selection**, subsequent to the submission of the Bellrock WFDA Scoping Report, the National Energy System Operator (NESO) imposed a change to the grid connection design which resulted in the Bellrock Project requiring an onshore connection to SSEN Transmission's proposed Hurlie substation. As a result, to provide an opportunity to improve the cost efficiency and competitiveness of the Bellrock Project, the Applicant has increased the export capacity of the Bellrock Project to the National Electricity Transmission System from 1.2 GW to 1.8 GW. In addition, the Applicant has also sought to optimise the density and layout of FOUs within the WFDA, and ultimately the annual renewable energy output of the Bellrock Project, by

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[1] The introduction of GBAs to the project design envelope have not resulted in any new potential environmental impacts outside of those scoped within the Bellrock WFDA Scoping Report.

providing up to 10% overplanting[2], which is reflected in the impact assessments undertaken in the technical chapters. As the Bellrock WFDA boundary remained unchanged, the update in design parameters including the additional WTGs, associated infrastructure (i.e. the FSS, SKSs, IACs, subsea cable hubs, cable and scour protection, and buoys) and additional construction and O&M, and decommissioning activities associated with this capacity increase, remain as described in the Bellrock WFDA Scoping Report (**Appendix 1.1 (Volume IV)**), albeit the quantity (i.e. number, length or duration) have increased accordingly.

10. The change in the number of WTGs as a result of this capacity increase is presented in **Table 4.1**.

Table 4.1: Change in the Number of Wind Turbine Generators as a Result of the Capacity Increase

Parameter	WTG Type A		WTG Type B	
	Number Included within the Bellrock WFDA Scoping Report	Number Included within this Bellrock WFDA EIA Report[1]	Number Included within the Bellrock WFDA Scoping Report	Number Included within this Bellrock WFDA EIA Report[1]
Maximum number of WTGs	80 [2]	132 [3]	42 [2]	90 [3]

Notes:

[1] This Bellrock WFDA EIA Report and the project design envelope presented are based on number of WTGs rather than a WTG generation capacity.

[2] Excluding overplanting.

[3] Including up to 10% overplanting.

4.1.3 Detailed Design

11. As mentioned above, the project design envelope must provide sufficient flexibility to allow the Applicant and their supply chain to use the most efficient and economical technology and techniques in the construction, O&M and decommissioning of the Wind Farm Infrastructure.

12. Detailed design will be completed post consent and will be informed by a number of factors including:

- Compliance with the Bellrock WFDA s.36 Consent and Marine Licence conditions;
- Compliance with this Bellrock WFDA EIA Report and any other documentation and information provided by the Applicant in support of the consent applications;
- Development and availability of components which will evolve over the coming decade to meet the needs of the floating offshore wind sector, in particular the WTGs and FSS;
- Cost efficiency of key components;

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[2] Overplanting is the installation of additional capacity within the Bellrock WFDA to allow additional renewable energy to be generated and supplied during times of lower wind speed or during wind turbine generator maintenance, than would otherwise have been the case.

- Commercial acceptability of key components;
- Relevant experience from operational floating wind farms;
- Optimisation of the design with improved understanding of the seabed and metocean conditions within the Bellrock WFDA;
- Insurance industry requirements; and
- Promotion of health and safety across the construction, O&M, and decommissioning of the Wind Farm Infrastructure.

4.1.4 Embedded Mitigation Measures

13. As part of the design process and in response to consultation, embedded mitigation measures have been incorporated into the Wind Farm Infrastructure design to reduce the potential for environmental impacts and effects. As there is a commitment to implementing these embedded mitigation measures and to various standard sectoral practices and procedures, they are inherently considered part of the design.

14. Embedded mitigation measures (also referred to as primary and tertiary mitigation designed-in measures) are defined in **Section 5.9.2.5** of **Chapter 5: Environmental Impact Assessment Methodology (Volume II)**) and are presented in **Appendix 5.1: Mitigation and Monitoring Register (Volume IV)**.

15. The environmental assessments presented in **Chapters 6 to 19 (Volume II)** provide details of how specific embedded environmental measures are proposed to avoid or reduce environmental effects. The Applicant acknowledges the importance of contributing positively to biodiversity and supports the principle of including nature inclusive design and nature enhancement where feasible. Opportunities, both onshore and offshore, for biodiversity enhancement will be considered as the design progresses. During the detailed design of the Bellrock Wind Farm Infrastructure, consideration will be given to opportunities to apply Nature Inclusive Design to the Bellrock Project in order to contribute to biodiversity enhancement and nature positive outcomes, in line with available guidance at the time.

4.1.5 Project Description Terminology

16. Terminology used throughout this project description Chapter is presented in the Glossary of Terminology.

17. As described in **Chapter 1: Introduction (Volume II)** the Bellrock Project comprises three Development Areas:

- The Bellrock WFDA;
- The Bellrock Offshore Transmission Development Area (OfTDA); and
- The Bellrock Onshore Transmission Development Area (OnTDA).

18. Key infrastructure associated with each Development Area is presented in **Table 4.2**.

Table 4.2: Key Infrastructure within Each Development Area

Development Area	Infrastructure Type	Key Infrastructure
Bellrock WFDA	Wind Farm Infrastructure	Infrastructure located within the WFDA including WTGs; FSSs, SKSs and associated scour protection; IAC and associated cable protection; subsea cable hubs; and ancillary infrastructure including buoys (including activities associated with the Wind Farm Infrastructure construction, O&M, and decommissioning).
Bellrock OfTDA	Offshore Transmission Infrastructure	Infrastructure located within the OfTDA including fixed bottom or floating offshore substations (OfSS) and associated scour protection, fixed bottom offshore reactive compensation station(s) (OfRCS) and associated scour protection; interconnector cables and associated cable protection; and offshore export cables and associated cable protection (including activities associated with the Offshore Transmission Infrastructure construction, O&M, and decommissioning).
Bellrock OnTDA	Onshore Transmission Infrastructure	Infrastructure located within the OnTDA including transition joint bay(s); onshore export cables; onshore substation; temporary construction compounds; temporary working areas; environmental mitigation areas; drainage/irrigation infrastructure; access works; and any other associated infrastructure (including activities associated with the Onshore Transmission Infrastructure construction, O&M, and decommissioning).

19. As noted in **Table 4.2**, the Bellrock OfTDA comprises the Offshore Transmission Infrastructure and part of the OfTDA overlaps with the whole of the Bellrock WFDA. As a result, the OfSSs, interconnector cables and part of the offshore export cables will be geographically located within the Bellrock WFDA. However, this infrastructure does not form part of this Bellrock WFDA EIA Report or associated consent application for the Bellrock WFDA and will be subject to a separate Bellrock OfTDA EIA Report and consent application. To ensure a comprehensive assessment is undertaken, the OfTDA has been included as part of the Cumulative Effects Assessment (CEA) and as part of whole-project assessments for socioeconomics and greenhouse gas assessments within this Bellrock WFDA EIA Report (refer to **Section 4.12** or details).

4.2 Consultation

20. Consultation relevant to the project description and project design envelope has been undertaken in line with the general process described in **Chapter 5: EIA Methodology (Volume II)**.

21. In preparing this project description, the Applicant has considered the Scoping Opinion issued by Scottish Ministers (MD-LOT, 2024) and Scoping Responses from stakeholders who contributed to the scoping process, including NatureScot, Maritime and Coastguard Agency (MCA), the Ministry of Defence (MOD), National Air Traffic Services, Joint Radio Company, and Scottish Fishermen's Federation.

22. A Bellrock Project update consultation letter which outlined the key updates to the Bellrock Project since the Bellrock WFDA Scoping Report, was circulated to a range of stakeholders in mid-October 2025. Updates discussed included the change in the grid connection design, increase in export capacity to 1.8 GW, and an update in design parameters including additional WTGs and associated infrastructure (i.e. the FSSs, SKSs, IACs, subsea cable hubs, and cable and scour protection). In relation to the increased capacity and change in grid connection design, the letter also detailed any relevant changes to the approach and methodology of the EIA topics since Scoping and confirmed that the Bellrock Project updates did not necessitate the consideration of new impacts. No concerns were raised regarding these updates. As a result, the Bellrock WFDA Scoping Opinion remains valid. The letter also included the refinement of design parameters as a result of the EIA process (for the letter refer to **Annex E** of **Appendix 5.2: Pre-application Consultation Report (Volume IV)**; and **Chapter 3: Site Selection (Volume II)** for more detail).

23. This Chapter provides a full and detailed description of all Wind Farm Infrastructure within the project design envelope (including WTG dimensions, substructures, moorings and anchors, scour protection, cabling, subsea cable hubs and seabed preparation) and activities associated with construction, O&M, and decommissioning of the Bellrock Wind Farm Infrastructure, as raised by consultees. Details of Scoping responses relevant to the project description and how they have been addressed are provided in **Appendix 4.1: Consultations Undertaken Relating to the WFDA Project Description (Volume IV)** and a summary of responses received from the above mentioned Bellrock Project consultation letter are provided in **Appendix 5.2: Pre-application Consultation Report (Volume IV)**.

4.3 Wind Farm Development Area Description

24. The location of the Bellrock WFDA is shown in **Figure 4.1: Bellrock Wind Farm Development Area Coordinates (Volume III)**. Key Bellrock WFDA parameters are presented in **Table 4.3**. The Bellrock Wind Farm Development Area Coordinates are presented in **Table 4.4** below.

Table 4.3: Bellrock Wind Farm Development Area Parameters

Parameter	Value
Crown Estate Scotland Lease Period (years)	Up to 60
Operational life (years)	Up to 35

Parameter	Value
Distance from Stonehaven (km)	120
Distance from Peterhead (km)	116
Area (km^2)	280
Water depth below LAT (m)	69 to 121

Table 4.4: Bellrock Wind Farm Development Area Coordinates

Point[1]	UTM Grid Coordinates (EPSG:32630 - WGS 84/UTM Zone 30N)		Degrees Decimal Minutes (WGS84)		Degrees Minutes Seconds	
	Easting (m)	Northing (m)	Latitude	Longitude	Latitude	Longitude
1	672595.505	6310030.781	56° 54.1073’ N	0° 09.9490’ W	56° 54′ 06.4365″ N	0° 09′ 56.9402″ W
2	702615.905	6308828.917	56° 52.7322’ N	0° 19.5189’ E	56° 52′ 43.9301″ N	0° 19′ 31.1369″ E
3	702766.207	6302440.503	56° 49.2905’ N	0° 19.3615’ E	56° 49′ 17.4321″ N	0° 19′ 21.6883″ E
4	689101.433	6302889.191	56° 49.8774’ N	0° 05.9692’ E	56° 49′ 52.6410″ N	0° 05′ 58.1521″ E
5	681556.180	6296113.017	56° 46.4101’ N	0° 01.7285’ W	56° 46′ 24.6090″ N	0° 01′ 43.7101″ W
6	673269.390	6296476.010	56° 46.7948’ N	0° 09.8391’ W	56° 46′47.6908″ N	0° 09′ 50.3431″ W
Centre	680796.875	6304132.436	56° 50.7448 N	0° 02.1322' W	56° 50' 44.6854” N	0° 02' 7.9321" W

Notes:

[1] See **Figure 4.1: Bellrock Wind Farm Development Area Coordinates (Volume III)** for the locations of the points shown.

25. A geophysical survey of the Bellrock WFDA was conducted by the Applicant between August and September 2023 to collect geophysical and bathymetric data. The Bellrock WFDA is generally flat with the exception of four north to south channels across the Bellrock WFDA which range from 1 to 3 km wide and 8 to 40 m below surrounding seabed. Further details of the bathymetry and seabed composition are presented within **Chapter 6: Marine Geology, Oceanography and Physical Processes** and **Figure 4.1: Bellrock Wind Farm Development Area Coordinates (Volume III)** presents the coordinates for each point of the Bellrock WFDA.

4.4 Wind Farm Infrastructure

4.4.1 Overview of Wind Farm Infrastructure

26. The Wind Farm Infrastructure comprises:

- Up to 132 WTGs with FSSs (together termed as an FOU) (**Section 4.4.2** and **Section 4.4.3**);
- SKS for each FSS, including mooring lines, anchoring systems and ancillary elements (**Section 4.4.4**);
- Scour protection for FSS anchoring points where required (**Section 4.4.4.5**);
- Approximately 300 km of IACs comprising static and dynamic sections of IACs linking the individual FOUs to subsea cable hub(s) or to the OfSSs[3] (**Section 4.4.5**);
- Associated cable protection as required (**Section 4.4.6** and **Section 4.4.7**);
- Up to 18 subsea cable hubs (**Section 4.4.9**); and
- Ancillary infrastructure including buoys (**Section 4.4.10**).

4.4.2 Wind Turbine Generators

27. The WTGs convert wind energy into electrical energy. Each WTG is a complex system composed of a large number of components. The main components are:

- Rotor assembly, composed of three blades and a hub;
- Nacelle, containing the generator, shaft and gearbox (if applicable), power electronic converter and transformer; and
- Tower, containing lifting equipment and, if applicable, switchgear.

28. The physical size of WTGs is expected to increase over the coming years as the supply chain and global markets develop. The WTG parameters considered within the project design envelope are reflective of WTG technology currently available and that which the Applicant expects to be available in the early to mid-2030s. The final WTG model(s) that will be used for the Bellrock WFDA will be selected post-consent.

29. The key components of a WTG are illustrated in **Plate 4.1.** The WTG design envelope for the Wind Farm Infrastructure is outlined in **Table 4.5**.

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[3] OfSSs will be consented as part of the OfTDA and will be assessed as part of the Bellrock OfTDA EIA Report. The OfTDA is also considered within the Bellrock WFDA EIA's cumulative effects assessments.

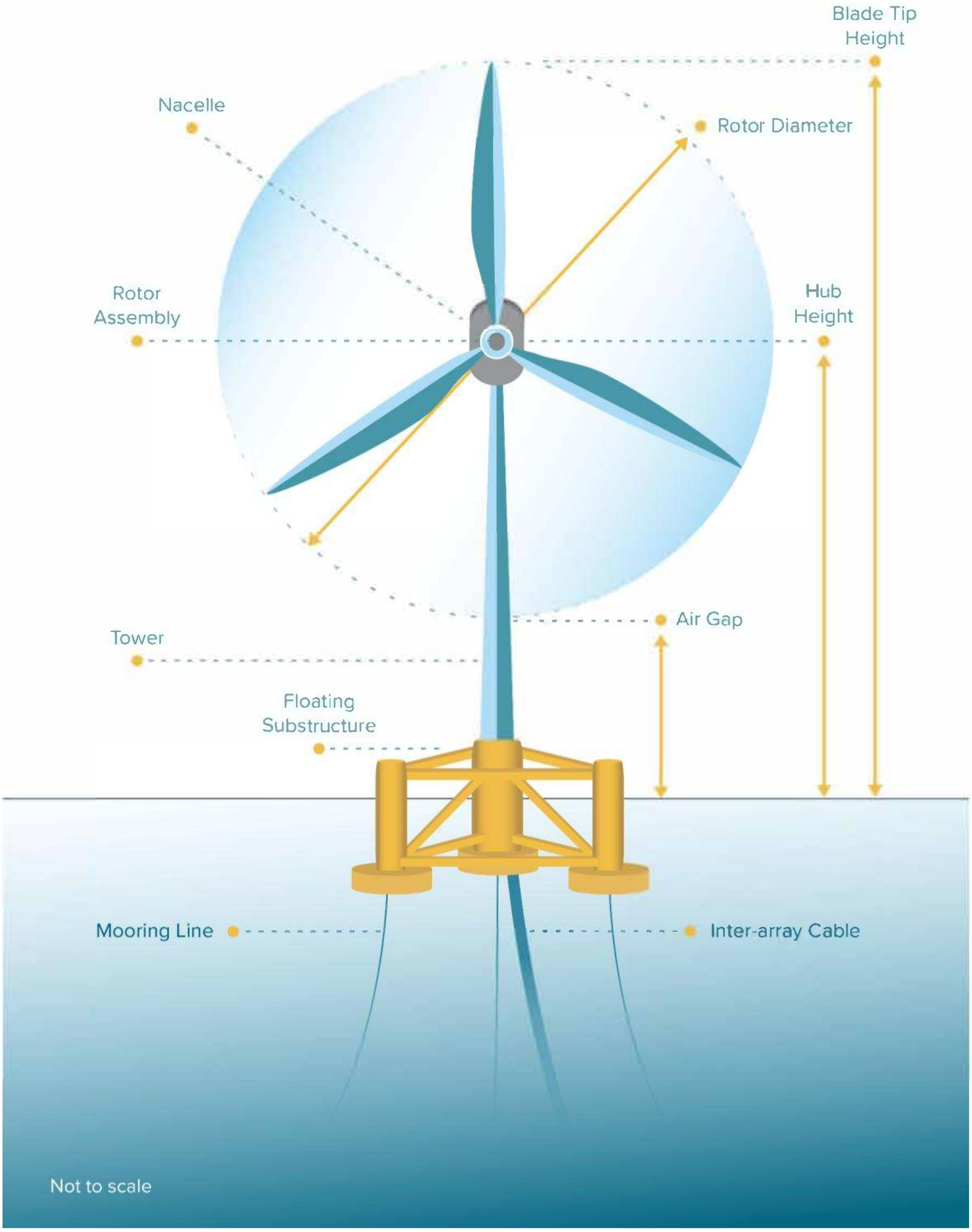
Table 4.5: Wind Turbine Generator Design Envelope

Parameter	**WTG Type 1**	**WTG Type 2**
Maximum number of WTGs	132	90
Minimum blade clearance above sea surface (m)[1]	22	22
Minimum hub height above sea surface (m) [1]	140	172
Maximum hub height above sea surface (m) [1]	153	185
Maximum blade tip height above sea surface (m) [1]	271	335
Maximum rotor diameter (m)	236	300
Maximum rotor swept area per WTG (m^2)	43,744	70,686
Maximum total swept area for the Bellrock WFDA (km^2)	5.77	6.36
Minimum spacing between WTGs (m) (measured centre to centre)	1,150	1,150
Colour	RAL 7035 (light grey) or similar, with yellow substructure	

Notes:

[1] For FSS designs that move with the tide (i.e. semi-submersible platform and barge), these parameters will be maintained relative to the sea surface. For the Tension Leg Platform FSS design, which is restrained by tensioned moorings and does not notably move with the tide, these parameters will be within the stated project design envelope. See **Chapters: 10 Offshore Ornithology, 12 Shipping and Navigation** and **13 Aviation and Radar (Volume II)** for further detail on the air gap and maximum blade tip height and corresponding reference tidal levels that apply to those specific assessments.

