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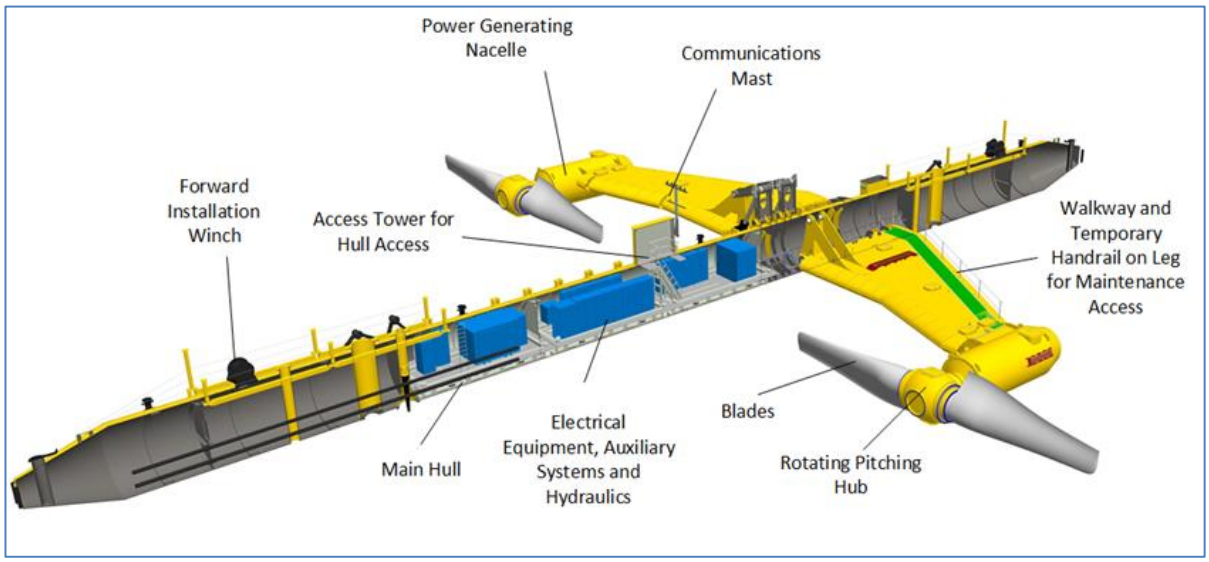
ORBITAL MARINE POWER (LIMITED)

FALL OF WARNESS BERTH 6 ORBITAL O2 DEVICE NAVIGATION RISK ASSESSMENT



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MARINE AND RISK CONSULTANTS LTD

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FALL OF WARNESS BERTH 6 ORBITAL O2 DEVICE NAVIGATION RISK ASSESSMENT

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12 February 2021

EXECUTIVE SUMMARY

This Navigation Risk Assessment was commissioned by Orbital Marine Power (Limited) to assess the impact to navigational safety of the installation of the next generation Orbital O2 device, at the EMEC Berth 6 Fall of Warness test site, Eday, Orkney. This study is required to obtain a new marine licence from Marine Scotland under Section 20(1) of the Marine (Scotland) Act 2010 and considers two phases of the project:

1. Tow to and from Berth 6 of EMEC's Fall of Warness test site; and
2. Mooring at Berth 6 of EMEC's Fall of Warness test site (includes installation, operation, and decommissioning).

The study seeks to identify the level of risk to navigating vessels of all types resulting from the device while on transit to and from and moored at Berth 6 (in combination with other existing nearby devices), and where necessary, identify risk controls that should be implemented to ensure the risk remains at or less than As Low as Reasonably Practicable.

All hazards were scored as low risk. The highest scoring hazards were associated with project vessels (maintenance and towing), due to the proximity of the vessels to the device. The risk however, was scored as low, due to the experience and awareness of the project vessel team.

Consultation confirmed that the majority of local marine users are used to navigating around the existing berths /devices within the area and as such, were not concerned with the presence of the new device.

A review of the impacts of the devices shows little impact on collision and contact risk, search and rescue or communications, radar and position systems.

Two additional risk control measures have been identified, the implementation of which is recommended.

In summary, the increase in risk to navigating vessels as a result of the installation, operation (including maintenance) and decommissioning of the Orbital O2 device at berth 6 is Low.

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TABLES

ANNEXES

ABBREVIATIONS

Abbreviation	Detail
AHT	Anchor Handling Tug
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
CHA	Competent Harbour Authority
DECC	Department of Energy and Climate Change
EMEC	European Marine Energy Centre
ERCOP	Emergency Response and Cooperation Plan
gt	Gross Tonnage
HSE	Health and Safety Executive
HW	High Water
IALA	International Association of Lighthouse Authorities
ICW	In Collision With
IMO	International Maritime Organisation
kt	Knot (unit of speed equal to nautical mile per hour, approximately 1.15 mph)
LAT	Lowest Astronomical Tide
LOA	Length Overall
LW	Low Water
m	Metre
MAIB	Marine Accident Investigation Branch
Marico Marine	Marine and Risk Consultants Ltd
MCA	Maritime and Coast Guard Agency
MGN	Marine Guidance Note
ML	Most Likely
MMO	Marine Management Organisation
NLB	Northern Lighthouse Board
nm	Nautical Mile
NRA	Navigation Risk Assessment
O&M	Operations and Maintenance
OREI	Offshore Renewable Energy Installation
PEC	Pilotage Exemption Certificate
RIB	Rigid Inflatable Boat

Abbreviation	Detail
RYA	Royal Yachting Association
SAR	Search and Rescue
SHA	Statutory Harbour Authority
SMS	Safety Management System
STCW	Standards of Training Certification and Watchkeeping
VHF	Very High Frequency (radio communication)
VMS	Vessel Monitoring System
VTS	Vessel Traffic Service
WC	Worst Credible

1 INTRODUCTION

This Navigation Risk Assessment (NRA) was commissioned by Orbital Marine Power (Limited) (Orbital) to assess the impact to navigational safety of the installation of the next generation Orbital O2 device, at the EMEC Berth 6 Fall of Warness test site, Eday, Orkney. This study is required to obtain a new marine licence from Marine Scotland under Section 20(1) of the Marine (Scotland) Act 2010 and considers two phases of the project:

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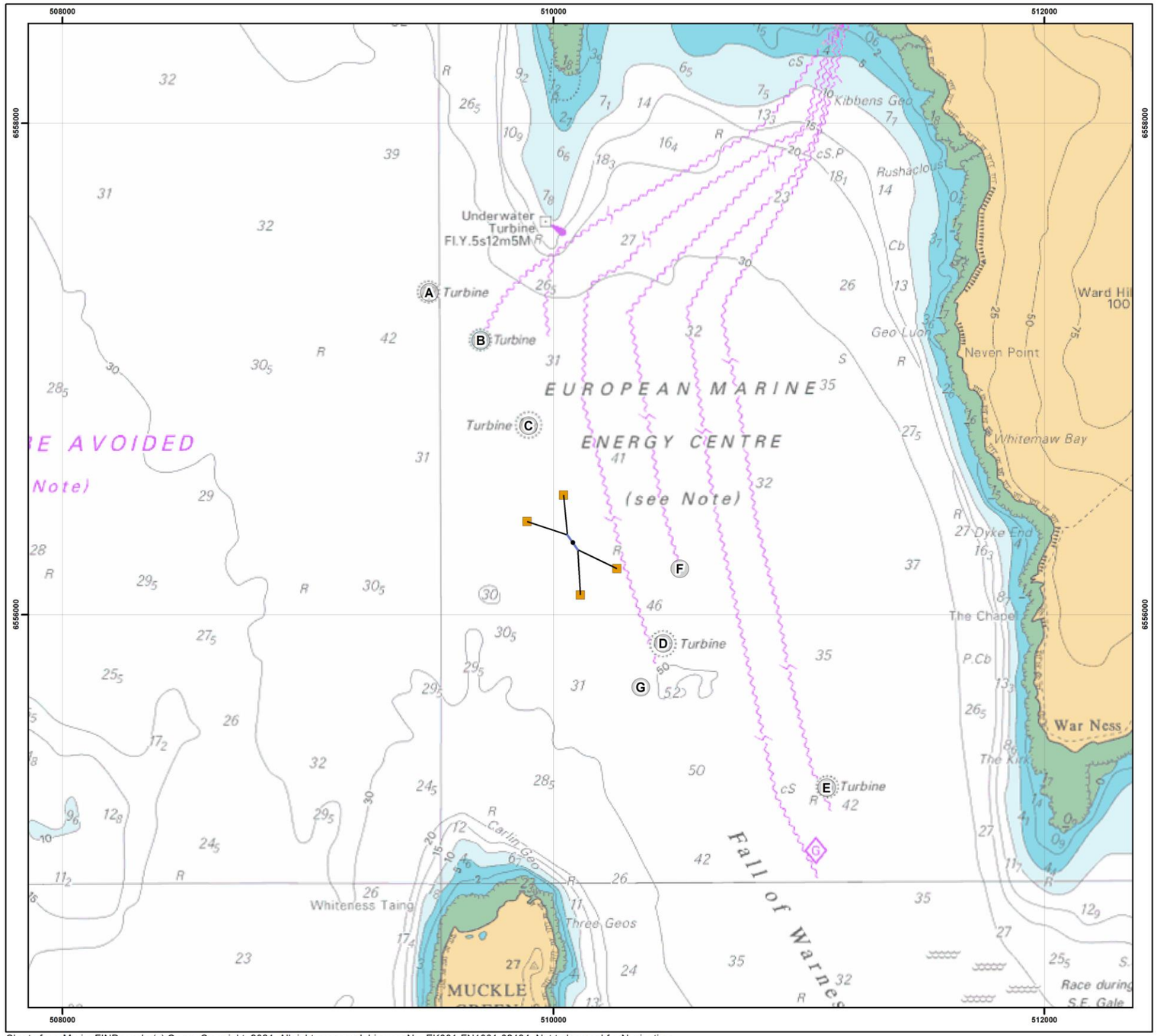
The study seeks to identify the level of risk to navigating vessels of all types resulting from the device while on transit to and from and moored at Berth 6 (in combination with other existing nearby devices), and where necessary, identify risk controls that should be implemented to ensure the risk remains at or less than As Low as Reasonably Practicable (ALARP).

This assessment was conducted to the Maritime and Coastguard Agency's MGN 543 standard for assessing Offshore Renewable Energy Installations (OREIs) as well as other guidance described in **Section 1.3**.

1.1 STUDY AREA

Figure 1-1 shows the study area for assessment in addition to the location and layout of the device. The water depth at the anchor locations is between 34m and 44m below CD.



Berth 6 Layout, Fall of Warness.
Orbital Marine Power Navigation Risk Assessment

Berth 6 Study Area

Legend

- Chart Correction
- Mooring Line
- Anchor
- Device Centrepoint
- Device Footprint

Chart Corrections

ID	Detail
A	No turbine deployed
B	Voith turbine. No longer deployed. Monopile remains in place 13m from seabed (Approximately 20m water depth)
C	Atlantis turbine. No longer deployed. Clear seabed
D	Hammerfest turbine. No longer deployed. Tripod foundation remains, standing 22m from seabed (Approximately 28m water depth)
E	TGL turbine. No longer deployed. Clear seabed
F	Orbital Marine Power floating tidal turbine. Not present, due for installation within 6 months
G	Magallanes floating tidal turbine. Not present, due for installation within 6 months

Project No.	Date	Issue Number
20UK1675	12/02/2021	001
Author	**Checked By**	**Scale at A3**
Richard Marlow	Stephanie Gilbert	1:15,000

Data Source(s)
Device Layout & Chart Corrections: EMEC;
Charts: MarineFIND.

Coordinate System
WGS 1984 UTM Zone 30N
Projection:
Transverse Mercator
Datum:
WGS 1984
Units:
Metres

0 0.125 0.25 0.5 N
Nautical Miles

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Figure Reference: 20UK1675_OrbitalMarine_FOW_Berth6

Figure 1-1: Berth 6 Study Area

1.2 SCOPE AND METHODOLOGY

The scope of this document is to:

1) Describe the Orbital O2 device; its layout, marking, construction methodology and towage to site.
2) Provide a description of the existing environment and activities within the study area, including:
    a. Local ports and harbours;
    b. Metocean conditions;
    c. Existing vessel management plans;
    d. Other users of the area such as aquaculture, anchorages, military and renewable energy installations;
    e. Existing vessel traffic patterns, including frequency and types; and
    f. Existing risk profile for navigational incidents.
3) Identify and assess impacts of the development to shipping and navigation, including:
    a. Traffic routeing;
    b. Collision risk;
    c. Contact risk;
    d. Communications, radar and positioning systems;
    e. Search and Rescue (SAR); and
    f. Cumulative and in-combination effects.
4) Undertake an NRA that identifies navigation hazards during all phases of the development. These hazards are then assessed, and risk controls identified to reduce the risk to ALARP; and
5) Make recommendations as to the safety of the development and what measures should be implemented to improve it.

1.3 GUIDANCE

Guidance on the assessment requirement was primarily sought from the Maritime Coastguard Agency Marine Guidance Note (MGN) 543 (M+F)[1]. This advises the correct methodology to evaluate navigational safety around OREIs, through traffic surveys. This report adheres to this standard accordingly. Guidance was also sought from a variety of other publications (**Table 1**).