Plate 4.1: Key Features of a Typical Floating Offshore Unit



30. The final WTG layout will be determined post consent and will consider environmental constraints, wind resource and seabed conditions. The final WTG layout will be presented within the Development Specification and Layout Plan (DSLP) which require the approval of the Scottish Ministers in line with the Bellrock WFDA consent conditions.

31. It should be noted that whilst the final design and layout will be agreed through the DSLP, the impacts of the final design and layout will not be greater than those for the worst-case scenarios assessed in this Bellrock WFDA EIA Report.

32. For the purposes of the project description presented in this Chapter, on which the EIA technical chapters have based their impact assessments, the whole of the Bellrock WFDA is assumed to be available for the placement of Wind Farm Infrastructure. However, in progressing the Bellrock WFDA EIA, the following topic specific mitigation has been adopted to reduce the residual impact of Bellrock WFDA:

- Aviation and Radar (**Chapter 13**): The Aviation and Radar impact assessment concluded a significant effect on the Air Defence Radar at Buchan Remote Radar Head from WTG Type 2 (refer to **Table 4.5** for parameters). Therefore, secondary mitigation is proposed (if required at the time) to ensure no part of a WTG blade is 318 m above HAT (i.e. 320 m above MSL) within the Buchan Remote Radar Head's Radar Line of Sight (which extends slightly into the northwestern corner of the Bellrock WFDA). As a result, the residual impact is reduced to non-significant.

33. It is intended that the above secondary mitigation will be secured in the s.36 Consent via a condition requiring an obstacle free area (if required) for WTGs with an equivalent blade tip height of 320 m above MSL. These measures do not materially affect the project design envelope relevant to the other EIA topics and do not therefore change the impacts presented across the other EIA technical chapters.

4.4.3 Floating Substructures

34. An FSS provides a base for a WTG, ensuring the necessary buoyancy and stability to allow the WTG to operate safely and efficiently. **Section 4.7.11** provides information on the proposed construction ports associated with the assembly of the FSS (the assembly port(s))[4] and the integration of the WTG onto the FSS (the integration port(s)). There are various FSS design options possible, each with varying dimensions reflecting the unique engineering challenges associated with supporting WTGs of various sizes, site conditions and project specific requirements.

35. The FSSs will mainly comprise either steel and/or concrete. The general arrangement of the FSSs can vary between different technology design. Generally, FSSs are composed of two or more buoyant structures connected by bracing. In steel designs, it is common for the FSS to be arranged on a triangular shape or a star shape when viewed from above. For the concrete designs, it is common for the FSS to be arranged on a square or star shape, or a compact multi-cylindrical shape.

36. The sections below describe the FSS options being considered for the WTGs:

- Tension leg platform (TLP) (**Section 4.4.3.1**);

---

[4] The assembly port and integration port terminology reflects the nature of the activities being undertaken at a particular port and therefore the same port could be both an assembly port and an integration port. Multiple construction ports could be used during the construction phase.

- Semi-submersible (**Section 4.4.3.2**); and
- Barge (**Section 4.4.3.3**).

37. All FSS options listed above will include either an active or passive ballast system, which are required to aid stability of the FSS and FOU during transportation, installation and operation. Active ballasting systems use pumps and monitoring and control systems to continuously monitor movements and conditions and to move water between structural components of the FSS to ensure stability. Passive ballast systems can use the weight of the structure, and/or added solid or liquid material to achieve the required level of ballast.

38. An illustration of the above FSS options is provided in **Plate 4.2** and their design envelope is provided in **Table 4.6**. **Plate 4.3** illustrates an FSS excursion limit.

4.4.3.1 Tension Leg Platform

39. A TLP is a highly buoyant semi-submerged structure which maintains its position and stability through the opposite forces of excess buoyancy in the FSS, and the highly tensioned tendons anchoring the FSS to the seabed (using tension moorings). This results in slightly different behaviour compared to other FSS options described in the sections below, as it allows for a limited drift (horizontally) and limited heave motion (vertically), due to the high restoring forces applied by the tendons.

40. The integration of the WTG onto a TLP would take place at an integration port, prior to towing the FOU to the Bellrock WFDA or wet storage facility[5]. Additional buoyancy equipment would however be required during transportation to improve stability of the TLP, as the tendons would not be secured to the seabed during transportation.

41. Major component replacement or repair during the O&M phase could be undertaken in-situ (within the Bellrock WFDA) or the FOU could be towed to a suitable port (with the addition of supplemental buoyance equipment).

42. TLPs are compatible with the tension mooring option only.

4.4.3.2 Semi-submersible

43. Semi-submersibles are buoyancy-stabilised structures which float semi-submerged and maintain position via a SKS. These structures usually consist of a set of three or more columns connected via bracings or pontoons with heave plates, however designs may vary.

44. The integration of the WTG onto a semi-submersible platform would take place at an integration port, prior to towing the FOU to the Bellrock WFDA or wet storage facility.

---

[5] The temporary mooring of FSSs and/or FOUs at dedicated locations (known as 'wet storage') for the Bellrock Project will be considered through separate consenting process(es) as required. The Applicant is not seeking consent for wet storage within this application, and it has not been included within the scope of this EIA Report. Any proposed projects in the public domain for wet storage facilities on the east coast of Scotland have been considered within the cumulative assessment along with other plans and projects (**Appendix 5.3 (Volume IV)**).

45. Major component replacement or repair during the O&M phase could be undertaken in-situ (within the Bellrock WFDA) or the FOU could be towed to a suitable port.

46. Semi-submersible platforms are compatible with catenary, taut and semi-taut mooring options.

4.4.3.3 Barge

47. Barge platform technology offers low draught but a large water-plane area which provides the distributed buoyancy by which the platform achieves stability. Generally, barge substructures comprise of a single hull, but variations of barge FSSs exist such as twin hulled barges.

48. The integration of the WTG onto a barge platform would take place at an integration port, prior to towing the FOU to the Bellrock WFDA or wet storage facility.

49. Major component replacement or repair during the O&M phase could be undertaken in-situ (within the Bellrock WFDA) or the FOU could be towed to a suitable port.

50. Barge platforms are compatible with catenary, taut and semi-taut mooring options.

51. **Table 4.6** presents a summary of the FSS design envelope.

Table 4.6: Floating Substructure Design Envelope

Parameter	Design Envelope
FSS types under consideration	▪ TLP; ▪ Semi-submersible; or ▪ Barge.
Material options	▪ Steel; or ▪ Concrete.
Geometry/shape of FSS	▪ Triangular; ▪ Square; ▪ Star; or ▪ Multi-cylindrical.
Ballast system	Active or passive ballast system for all FSS options
Maximum FSS dimensions (l x w) (m)	135 x 135
Maximum draught of FSS below sea surface (m)	30
Maximum height of FSS above sea surface (m)	30
Total maximum height of FSS (m)	60
FSS excursion limit (m)	100

Plate 4.2: Floating Substructure Design Options

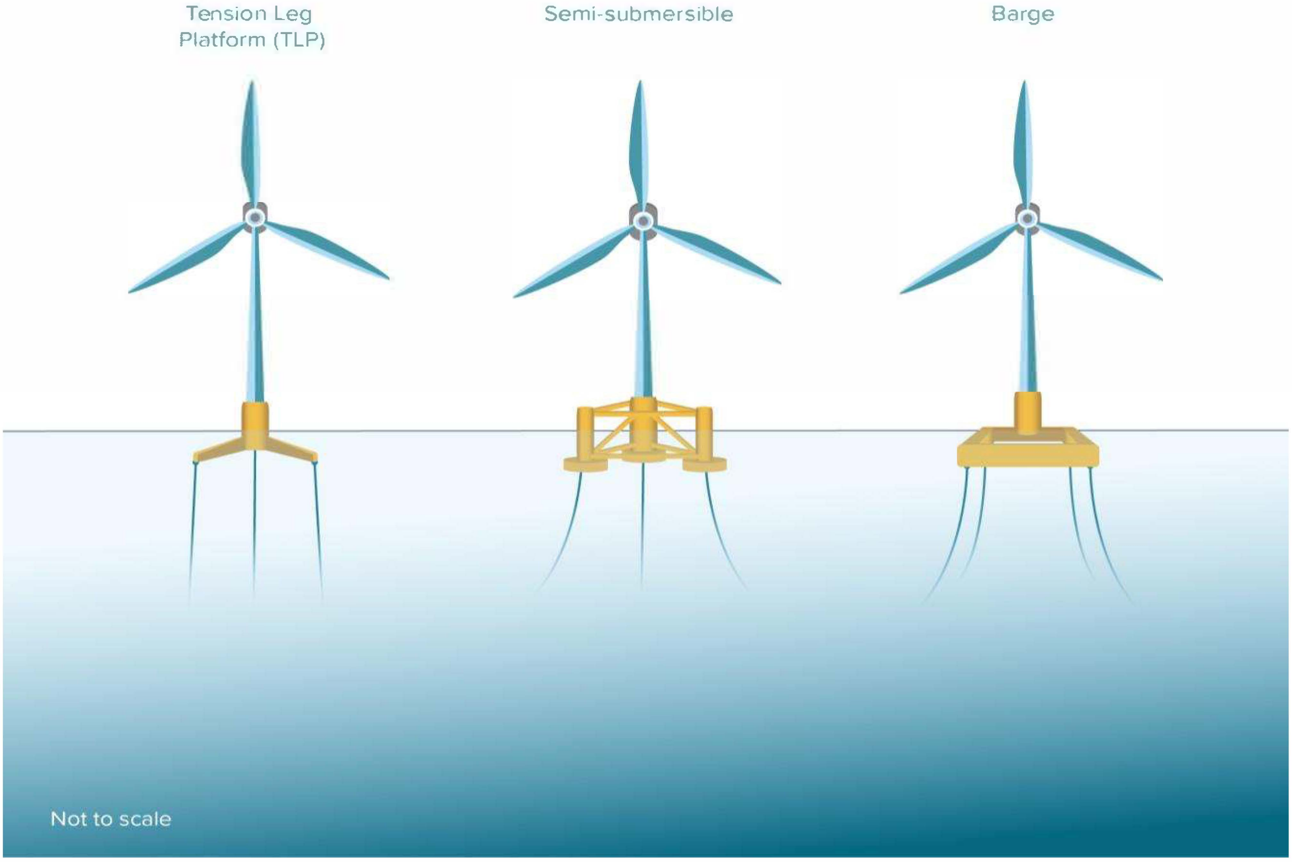
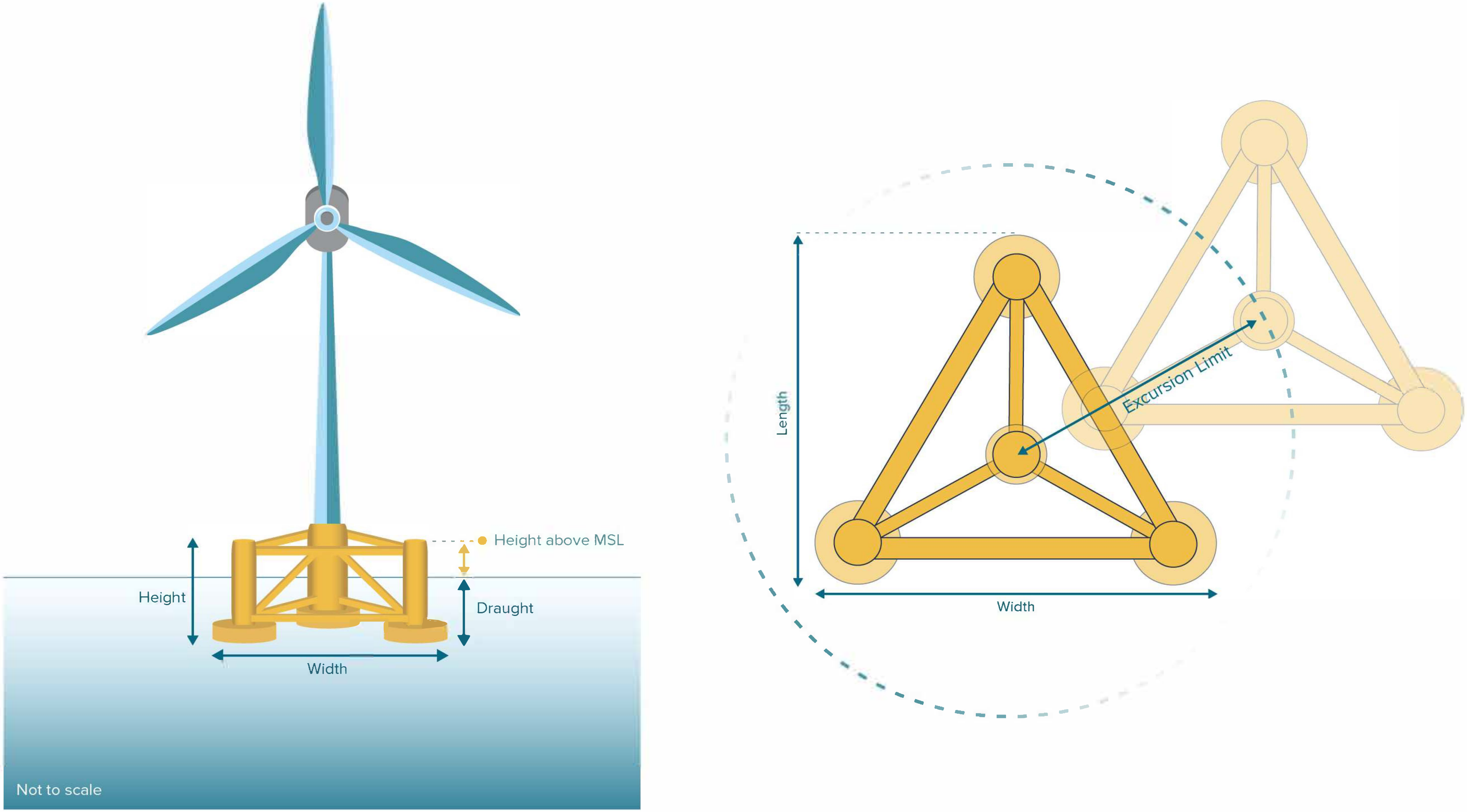


Plate 4.3: Floating Substructure Excursion Limit



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4.4.4 Station Keeping Systems

52. To maintain the position of a FOU, it is necessary to connect the FSS to the seabed via a SKS. The SKS principally comprises mooring lines and anchors, which can also provide stability to the FOU depending on the FSS design selected.

53. The design of the SKS depends on the site characteristics and the FSS technology being used. It is possible that different mooring and anchor solutions may be used across the Bellrock WFDA. This will be dependent on the site characteristics (i.e. ground conditions) and determined during the detailed design phase.

54. The final selection of FSS and associated SKS will depend on factors including but not limited to seabed conditions, water depth, wave, wind and tidal conditions, health and safety, economics and procurement strategy.

55. The sections below describe the SKS options being considered are:

- Mooring lines:
  - Catenary mooring (**Section 4.4.4.1.1**);
  - Taut mooring (**Section 4.4.4.1.2**);
  - Semi-taut mooring (**Section 4.4.4.1.3**); and
  - Tension mooring (**Section 4.4.4.1.4**).
- Anchor options:
  - Driven pile (**Section 4.4.4.2.1**);
  - Suction pile (**Section 4.4.4.2.2)**;
  - Drag embedment anchor (DEA) (**Section 4.4.4.2.3**); and
  - GBA (**Section 4.4.4.2.4**).

56. A summary matrix of substructures and SKS options are provided in **Table 4.10.** Illustrations of the mooring line and anchor options are provided in **Plate 4.4** and **Plate 4.6**, respectively. The project design envelope for the mooring line and anchor options is also provided in **Table 4.7**. Details of a shared anchor design is also provided in **Section 4.4.4.3.**

4.4.4.1 Mooring Lines

57. Mooring lines can be connected to the FSS at various points, both above and/or below the water line. Mooring lines can be made of several different materials in various forms, for example:

- Steel (e.g. chain, sheathed spiral strand wire rope, steel pipe); and
- Synthetic rope (e.g. polyester, nylon, high modulus polyethylene).

58. A description of the mooring types considered for the Bellrock WFDA is given in **Sections 4.4.4.1.1** to **4.4.4.1.4** and illustrated in **Plate 4.4**. The design envelope for the mooring line options is presented in **Table 4.7**. The anchors in which the mooring line types are compatible with are presented in **Table 4.8**.

4.4.4.1.1 Catenary Mooring

59. The catenary mooring configuration uses free hanging chain, whereby the weight of the chain leads to the catenary shape through the water column between the FSS and the anchor. A section of chain rests on the seabed prior to connection at the designated anchor, meaning the anchors will generally only experience horizontal loads. Generally, the weight of the chain resists excursion of the FOU and provides stability to the FOU. During operation, there remains some mooring line contact with the seabed. Catenary mooring can be used with semi-submersible and barge FSS designs.

4.4.4.1.2 Taut Mooring

60. The taut mooring configuration uses lines usually made of synthetic rope, which are tensioned between the FSS and the anchor until taut. The tension and flexibility in the lines are used to provide stability and resist excursions of a FOU. As all mooring lines from a FOU are taut, they do not make contact with the seabed.

61. In this configuration the load on the anchor is both vertical and horizontal, therefore pile or suction anchors are most compatible anchors to be used. Taut mooring can be used with semi-submersible and barge FSS designs.

4.4.4.1.3 Semi-taut Mooring

62. The semi-taut mooring configuration uses chain at the top and bottom of the mooring line, and synthetic rope in the mid-section of the mooring line, forming a combination of a taut and catenary system. Buoyancy modules are used to suspend the rope off the seabed and prevent damage to these sections, however, there remains some mooring line contact with the seabed. Semi-taut mooring can be used with semi-submersible and barge FSS designs.

4.4.4.1.4 Tension Mooring

63. Due to the vertical loading and high tension on these systems, tendons with low strain and high strength are used, which can be sheathed spiral strand synthetic rope or steel tubulars. Tension mooring can be used with a TLP design only.

Plate 4.4: **Mooring Line Options**

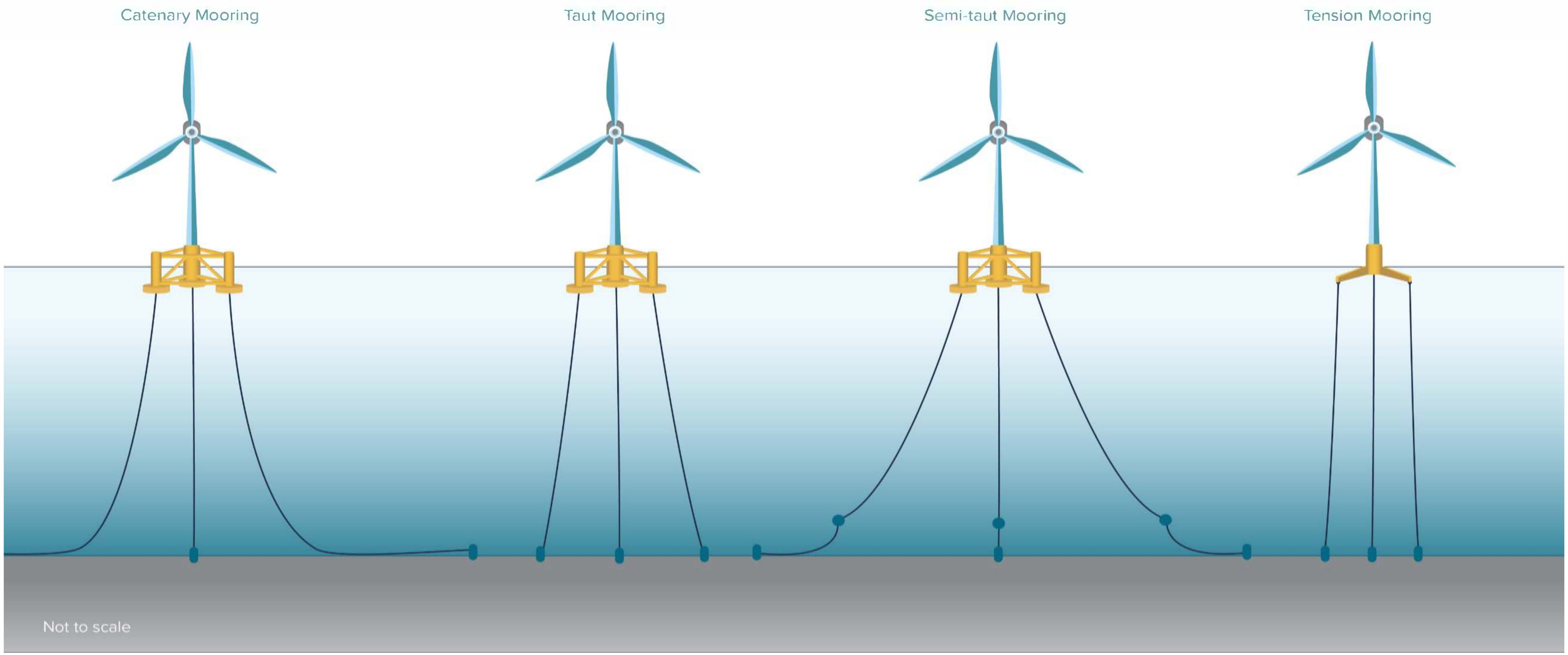

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Table 4.7: Mooring Line Design Envelope

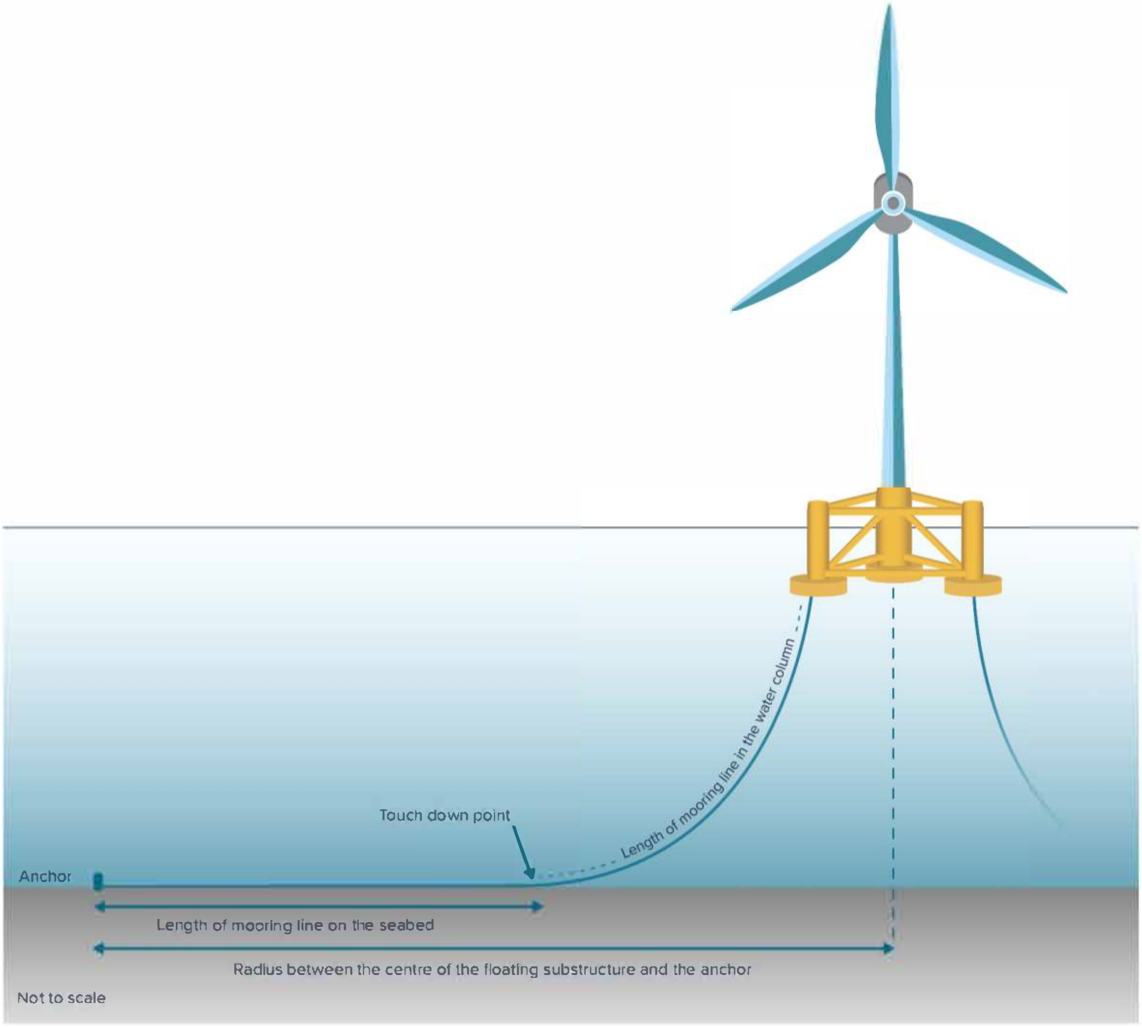
Parameter	Design Envelope
Mooring line type	▪ Catenary; ▪ Taut; ▪ Semi-taut; or ▪ Tension.
Maximum number of mooring lines per FSS	9
Maximum mooring radius (m)[1]	1,300
Maximum length of individual mooring line within the water column (m)	920
Maximum length of individual mooring line on the seabed (m)	770
Maximum seabed swept zone per WTG (m^2)[2]	350,000
Maximum footprint from pre-lay of mooring lines (including clump weights) on the seabed (m^2)[3]	532,224

[1] Horizontal distance from the centre of the FSS to the anchor.

[2] Area of seabed in contact with catenary mooring line option.

[3] As noted in **Section 4.7.3.2**, mooring lines will be stored in the Bellrock WFDA.

Plate 4.5: Mooring Line Measurements



4.4.4.2 Anchors

64. The anchor is the connection point between the mooring line and the seabed. The anchor type will be selected during the detailed design phase, considering the site-specific ground conditions and the performance requirements of the anchors. A description of the anchor types considered for the Bellrock WFDA is given in **Section 4.4.4.2.1** to **4.4.4.2.4** and are illustrated in **Plate 4.6**. The anchor design envelope is presented in **Table 4.8**.

4.4.4.2.1 Driven Pile

65. Driven piles are steel tubes and are typically used for anchoring in hard or challenging seabed conditions. The pile is typically driven to the required penetration depth by an impact or vibratory hammer. Driven pile anchors can be used to support both vertical and horizontal loads. Driven piles are the only anchor option being considered for the Bellrock WFDA which require to be piled. The maximum hammer energy required to drive each pile is up to 3,000 kJ.

66. Piling will commence with a lower hammer energy and will slowly ramp up energy up to a maximum 3,000 kJ, if required. Detailed geotechnical data of the WFDA will be reviewed to inform a driveability assessment which will in turn inform maximum realistic hammer energy required for piling. The findings of this study will allow the final hammer energies used to be optimised so that piling progress can be maintained whilst minimising required hammer energy. Up to two piling events for FOUs occurring concurrently within the WFDA are considered within the project design envelope. The CEA considers a third concurrent piling event within the same geographical extent of the WFDA for the OfSS (subject to separate consent).

67. Preliminary assessment on soil conditions within the Bellrock WFDA concluded that pile anchors will not require to be drilled into the seabed by design. However, there may be a risk of pile refusal during the installation of driven piles, in cases where the soil becomes stiffer than expected. If this risk materialises, then the piled anchor installation at that location will be adapted to a drive-drill-drive (DDD) method. In this case, after the piled anchor is refused, the pile hammer will be removed from the pile head and a drilling tool inserted into the embedded pile. The drilling tool is used to drill the pile further into the seabed. The drilling tool is then recalled and the hammer is placed on the pile head, to continue driving the pile into the seabed. The DDD process may be repeated a number of times until the pile reaches the required penetration depth. Drill arisings from the DDD method will be disposed of at sea adjacent to the location of the piling event.

68. Catenary, taut, semi-taut and tension mooring options are compatible with driven piles.

4.4.4.2.2 Suction Pile

69. Suction piles (also known as suction caisson, suction buckets or suction cans) are hollow steel tubes with the top end capped. They are installed by creating suction that forces the pile into the seabed. Due to their installation method, they are suitable for soft to medium clays, silts and sands. Suction piles do not require to be drilled or hammered into the seabed. Suction piles can be used to support both vertical and horizontal loads.

70. Catenary, taut, semi-taut and tension mooring options are compatible with suction piles.

4.4.4.2.3 Drag Embedment Anchor

71. DEAs are dragged across the seabed during installation, embedding themselves in the seabed to the required depth. DEAs support horizontal loading only and are therefore only compatible for use with catenary and semi-taut mooring lines only. They work well in seabed conditions which contain a significant proportion of clay which allow the anchor to be embedding in the seabed to the required depth.

4.4.4.2.4 Gravity Based Anchor

72. GBAs are a heavy dead weight base, usually large concrete blocks, laid on the seabed. Penetration into the seabed is limited but the footprint of the GBA is large. GBAs can be used to support both vertical and horizontal loads, with the weight of the GBA supporting vertical loads and the friction with seabed supporting horizontal loads.

73. Catenary, taut, semi-taut and tension mooring options are compatible with GBAs.

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Plate 4.6: **Anchor Options**

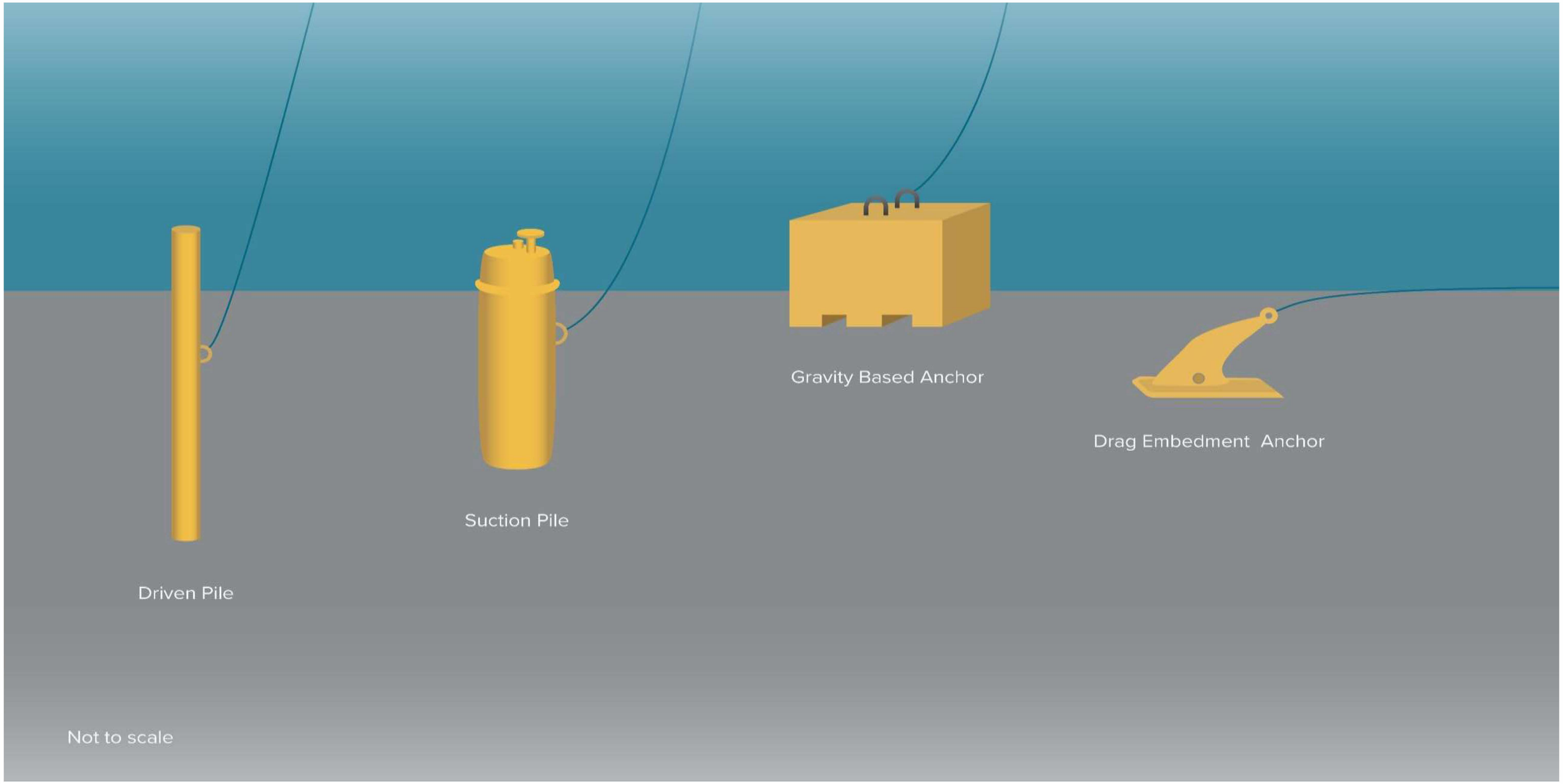

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Table 4.8: Anchor Design Envelope