Table 1: Guidance Document Table

Policy / legislation	Key provisions
MGN 543 Guidance on UK Navigational Practice, Safety and Emergency Response Issues	This MGN highlights issues to be considered when assessing the impact on navigational safety and emergency response, caused by OREI developments. Including traffic surveys, consultation, structure layout, collision avoidance, impacts on communications/ radar/ positioning systems and hydrography.
Department of Energy and Climate Change (DECC) Methodology for Assessing Marine Navigational Safety Risks of Offshore Wind Farms	The DECC document provides a template for preparing NRA's for offshore wind farms. This template has been used throughout to define the methodology of OREI assessment and is read in conjunction with MGN 543.
MGN 372 Guidance to Mariners Operating in the Vicinity of UK OREIs	Issues to be considered when planning and undertaking voyages near OREI off the UK coast.
International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures.	Guidance to national authorities on the marking of offshore structures.
International Maritime Organisation (IMO) Formal Safety Assessment.	Process for undertaking marine navigation risk assessments.
Royal Yachting Association (RYA) Position on Offshore Energy Developments	Outlines recreational boating concerns for offshore renewable energy developments.

[1] (MGN) 543 (M+F) replaces MGN 371

Policy / legislation	Key provisions
Regulatory expectations on moorings for floating wind and marine devices – HSE and MCA 2017	Guidance document on mooring arrangements for OREIs.

1.3.1 MGN 543 Compliance Table

The following table (**Table 2**) acts as an aid for developers when completing and submitting an NRA to ensure all guidance has been considered and addressed. The full compliance table can be found in **Annex A**.

Table 2: MGN 543 Compliance Table.

MGN 543 Annex 1		Report Section
1	An up-to-date traffic survey of the area.	**Section 5**
2	OREI Structures.	**Section 2**
3	Assessment of Access to and Navigation within, or close to, an OREI.	**Section 7**
MGN 543 Annex 2		**Report Section**
1	Effects of Tides and Tidal Streams.	**Section 3.1** and **Section 7.1**
2	Weather.	**Section 3.1 and Section 7.1**
3	Visual Navigation and Collision Avoidance.	**Section 7.7**
4	Communications, Radar and Positioning Systems.	**Section 7.8**
5	Marine Navigational Marking	**Section 2.2.4 and Section 8**
MGN 543 Annex 3		**Report Section**
1	OREI Risk Register and Risk Mitigation Measures for Development	**Section 8, Section 9, Section 11 Annex D, Annex E**

2 BERTH 6 ORBITAL O2 PROJECT

2.1 THE PROJECT

The Orbital project at the EMEC Fall of Warness tidal test site Berth 6 is composed of the following main components:

- Orbital Marine Power's commercial demonstrator turbine, the Orbital O2;
- Anchoring and mooring system; and,
- Installation, maintenance and decommissioning vessels.

The subsea cable connection to shore forms part of the EMEC facility and is, therefore, not considered part of the project. A description of the cable splice and umbilical line connecting the unit with the EMEC cables is included as part of the anchoring and mooring system. It is proposed to use the same onshore infrastructure as for the Berth 5 O2 tidal turbine at the consented EMEC Cauldale facility.

2.2 THE DEVICE

Orbital Marine Power's Tidal Technology is a floating tidal stream energy generator. A cylindrical floating steel superstructure, which houses power conversion and auxiliary systems, provides reference and attachment for two leg structures with nacelles mounted at their ends. The leg structures have hinge attachments to the superstructure such that, with an actuation system, they can be lowered to position the nacelles and contra-rotating rotors in the optimal part of the tidal stream resource to generate power or be raised to bring the legs, nacelles and rotors to the surface for the purpose of servicing and turbine towing. Station keeping is provided to the superstructure via a multi-anchor catenary mooring system consisting of rope tethers, mooring chain and anchors. Power is exported from the turbine via a dynamic cable from the superstructure to the seabed where it connects to seabed static cabling infrastructure that exports power ashore to the EMEC substation.

The Orbital O2 turbine model to be deployed at Berth 6 will have a superstructure of up to 80m length and 3.8m diameter supporting two 1MW rated turbines at the end of each leg structure providing the Orbital O2 with a rated power of 2MW. The generators will reach rated power at current speeds of 2.5m/s. The device to be installed at Berth 6 is a second generation O2 device, and is both slightly larger, and more technologically advanced than the first generation O2 device to be deployed at Berth 5.

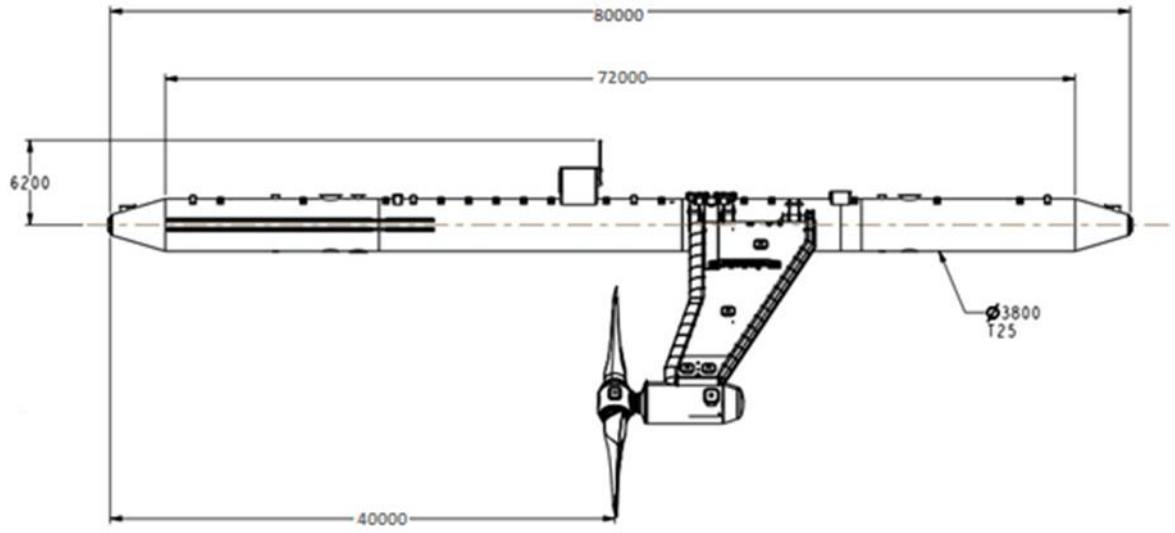


Figure 2-1: Schematic of Device - Legs Down (metres)

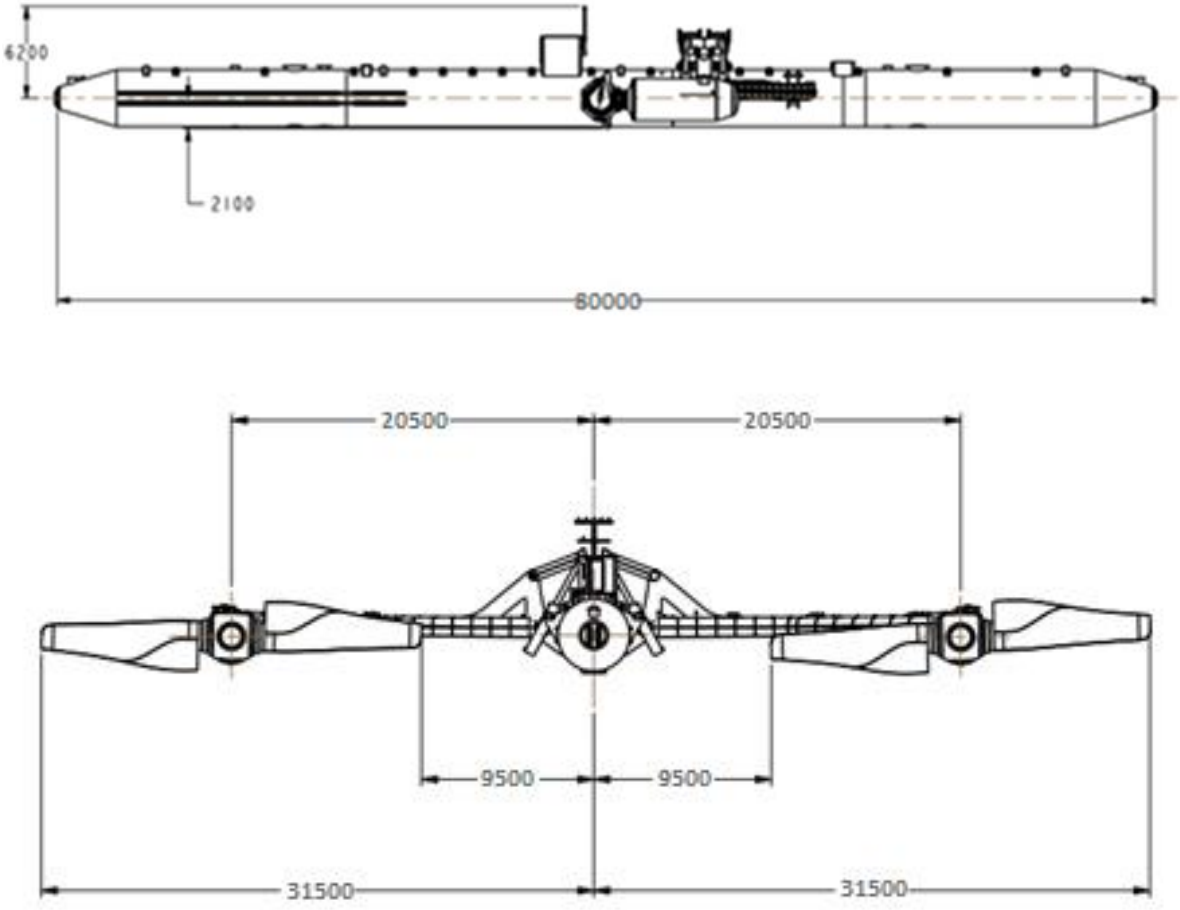


Figure 2-2: Schematic of Device - Legs Up (metres)

2.2.1 Moorings

The HSE and MCA (2017) guidance on the mooring of marine offshore renewable energy installation outlines the principles expected from mooring arrangements:

- It can withstand such forces acting on it as are reasonably foreseeable;
- Its construction, commissioning, operation, modification, maintenance and repair of the installation may proceed without prejudicing its integrity;
- It may be decommissioned and dismantled safely; and
- In the event of reasonably foreseeable damage to the installation or its moorings, it will retain sufficient integrity to enable action to be taken to safeguard the health and safety of persons on or near it.

The mooring system for the Orbital O2 comprises of four catenary mooring lines which are moored to the seabed via four separate anchors. The mooring system has been designed accordance with Offshore Standard DNV-OS-E301.

Two lines would be connected at both the forward and aft ends of the hull to hold the platform on station. On each tidal cycle, the platform would be held on station by one of these two lines. As the tide changes direction, the turbine will move by up to 25 m in all directions as slack in the mooring lines is taken up, with the opposite lines then holding the turbine in position. Mooring line lengths will be subject to detailed design and micrositing but will each be in the region of 225m in length.

In the highly unlikely event that a mooring line failed, any single remaining mooring line is capable of holding the platform in place.

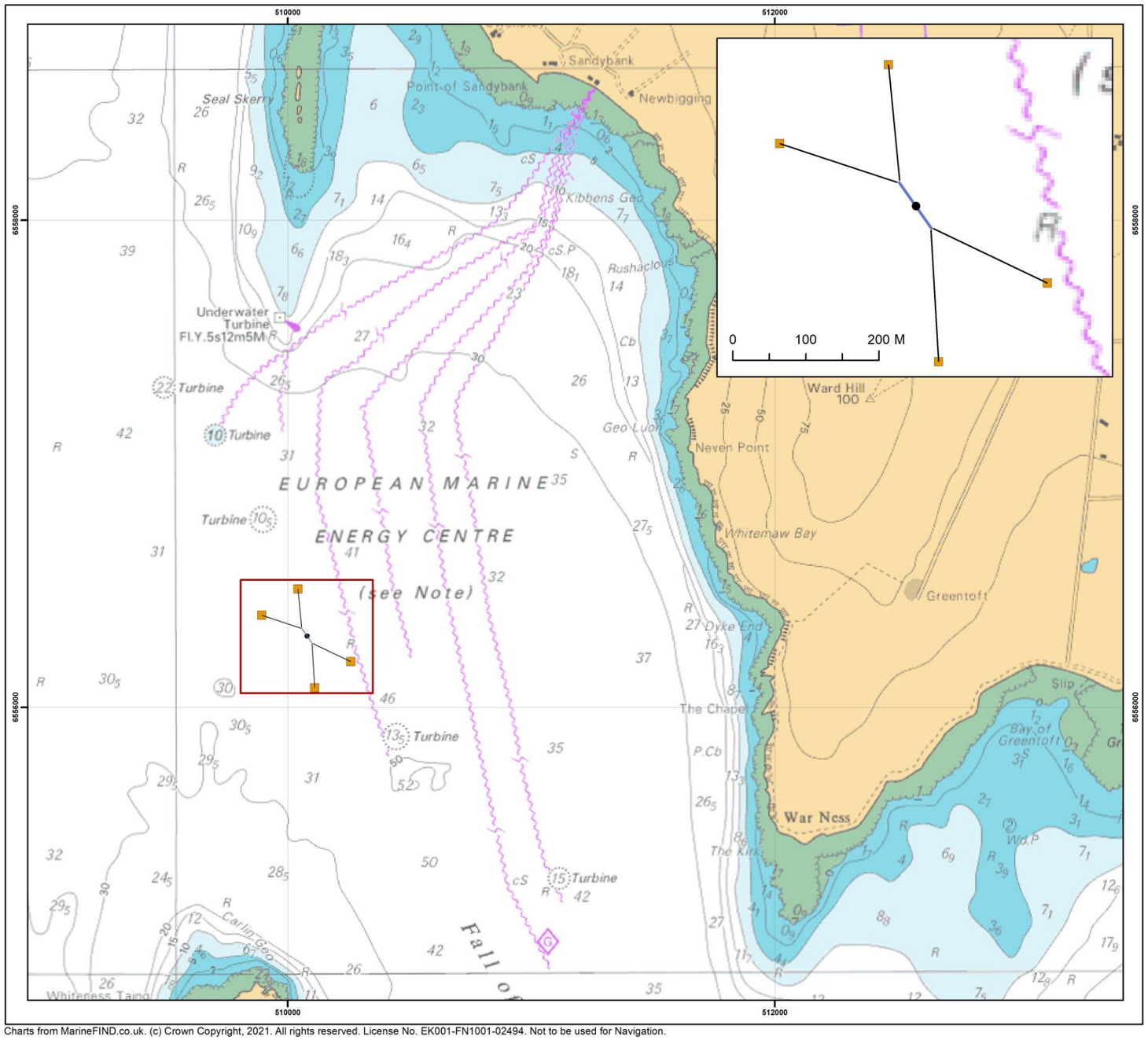
The maximum area covered by the mooring spread will be approximately 420m x 220m.