Parameter	Design Envelope
Driven Pile	
Compatible mooring lines	▪ Catenary; ▪ Taut; ▪ Semi-taut; or ▪ Tension.
Maximum number of anchors per FSS	9
Maximum anchor dimension (diameter) (m)	6
Maximum seabed footprint per FSS (m^2)	279
Total anchor seabed footprint within Bellrock WFDA (m^2)	36,828
Maximum anchor penetration depth (m)	44
Maximum hammer energy (kJ)	3,000
Volume arisings per pile (from DDD) (m^3)	796
Total volume of drill risings (assuming 10% of anchors are DDD) (m^3)	94,589
Suction Pile	
Compatible mooring lines	▪ Catenary; ▪ Taut; ▪ Semi-taut; or ▪ Tension.
Maximum number of anchors per FSS	9
Maximum anchor dimension (diameter) (m)	18
Maximum seabed footprint per FSS (m^2)	2,862
Total anchor seabed footprint for Bellrock WFDA (m^2)	377,784
Maximum anchor penetration depth (m)	18.5
DEA	
Compatible mooring lines	▪ Catenary; or ▪ Semi-taut
Maximum number of anchors per FSS	9
Maximum anchor dimension (length x width) (m)	11 x 12
Maximum seabed footprint per FSS (m^2)	1,314

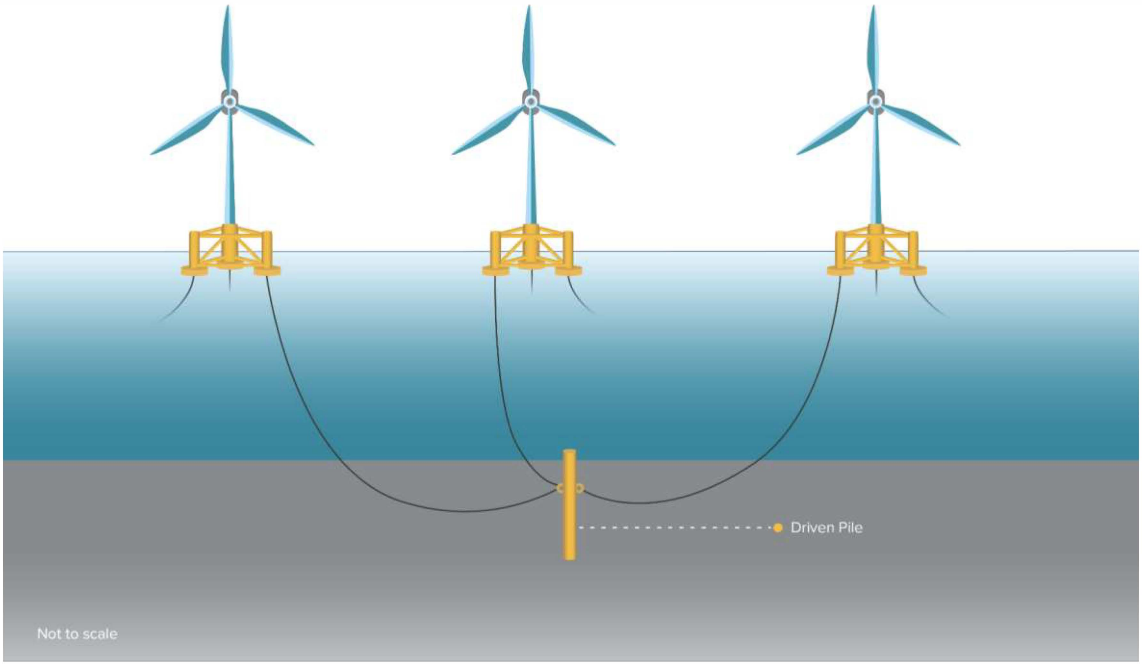
Parameter	Design Envelope
Total anchor seabed footprint for Bellrock WFDA (m^2)	173,448
Total anchor seabed disturbance including installation (including drag distance) (m^2)	855,360
Maximum anchor penetration depth (m)	8.75
GBA	
Compatible mooring lines	▪ Catenary; ▪ Taut; ▪ Semi-taut; or ▪ Tension.
Maximum number of anchors per FSS	9
Maximum anchor dimension (width x length x height) (m)	12.5 x 12.5 x 7
Maximum seabed footprint per FSS (m^2)	1,413
Total anchor seabed footprint for Bellrock WFDA (m^2)	186,516
Maximum anchor penetration depth (m)	2

4.4.4.3 Shared Anchor Design

74. Shared anchors connect multiple mooring lines from multiple FOUs to a single anchor point (rather than individual mooring lines connecting to a dedicated anchor), thereby reducing the number of anchors required. As the concept of shared anchors for floating offshore wind projects is largely in the research and development phase, detailed parameters are uncertain. However, this design option has been taken through to the technical assessments and falls within the project design envelope presented within this Chapter.

75. The shared anchor design is compatible with catenary and semi-taut mooring designs, and with driven pile, suction pile and to a lesser extent, GBA anchors. An example of the shared anchor design is provided in **Plate 4.7**.

Plate 4.7: Shared Anchor Design with Driven Pile Anchor Option



4.4.4.4 Mooring Line Ancillary Elements

76. In addition to the mooring lines and anchors there are several ancillary elements which are deployed as part of the SKSs. These include, but may not be limited to:

- Buoyancy elements to help maintain the mooring line configuration and minimise contact with the seabed;
- Clump weights to enhance stability and reduce movement of the FOU;
- Shackles and connectors to link various components of the SKS; and
- Tensioners to maintain the desired line tension under varying oceanographic and operational conditions.

4.4.4.5 Scour Protection

77. Where the seabed sediment is soft enough to be mobilised, sediment transport can lead to the formation of scour around infrastructure installed on or in the seabed (i.e. anchors and subsea cable hubs). The depth of scour is dependent on the shape of the infrastructure installed, the characteristics of the seabed sedimentology and metocean conditions (mainly currents near the seabed). Refer to **Section 4.4.7** for cable protection.

78. Scour around anchors and/or subsea cable hubs, can, in turn, lead loss of stability or design capacity. In the worst-case, leading to the need for complex corrective maintenance campaigns.

Therefore, the use of scour protection, both in terms of volume and material of scour protection used, is an important design measure for the Wind Farm Infrastructure.

79. Scour protection may be required for the anchors. Subsea cables hubs, however; do not require scour protection as they are laid on gravel pads which acts as scour protection. Further information on subsea cable hubs can be found in **Section 4.4.9**.

80. The scour protection options under consideration are described below:

- Concrete mattresses: A commonly used form of scour protection where concrete blocks (typically several meters long and wide) are linked together by a rope or wire lattice. Typically placed around the structures to prevent erosion and help maintain seabed stability in the immediate area;
- Rock placement (berm or rock bags): Layers of graded stones placed on and/or around structures to inhibit erosion; or rock filled mesh fibre bags which adapt to the shape of the seabed/structure as they are lowered onto it;
- Grout bags: Sealed grout bags are placed on and/or around the structures where they cure in-situ post placement; and
- Artificial frond mats: Helps to slow the current velocity of water in the area in which they are installed and reduces the conditions that create scour and therefore eliminate or reduce the occurrence of scour.

81. **Table 4.9** provides the project design envelope for scour protection.

Table 4.9: Scour Protection Design Envelope

Parameter	Design Envelope
Scour protection type	▪ Concrete mattresses; ▪ Rock placement (berm or rock bags); ▪ Grout bags; and ▪ Artificial frond mats.
Maximum height of scour protection above seabed (m)	2
Maximum scour protection area per anchor (m^2)	2,036
Maximum scour protection volume per anchor (m^3)	4,073
Total scour protection footprint for all anchors (km^2)	2.42
Total scour protection volume for all anchors (m^3)	4,837,947

4.4.4.6 Summary of FSS, SKS and Scour Protection

82. A summary of the potential FSS types, detailing potential compatible configurations of associated mooring and anchor options, is presented in **Table 4.10** below. **Table 4.10** also identifies which design options would require scour protection and/or piling (see **Section 4.4.4.2.1**).

Table 4.10: Summary of Floating Substructure, Station Keeping System and Scour Protection Compatibility

Floating Substructure Options	Compatible Mooring Options	Compatible Anchor Options	Scour Protection Required	Impact Piling Required	Compatible with Shared Anchor System
TLP	Tension	Driven pile	Yes	Yes	No
		Suction pile	Yes	No	No
		GBA	Yes	No	No
Semi-submersible and barge	Taut	Driven pile	Yes	Yes	Yes
		Suction pile	Yes	No	Yes
		GBA	Yes	No	Yes
	Catenary and semi-taut	Driven pile	Yes	Yes	Yes
		Suction pile	Yes	No	Yes
		DEA	No	No	No
		GBA	Yes	No	Yes

4.4.5 Subsea Cables

4.4.5.1 Inter-array Cables

83. IACs are armoured cables containing three phase high voltage electrical cores and fibre optic cores, which link the WTGs to each other and/or to the subsea cable hub(s) and/or the OfSS(s) and include (for FSSs) dynamic IAC sections (moving in the water column) and static IAC sections (on the seabed).

84. IACs are formed primarily of three aluminium or copper conductors through which electricity is transferred (one for each electrical phase); fibre optic cable(s); cross linked polyethylene or ethylene propylene rubber insulation; steel wire armour; and an outer polyethylene or roving material. Some IACs utilise lead sheathing around the conductors whereas others utilise aluminium or other shielding materials. No oil filled IAC designs are included in the project design envelope.

85. It is typical for groups of WTGs to be connected together via strings or loops of IACs, dependent on the electrical design selected.

86. Currently, the typical voltage rating of an IAC is 66 kV, however, due to the increasing WTG output expected over the coming years, the supply chain is developing IACs with a voltage rating of 132 kV. These higher voltage IACs are also being considered for the Bellrock WFDA.

87. For FSSs, due to the nature and movement of the structure, static IAC and dynamic IAC are required, joined together by a connector to form one continuous IAC cable. The dynamic IAC section is designed to accommodate the dynamic movement of the FSS.

88. Dynamic IAC sections can be deployed in various configurations, depending on a number of factors such as water depth and on-site conditions. These configurations may include:

- Free hanging;
- Lazy “S” wave; and
- Steep wave.

89. The lazy “S” wave configuration is the configuration most commonly associated with floating offshore wind farms. However, further detailed design is required to define the most suitable configuration for the Bellrock WFDA. **Plate 4.8** provides an overview of these IAC configuration options.

90. Dynamic cable configurations require a number of ancillary elements to help reduce fatigue and protect the cable, such as:

- Buoyancy modules;
- Bend stiffeners;
- Bend restrictors;
- Abrasion protection at the touch down point; and
- Connector potentially used to join the dynamic IAC to the static IAC.

91. Static IAC sections may be surface laid on the seabed and/or buried. Refer to **Section 4.4.6** for detail on cable burial and protection.

Plate 4.8: **Dynamic Inter-array Cable Options**

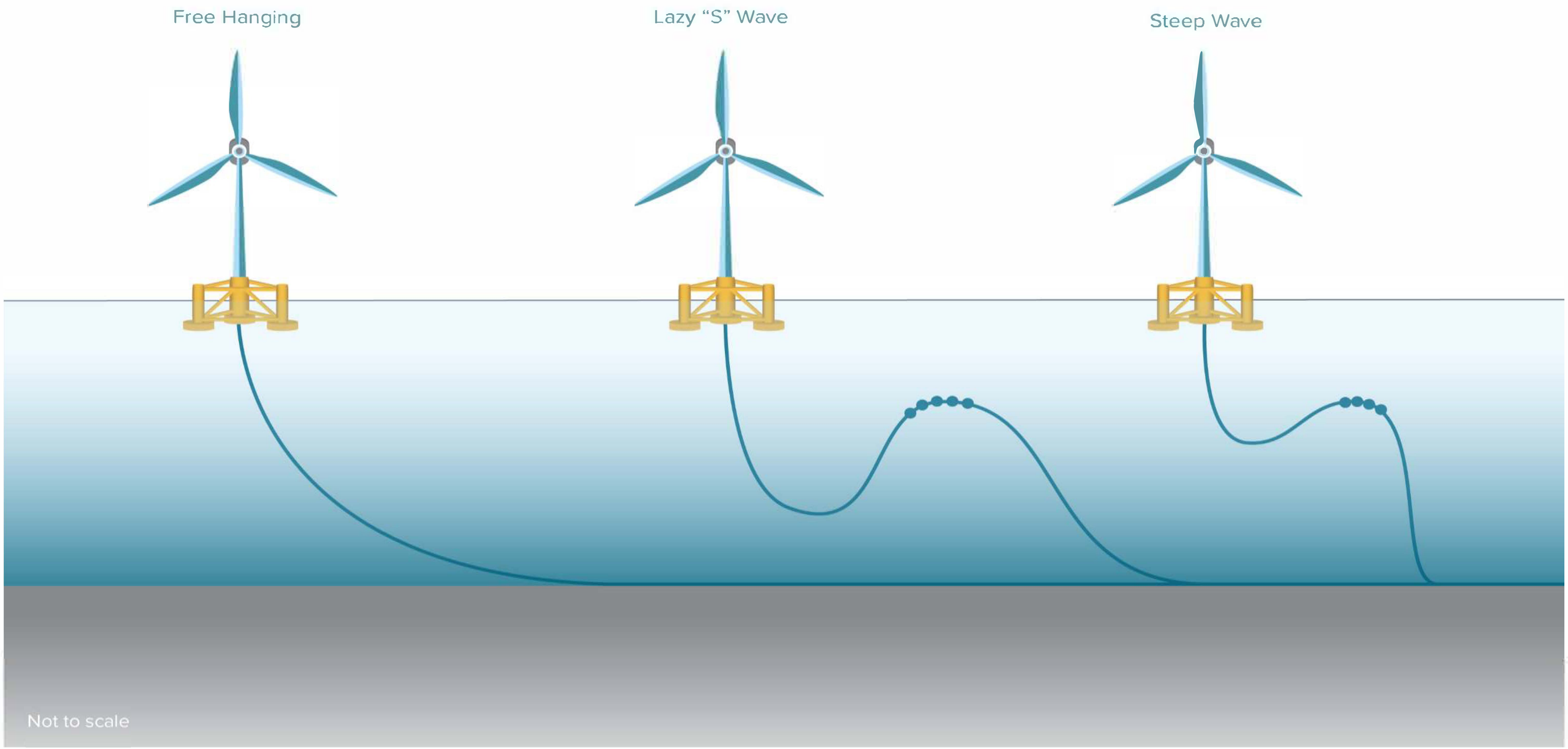


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Table 4.11: Inter-array Cable Design Envelope

Parameter	Design Envelope
Voltage (kV)	66 - 132
Total length (km)	300
Maximum external diameter (mm)	270
Maximum total length of dynamic cable (km)[1]	92.4
Maximum length of dynamic IAC in the water column (per IAC connection to an FSS) (m)	350
Maximum length of buried cable	225
Notes: [1] The maximum IAC length is 300 km; however, the maximum values presented for buried IAC (225 km), and dynamic unburied IAC (92.4 km) represent individual worst-case parameters and would not occur simultaneously. Accordingly, these values do not sum to the total IAC length.	

4.4.6 Cable Burial

92. Cables will be buried where possible. A detailed Cable Burial Risk Assessment (CBRA) will be undertaken to determine the target burial depth and installation method(s). The CBRA will also highlight instances where no burial is possible or where adequate burial cannot be achieved and alternative protection is needed.

93. The cable burial methods that may be used comprise:

- Jet trenching - The method of jet trenching comprises injecting water at high pressure into the sediment surrounding the cable which has been placed on the seabed surface. Jet trenching tools use water jets to fluidise the seabed around the cable which allows the cable to sink into the seabed under its own weight;
- Mechanical trenching - The method of mechanical trenching is usually mounted on tracked vehicles, which use chain cutters or wheeled arms with teeth or chisels to cut a trench into the seabed; and
- Cable ploughing - Cable ploughing usually involves towing either from a vessel or remotely operated vehicle (ROV) on the seabed. There are two methods of cable ploughing. The first is displacement plough which creates a V shaped trench into which the cable can be laid. The second is a non-displacement plough which simultaneously lifts an area of seabed whilst depressing the cable into the bottom of the trench. As the plough progresses, the area of the seabed is replaced on top of the IAC

94. **Table 4.12** provides the installation and burial design envelope for IACs. Burial depths may vary depending on the findings of the CBRA and seabed conditions.

Table 4.12: Installation and Burial Design Envelope for Inter-array Cables

Parameter	Design Envelope
Cable burial technique	▪ Jet trenching; ▪ Mechanical trenching; and ▪ Cable ploughing.
Target burial depth (m) (if burial is required)[1]	0.5 to 2.5
Target cable trench width (m) (if buried)[2]	0.5 to 2
Maximum width of seabed disturbance from installation tool/process per static IAC (m)[3]	7
Total footprint of disturbance on the seabed from installation (ploughing) (km^2)	1.45
Total footprint of disturbance on the seabed from installation (jet trenching) (m^2)	570,000
Total volume of disturbance during installation (ploughing) (m^3)	3,618,750
Total volume of disturbance during installation (jet trenching) (m^3)	1,425,000

Notes:

[1] Burial depth could be up to 5 m in certain areas depending on seabed conditions and will be subject to the findings of the CBRA.

[2] Trench width could be up to 5 m in certain areas depending on seabed conditions and will be subject to the findings of the CBRA.

[3] Refers to the cable ploughing burial technique. Jet trenching width is 3 m, however, due to the technique used, this is worst case for marine geology, oceanography and physical processes (refer to **Chapter 6)** as it disperses more sediment into the water column compared to other methods.

4.4.7 Cable Protection

95. Where it is not possible to achieve the required burial depth, for example due to seabed conditions or at cable crossings, clump weights/ballast and tethering anchors may be used to hold the IAC in position and external cable protection may be required. Cable protection will protect cables from activities such as fishing, anchor placement or dropped objects, and will reduce electromagnetic field effects.

96. The type of cable protection selected will be dependent on various factors, for example seabed and sediment conditions, the physical processes present, and safety considerations associated with installation, maintenance and decommissioning. External cable protection may include concrete mattresses, rock placement (berm or rock bags), grout bags and cast-iron shells (articulated pipes). Concrete mattresses and rock placement are the two most common types of cable protection and are described in **Section 4.4.4.5.**

97. In addition to the cable protection methods described above, ancillary elements will also be considered for securing cable protection and ensuring limited movement. These may include touch down protection (sleeves and anchoring), bend stiffeners and buoyancy modules (to minimise cable contact with the seabed). The final installation and cable protection type will be determined during the detailed design phase.

98. **Table 4.13** presents the external cable protection design envelope for IACs.

Table 4.13: Cable Protection Design Envelope for Inter-array Cables

Parameter	Design Envelope
Cable protection technique	▪ Concrete mattresses; ▪ Rock placement (berm or rock bags); ▪ Grout bags; and ▪ Cast-iron shells (articulated pipes).
Maximum length of unburied cable requiring protection (km)	26.2
Maximum width of cable protection at the seabed (m)	4.8
Maximum height of cable protection (m)[1]	0.5
Side slope (v:h)	1:3
Maximum seabed footprint of total external cable protection (km^2)	0.13
Maximum total area of cable protection (m^2)	125,760
Maximum total volume of cable protection (m^3)	58,730
Notes: [1] This is below the 5% reduction of water depth required by MCA for cable protection measures (as referenced in the MCA's Scoping response).	

4.4.8 Cable Crossings

99. There are no existing third party subsea cables or pipelines currently within the Bellrock WFDA and therefore cable crossings with third party infrastructure is not anticipated. There may be a requirement for the Bellrock WFDA IAC cables to cross each other. **Table 4.14** presents the project design envelope for cable crossings and associated cable protection.

Table 4.14: Cable Crossing Installation and Burial Parameters Design Envelope for Inter-array Cables

Parameter	Design Envelope
Cable protection material	▪ Concrete mattresses; ▪ Rock placement (berm or rock bags); ▪ Grout bags; and ▪ Cast-iron shells (articulated pipes).
Minimum number of crossings	0
Maximum number of IAC crossings by IACs	3
Maximum height of cable protection at a crossing (m)	1.2
Maximum width of crossing protection at the seabed (m)	5.6
Maximum length of crossing protection at the seabed (m)	53.6
Maximum area of cable protection per crossing (m^2)	327
Maximum total volume of crossing protection for all crossings (m^3)	417

4.4.9 Subsea Cable Hubs

100. A subsea cable hub connects multiple IACs (from multiple FOUs) into a single IAC which then connects to an OfSS.

101. Up to 18 subsea cable hubs could be utilised within the Bellrock WFDA, the locations of which will be determined post-consent during the detail design phase. Refer to **Section 4.7.5** for detail on installation of subsea cable hubs.

102. The aim of the subsea cable hubs is to increase the electrical system availability. The subsea cable hubs are likely to comprise a steel framed structure supporting the electrical equipment, positioned on a mudmat and gravel pad to provide a stable and level platform for the subsea cable hub. Should the final design require the subsea cable hubs to be fixed to the seabed with pin piles, the pin piles will be no greater in size than those that have been considered for the TLP anchors and the total number of TLP within the Bellrock WFDA will not exceed the design envelope presented in **Table 4.8**.

103. **Table 4.15** presents the subsea cable hubs design envelope.

Table 4.15: Subsea Cable Hub Design Envelope

Parameter	Design Envelope
Maximum number of subsea cable hubs	18
Maximum dimensions of a subsea cable hub including shallow foundations gravel pad (length x width) (m)	13 x 13
Maximum footprint per subsea cable hub (during construction and O&M) (m^2)	169
Foundation type	Steel framed structure with mudmat and gravel pad
List of materials	▪ Steel; ▪ Aluminium anodes; and/or ▪ Polyurethane.
Scour protection	No additional scour protection anticipated

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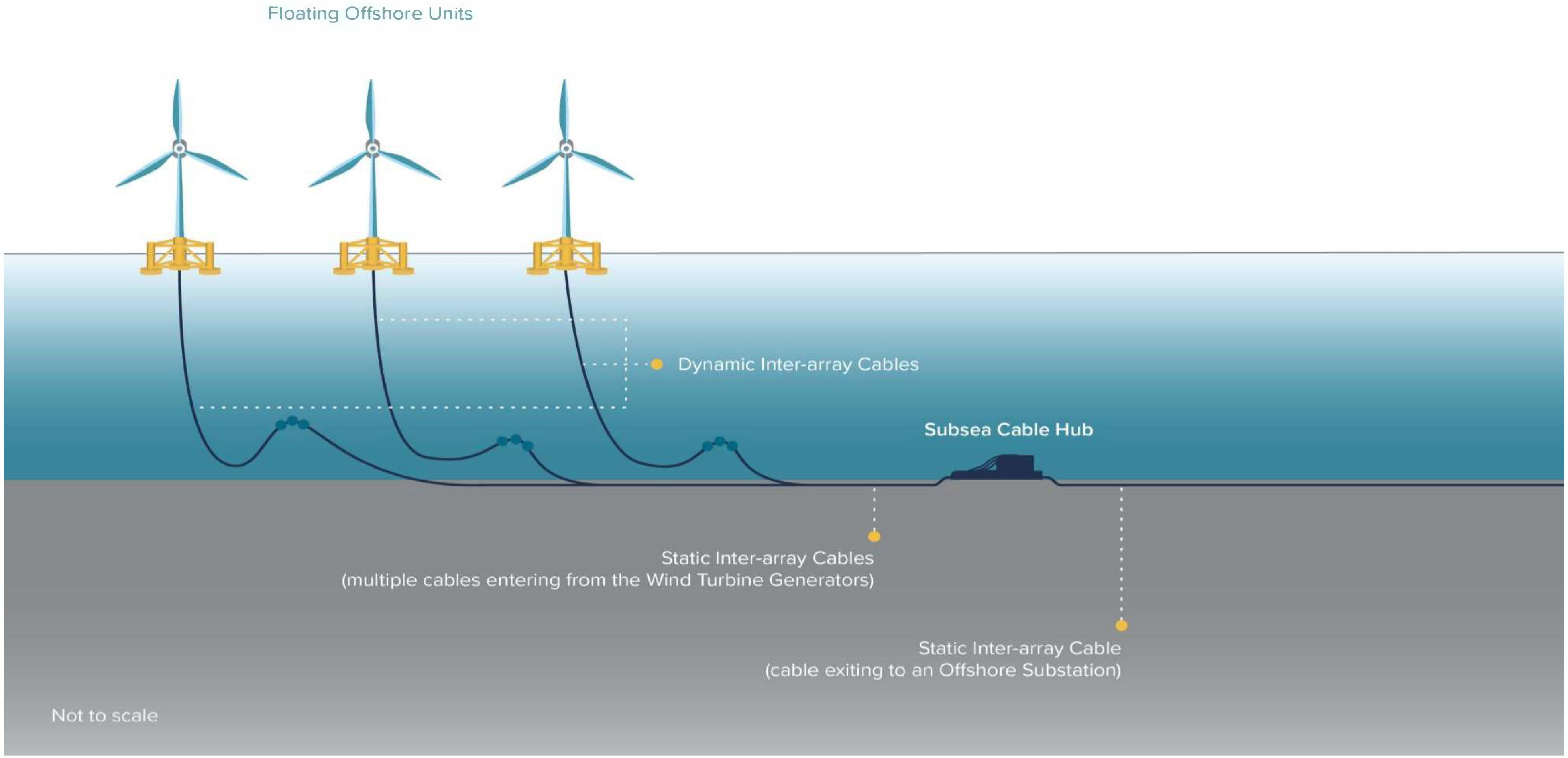
Plate 4.9: Subsea Cable Hub



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4.4.10 Ancillary Infrastructure

104. Details around ancillary infrastructure would be determined at the detailed design phase, post consent. However, it is anticipated that the following will be included within the Bellrock WFDA:

- Mooring buoys (refer to **Section 4.4.10.1**);
- Metocean buoys (refer to **Section 4.4.10.2**); and
- Marker buoys (also referred to as construction buoyage in the Outline LMP, refer to **Section 3.1**).

105. Any temporary works during construction would also be determined at the detailed design phase.

4.4.10.1 Mooring Buoys

106. There is potential for up to two mooring buoys to be installed within the Bellrock WFDA. These would have a maximum diameter of 12 m and up to three GBAs or suction pile anchors. Refer to **Table 4.16** for key parameters.

107. The mooring buoys may serve both as a mooring point and charging station for vessels, with the latter purpose served by a dynamic power cable. Other charging solutions include hang-off charging systems from the WTG or OfSS.

108. Use of the mooring buoys for charging during O&M remains an innovative technology and subsequently detail design information is not yet available. The s.36 Consent and Marine Licence applications include for the installation of mooring buoys. The NRA also qualitatively assesses the physical presence of the mooring buoys where relevant but does not assess the operation of using a mooring buoy for charging a project vessel; this facet of the mooring buoys would be assessed post-consent when detailed parameters are available and in compliance with any relevant MCA guidance published at the time.

Table 4.16: Design Envelope of Mooring Buoys During Operations and Maintenance

Parameter	Design Envelope
Maximum diameter of the buoy (m)	12
Mooring line configuration	Taut, semi-taut, catenary
Anchor options	GBA and/or suction pile
Maximum number of mooring buoys	2
Maximum number of anchors per mooring buoy	3
Maximum anchor footprint (m^2) per mooring buoy	147

4.4.10.2 Metocean Buoys

109. Data from the on-site weather and sea condition monitoring equipment will be used to support the Bellrock Project. Fixed light detection and ranging (LiDAR(s)) may be installed on the nacelle of WTG structures or on the OfSSs to measure weather. Metocean buoys may be deployed to measure, for example, waves, currents, wind, temperature and air pressure.

110. It is anticipated that each metocean buoy would include a lantern suitable for use as a navigational aid. Metocean buoys would likely be attached to the seabed using mooring devices such as common sinkers (a small block of heavy material such as concrete or steel) or anchored (e.g. clump weights). They could have one single mooring point or several points (usually up to three), with an anticipated total footprint including scour protection of 5 m^2 per anchor.

111. Indicative details of metocean buoys anticipated during construction and O&M phases are presented in **Table 4.17**.

Table 4.17: Design Envelope for Metocean Buoys

Parameter	Value
Maximum dimensions (m) (w x h)	5 x 4
Maximum number during construction	2
Total anchor footprint during construction (m^2)	30
Maximum number during operation	2
Total anchor footprint during operation (m^2)	30

4.5 Site Preparation Works

112. Site preparation works are any preparatory works undertaken within the Bellrock WFDA prior to the commencement of construction, and may comprise:

- Surveys, including geophysical surveys, geotechnical surveys and non-archaeological/archaeological diver/remotely operated vehicle (ROV) surveys (see **Section 4.5.1.1**);
- Seabed preparation including sand wave levelling, slope levelling for GBAs (if selected), boulder clearance and pre-lay grapnel runs (PLGR) (**Section 4.5.1.2.4**);
- Unexploded ordnance (UXO) survey and/or clearance (**Section 4.5.1.3**);
- Debris clearance (**Section 4.5.1.4**); and
- Out of service cable/pipeline removal (**Section 4.5.1.5**).

113. Site preparation works (undertaken prior to commencement of construction) are outside the scope of the Bellrock WFDA s.36 Consent and Marine Licence applications; and will be consented through separate Marine Licence applications. However, to ensure a comprehensive EIA is undertaken, that considers and assesses all impacts associated with the Bellrock WFDA, site preparation works have been assessed in the relevant technical chapters of this Bellrock WFDA EIA Report, within the construction phase assessment of the Bellrock WFDA.

114. Site preparation works will be undertaken for up to one year before commencement of construction, at which point they may continue albeit as construction works (rather than site preparation works).

115. A summary of site preparation activities is presented in the sections below.

4.5.1.1 Site Preparation Surveys

116. Surveys undertaken as site preparation works include:

- Geophysical surveys to inform on the presence of UXO, bedform and mapping of boulders, geohazards, bathymetry, topography and subsurface layers;
- Geotechnical surveys to inform on seabed conditions; and
- ROV surveys to verify the presence and nature of features identified through other surveys.

4.5.1.2 Seabed Preparation

117. Seabed preparation activities include sand wave levelling, boulder clearance and PLGR which are undertaken to prepare the seabed for the laying of infrastructure such as IACs and anchors. This is particularly important for cable laying works where boulder clearance may need to be undertaken to provide a flat seabed free from obstructions and mobile sediments.

4.5.1.2.1 Sand Wave Levelling

118. From the 2023 geophysical surveys undertaken within the Bellrock WFDA (Acteon, 2024), sand waves are present in the southwest of the Bellrock WFDA. These are minimal and approximately 2 m in height, and 300 m to 400 m apart. Published data (British Geological Survey (BGS), 1984, 1985a) has mapped sand across most of the Bellrock WFDA and a small area of muddy sand in the east. The shallow (Quaternary) geology of the Bellrock WFDA is mainly sand and gravel, greater than 50 m thick (BGS, 1985b, 1985c). If required, sand wave levelling would be conducted to flatten sand waves and push sediment from wave crests into adjacent areas to level the seabed.

119. It is anticipated that a maximum area of 420,000 m^2 will require sand wave levelling across the Bellrock WFDA.

120. It is not anticipated that any dredging would be required within the Bellrock WFDA.

4.5.1.2.2 Slope Levelling for Gravity Based Anchors

121. GBAs are expected to be installed on a largely level area of prepared seabed. With the presence of sand waves in some parts of the Bellrock WFDA (refer to **Section 4.5.1.2.1**), it is expected that slope levelling may be required prior to the GBAs being positioned (if used). It is anticipated that slope levelling would be conducted either immediately prior to the GBA placement, or in the

proceeding summer season. In the event that GBAs are being installed within the first year of construction, then slope levelling would therefore take place prior to the commencement of construction (i.e. during site preparation works - Year 0).

122. It is anticipated that a maximum area of 373,032 m^2 will require slope levelling for GBAs.

4.5.1.2.3 Boulder Clearance

123. Boulder clearance may be required prior to commencement of construction to clear areas of the seabed, in particular, at anchor locations, and along IACs routes. A boulder is defined as being over 256 mm in diameter and/or length (as per the Wentworth Scale (BGS, 2025)).

124. Boulder clearance is required to aid cable installation and increase the success rate for achieving minimum target burial depth during cable burial, therefore, reducing the risk of further cable burial works and/or the need for cable protection. Boulder clearance also reduces the risk of cable damage during installation and subsequent burial.

125. Boulders may be cleared using a plough (along cable routes) or a tyne grab, however, the site preparation surveys, and the parameters of any boulders present (e.g. size, density and location of boulders), will inform the methodology to be used for their removal. It is possible that more than one method of boulder clearance will be deployed across the Bellrock WFDA. Cleared boulders will be relocated to an appropriate location within the Bellrock WFDA.

126. **Table 4.18** below provides an estimation of the number of boulders to be cleared within the Bellrock WFDA to accommodate the installation of Wind Farm Infrastructure. These have been estimated by reviewing the 2023 Bellrock WFDA geophysical survey results (Acteon, 2024) and identifying the number of boulders across the site which have dimensions of ca. 256 mm or greater.

Table 4.18: Boulder Clearance Design Envelope

Parameter	Value
Estimated maximum number of boulders to be cleared and relocated within the Bellrock WFDA to accommodate the installation of Wind Farm Infrastructure	400
Diameter of boulders (mm)	ca. 256 mm or greater
Maximum seabed footprint of boulders cleared and relocated on the seabed within the Bellrock WFDA (m^2)	4,000

4.5.1.2.4 Pre-lay Grapnel Run

127. A PLGR involves a vessel dragging a grapnel train on the seabed along the planned cable route to remove any debris on or buried in the shallow seabed that could obstruct the cable laying activity (such as fishing nets or rope).

128. The PLGR activity is undertaken just prior to the cable installation activity to minimise the risk of further debris settling on the cable route before the cables are installed, although it may also be undertaken in certain circumstances during the site preparation works.