Each mooring line will be predominantly composed of studlink mooring chain.

The composition of the mooring lines and approximate length is given below.

Table 3: Mooring Characteristics

Description	Length (m)	Weight (kg/m)
95mm studlink chain	125m	200
115mm studlink chain	100m	315



Berth 6 Layout, Fall of Warness.
Orbital Marine Power Navigation Risk Assessment

Berth 6 Mooring Arrangement

Legend

- Anchor
- Device Centrepoint
- Mooring Line
- Device Footprint

Project No.	Date	Issue Number
20UK1675	02/02/2021	001
Author	**Checked By**	**Scale at A3**
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Figure Reference: 20UK1675_Mooring_Arrangement

Figure 2-3: Planned Orbital O2 Mooring Arrangements

2.2.2 Anchors

The Orbital O2 will be anchored with either 4 gravity anchors or 4 rockbolt anchors (the latter option is preferred).

If **gravity anchors** are deployed they will be composed of a 'steel basket' which will be filled with ballast. The baskets will be approximately 11m x 11m x 2.5m and will have a weight of approximately 35T.

The ballast will consist of a scrap steel chain or steel modules, where:

- Scrap chain will be approximately 76mm diameter.
- Steel modules will be approximately 5.6m x 5.2m x 2m.

The total weight of the anchors including ballast will be no more than 600T per anchor.

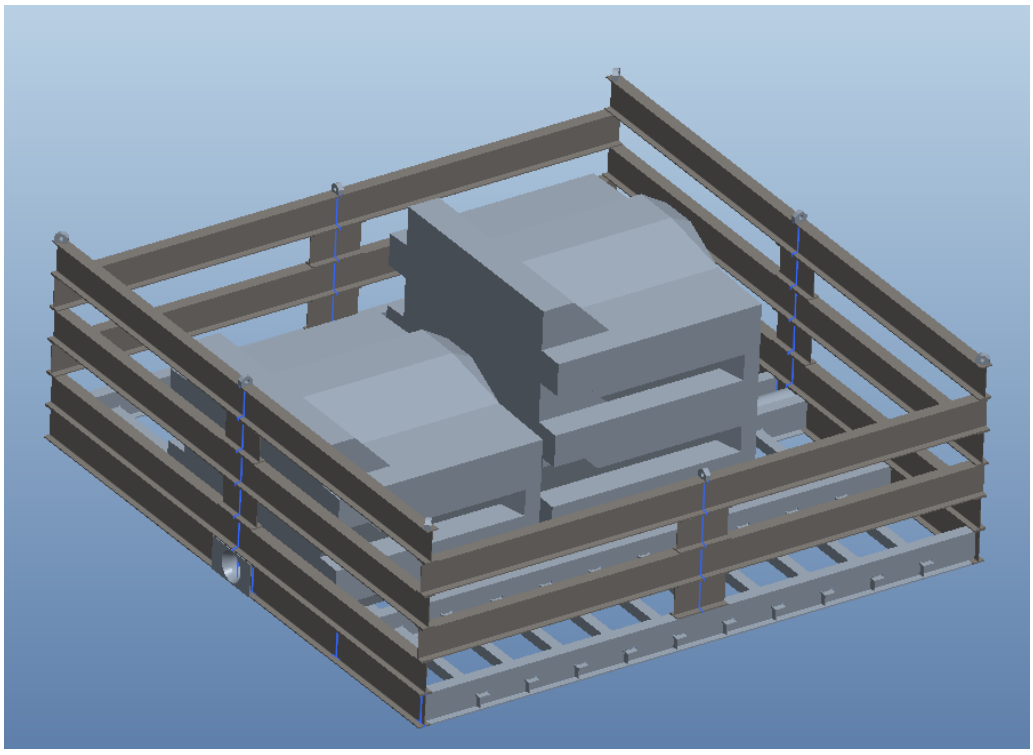


Figure 2-4 : Anchor basket with ballast

If **rockbolt anchors** are deployed, they will be as follows:

The principle of rock bolts anchors is to use a drilling rig to insert a steel vertical bolt or bolts into the seabed to provide station keeping for the device. The bolts will provide station keeping by either being grouted in place or a groutless installation whereby a mechanical lock is used to prevent pull out. In this system, the 'cutting fingers' themselves of the drilling bit are expanded within the bolt hole to secure the anchor in place.

Subject to detailed design, each bolt would be around 6m in vertical length and up to 600mm in diameter Each would be entirely drilled into the seabed with its head protruding from the seabed with a bespoke mooring connector.

It is envisaged that there would be a single rock bolt for each of the 4 mooring points, i.e: 4 rock bolts in total. However, subject to ground conditions analysis and detailed design, this may be revised to a larger number of smaller bolts.

Figure 2-5: Rockbolt

2.2.3 Scour Protection

Concrete mattresses will be placed around each anchor to prevent scour. Each mattress will have a weight of up to 10T and size of around 6m x 3m x 0.3m. Up to 8 mattresses will be used per anchor, giving a total of 32 mattresses.

2.2.4 Marking and Lighting

The device will be predominantly yellow in colour/ above the water line and a maroon/brown (antifoul) paint colour below the waterline. The Orbital O2 will be lit by 2 yellow lights synchronised flashing once every three seconds (Fl Y 3s) with a nominal range of 3 nautical miles and mounted a minimum of 3m above the waterline. Additionally, the device will be fitted with a radar reflector at a similar elevation and a navigation aid AIS (Automated Identification System) transmitter as requested by the Northern Lighthouse Board (NLB).

2.3 CONSTRUCTION, OPERATION AND DECOMMISSIONING

The vast majority of Orbital O2 marine operations will be undertaken using a multi-cat work vessel, and a RIB where necessary. Multi-cat vessels are relatively small but very powerful workboat tugs that typically have a large deck area, high-capacity hydraulic cranes and large winches.

If rock drilled anchors are used, the intention is to employ a multi-cat vessel to employ a drilling rig to carry out the drilling operation.

An Anchor Handling Tug (AHT) style vessel may also be employed to load test the moorings prior to connection of the Orbital O2.

Approximately 60 multi-cat style vessel transits will be required throughout the duration of construction activities and a further 60 multi-cat transits estimated for decommissioning.

Table 4: Installation Programme

Activity	Location	Approximate Duration	Approximate Timescale
Mooring installation	Berth 6	8 weeks in 12 months window	June 2022 – June 23
Dynamic Cable installation	Berth 6	1 week	March – April 2023
Turbine delivery to Orkney		5 days	June 2023
Install on moorings	Berth 6	2 days	July 2023
First Grid connection	Berth 6	2 days	August 2023
Commissioning	Berth 6	12 weeks	August – October 2023
Operation	Berth 6	14 years	November 2023 – Dec 2037
Decommissioning	Berth 6	6 months	2038

2.4 TOW TO / FROM BERTH 6

Once construction is complete the device will undergo sea trials close to the construction site prior to being towed to Orkney. The device is likely to be towed with hull and legs assembled, but without nacelles and blades which would be road-transported to Orkney separately. The full machine would be assembled in Orkney at a harbour-side location, most likely Hatston Pier.

Once fully assembled, owing to its 'gull-wing' configuration, it is unlikely to be practical for the Orbital O2 to be berthed at a harbour facility. Instead, it is likely that the Orbital O2 would be temporarily moored at a sheltered bay close to the project site.

The device will be towed from Hatston Pier to the site. The assembled device is to be towed by a multi-cat style vessel with a minimum towing capability of 50 tonnes and a 90-tonne brake, 36mm wire and 500m length. It will meet the pilotage requirements for the Orkney pilotage regulations. Due consideration is to be given to the effect of the tidal stream during towing, to include sufficient fuel capacity. During the tow, the platform legs will be raised with rotors resting at the surface. A formal towage plan or passage plan for the route has not yet been agreed.

Figure 2-6: Example towage arrangement (SR1-2000).

2.5 INSTALLATION

The Installation operation comprises the following:

1. Towage of turbine and connection to moorings – These works require a vessel that has capacity to carefully move the turbine from the holding location, tow the turbine to the installation site and maintain control of the turbine in tidal stream during connection. This vessel will have the same specification as that required for towing the turbine.

2. Connection operation will take place over a neap tidal cycle (two slack periods) using the winching systems installed on the turbine to recover the catenary based mooring system and latch into the connection points installed on the terminal end of the synthetic risers.

2.6 OPERATION AND MAINTENANCE

Following an initial commissioning phase of approximately 3 months, it is intended that following installation, the Orbital O2 will be operational at Berth 6 for up to 14 years.

The Orbital O2 is fundamentally designed for ease of access and inexpensive maintenance. As a floating device, scheduled and unscheduled maintenance operations on electrical, control and hydraulic systems can be carried out onboard the device simply by transferring personnel from a small vessel such as a RIB onto the hull of the Orbital O2. From here personnel can enter the hull and access the majority of equipment. It is envisaged that such regular maintenance could take around once per month.

For more significant maintenance operations or where weather conditions preclude personnel transfer the Orbital O2 can be disconnected from its mooring and towed to a maintenance location. Once disconnected from its moorings and the rotor legs are retracted, the low transport draught of the turbine allows the use of local shallow bays / pontoon facilities for maintenance.

2.7 DECOMMISSIONING

Decommissioning of the mooring system at the EMEC Fall of Warness site is included in the project and will take place in 2038 at the latest. As per the requirements of Section 105 of the Energy Act 2004, Orbital will prepare a draft Decommissioning Programme prior to the commencement of the Orbital O2 project. This document will be circulated for consultation as per the requirements of Marine Scotland and the responses to this consultation will inform the final document.

3 OVERVIEW OF THE BASELINE ENVIRONMENT

The Orkney Islands, a group of more than 50 islands, lie NNE of the NE extremity of mainland Scotland, north of the Pentland Firth. The Fall of Warness is located to the west of Eday and exhibits significant tidal flows.

3.1 METOCEAN CONDITIONS

3.1.1 Wind

The Admiralty Sailing Directions for the North Coast of Scotland give the days with gales per year as 50 in Kirkwall. This ranges from between one and nine per month, with gales most frequently in the winter months. **Figure 3-1** shows the wind directions and speeds for the Fall of Warness site.

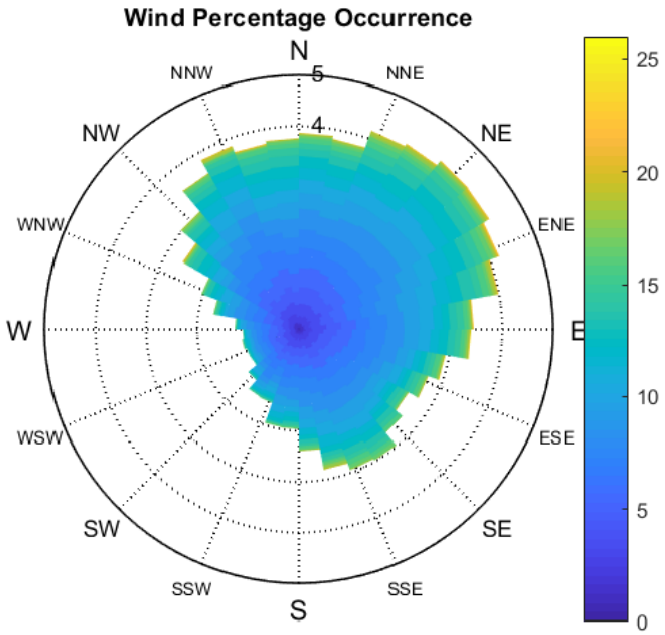


Figure 3-1: Percentage occurrence of wind directions (m/s) – Source TDK-MAG-MOOR-TR-001.

3.1.2 Wave

Figure 3-2 shows the wave rose for the project site, the predominant direction is north-westerly and south-easterly with the significant wave heights generally below two metres.

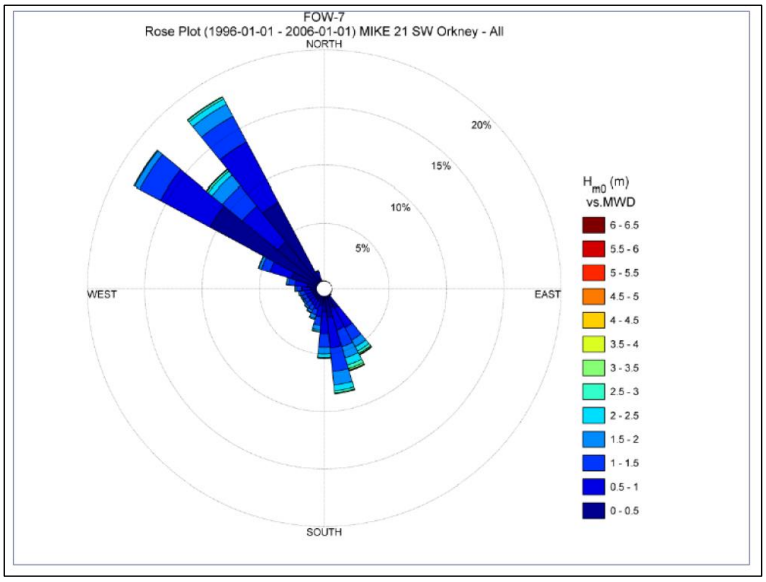


Figure 3-2: Wave rose plot for percentage occurrence with Hm0 and direction (EMEC Fall of Warness – Berth 1: MetOcean & Physical Description 2015).

3.1.3 Tide

Table 5 and **Table 6** give the tidal characteristics near to the project site. Spring tidal speeds are significant and can reach up to 7 knots, with neap flows being greater than spring tides compared to many other parts of the UK coastline.

Figure 3-3 gives a graphical model of tidal flows through the project site. The tide races in a north-westerly and south-easterly direction between Muckle Green Holm and Eday.

Table 5: Tidal Heights

Place	Lat N	Long W	HAT	MHWS	MHWN	MLWN	MLWS	LAT
Loth	59° 11	002° 42	3.5	3.1	2.5	1.5	0.9	0.3
Rapness	59° 15	002° 52	4.1	3.6	2.9	1.6	0.7	-0.1
Kirkwall	58° 59	002° 58	3.5	3.0	2.4	1.3	0.6	-0.1

Table 6: Admiralty Total Tide Predictions

Fall of Warness (59° 08.07'N 002° 48.40W)			
Tidal Hour	**Direction (deg)**	**Spring**	**Neaps**
-6	150	6.2	2.4
-5	144	7.2	2.8
-4	141	5.8	2.3
-3	116	2.8	1.1
-2	350	0.3	0.1
-1	308	3.8	1.6
HW	329	6.4	2.5
+1	329	6.5	2.5
+2	320	4.9	1.9
+3	325	3.8	1.7
+4	324	1.2	0.5
+5	160	1.7	0.7
+6	153	5.7	2.3

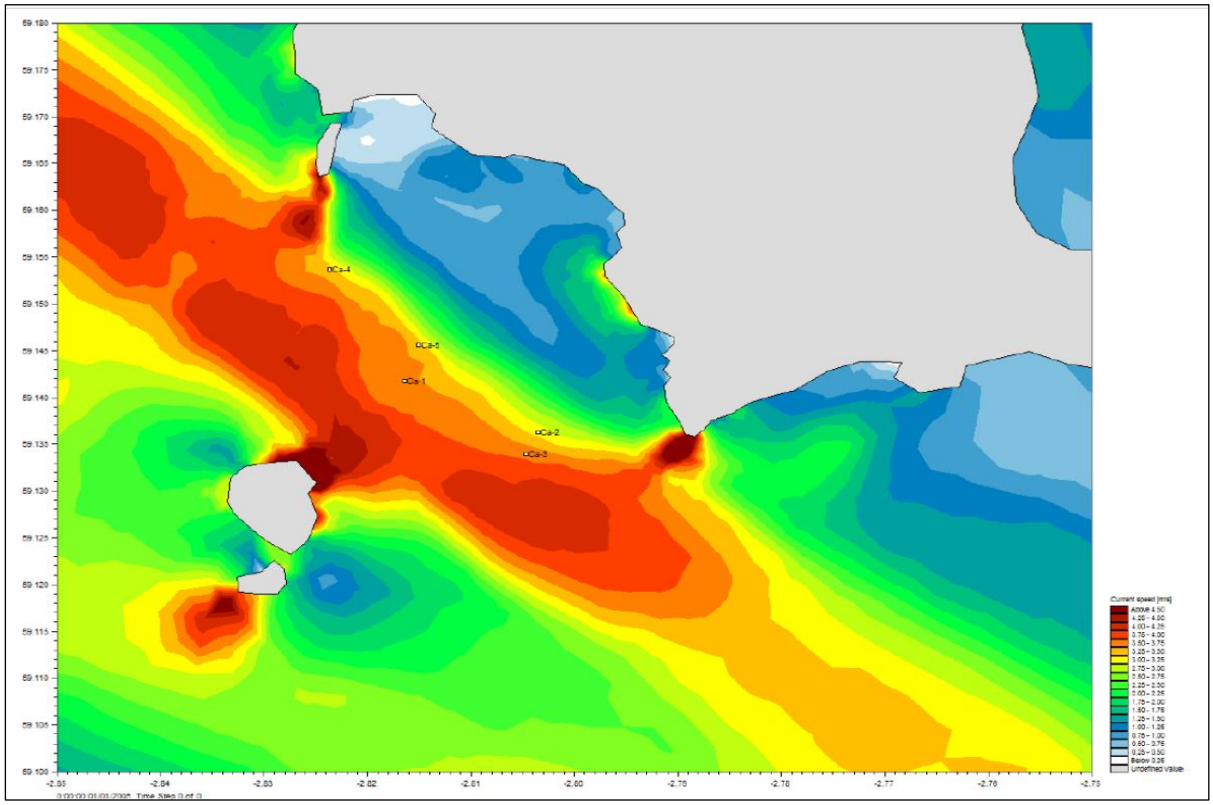


Figure 3-3:Maximum Tidal Flow for 2005 (EMEC Fall of Warness – Berth 1: MetOcean & Physical Description 2015).

3.1.4 Visibility

The Admiralty Sailing Directions for the North Coast of Scotland give the days with fog per year as 41 in Kirkwall. This ranges from between two and five per month, with fog most frequently in the summer months.

3.2 EXISTING VESSEL TRAFFIC MANAGEMENT

Within the Orkney Harbour Competent Harbour Authority (CHA) Area pilotage is compulsory for the following vessel types:

- Passenger vessels over 65m LOA;
- Other vessels over 80m LOA;
- Vessels under tow where the combined overall length of the towing vessel and the vessel being towed is over 65m; and
- Vessels over 300gt carrying persistent oils in bulk.

The Fall of Warness is not within the port limits.

3.3 SEARCH AND RESCUE

RNLI lifeboats are stationed in the Orkneys at Longhope, Stromness and Kirkwall. The Kirkwall lifeboat is a Severn class all weather lifeboat. This vessel is 17m LOA, has a crew of seven, is capable of 25 knots and has a range of 250 nm.

3.4 OTHER OFFSHORE ACTIVITIES

3.4.1 Aquaculture

Authorised marine farms of various types are numerous throughout the waters of the Orkney Islands with farms being added and removed on a continuous basis. Farms in proximity to shipping routes are marked by buoys. Other farms are marked by beacons (X topmark) and some are fitted with radar reflectors. Lights, when fitted, show flashing yellow.

Orkney Islands Council prohibits anchoring and diving close to marine farms within Orkney Harbour Areas and mariners are required to give as wide a berth as possible to the farms and to proceed with caution, consideration, and at slow speed in their vicinity.

There are no charted marine farms in the Fall of Warness.

3.4.2 Renewables

The EMEC development site is located in the Fall of Warness. Other development areas exist in the Orkney Islands but are well clear of the project sites. In April 2014 DP Energy acquired the development rights to the Westray South proposal. The project was awarded a 200MW Agreement for Lease (AfL) from The Crown Estate (TCE) in March 2010.

Ecological surveys were initiated in January 2012 in order to provide baseline data relating to habitats and species which use the proposed development area.

At present the electricity network on Orkney and beyond is not able to accommodate projects of this scale and options for development of new grid connection infrastructure are being investigated. Similarly, proposals for developments at Lashy Sound and Stronsay Firth have also not progressed.

3.4.3 Subsea Cables

The Fall of Warness has multiple subsea cables associated with the EMEC test facilities.

3.4.4 Anchorages

There are no anchorages near to the project site.

3.4.5 Military Exercise Areas

There are no military practice areas near to the project site.

3.4.6 Spoil Grounds

A spoil ground exists opposite Kirkwall but is well clear of the Fall of Warness test site.

4 CONSULTATION

Consultation with local marine stakeholders and regulators is fundamental to understanding current and likely future vessel traffic patterns, and navigational issues. Local stakeholders also have a good knowledge of incidents – some of which may be minor and not formally reported to other authorities. Seven key local stakeholders were identified for consultation, and all agreed to contribute.

The consultations were undertaken remotely via video conference chiefly as a consequence of travel and meeting restrictions in force due to the ongoing Covid-19 pandemic. The consultation meetings were structured similarly for each stakeholder group and proved effective, despite the remote nature of the discussions.

It should be noted that all of the stakeholders approached have previously been consulted with respect to the site wide NRA for the whole EMEC Falls of Warness test site, as well as for device specific NRAs within the site. Most recently Marico has consulted the stakeholders with regard to the O2 device proposed for berth 5. As a consequence, the current consultation concentrated on explaining the new device and seeking views on any issues posed by the new device and specific location, any changes in traffic patterns or incidents which have occurred since the previous NRAs.

It should also be noted that it was made clear to all consultees that, as a result of Covid related restrictions, it was acknowledged that traffic patterns during 2020 were far from typical, and that this assessment would be undertaken on the assumption that traffic levels would return to pre-pandemic levels by the time the device is deployed.

A list of stakeholder consultations undertaken is given in **Table 7**. (Note that the RYA and Orkney Marinas contributed to the process jointly). Following each conversation, summary notes were drafted and agreed – these are appended at **Annex C.**

The knowledge, themes and issues gained from the stakeholder consultations have been embedded in the assessment of navigation risk for this study.

Table 7: List of stakeholder consultation.

Organisation	Date Undertaken	Purpose
Maritime and Coastguard Agency	7 January 2021	Methodology and Guidance Documentation for Assessment Incident records
Northern Lighthouse Board	13 January 2021	Marking and Lighting requirements
Orkney Ferries	11 January 2021	Background on Orkney Ferries Passages through study area Possible impacts of device Risk Control Measures
RYA and Orkney Marinas (joint meeting)	7 January 2021	Background on Recreational Traffic Racing areas and cruising routes Risk Control Measures
Orkney Fisheries	14 January 2021	Background on Fishing in Orkneys Consideration of Impact on Fishing Risk Control Measures
Orkney Islands Council Marine Services	14 January 2021	Navigation of vessels through Fall of Warness Any incident records Risk Control Measures

5 EXISTING VESSEL TRAFFIC AND RISK PROFILE

5.1 DATA SOURCES

The principal source of data for this assessment is AIS data recorded by EMEC for the following periods:

- July 2017 – one full month to be representative of summer traffic;
- January 2018 – one full month to be representative of winter traffic.

Additional information was obtained from stakeholders and secondary sources. The RYA's boating intensity database and MMO data from the Vessel Monitoring System (VMS) were considered for the site wide NRA. Information on other activities was obtained through consultation (**Section 4**).

5.1.1 Data currency

While it is noted that the AIS data used in this assessment is now up to 3.5 years old, it has been used for this assessment for the following reasons:

- The original data is utilised as it is part of the terms of the site wide NRA agreement with the MCA;
- The most recent data available would cover 2020, which is far from typical due to the significant reduction in marine traffic of all types due to travel and economic restrictions during the Covid-19 pandemic. Older data is considered more representative;
- Stakeholders unanimously agreed that the original data was the most representative of true traffic densities within the project area and did not foresee any significant changes to those levels once restrictions are lifted; and
- Using the existing data ensures consistency with previous recent assessments.

The most recent version of RYA Coastal Atlas was not obtained, for the following reasons:

- The AIS data set utilised is contemporaneous with the Coastal Atlas data used;
- Leisure traffic densities in the project area are very low, and are shown at very low resolution in the costal atlas;
- Stakeholders confirmed no changes in leisure traffic density and
- While a useful data set, there is no requirement to use this data under MGN 543.

5.1.2 Requirement for Radar Survey

MGN 543 states that *"an up to date, traffic survey of the area should be undertaken within 12 months prior to submission of the Environmental Statement. This should include all the vessel types found in the area and total at least 28 days duration but also take account of seasonal variation in traffic*

patterns and fishing operations. (Note: AIS data alone will not constitute an appropriate traffic survey).” MGN 543, page 7.

Under MCA guidance document: “*Methodology for Assessing the Marine Navigational Safety Risks of OREIs*”, Section 3 considers the scope and proportionality of assessments. It states that the scope and depth of the assessment should be proportionate to the scale of the development, magnitude of the risks and should be considered on a case-by-case basis. It considers that a small scale or low risk development may require a less detailed assessment.

The Orbital O2 will be located in a licensed test site which has been host to similar devices and is well charted. This assessment has been conducted based on AIS data and information provided by secondary sources and local consultees ensuring the activities of small craft are included in the assessment.