129. PLGR is carried out on the cable route and is therefore within the maximum footprint of disturbance within the cable ploughing footprint of disturbance (refer to **Table 4.12**).

4.5.1.3 UXO Survey and/or Clearance

130. UXO on or in the seabed may exist as a result of previous conflict or munition dumping and, if present, poses a significant health and safety hazard during construction of the Bellrock WFDA. Therefore, UXO must be appropriately managed (e.g. identification of potential UXOs through undertaking desktop studies, geophysical surveys, and field investigations, avoiding potential UXOs through micro-siting of Wind Farm Infrastructure, and ultimately relocation (if applicable and permitted as an option), or UXO clearance in-situ). If UXO clearance is considered necessary, separate Marine Licence application(s) will be submitted prior to UXO clearance works, supported by an accompanying assessment of potential effects on relevant receptors.

131. The final layout of Wind Farm Infrastructure is required before conducting a UXO survey prior to construction, to ensure the UXO survey is targeted in the areas where Wind Farm Infrastructure is to be placed. A desktop UXO Threat and Risk Assessment for the Bellrock WFDA was undertaken on behalf of the Applicant in 2023 (6 Alpha Associates, 2023) based only on historical records. This assessment resulted in an overall Bellrock WFDA UXO risk rating of low, although there remains the potential for some UXO to be present. This will be confirmed as the understanding of the Bellrock WFDA evolves through furthermore detailed geophysical surveys.

132. The hierarchy of UXO mitigation and clearance techniques which will be adopted during design and construction and if necessary, O&M, and decommissioning of the Bellrock WFDA, in order of preference, are:

- Avoid (through micro-siting of infrastructure);
- Move UXO without clearing it (if applicable and accepted as an option);
- Remove the UXO without clearing it (if applicable and accepted as an option);
- Low-order clearance, such as deflagration (if above options not suitable/unsafe); and
- High-order clearance (if above options not suitable/unsafe or in the event that low-order deflagration was unsuccessful after a minimum of 3 attempts, as per Marine Environment: UXO Clearance Joint Position Statement (UK Gov., 2025).

133. Site preparation works will be considered as appropriate within the technical chapters of this Bellrock WFDA EIA Report under construction phase impacts. While UXO clearance will be subject to separate Marine Licence(s) in due course, an indicative assessment of potential impacts is included within this Bellrock WFDA EIA Report for relevant receptors (e.g. benthic ecology, fish and shellfish ecology, and marine mammals).

134. **Table 4.19** describes the UXOs within the Bellrock WFDA.

Table 4.19: Unexploded Ordnance Values Expected Within the Bellrock WFDA

Parameter	Description
Estimated maximum size (Ferrous Mass) of a UXO expected within the Bellrock WFDA	364 kg
Example type	Naval torpedo (53.3 cm G7e torpedo)
Notes: Refer to **Appendix 9.3: Bellrock WFDA Marine Mammals UXO Assessment (Volume IV)**	

4.5.1.4 Debris Clearance

135. Any debris which is of no archaeological importance or a potential UXO and which is deemed to be a risk to construction may be relocated on the seabed or removed completely using a tyne grab or similar. Where the object is too large to be relocated or removed it shall be avoided through mircositing of the Wind Farm Infrastructure.

4.5.1.5 Out of Service Cable/Pipeline Removal

136. No out of service cable/pipelines were identified within the Bellrock WFDA during the 2023 geophysical survey (Acteon, 2024), however if any are identified during surveys the following may occur:

- A cable detection survey using an ROV and TSS 440 cable detection system (or similar) will be undertaken to map the cable to at least 100 m outside of any construction area;
- If the cable section is sufficiently short it may be pulled away from the area of construction by the ROV, alternatively it may be pulled away or recovered using a grapnel train towed by the PLGR vessel; or
- If the cable is too long or buried too deeply to be dragged away, it may be uncovered (if not already on the surface), then cut using a cutter on the ROV, or on the deck of ship and re-laid on the seabed with clump weights at the cut ends as per International Cable Protection Committee (ICPC) guidelines (ICPC, 2011).

137. If out of service pipelines are identified during site preparation surveys, any of the following may occur:

- The Wind Farm Infrastructure will be designed to avoid the pipeline if practicable;
- The pipeline owner will be requested to remove the pipeline; or
- A pipeline crossing will be constructed to allow the installation of IAC cables.

4.6 Safety Zones, Safe Passing Distances, Aids to Navigation and Notice to Mariners

4.6.1.1 Safety Zones

138. Section 95 and Schedule 16 of the Energy Act 2004 sets out that Safety Zones can be established for any phase of an offshore renewable energy project in designated areas, where it is deemed appropriate for safety reasons.

139. The Electricity (Offshore Generating Stations) (Safety Zones) (Applications Procedures and Control of Access) Regulations 2007 (UK Gov., 2007) were introduced in August 2006 clarifying the process for applying for a Safety Zone and advertising such applications. The Applicant will follow these regulations and associated guidelines when applying for Safety Zones noting that the Marine Directorate are now responsible for Safety Zone applications for projects within Scottish Waters.

140. Safety Zones are intended to ensure the safety of individuals on the relevant Wind Farm Infrastructure and vessel(s) during construction, O&M, extension or decommissioning by prohibiting non-project vessels from navigating through a designated area for a specific period. Vessels are generally prohibited from entering an active Safety Zone unless for the purposes of saving life, property, or if in distress, with further exceptions detailed in the Electricity Regulations 2007.

141. While the total number and sequencing of Safety Zones to be established within the Bellrock WFDA has not yet been defined, it is anticipated that the following maximum Safety Zones will be applied for in advance of construction, O&M and decommissioning, in relation to all relevant sea surface structures within the Bellrock WFDA:

- Safety Zones for up to 500 m around each FOU during its construction;
- Safety Zones for up to 50 m around each FOU when construction works have been completed but prior to commissioning, or where construction works are partially completed and a construction vessel is not present;
- Safety Zones for up to 500 m around each FOU during major maintenance during operation;
- Prior to commencement of decommissioning, Safety Zones for up to 500 m around each FOU during its decommissioning; and
- Consideration will also be given to an application for up to 500 m operational Safety Zones throughout the O&M phase, with any such application following the relevant application process and consultation requirements in place at the time.

142. Detail of the Safety Zones will be published by the Applicant and communicated through multiple channels to ensure that mariners and other stakeholders are fully aware of any access restrictions within the Bellrock WFDA. The Safety Zones will also be monitored by support craft (i.e. guard vessels). The means and level of required monitoring will be risk assessed and agreed with MCA prior to the commencement of construction.

143. Installation of subsea infrastructure, comprising the SKSs, IACs and subsea cable hubs, will be marked during construction using marker buoys (see **Section 4.6.1.3**).

144. Advisory safe passing distance may also be requested around maintenance activities on IACs as required.

4.6.1.2 Recommended Safe Passing Distances

145. For the safety of third-party vessels, safe passing distances around activities may be recommended by the Applicant during the construction, O&M and decommissioning phases. Notice to Mariners (NtMs) will be used to communicate these to sea users during all phases of the WFDA.

146. When the FSS or FOUs are being towed, compliance is required with COLREGs (the International Regulations for the Prevention of Collisions at Sea). COLREGS instruct how vessels behave around tows and dictate lights/symbols that show the length of tow/hazard. Vessels associated with activities may also issue Very High Frequency warnings to warn third-party vessels of safe passing distances.

4.6.1.3 Aids to Navigation

147. The WFDA will be lit and marked to assist navigation in line with relevant guidance and consultation with the Northern Lighthouse Board (NLB), MCA, the Civil Aviation Authority (CAA) and the MOD.

148. Marker buoys are required across the Bellrock WFDA. A marker buoy is a floating device anchored to the seabed used to mark specific points or areas on the water.

149. An **Outline Lighting and Marking Plan (LMP) (Volume V)** has been submitted with this Bellrock WFDA EIA Report. The final LMP will be agreed with the Scottish Ministers (in consultation with the NLB, MCA, CAA and MOD) prior to the commencement of construction. It will include details of the construction and operational lighting and marking requirements that will be deployed within the Bellrock WFDA. If directed by NLB, temporary marker buoys deployed for construction prior to anchor and mooring installation will be modified during the construction period to reflect the nature of construction works being undertaken.

150. Throughout the construction phase and, subject to discussions with the MCA and other stakeholders, the number of marker buoys required across the construction programme to mark the Bellrock WFDA boundary, FSSs, anchors and other infrastructure on the seabed during installation will be finalised. These temporary measures may be replaced by permanent markings in accordance with agreed requirements, for the lifetime of the Bellrock WFDA. During the O&M phase, the Bellrock WFDA will be marked with appropriate navigational marker buoys to provide the necessary warning to mariners of the presence of the Bellrock WFDA. The exact type and configuration of any navigational markers will be determined via consultation with the MCA and NLB and will also be informed by the outputs of the project-specific Navigation Risk Assessment and supported by non-physical aids to navigation (AtoN).

4.6.1.4 Notice to Mariners

151. Details and locations of any Safety Zones and advisory safe passing distances will be communicated by the publications of NtMs and within the Kingfisher Bulletin as a minimum.

4.6.1.5 Anchoring

152. At the time of writing there are no defined anchors within the Bellrock WFDA or in its vicinity.

153. Anchoring is at the discretion of the Vessel Master who may consult with the Marine Coordination Centre or port authorities, where relevant. All vessels associated with the construction O&M or decommissioning of the Wind Farm Infrastructure will follow standard marine practices and will consult with the Marine Coordination Centre prior to anchoring.

4.7 Construction Works

4.7.1 Overview of Construction Activities

154. Construction of the Wind Farm Infrastructure is expected to take up to seven years[6]. Due to Bellrock WFDA's distance offshore, construction is expected to be predominantly undertaken on a seasonal basis, typically between March and October (inclusive), each year. Whilst the construction strategy (and sequence) will be confirmed during the detailed design phase, the following steps present a reasonable sequence for the construction activities within each season:

- **Step 1:** Site preparation works undertaken after commencement of construction (see **Section 4.7.2**);
- **Step 2:** Installation of the SKSs (anchors and mooring lines) at each FOU location, and installation of scour protection that may be required around anchors (see **Section 4.7.3**);
- **Step 3**: Towing of FOUs using appropriate vessels, from an integration port or wet storage facility to the Bellrock WFDA and connection to the SKS. Once in place, they will be connected to the SKSs. (see **Section 4.7.4**);
- **Step 4:** Installation of subsea cable hub(s) (see **Section 4.7.5**);
- **Step 5:** Installation of IACs, including seabed preparation, cable burial and protection (where required) (see **Section 4.7.6**);
- **Step 6:** Integration with Offshore Transmission Infrastructure, testing and commissioning (see **Section 4.7.7**); and
- **Step 7**: Wind Farm Infrastructure snagging and repairs (see **Section 4.7.8**).

155. The above steps are an indicative sequence and in practice all steps may happen concurrently within the WFDA (e.g. steps 1, 2, 3, 4, 5 and 6 could occur in parallel across different areas of the WFDA). The following sections summarise the above steps.

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[6] Excluding site preparation works, which are undertaken for up to one year prior to commencement of construction, as described in **Section 4.5.**

4.7.2 Step 1: Site Preparation Works Undertaken After Commencement of Construction

156. Site preparation works undertaken after commencement of construction are as described in **Section 4.5**.

4.7.3 Step 2: Installation of Station Keeping Systems

4.7.3.1 Anchor Installation

157. Anchor installation will take place prior to FOU connection. The anchor installation procedure and associated vessels will vary depending on the final anchor solution(s). The installation methods for each anchor option and the types of vessels required are generally as follows:

- Driven piles are driven into the seabed from a heavy lift vessel (HLV) or similarly capable vessel positioned at the installation location. The pile is typically driven to the required penetration depth by an impact or vibratory hammer. In the event of a pile refusal (i.e. the pile becoming stuck due to challenging or unforeseen conditions) drilling may be used in a DDD process to progress the pile before being driven again until the final penetration depth is reached. Drill arisings from the DDD method will be disposed of at sea adjacent to the location of the piling event (refer to **Section 4.4.4.2.1**).
- Suction piles are lowered to the seabed by an HLV or similarly capable vessel and positioned at the installation location. A pipe runs through each suction pile which pumps/sucks water out of each pile. As this happens, and as a result of the suction force generated, the piles are pulled down into the seabed. Once the required penetration depth has been achieved the pump is switched off and, if needed, grout is injected under the pile to fill any remaining airgap and ensure contact between soil and the pile. Suction piles do not require to be drilled or hammered into the seabed.
- DEAs are installed using a tug/anchor handler or equivalent, by being dragged/pulled by the vessel in a controlled manner across the seabed for up to 60 m, embedding itself to the required depth/tension. The required penetration depth and pull length will be determined during the detailed design phase. Once in place, the DEA is proof loaded by applying a large horizontal tension to the anchor for a short duration. This tension is achieved through bollard pull of the tug/anchor handler or by means of reaction anchor and tensioning devices such as in line tensioners.
- GBAs are installed with an HLV or similarly capable vessel. The vessel lifts the GBA from deck or a transport vessel and gradually, using a crane, the GBA is lowered to the seabed. The descent and the positioning of the GBA may be assisted by ROV and/or auxiliary vessels. Once positioned, ballast (liquid or solid material) may be added to increase the weight of the GBA. Water ballasting of the GBA would occur by opening internal compartments of the GBA and allowing it to fill with seawater. This operation would typically be conducted by ROV operated from the installation vessel or support vessel. Ballasting using solid material, typically stone, would be carried out by a dedicated vessel using either a crane for rock bags, or a fall-pipe vessel or other rock-placement vessels for graded rock.

158. Suction piles and driven piles will likely be transported on suitably sized vessels (e.g. construction service vessel (CSV) or a large installation vessel), GBAs will likely be transported on the deck of the installation vessel or on a feeder barge, and DEAs will likely be transported on a tug/anchor handler.

159. Scour protection, if required for the above anchor types, will either be pre-laid prior to anchor installation (with the anchor installed through the scour protection) or following installation of the anchor. The scour protection, (e.g. concrete mattresses, rock placement (berm or rock bags), grout bags or/and artificial frond mats) , will be deployed from a dedicated vessel using either a crane for rock bags, frond mats and concrete mattresses or a fall-pipe vessel or other rock-placement vessels for graded rocks.

4.7.3.2 Mooring Line Installation

160. Mooring line (including ancillary elements) installation will take place prior to FOU connection. Mooring lines will be transported from the construction port(s) or marshalling port(s) to the Bellrock WFDA where they will be installed at their final position. Components will be recovered and hooked-up to the FOU when it arrives at the Bellrock WFDA.

161. The mooring line installation procedure and associated vessels will vary depending on the detailed design. The mooring line options presented in **Section 4.4.4.1** will have an expected mooring line installation sequence as follows:

- Following anchor installation, the mooring lines will be connected to the anchor at the seabed. The mooring line installation is performed with a tug/anchor handler or similarly capable vessel. The anchor connection end of the mooring line is lowered from the vessel towards the anchor and connected to the anchor with an ROV.
- After connection to the anchor, the remaining mooring line is lowered into the water, left in-situ and buoyed until they are hooked up to the FOU. Clump weights or equivalent may be used to temporarily hold the anchor the mooring lines in position and restrict movement prior to hook-up to the FOU.

162. For fibre ropes, pre-stretching operations may be required. This consists of applying a large tension to the line once deployed. This tension is achieved through the bollard pull of the installation vessel or by means of reaction anchor and tensioning devices such as in-line tensioners. This can take place following installation of the mooring lines or prior to the hook-up of the FOU utilising the vessel undertaking those activities.

4.7.4 Step 3: Towing of Floating Offshore Units and Connection to the Station Keeping Systems

163. The FOUs will be towed from the integration port or wet storage facility to the Bellrock WFDA by suitable vessels (i.e. tug/anchor handlers and support vessels) and connected to the pre-installed SKS utilising a range of suitable vessels (i.e. tug/anchor handlers, and CSVs and/or other types of support vessels). Final ballasting operations will take place when the FOU is in its final position, ensuring the FOU and all systems are safe to be disconnected from the vessels and safe to be left in their final position.

4.7.5 Step 4: Installation of Subsea Cable Hubs

164. Subsea cable hubs will be loaded onto a CSV at port and transported to the Bellrock WFDA for installation. The subsea cable hubs will be laid on the seabed on a pre-laid gravel pad using a crane deployed from the CSV. Once laid on the seabed the IAC cables will be pulled into the subsea cable hubs and secured in place by a ROV.

4.7.6 Step 5: Installation of Inter-array Cables

165. There is potential for IACs installation to commence prior to the FOUs connecting to the SKSs (i.e. around the same time as anchor and mooring line installation). However, it is likely that IACs will be installed after connection of the FOUs to the SKSs.

166. IACs will be loaded onto a CSV or cable laying vessel (CLV) at port and transported to the Bellrock WFDA for installation. Refer to **Table 4.20** for IAC installation vessel types. The cables will either be laid on the seabed and subsequently buried or suitably protected, installed into a pre-cut trench prior to burial, or simultaneously laid and buried (refer to **Section 4.4.6** for cable burial techniques).