5.2 VESSEL TRAFFIC ANALYSIS

Berth 6 is located within the Fall of Warness site and is clear of the main routes used by ferries from Kirkwall to Eday (see **Figure 5-1**). A route through the Fall of Warness is used by some deeper draught vessels when the weather and tidal conditions are suitable (see **Figure 5-4**), particularly cruise ships. No tankers operate in this area and cargo transits are infrequent (see **Figure 5-2**).

Figure 5-3 shows the tracks of passenger vessels, which are split between the north-south route between Westray and Kirkwall, and an east-west route between Kirkwall and Eday. Whilst both of these routes are clear of the development site, ferries do on specific occasions transit through the Fall of Warness site, this is discussed in detail in **Section 7.1**.

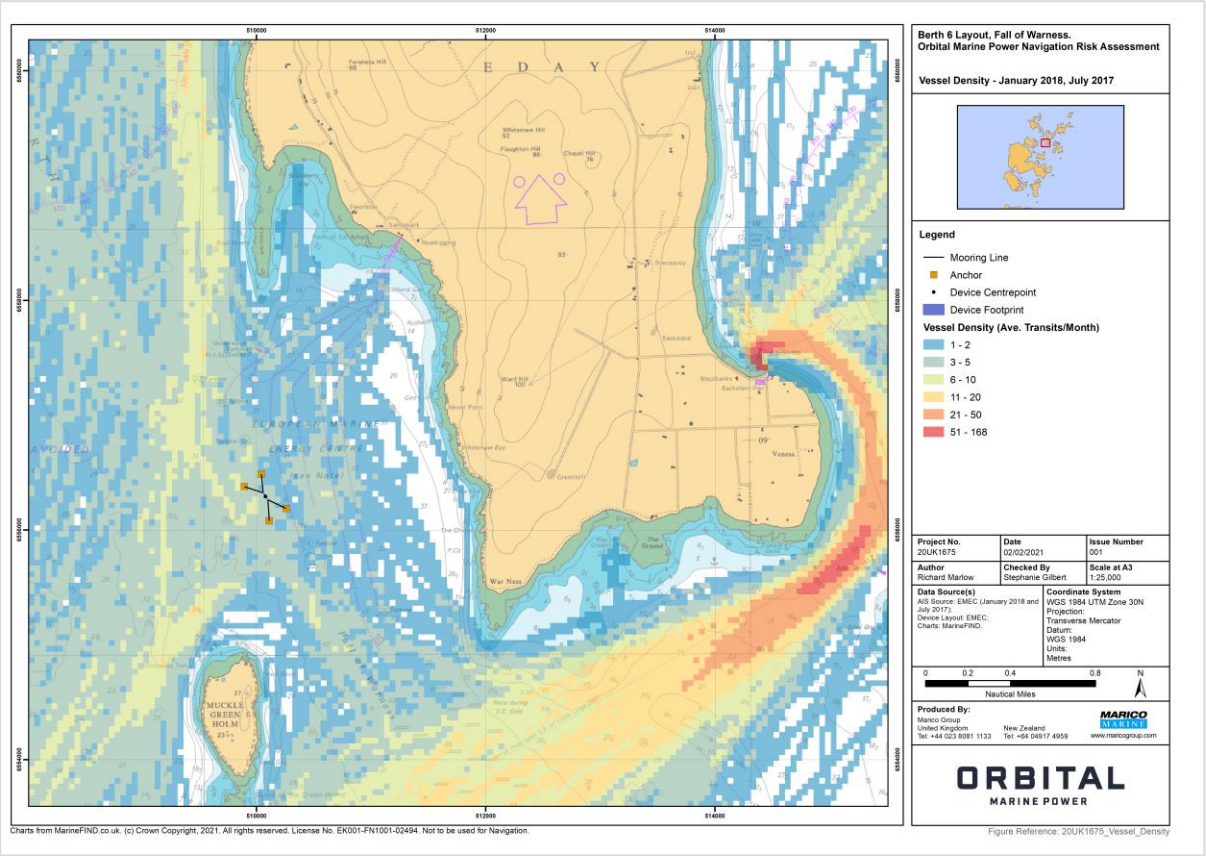


Figure 5-1: Vessel transit density in Proximity to Berth 6.

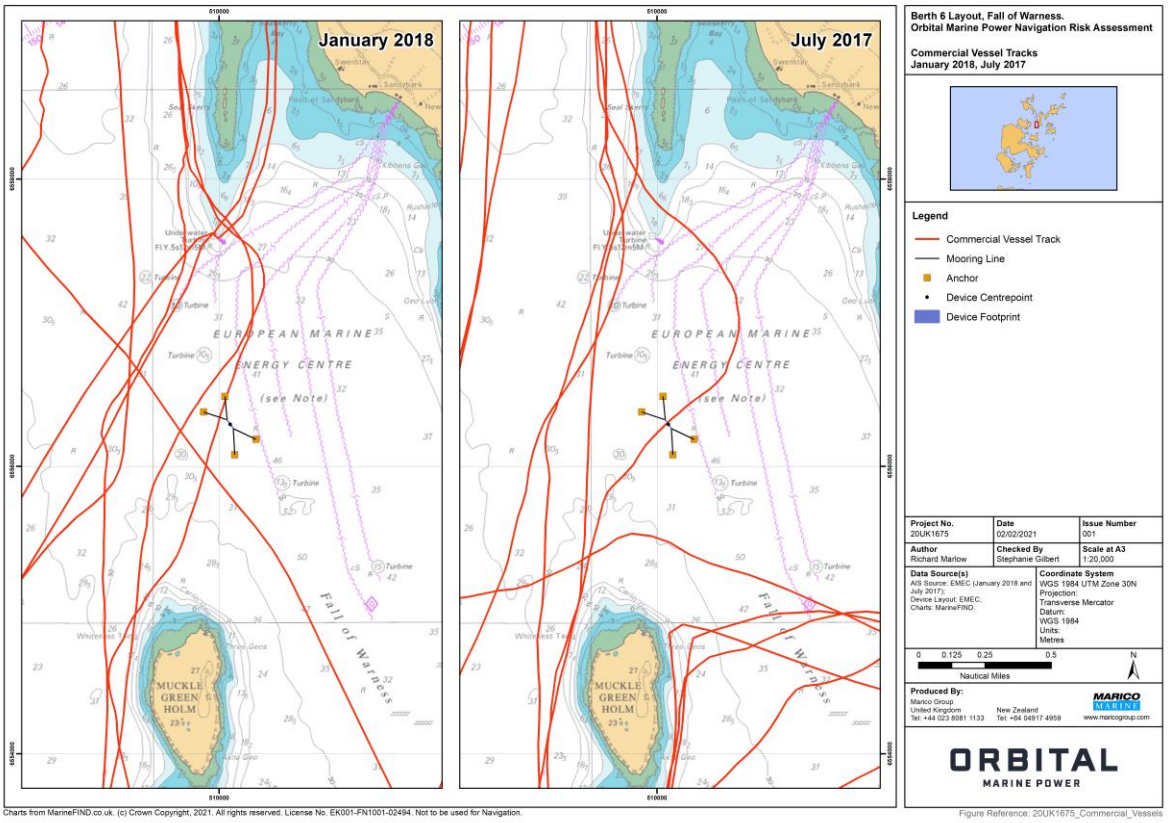


Figure 5-2: Commercial vessel transits in Proximity to Berth 6.

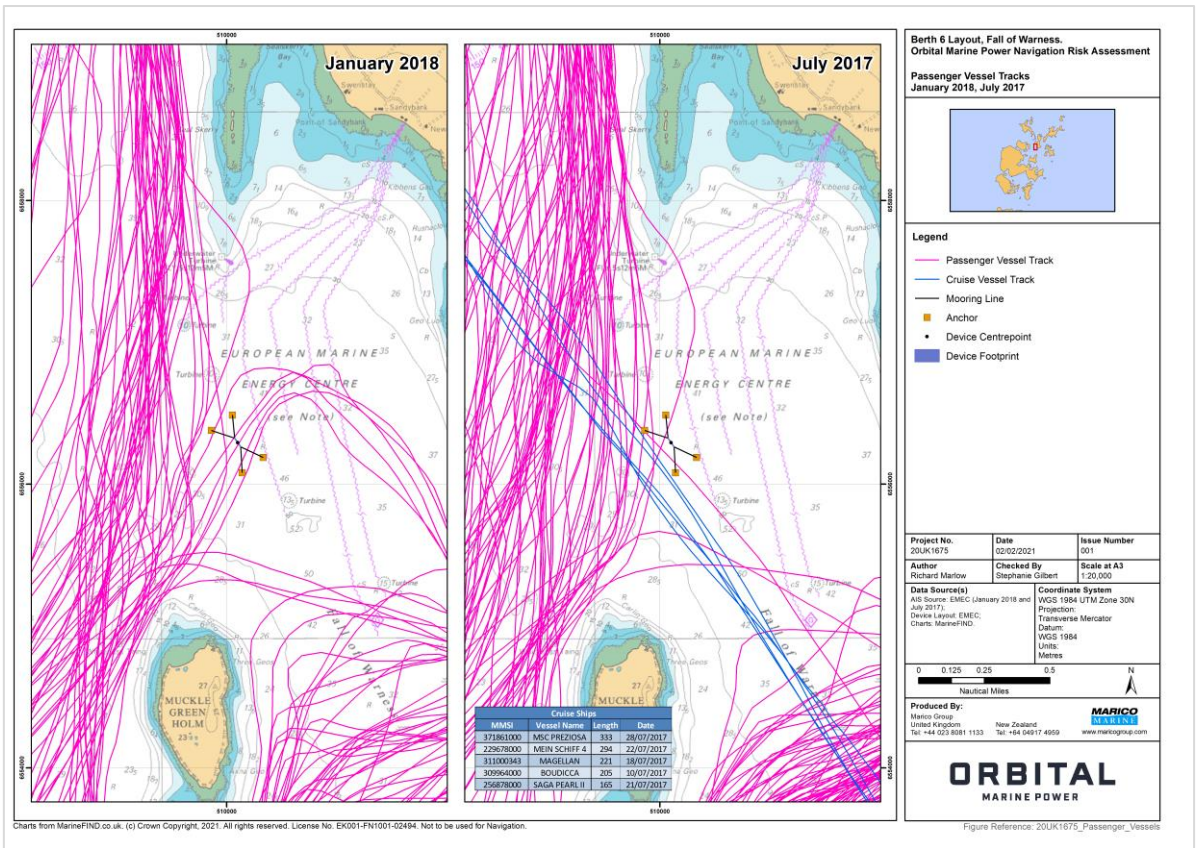


Figure 5-3: Passenger vessel transits in Proximity to Berth 6.

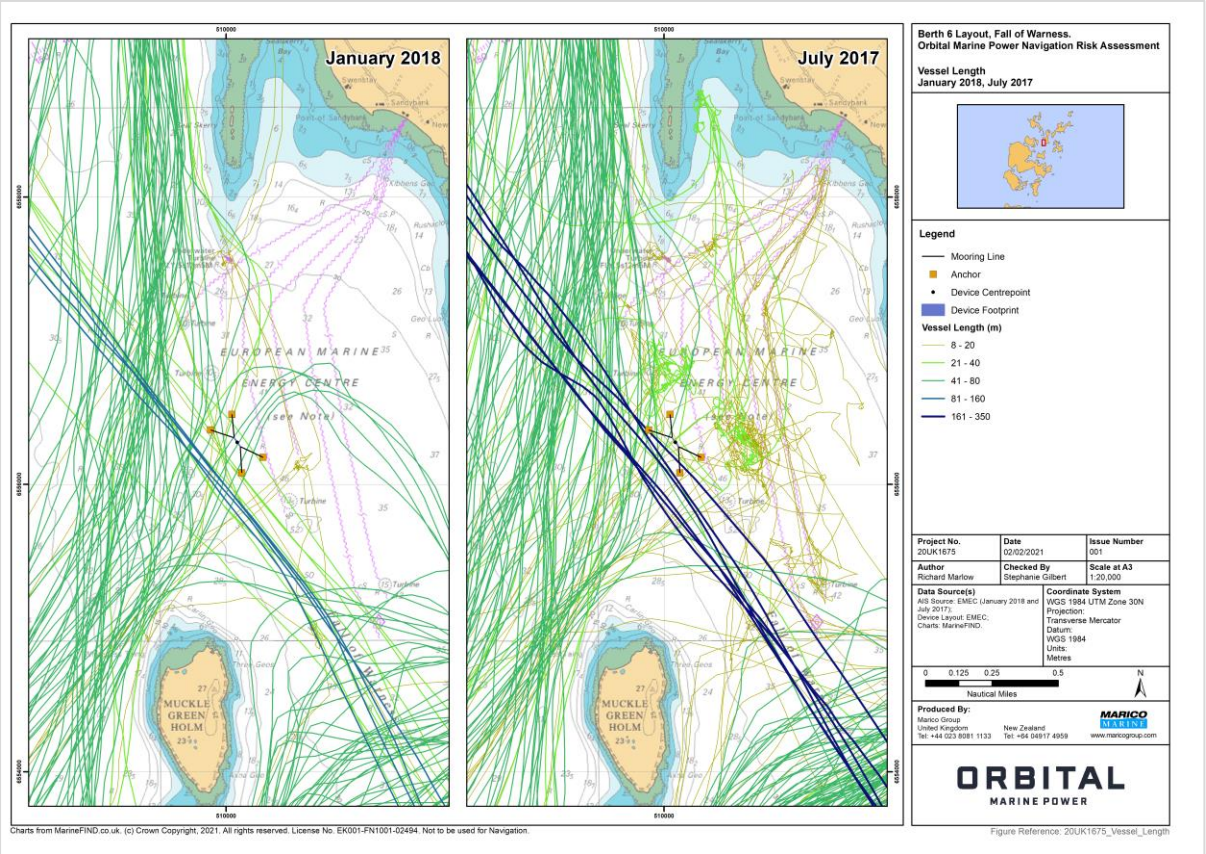


Figure 5-4: Vessel transits in Proximity to Berth 6 by size.

Fishing is sparse in the Fall of Warness, principally due to the presence of the EMEC test sites and the cables to the devices. Fishermen, therefore, generally avoid this area unless they are transiting through (**Figure 5-5**). As such, the impact is limited. Occasionally, scallop dredgers are known to operate in this area but would do so clear of the cables and devices.

Similarly, recreational yachts transit through this area (**Figure 5-6**) but would generally stay close inshore away from the device. Consultees noted the inshore route to allow yachts to pass close to Eday and would expect this to remain open. No small boat activity or racing takes place in the Fall of Warness and the device is located in an area of deep water and strong tides which would not be a suitable anchorage.

Tugs and service craft, including pilot boats, tugs, maintenance vessels and other workboats are shown in **Figure 5-7**. The majority of vessels in this category are EMEC site maintenance vessels, with few through transits.

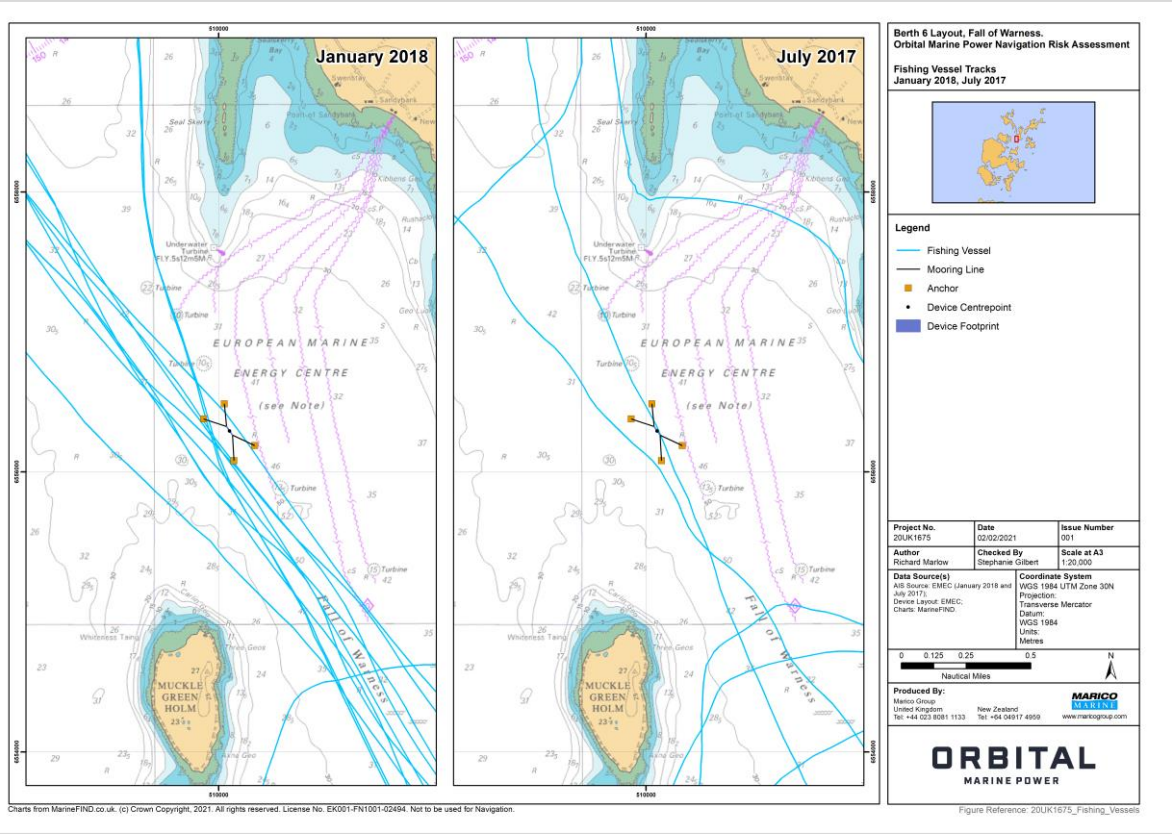


Figure 5-5: Fishing vessel transits in Proximity to Berth 6.

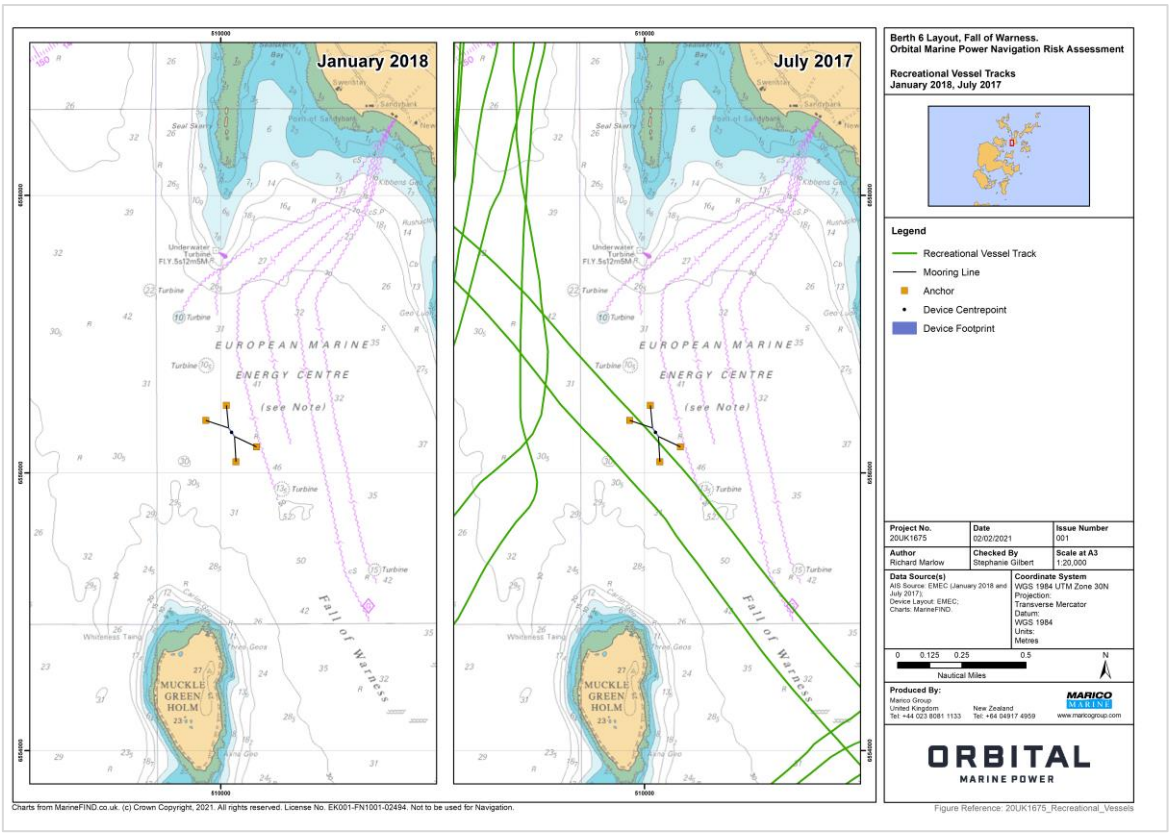


Figure 5-6: Recreational vessel transits in Proximity to Berth 6.

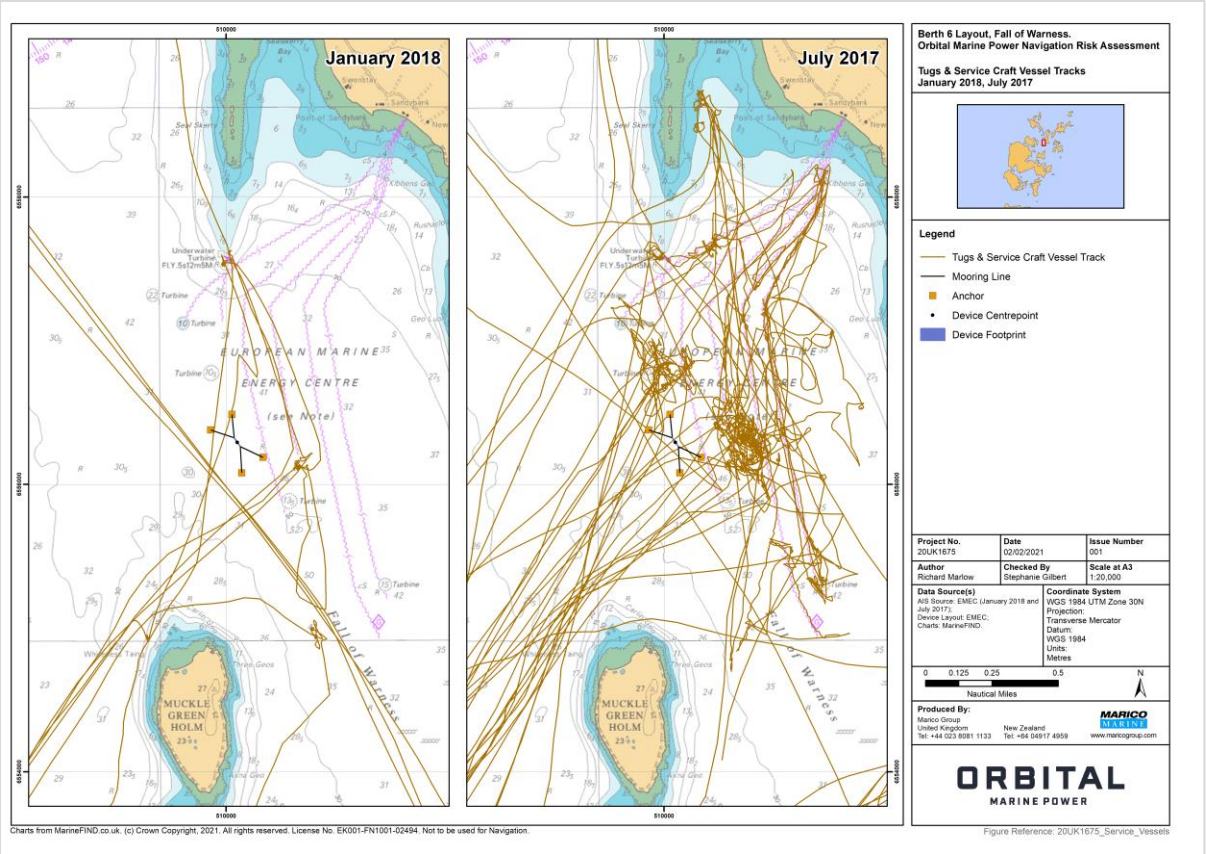


Figure 5-7: Tug and Service vessel transits in Proximity to Berth 6.

5.3 PROXIMITY ANALYSIS

Frequency and distribution analysis was undertaken to understand vessel movements near to the site. **Figure 5-8** shows the distribution of traffic (all vessels) passing Berth 6. Transits within 0.5nm were extracted and analysed below.

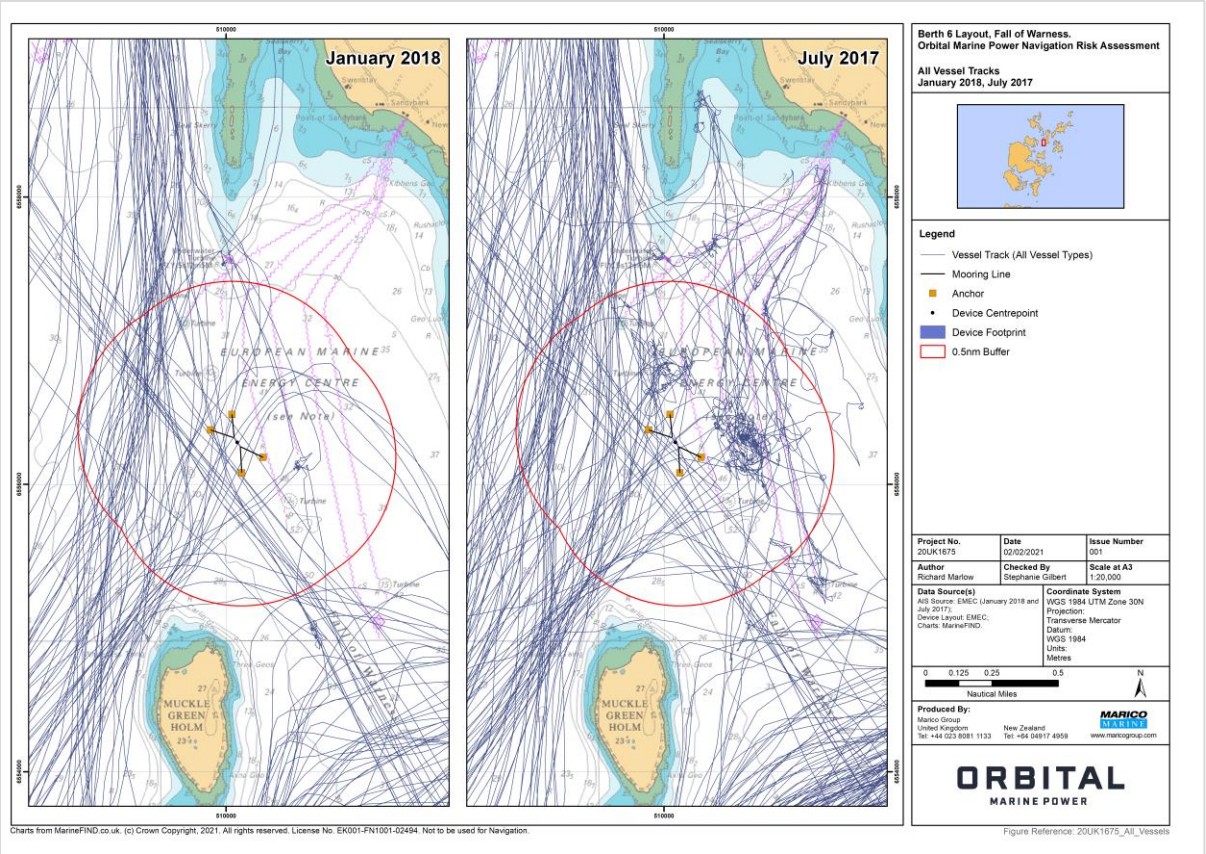


Figure 5-8: Vessel traffic at Berth 6.