167. The IACs will be connected between the WTGs, subsea cable hubs and the OfSSs and, where required, cable protection will be installed.

4.7.7 Step 6: Integration with Offshore Transmission Infrastructure, Testing and Commissioning

168. Connection to the Offshore Transmission Infrastructure, testing and commissioning will be undertaken on a rolling basis, as and when FOUs are installed, and typically involves the following activities:

- Testing of components, systems and communications; and
- On connection to the Offshore Transmission Infrastructure, energisation of the electrical systems, testing and commissioning.

169. Commissioning activities are expected to be carried out from suitably sized vessels (e.g. service operation vessels (SOV), crew transfer vessels (CTV) and CSVs) operating offshore for multiple weeks at a time.

170. The Bellrock WFDA's Commercial Operation Date will occur when the Wind Farm Infrastructure is fully transferred to the operations team which is likely to be the date of the taking over certificate of the last WTG to be installed.

4.7.8 Step 7: Wind Farm Infrastructure Snagging and Repairs

171. Any defects which require to be rectified will be undertaken during the construction phase and through the initial O&M phase.

4.7.9 Construction Programme

172. The indicative Bellrock WFDA construction programme (including site preparation works[7]) is provided in **Plate 4.10**. This indicative programme, including the estimated commencement of construction and estimated durations of key activities associated with the Wind Farm Infrastructure, has been used within the technical Chapters for construction impacts. Although site preparation works are undertaken ahead of the commencement of construction (and may, where required, be consented via standalone Marine Licence(s)), these activities have been assessed as construction activities in the technical Chapters' impact assessment for completeness and to ensure a robust assessment. Therefore, the impact assessments have assessed one year of site preparation works plus seven years of construction activities (overall eight years of activities for Bellrock Wind Farm Infrastructure). On commencement of construction, site preparation works will continue albeit from this point these works will be considered construction activities as authorised by the WFDA s.36 Consent/Marine Licence (noting that UXO clearance will continue to be authorised under a separate Marine Licence).

173. Construction works will typically be undertaken on a 24 hour, seven days a week basis over the construction season. Due to the Bellrock WFDA's distance from shore and unsuitable weather and sea conditions expected during the winter period, the construction season is assumed to be from March to October inclusive (although limited activities may take place outside of the construction season). As a consequence, construction of the Wind Farm Infrastructure is anticipated to be carried out over a seven-year period[8]. Activities may not be continuous during the construction season and the sequence of construction activities presented below may change. The durations may also change as a result of weather conditions, site conditions, equipment lead times and supply programmes, sequential work requirements, and logistical matters.

174. Construction activities are generally phased to allow for the sequential construction and commissioning of a 'string' (or group) of FOUs in each construction season. Each commissioned string of FOUs will generate and export renewable energy during the remaining construction period.

175. Within this timeframe further relevant information may emerge from post-consent monitoring and/or data associated with both offshore wind farms and climate change. It is not expected that any new information would affect the conclusions of this Bellrock WFDA EIA Report.

176. Commencement of construction of Wind Farm Infrastructure is scheduled to occur in 2031 (with site preparation works commencing in 2030) and commercial operation is scheduled to be achieved in 2037 (see **Plate 4.10**). This Bellrock WFDA EIA Report takes account of the latest information available. Where new information relating to the potential impact of the Wind Farm Infrastructure becomes available prior to the commencement of construction, this information will be considered, as appropriate. Whilst the commencement of construction is expected to occur within five years of consent being granted, a seven year s.36 Consent validity date is being sought to provide necessary flexibility in light of uncertainties over the Contract for Difference process and supply chain capacity.

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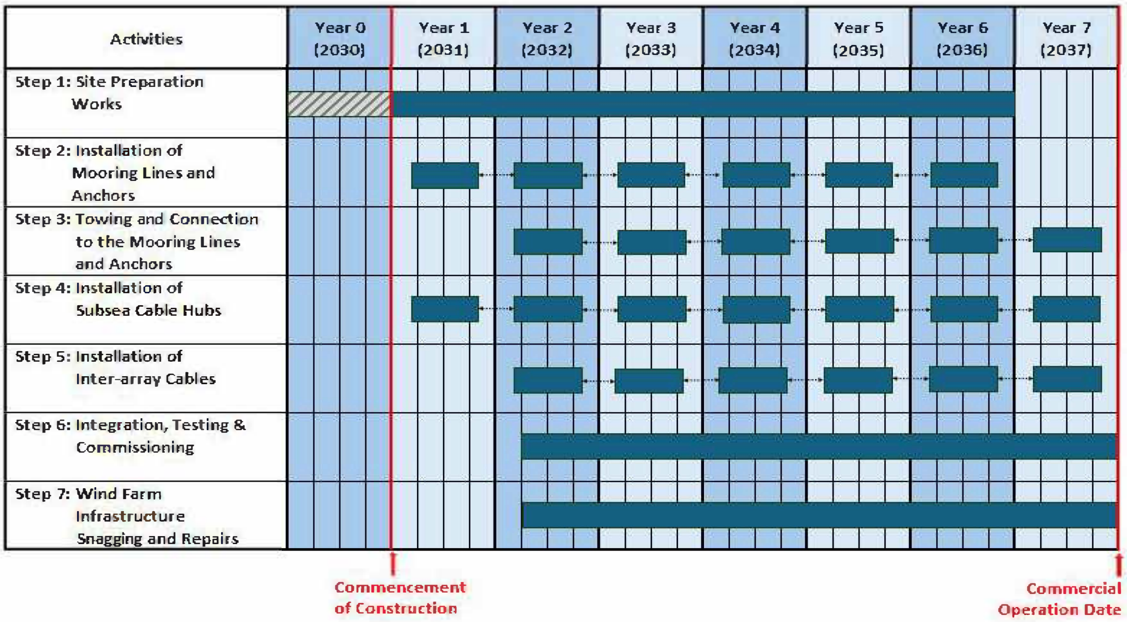
[7] Site preparation works will commence up to one year prior to the commencement of construction, at which point they may continue albeit as construction works (rather than site preparation works).

[8] Excluding site preparation works undertaken for up to one year prior to commencement of construction, as described in **Section 4.5**.

Plate 4.10: Indicative Construction Programme



4.7.10 Construction Vessels and Helicopters

177. Vessels anticipated to be used during construction of the Wind Farm Infrastructure include:

- CLV;
- CSV;
- CTV;
- Feeder barge;
- Guard vessel;
- HLV;
- Heavy transport vessel (HTV);
- PLGR vessel;
- ROV support vessel;
- Scour installation vessel (e.g. Fallpipe vessel);
- SOV;
- Survey vessel;
- Support vessel; and
- Tug/anchor handler.

178. **Table 4.20** presents the maximum number of return vessel trips during the construction phase (and site preparation works). One return trip comprises two movements (i.e. one to and one from the Bellrock WFDA). To assess a worst-case scenario, the technical assessments within this Bellrock

WFDA EIA Report consider a maximum number of vessels and vessel movements to/from the port(s) and the Bellrock WFDA. See **Section 4.7.11** and **Section 4.8.3** for the list of potential construction and O&M ports, respectively, as final port locations have not yet been confirmed. The fabrication of components may also occur outside of the United Kingdom (UK) and subsequently transported directly to the Bellrock WFDA or held at marshalling ports until required. However, it is anticipated the majority of components will first be transported to the assembly ports (see **Section 4.7.11** for details of integration ports).

179. The maximum number of return trips are calculated for the site preparation works (one year) and the seven-year construction programme (total eight years of activities). The vessel types and numbers presented are estimates for the purposes of the EIA.

Table 4.20: Construction Works (Inclusive of Site Preparation Works) Vessels Design Envelope

Works	Key Vessel Type	Maximum Number of Return Trips[1] During Construction for all Vessels [1]	Number of Vessels within the Bellrock WFDA at One Time
Activities during the construction works phase, inclusive of site preparation works	Survey vessel, ROV support vessel, tug/anchor handler, PLGR vessel	93	8
FOUs, IACs and associated works	ROV support vessel, tug/anchor handler, CSV, HTV, HLV, SOV, CTV, CLV, installation vessel, and guard vessel	1,522	26
Total		**1,615**	**34**

Notes:

[1] One return trip comprises two movements (i.e. one to and one from the Bellrock WFDA).

180. Helicopter transfers may be utilised during the construction phase for the transfer of crew. **Table 4.21** below details the helicopter design envelope during construction.

Table 4.21: Helicopter Design Envelope

Type	Maximum Number of Return Trips[1] During the Construction Phase
Helicopters	816
Notes: [1] One return trip comprises two movements (i.e. one to and one from the Bellrock WFDA).	

4.7.11 Construction Ports

181. The construction port(s), which comprise integration port(s) and assembly port(s), will be utilised during the construction phase of the Bellrock WFDA have not yet been selected. The construction port(s) may be located across Scotland, the UK, Europe and potentially further afield, however the Applicant is focused on the significant utilisation of Scottish ports in the first instance across these scopes.

182. The construction port(s) may include one or more of the following:

- Aberdeen;
- Ardersier;
- Burntisland;
- Cromarty Firth;
- Kishorn;
- Leith;
- Methil;
- Nigg;
- Orkney (Scapa);
- Peterhead; and
- Rosyth.

183. Marshalling of components (i.e. SKS and IACs) and ports used for vessel support (i.e. CTVs, SOVs, and/or helicopters) will also be used during the construction phase, however, these are not yet identified and do not form part of the consent application or (as insufficient information exists) the EIA.

184. The Applicant continues to assess construction port options to provide an optimal delivery strategy for the Bellrock Project. The construction port to be utilised for the Bellrock WFDA will be selected during the detailed design phase.

185. To assess a worst-case scenario, the assessments within this Bellrock WFDA EIA Report consider a maximum number of vessels and vessel movements to/from the Bellrock WFDA, where relevant from the east coast of Scotland or England as final port locations have not yet been confirmed. The

fabrication of components may also occur outside of the UK and subsequently transported directly to the Bellrock WFDA or marshalling port(s). It is anticipated that the majority of components will first be transported to ports on the east coast of Scotland or England.

4.7.12 Waste Management

186. Waste will be generated mainly in the construction and decommissioning phases of the Bellrock WFDA. A Site Waste Management Plan (SWMP) will be prepared as part of the Environmental Management Plan, prior to construction when further detailed design information is available. The SWMP will be a comprehensive document that outlines how waste will be managed throughout the lifecycle of the Bellrock WFDA. It will describe the procedures for handling waste materials, the quantities of waste types generated as a result of the Bellrock WFDA activities, and how these will be managed (e.g. using the waste hierarchy: reduce, reuse, recycle, recover, dispose). Information on the management arrangements for the identified waste types and management facilities in the vicinity of the Bellrock WFDA will also be provided within the SWMP.

4.8 Operations and Maintenance

4.8.1 Methodology

187. The operational life of the Bellrock WFDA is anticipated to be up to 35 years (from the Commercial Operation Date).

188. The overall O&M strategy of the Bellrock WFDA is not yet established. A number of O&M methods are possible for the Bellrock WFDA and the optimum strategy will be influenced by a number of factors such as the detailed design of WTGs, FSSs, SKSs and electrical systems, the O&M port(s) location, weather and metocean conditions, safety requirements, and transit durations. Therefore, the Operation and Maintenance Plan (OMP) will be submitted to the Scottish Ministers for approval prior to the commencement of construction.

189. A summary of the reasonably foreseeable O&M activities for the Bellrock WFDA is provided in the following sections.

4.8.1.1 Wind Turbine Generators

190. O&M activities associated with the WTG include both preventative and corrective maintenance activities. The Applicant will enter into a WTG service and maintenance agreement with the WTG original equipment manufacturer (OEM) to cover the delivery of preventative and corrective maintenance activities. The term and scope of this agreement is yet to be determined and will be agreed post consent.

191. WTG corrective maintenance activities can be split into two general categories: minor corrective maintenance; and major corrective maintenance. Minor corrective maintenance includes the repair of any damage or defective components and fault finding which can be completed using the site technicians and day-to-day logistics set-up. Major corrective maintenance includes the replacement of main components such as generators, gearboxes, blades, converter, transformers, main bearings and blade bearings.

192. The method for major corrective maintenance is not yet determined. Prior to construction, in cooperation with the WTG OEM and technology developers, the Applicant will determine the best strategy for replacement of major components such as in-situ Major Component Repair using nacelle or tower-mounted cranes, floating to floating exchanges using specialist HLV or tow-to-shore/tow-to-shallow methods which involve decoupling the FOU from the SKS to tow the FOU to a suitable shallow location or port to carry out the exchange.

4.8.1.2 Floating Substructures

193. The maintenance activities of FSSs depend on the type of FSS used. The scheduled maintenance regime of the FSS will be established in conjunction with the designer of the FSS and the assets will be maintained according to the manufacturer's recommendations and design standards initially. The performance of the FSS will be continually monitored, and the preventative maintenance regime may be modified after a period of continuous monitoring.

194. Subsea infrastructure will be designed to accommodate the development of marine growth and will be subject to routine monitoring to ensure marine growth remains within design tolerance. Removal of marine growth may be necessary throughout the operational lifetime, and required, localised cleaning will be undertaken to prevent excessive accumulation. This may involve scraping or jetting of marine growth by ROV or divers and depositing marine growth debris on the seabed. The frequency of these unscheduled activities will be dependent on the findings of routine inspections and will be carried out during other works as and when required. The Applicant will comply with all necessary legislative requirements in place at the time of marine growth removal.

4.8.1.3 Station Keeping Systems

195. The O&M strategy for the SKS will be developed post-consent however, it is anticipated that the inspections will follow the scheme established by the classification society (currently every 5 years) and the inspection scheme stipulated by the mooring line OEM. Considering the criticality of the system, a more in-depth approach could be adopted, combining condition monitoring systems with a risk-based approach to inspection. Inspections will likely be undertaken using an ROV and will check anchor condition, mooring line condition, marine growth levels and the presence of any fishing gear or marine debris.

4.8.1.4 Inter-array Cables

196. The following O&M activities are expected to occur in relation to the IACs:

- Routine inspections and geophysical surveys;
- IAC cable repair;
- IAC ancillary equipment repair or replacement;
- IAC reburial or installation of cable protection (if required);
- Removal of marine growth and/or fishing debris (and deposit of marine growth debris on the seabed); and
- Replacement of scour protection.

4.8.1.5 Subsea Cable Hubs

197. Subsea cables are designed to be zero maintenance, however the following O&M activities are expected to occur:

- Routine inspections and geophysical surveys;
- Removal of marine growth and/or fishing debris (and deposit of marine growth debris on the seabed); and
- Maintenance of gravel pads.

4.8.1.6 WTG Consumables

198. A number of consumables will be required throughout the lifecycle of the WTGs to improve operation, productivity and reduce wear on parts. These may include:

- Grease;
- Synthetic oil;
- Hydraulic oil;
- Gear oil;
- Lubricants;
- Nitrogen;
- Water/glycerol;
- Transformer silicon/ester oil;
- Sulphur Hexafluoride;
- Diesel fuel; and
- Glycol/coolants.

4.8.2 Operations and Maintenance Vessels

199. Routine preventative and corrective maintenance activities are likely to take place using the following vessels and transport:

- Cable repair vessel
- CLV;
- Tug/anchor handler;
- CTV;
- Drone;
- Guard vessel;
- Helicopter;

- HLV;
- Jack-up vessel;
- ROV support vessel;
- SOV;
- Survey vessel;
- Tow tug; and
- Uncrewed service vessel (USV).

200. Major repairs requiring large component replacements and extensive remedial works will require additional vessels and logistics. These may involve replacement of WTG components (e.g. generator, blades, gearbox) or entire WTGs or repairs to the FOU, IACs or SKS. Specialist HLVs and/or jack-up vessels **(Table 4.22)** may be used for major repairs that can be carried out in-situ. If the FOU is to be repaired at shore, the activities will involve decoupling the FOU from its SKS and towing to a suitable port or sheltered waters for the corrective maintenance to take place. For this purpose, tug/anchor handlers, tow tugs, guard vessels, and other support vessels may be required.

201. Specialist vessels with the appropriate equipment to perform its intended operation safely will be used to complete activities such as underwater surveys, cable repair and burial and mooring line repair and replacements.

202. **Table 4.23** presents the design envelope for vessels as involved in O&M activities for the Bellrock WFDA.

Table 4.22: Jack-up Vessels Design Envelope During the Operations and Maintenance Phase

Parameter	Maximum During O&M Phase
Number of legs per vessel	4
Individual leg diameter (m)	22
Area of each spud can[1] (m^2)	360
Maximum seabed footprint per jack-up vessel (m^2)	1,440
Number of jack-up positions during O&M phase	132
Notes: [1] A spud can is a large, inverted cone that attaches to the base of each leg on a jack-up vessel, primary used to provide a stable, wide base for the vessel to stand on when jacked-up on the seabed.	

Table 4.23: Design Envelope for Vessels Required During the Operations and Maintenance Phase

Type of Vessel	Maximum Total Number of Vessels Within the Bellrock WFDA at Any One Time	Maximum Total Movements (Return Trips per Year)[1]
CTV/SOV	4	92
Tug/anchor handlers	8	94
Jack-up vessels	1	8
Cable repair and burial vessels	2	3
Survey vessels (including ROV support vessels)	5	13
Other vessels	1	1
Helicopters	2	986
Total	**23**	**1,197**
Total (excluding helicopters)	**21**	**211**

Notes:

[1] One return trip comprises two movements (i.e. one to and one from the Bellrock WFDA).