Figure 5-9 shows the number of transits per day past Berth 6 within summer and winter. 76 transits passed within 0.5nm of the device during summer and 85 in the winter, indicating seasonality is not a driving factor of vessel traffic levels within 0.5nm of the device.

Figure 5-10 shows transits by time of day. There is a more defined peak within the summer, likely reflecting the ferry timetable, than in winter, where peak distribution is more sporadic and of shorter duration.

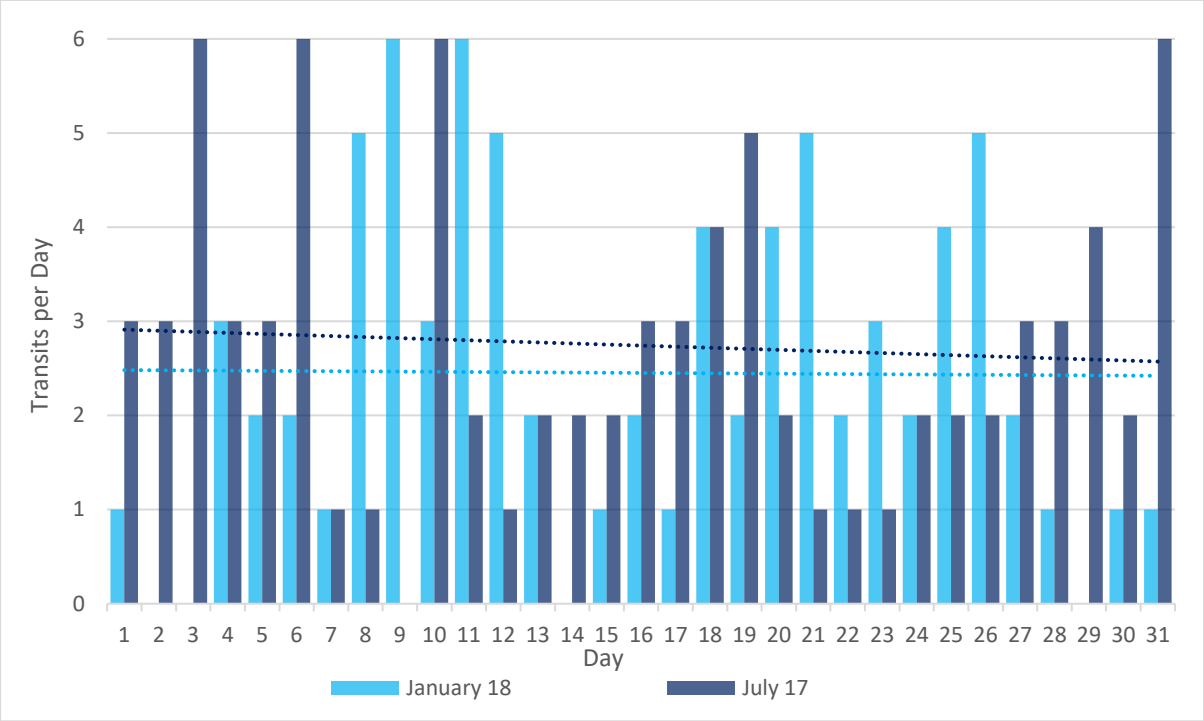


Figure 5-9: Vessel transits per day -July 2017, January 2018.

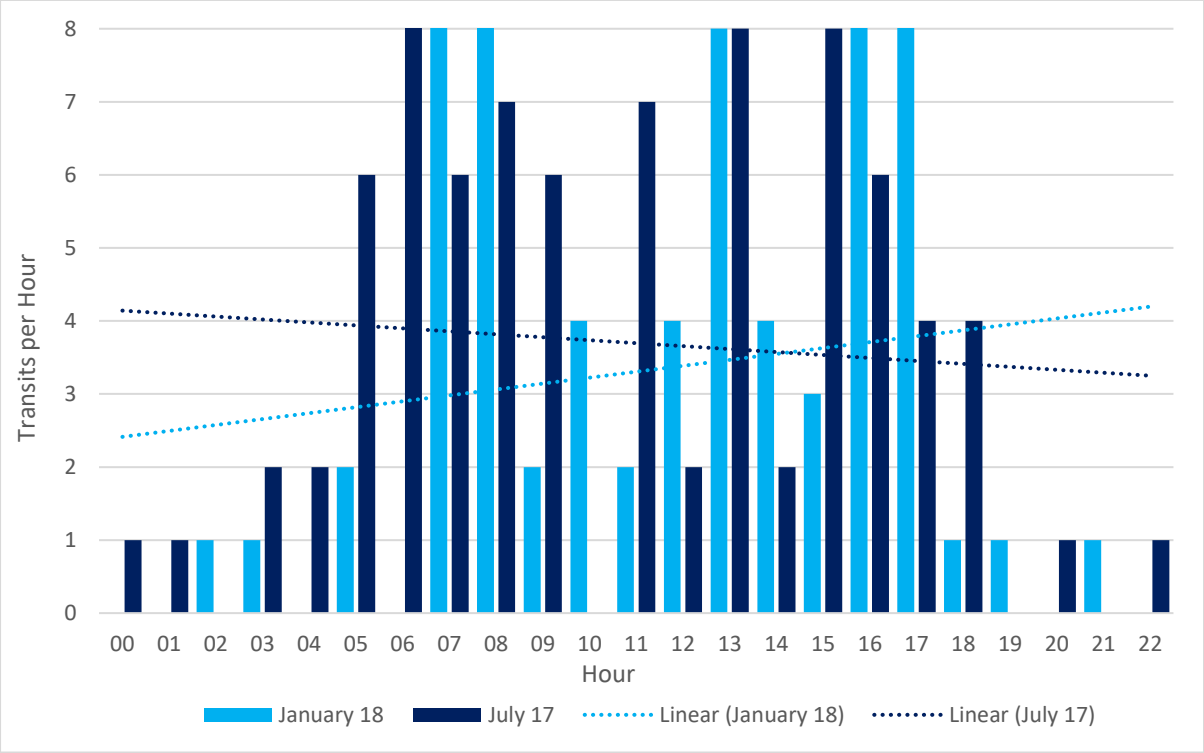


Figure 5-10: Transits by time of day -July 2017, January 2018.

Figure 5-11 and **Figure 5-12** show the type and sizes of vessels passing the device. Fishing vessels are the most numerous vessel type within both summer and winter. All other vessel types are infrequent in close proximity to the device, though recreational vessels are noticeably more numerous in summer (as would be expected).

The most frequent size of vessel to transit within 0.5nm is between 40 and 60m LOA as shown in **Figure 5-12**. This category includes, ferries, workboats and fishing vessels as identified within **Figure 5-11.**

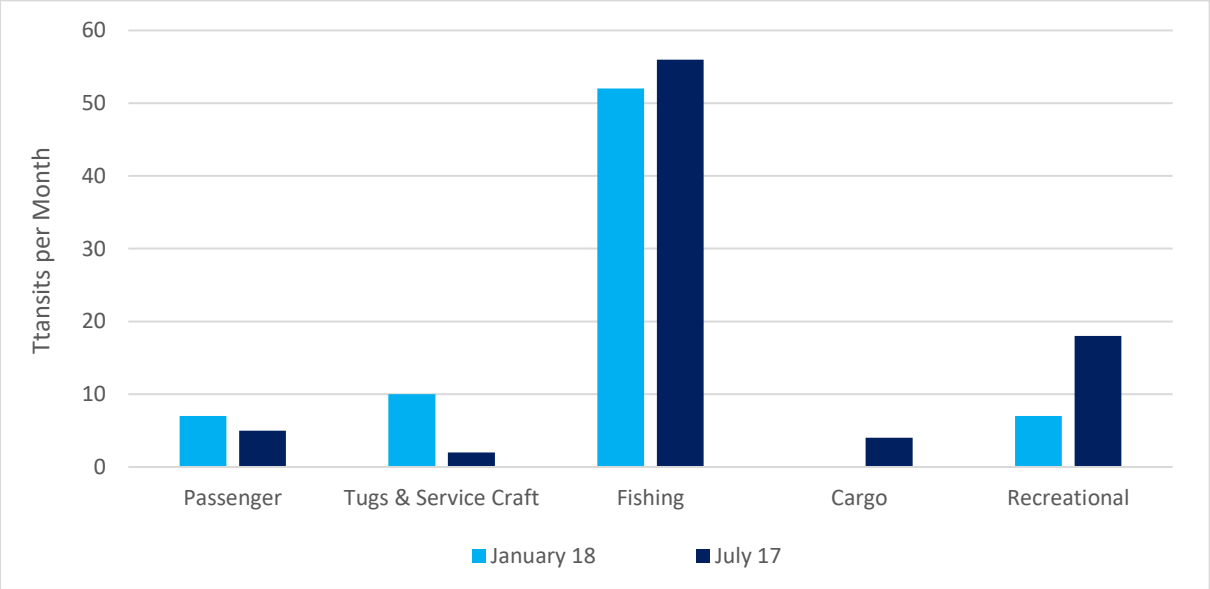


Figure 5-11: Transits by type.

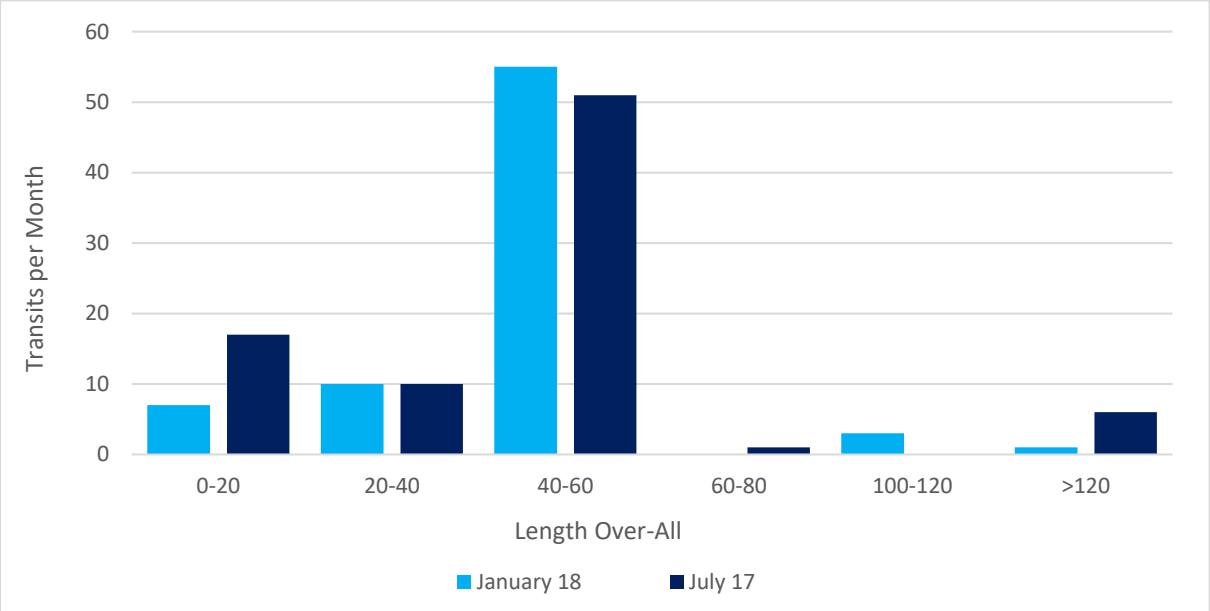


Figure 5-12: Transits by Length.

5.4 HISTORICAL INCIDENTS

Analysis of MAIB incidents between 1997 and 2018 was conducted.

Within 3nm of the Fall of Warness (Berth 6), 9 incidents were recorded:

- 1 Accident to person on a fishing vessel;
- 3 groundings (involving 2 fishing vessels and a renewable maintenance vessel);

- 1 Flooding/Foundering of a fishing vessel;
- 1 Near miss involving a renewable maintenance vessel;
- 2 mechanical failures/loss of control/propulsion involving a fishing vessel and a renewable maintenance vessel.
- 1 contact (unknown)

The incident data for both sites suggests that the incident rate is low, particularly for collisions and contacts. There was, however, a higher frequency of groundings close to shore, which given the tidal conditions in the area, was not unexpected.

No formal incident data has been obtained since the site wide NRA[2] was completed in 2019, however none of the consultees approached in respect of this assessment had any records or recollections of any incidents within the Falls of Warness area since that report was completed.