203. CTVs are assumed to be operating as daughter craft and therefore do not return to port unless the SOV returns to port.

4.8.3 Operations and Maintenance Port(s)

204. A suitable location for the port(s) to support day-to-day O&M will be selected post-consent for the Bellrock WFDA. Although other ports may be required for major maintenance, the main day-to-day O&M port(s) will be consented separately (if not previously consented) under the relevant legislative regime and is not part of the Bellrock WFDA consent application and Bellrock WFDA EIA Report.

205. The Bellrock Project is considering a number of potential O&M port(s) locations in Scotland, these may include:

- Aberdeen;
- Ardersier;
- Burntisland;
- Cromarty Firth;
- Fraserburgh;

- Leith;
- Montrose;
- Nigg; and
- Peterhead.

206. Factors to be considered in the final selection of an O&M port(s) will include distance from the Bellrock WFDA, port facilities for berthing and operating vessels, storage space for parts and tooling, space for an O&M offices, transport links and availability of personnel.

207. If major repairs are required to the FOU, SKS system or electrical components, the FOU may need to be towed to a suitable port. It is anticipated that the Applicant will utilise a port as close to the site as possible (i.e. in Scotland) but this is heavily reliant on the capacity of relevant ports to accommodate the FOU. The Applicant is focused on the utilisation of Scottish ports in the first instance, however; if they are unavailable to carry out major maintenance activities there is the possibility of towing the FOU to other port(s) within the UK or potentially overseas.

4.8.3.1 Operational Control

208. An Operations Control Centre will be established where the Wind Farm Infrastructure will be monitored 24 hours a day. Automatic identification system (AIS), closed-circuit television (CCTV) and radar coverage to identify vessels with AIS operating within the Bellrock WFDA. The WTGs, FSS and associated equipment will be monitored using a Supervisory Control and Data Acquisition (SCADA) system. The SCADA system acts as an interface for sensors and controls throughout the Bellrock WFDA, allowing the Bellrock WFDA status and performance to be monitored and controlled remotely.

209. Condition monitoring systems may also be implemented, aimed at detecting anomalies and identifying component deterioration to allow for proactive interventions to replace or repair components.

4.9 Decommissioning

4.9.1 Background

210. Sections 105 to 114 of the Energy Act 2004 set out statutory requirements in relation to the decommissioning of Offshore Renewable Energy Installations (OREI) and associated electrical lines. The Applicant will submit a Decommissioning Programme to the Scottish Ministers for approval.

211. Scottish Ministers also have the power to determine specific approaches to decommissioning, including stipulating the form, timing and size of financial securities required.

212. The document 'Decommissioning of Offshore Renewable Energy Installations in Scottish Waters or in the Scottish part of the Renewable Energy Zone under The Energy Act 2004: Guidance Notes for Industry (in Scotland)' was published by Marine Scotland in July 2022 (Scottish Government,

2022). This guidance document sets out the policy and legislative framework; decommissioning requirements in Scotland; requirements for Decommissioning Programmes; environmental and safety considerations; and financial considerations. Decommissioning Programmes are expected to contain information on decommissioning standards, financial security, residual liability and industrial cooperation and collaboration.

213. Section 5 of the Guidance Note states that *"an indication of the decommissioning proposals should be included as part of the statutory consenting or licensing process so that the feasibility of removing the infrastructure can be assessed as part of the application process"*.

214. Decommissioning of the Bellrock Wind Farm Infrastructure has been considered from the early stages of the design process and will continue to be so throughout the construction phase, with decommissioning considered during design risk assessment and technology selection processes. Environmental conditions and sensitivities will also be considered since removal of structures may result in greater environmental impacts in comparison to leaving in-situ.

215. Whilst the full details of the decommissioning plans are yet to be developed as this is dependent on technology selection and detailed design, the proposed principles for decommissioning of the Wind Farm Infrastructure are provided in this Section, and qualitative assessment of the potential impacts from decommissioning has been undertaken in all the technical impact assessment Chapters. It is expected that the Bellrock Wind Farm Infrastructure will be fully removed at the end of its operational life. In accordance with Scottish Government Guidance, exceptions to this would be where removal would create unacceptable risks to personnel or to the marine environment, be technically unfeasible or involve extreme costs (Scottish Government, 2022).

216. Prior to the commencement of construction, a Decommissioning Programme will be consulted on with stakeholders and submitted to Scottish Ministers for approval. The Decommissioning Programme will consider good industry practice, guidance and legislation for decommissioning works along with anticipated costs and financial securities. Throughout the O&M phase, the Decommissioning Programme will be reviewed at regular intervals and decommissioning best practices and legislation will be applied at the time of the Wind Farm Infrastructure's decommissioning. Legislation, guidance and good practice will be kept under review throughout the lifetime of the Bellrock Wind Farm Infrastructure and will be followed at the time of decommissioning.

217. The sequence of decommissioning is likely to be the reverse of the construction sequence, taking around seven years, with similar types and numbers of vessels and equipment expected to be involved.

218. **Sections 4.9.2** to **4.9.3** describe the removal of the Wind Farm Infrastructure from within the Bellrock WFDA.

4.9.2 Removal of Wind Farm Infrastructure

219. As mentioned above, where possible, it is expected that the Bellrock Wind Farm Infrastructure will be fully removed at the end of its operational life.

220. The removal and dismantling of the FOUs will largely be a reversal of the installation process. Generally, the FOUs will be towed from the Bellrock WFDA to a suitable port for decommissioning.

221. Mooring lines and anchors will be recovered and removed from the WFDA. For FOU driven pile anchors, these are expected to be either fully removed or cut off below seabed level with a proportion remaining in-situ (due to anticipated excessive cost in their complete removal) following good practice and consideration of environmental conditions and sensitivities.

222. Subsea cable hubs are expected to be fully removed from the seabed.

223. The dynamic sections of the IACs within the water column will be cut at the connector with the static IAC and fully removed. The approach for decommissioning the static IACs on the seabed is yet to be determined, however, this will be reviewed throughout the lifetime of the Bellrock WFDA and good practice guidance at time of decommissioning will be followed.

4.9.3 Removal of Scour and Cable Protection

224. Subject to the material used and environmental sensitivities, it may be preferable to leave scour protection in-situ to preserve the marine habitat that may have developed over the life of the Bellrock WFDA. The approach for decommissioning cable protection will be similar to scour protection. Relevant stakeholders and regulators will be consulted to establish the best approach. Good practice guidance at time of decommissioning will be followed.

4.9.4 Safety Zones, Safe Passing Distances, Aids to Navigation and Notice to Mariner

225. During decommissioning it is proposed that the Applicant will apply for 500 m Safety Zones around each FOU location. Refer to **Section 4.7.12** around safe passing distances, AtoN and NtMs.

4.10 Hazardous Materials

226. All WTGs will have the provision to retain all spilled fluids within the nacelle or tower. Nevertheless, where possible, all oils used in the WTGs should aim to be biodegradable.

227. Diesel powered generators may be required during commissioning to provide power to the WTGs prior to grid energisation. During the O&M phase, generators may also be required due to emergency shut-downs or grid interruptions to ensure that the WTGs have enough power available to perform required functions and to power the Uninterruptible Power Supply.

228. To avoid discharge of oils to the environment, the WTGs will be subject to best-practice design, for example with a self-contained bund to collect any possible oil spill. To avoid discharge or spillage of oils it is anticipated that the transformers would not require interim oil changes.

229. The **Marine Pollution and Contingency Plan (MPCP) (Volume V)** sets out the measures which will be in place to prevent and respond to marine pollution incidents during the construction and O&M phases of the Bellrock WFDA. It applies to all Bellrock Wind Farm Infrastructure and associated marine vessels involved in relevant activities. The primary aim of the MPCP is to protect the marine environment whilst safeguarding human health by ensuring a timely and coordinated response to accidental pollution. The MPCP has been developed to provide sufficient information

at the application stage to not require updating and/or further approval prior to commencement of construction.

4.11 Health and Safety

230. The Applicant recognises the importance of health and safety, and this will be fully incorporated across the lifetime of the Bellrock WFDA from development, through to construction, O&M, and eventual decommissioning. The health, safety and wellbeing of all employees, contractors and visitors will remain the highest priority of the Applicant with adequate controls put in place to ensure safety measures are both observed and followed, creating a safe and healthy working environment for all. All matters relating to health and safety will be closely monitored throughout the lifecycle of the Bellrock Wind Farm Infrastructure.

231. Risk assessments for the Bellrock WFDA will be undertaken as per the relevant guidance, the Applicant's procedures and in compliance with applicable UK health and safety legislation. Bellrock WFDA health and safety risks shall be managed through the implementation of task specific risk assessments, the identification of relevant health and safety risks within the overarching Bellrock Project register, and the undertaking of appropriate hazard identification workshops throughout the project lifecycle (Hazard Identification (HAZIDs), Construction Hazard Study (HAZCONs) and Hazard and Operability Study (HAZOPs)) The risk assessments will form the basis of the methods and safety mitigations put in place across the lifetime of the Bellrock WFDA.

232. The Applicant will encourage a “Zero Accident” safety culture and ensure that everyone working on the Bellrock WFDA has the right to stop work if they feel unsafe or feel that others are carrying out work in an unsafe manner. The Applicant will also ensure that all employees have undergone necessary health and safety training as required by legislation and the Applicant's procedures.

233. The Applicant's internal health and safety procedures will ensure that the Bellrock WFDA is safe by design, through detailed analysis at the development phase, and that any remained residual risks are controlled to as low as reasonably practicable prior to construction.

234. The Bellrock WFDA shall be designed and planned in compliance with the requirements of the Construction (Design and Management) Regulations 2015 (Construction Design and Management (CDM), 2015).

4.12 The Whole Bellrock Project

235. As discussed in **Chapter 1: Introduction (Volume II)**, this Bellrock WFDA EIA Report covers the Bellrock WFDA and associated Wind Farm Infrastructure only. The Applicant will apply for a separate Marine Licence for the Bellrock OfTDA, within which the Offshore Transmission Infrastructure will be constructed, and operated and maintained, and Planning Permission in Principle for the Bellrock OnTDA within which the Onshore Transmission Infrastructure will be constructed, operated and maintained.

236. In April 2025, the NESO imposed a change to the Bellrock Project's grid connection design which resulted in the Bellrock Project requiring an onshore connection to the proposed SSEN

Transmission Hurlie substation located to the west of Stonehaven in Aberdeenshire. As such, the details, including the location of Offshore Transmission Infrastructure and Onshore Transmission Infrastructure were not defined at the time of writing.

237. Although the Applicant has not yet submitted Scoping Reports for the Bellrock OfTDA and the OnTDA, the assumed parameters (at the time of writing) of the Bellrock OfTDA and Bellrock OnTDA, as presented in this section, have informed the whole-project assessments and the CEAs, as applicable, in the technical chapters (**Chapters 6 to 19 (Volume II)**. Further details on this approach are provided in **Section 5.12** of the **Chapter 5: EIA Methodology (Volume II)**. Details in this Bellrock WFDA EIA Report are in line with the information available at the time of writing, and further details on the Bellrock OfTDA and OnTDA will be provided in their forthcoming Scoping Reports.

4.12.1 Bellrock Offshore Transmission Development Area

238. Part of the Bellrock OfTDA overlaps with all of the Bellrock WFDA and spans to landfall at the south Aberdeenshire coast. The Bellrock OfTDA Area of Search has been informed by environmental constraints (including other marine infrastructure, environmental designated sites), technical constraints (such as bathymetry), development cost and development risk. The Bellrock OfTDA Area of Search (as of 3 March 2026) is presented in **Figure 4.2 (Volume III)**.

239. It is assumed that a maximum of six OfSSs will be located geographically within the boundary of the Bellrock WFDA. Substructures for the OfTDA may include fixed jackets or floating barge, semi-submersible platform or TLP. Interconnector cables (if required) will connect the OfSSs and will require cable protection as described above in **Section 4.4.7**.

240. Offshore export cables will be required to bring the renewable electricity ashore. The offshore export cables and interconnector cables will be buried below the seabed, where possible, to ensure these are protected and minimise interaction with other sea users. The effective burial depth target will be based on a CBRA and relevant guidance which will provide a specific target depth at each point on the route (see **Section 4.4.6**). It is assumed the burial technique would likely be cable ploughing, to a maximum cable trench width of 10 m. If burial to the required depth is not possible, either due to seabed conditions or crossings with other infrastructure, then further external cable protection may be required, as discussed in **Section 4.4.8**.

241. Due to the distance between the Bellrock WFDA and the grid connection at the proposed SSEN Transmission Hurlie substation, up to two OfRCSs may be required if a HVAC electrical design is adopted, to manage reactive power and maintain voltage stability across HVAC export cables. The OfRCS(s) would have a fixed substructure with the jackets including either pin piles or suction buckets/pile/cans. The OfRCS(s) would be a surface piercing structure, therefore the location of the OfRCS(s), with regards to shipping and navigation, seascape and visual, and technical constraints, are key considerations in the site selection process of the Bellrock OfTDA.

242. Landfall locations for the Bellrock Project are still under consideration by the Applicant along the south Aberdeenshire coastline (refer to **Figure 4.2**), to minimise the impact and length of transmission cables between the Bellrock WFDA and the proposed SSEN Transmission Hurlie substation. The landfall installation method is likely to be a trenchless technique such as horizontal directional drilling (HDD). The final landfall location will be refined through consideration of

environmental and technical constraints, cost, risk and in consultation with stakeholders and the local community.

243. The indicative construction programme for the Offshore Transmission Infrastructure is anticipated to occur between 2031 to 2036 (excluding site preparation works). Prior to any installation on the seabed, it is likely that seabed preparation activities will be required, either site preparation works or similar works undertaken as part of the construction works. This would involve activities such as boulder clearance, sand wave levelling, and survey and clearance of UXO.

244. An overview of the Bellrock OfTDA parameters as known at the end of 2025 are provided in **Table 4.24**. It is anticipated that the parameters presented are within the maximum project design envelope for the Offshore Transmission Infrastructure. These parameters will be confirmed in the Bellrock OfTDA Scoping Report.

Table 4.24: Overview of Offshore Transmission Development Area and Offshore Transmission Infrastructure Parameters

Parameter	Minimum	Maximum
Area of Search (km^2)	4,132	
Water depth below LAT (m)	0	120
Number of OfSSs	1 (HVDC)	6 (HVAC)
OfSS platform height above LAT (m)	-	90
OfSS dimensions (l x w) (m)		140 x 140
Number of OfRCSs	0 (HVDC)	2 (HVAC)
Piling hammer energy for OfSS and OfRCS	-	5,500 kJ
Number of offshore export cables	2 (HVDC)	6 (HVAC)
Length per export cable (km)	-	200
Total length of offshore export cables (km)	-	1,200
Number of interconnector cables	-	5
Length per interconnector cable (km)	-	25
Total length of all interconnector cables (km)	-	125

Notes:

[1] However, the Offshore Transmission Infrastructure could remain in place if alternative uses are identified.

4.12.2 Bellrock Onshore Transmission Development Area

245. It is assumed that a maximum of six onshore export cables (HVAC) will be laid between the landfall and the proposed SSEN Transmission Hurlie substation (see **Figure 4.2 (Volume III)** for the location of the Hurlie substation). The onshore export cables may be either HVAC or HVDC and buried to eliminate permanent visual and landscape effects and also reduce health and safety risks. Up to six cable trenches may be required and burial methods include open trenching and, where necessary to cross obstacles, trenchless techniques, such as HDD. Temporary works required to facilitate installation of the buried onshore export cables include construction of temporary road accesses, haul roads, construction compounds, HDD compounds, landscape and habitat reinstatement and mitigation.

246. An onshore substation (OnSS) will be required close to the proposed SSEN Transmission Hurlie substation. The OnSS will be either a converter station, for converting the electricity supplied from HVDC to HVAC, or a substation, for stepping the voltage up for connection into the proposed Hurlie substation and controlling the quality of the renewable electricity supplied. The OnSS will comprise electrical equipment (including either air-insulated switchgear or gas-insulated switchgear), and will include supporting buildings, an access road, drainage and landscaping. A temporary construction access track and construction compound will also be required to facilitate construction.

247. The indicative construction programme for the Bellrock OnTDA (excluding site preparation works) is anticipated to occur between 2030 and 2032.

248. An overview of the Bellrock OnTDA parameters as known at the end of 2025 are provided in **Table 4.25**. It is anticipated that the parameters presented are within the maximum project design envelope for the Onshore Transmission Infrastructure. These parameters will be confirmed in the Bellrock OnTDA Scoping Report.

Table 4.25: Overview of Bellrock Onshore Transmission Development Area and Onshore Transmission Infrastructure Parameters

Parameter	Minimum	Maximum
Number of onshore export cables	2 (HVDC)	6 (HVAC)
Number of cable trenches	2 (HVDC)	6 (HVAC)
Length of each onshore export cables (km)	10	30
Number of onshore substations	1	1

4.13 References

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