[2] 18UK1461 – Marico Marine - 11 February 2019

6 FUTURE TRAFFIC PROFILE

6.1 ORKNEY COMMERCIAL TRAFFIC

The following information was captured from the Orkney Islands Council Harbour Authority Annual report 2018-2019[3]

Pilotage movements to all facilities have continues an historic upward trend, and increased from 606 in 2016-17, to 708 in 2017-2018, to 835 in 2018-2019.

- Serco Northlink Ferries Traffic on Kirkwall-Aberdeen-Lerwick route has increased between 2017 and 2019 following a period of steady numbers, increasing from 49,825 passengers to 54,896 passengers;
- Demand for Orkney Ferries Ltd routes has also increased from 103,485 passengers to 105059 passengers between 2017 and 2019 for the outer islands, and from 225,799 to 234,457 during the same period for the inner islands.
- Cruise ships calls continued an historic significant year on year increase from 126 in 2016/2017 to 138 in 2018/2019. 2020 saw this business disappear due to Covid, but the OIC is confident that cruise ships will return after the pandemic is over. This increase is significant, but only a minority of the very smallest vessels may use the Fall of Warness route.

There are no known plans to increase the number of services in the area in the immediate future, though longer-term aspirations to replace vessels on the Orkney Ferries Ltd. Fleet and improve inter-island connectivity may see an extra vessel introduced, and more frequent sailings. However, such vessels would have improved navigational and sea-keeping abilities.

6.2 FISHING AND RECREATIONAL TRAFFIC

A review of the Scottish Sea Fisheries Statistics was undertaken from 2015 to 2019.[4]

The number of voyages by Scottish vessels in the Orkney region has remained fairly consistent: 3,410 in 2015 and 3490 in 2019. However, the catch quantity decreased year on year from 4,371 tonnes in

[3] Orkney Islands Council Marine Services

[4] Marine Scotland – Scottish Sea Fisheries Statistics 2019

2015 to 3,057 tonnes in 2016. The number of registered fishing vessels has declined from 142 in 2012 to 127 in 2019, mostly (93 of total) 10 metres and under used for creel fishing.

No figures were available for recreational activity in the Orkneys, however an assumption has been made (supported by consultation) that there would be no significant change in existing activity.

6.3 RENEWABLE ENERGY RELATED TRAFFIC

The EMEC devices are maintained by vessels from Kirkwall. The construction, maintenance and decommissioning of the Orbital O2 device, will increase small workboat activity in the area (as shown in **Section 2.3** and **2.5**). During the lifecycle of the Orbital O2 devices other EMEC devices will be operating or being decommissioned in the Fall of Warness and this will result in some in combination effects and increased vessel activity. In particular the first generation O2 device will be installed on Berth 5 and the Magallanes Ocean 2G and will be in operation at Berth 1 by the time the second Orbital O2 device is installed on Berth 6.

The Westray project described in **section 3.4.2** remains in the early stages of development and if successful will likely not be present for some years. Traffic related to that project is unlikely to transit the Falls of Warness for the reasons given in **Section 7.1.2**.

6.4 SUMMARY

It is not considered that the changes in the traffic profile discussed above will materially alter the risk profile around Berth 6 within the lifecycle of the device.

7 IMPACTS TO NAVIGATION

Based on consultation with stakeholders and a review of the traffic profile around the device, the following impacts were identified.

7.1 IMPACT ON VESSEL TRAFFIC ROUTEING

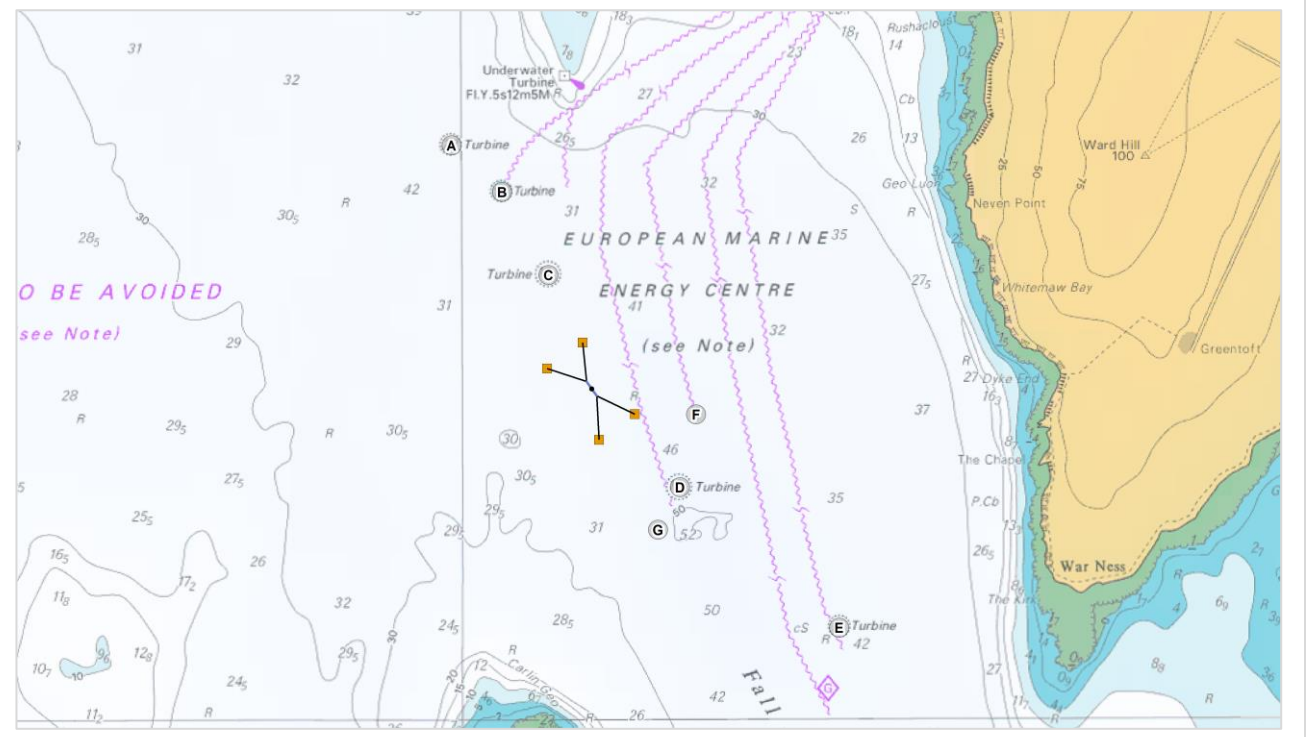
7.1.1 Charting of the Test Site

During this assessment it became clear that the current large scale Admiralty chart covering the Fall of Warness[5] including all updates issued by weekly Notice to Mariners, does not accurately reflect the current situation within the test site. In particular a number of turbines and other obstructions which have been removed are still charted as extant, and some of the clearance depths over remaining obstructions are less than is available in practice. This has resulted in some mariners (e.g. the ferries) believing there is less sea room available than is actually the case.

In this case the removal of obstructions is just as relevant as the addition of new ones, and every change in the area should be charted without delay.

This report uses the latest available UKHO chart background (fully corrected to January 2021), but additionally highlights further corrections to illustrate the actual situation at the test site, which are illustrated in **Figure 7-1** below.

[5] Chart 2562 Plans in Northern Orkney Isles



A	No turbine deployed.
B	Voith turbine. No longer deployed. Monopile remains in place 13m from seabed (Approximately 20m water depth).
C	Atlantis turbine. No longer deployed. Clear seabed.
D	Hammerfest turbine. No longer deployed. Tripod foundation remains, standing 22m from seabed (Approximately 28m water depth).
E	TGL turbine. No longer deployed. Clear seabed.
F	Orbital Marine Power floating tidal turbine. Not present, due for installation within 6 months.
G	Magallanes floating tidal turbine. Not present, due for installation within 6 months.

Figure 7-1: Summary of Additional Chart Corrections

7.1.2 Routing Advice for Mariners

The Fall of Warness is recognised as a challenging area for navigation, and the Admiralty Sailing Directions[6] give specific advice for route planning in the locality.

In particular the Directions draw attention to the strong tidal streams in the area (5.293 to 5.296) and the presence of the tidal device testing site (5.291 to 5.292).

[6] ADMIRALTY SAILING DIRECTIONS: NORTH COAST OF SCOTLAND PILOT (NP52 | 10TH EDITION | 2018)

Furthermore, specific routing guidance is given for passages east and west of Muckle Green Holm (5.299 and 5.300). While passage to the east through the Falls of Warness is "preferred to passing west", the directions are clear that mariners should be aware of the EMEC test site, and clear routing directions are given for the westward passage for those navigators wishing to avoid the test site.

EMEC also issue clear routing guidance, which is readily available locally, and published online[7] – see **Figure 7-2** below. It can therefore be expected that most, and especially inexperienced and non-local mariners, will actively avoid transiting the site.

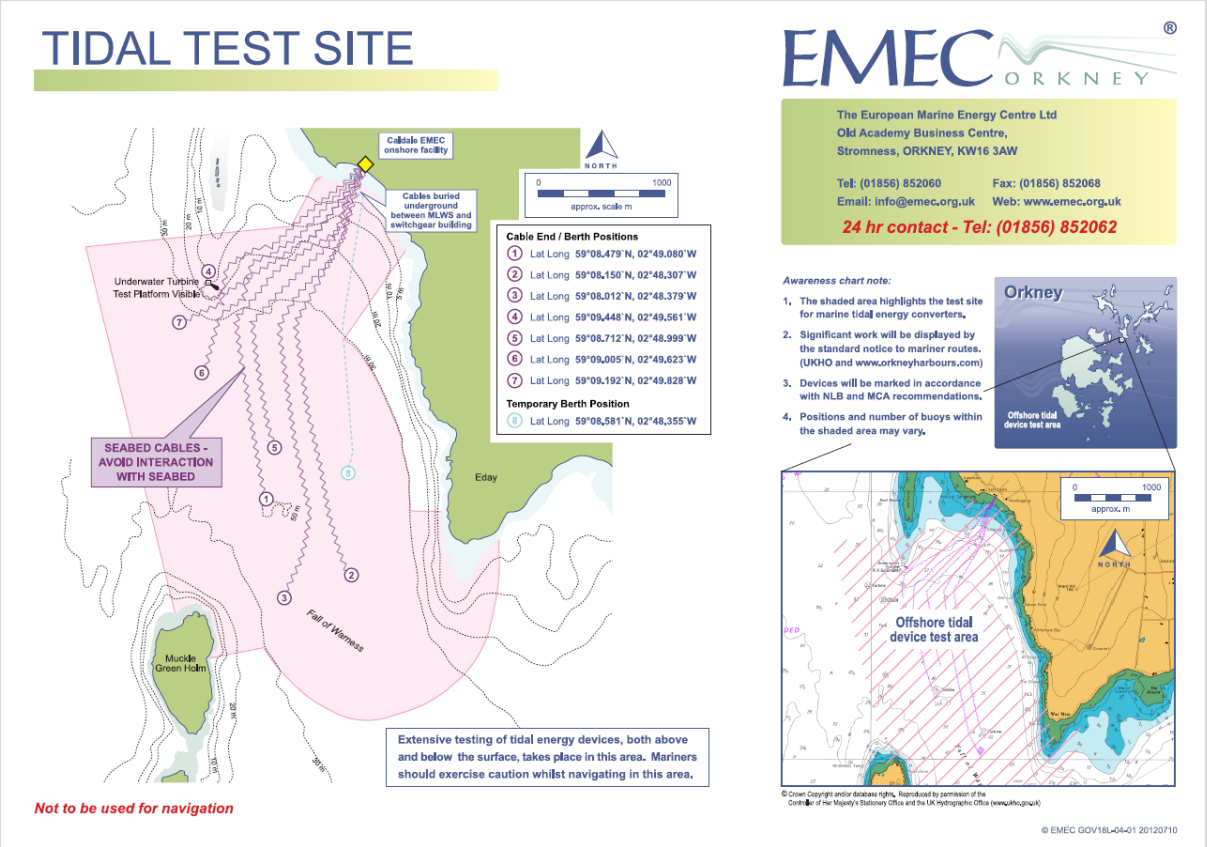


Figure 7-2: EMEC Tidal Test Site Awareness Document

7.1.3 Deep Draught Vessels

The available AIS data did not allow reliable identification of deep draught vessels, but an assumption was made that vessels of over 100m LOA would be relatively deep draught compared with other traffic. The analysis identified that such vessels occasionally transit through the Fall of Warness, to the east of the Muckle Green Holm. With the Orbital O2 devices in place on both Berths 5 and 6 (and the

[7] http://www.emec.org.uk/?wpfb_dl=51

Magallanes Ocean 2G device on Berth1), a navigable corridor will exist between the shallows of Muckle Green Holm and the devices. The Orbital Devices on Berth 5, and especially the device under assessment on Berth 6 will have less impact on this corridor than the device on Berth 1, which will reduce the width of the navigable corridor to 0.45nm.

Figure 7-3 below illustrates the recorded AIS tracks for vessels >100m LOA during the study period. It should be noted that these tracks represent decisions by mariners before any devices were in place, and naturally, post installation routes will be planned to use the navigable corridor to the west, as described above.

The PIANC Harbour Design Guidelines (2014) give criteria for acceptable widths of channels. Given the considerable depth of water and the prevailing metocean conditions being longitudinal rather than across the traffic flow, a 0.45nm fairway is considered to be sufficient.

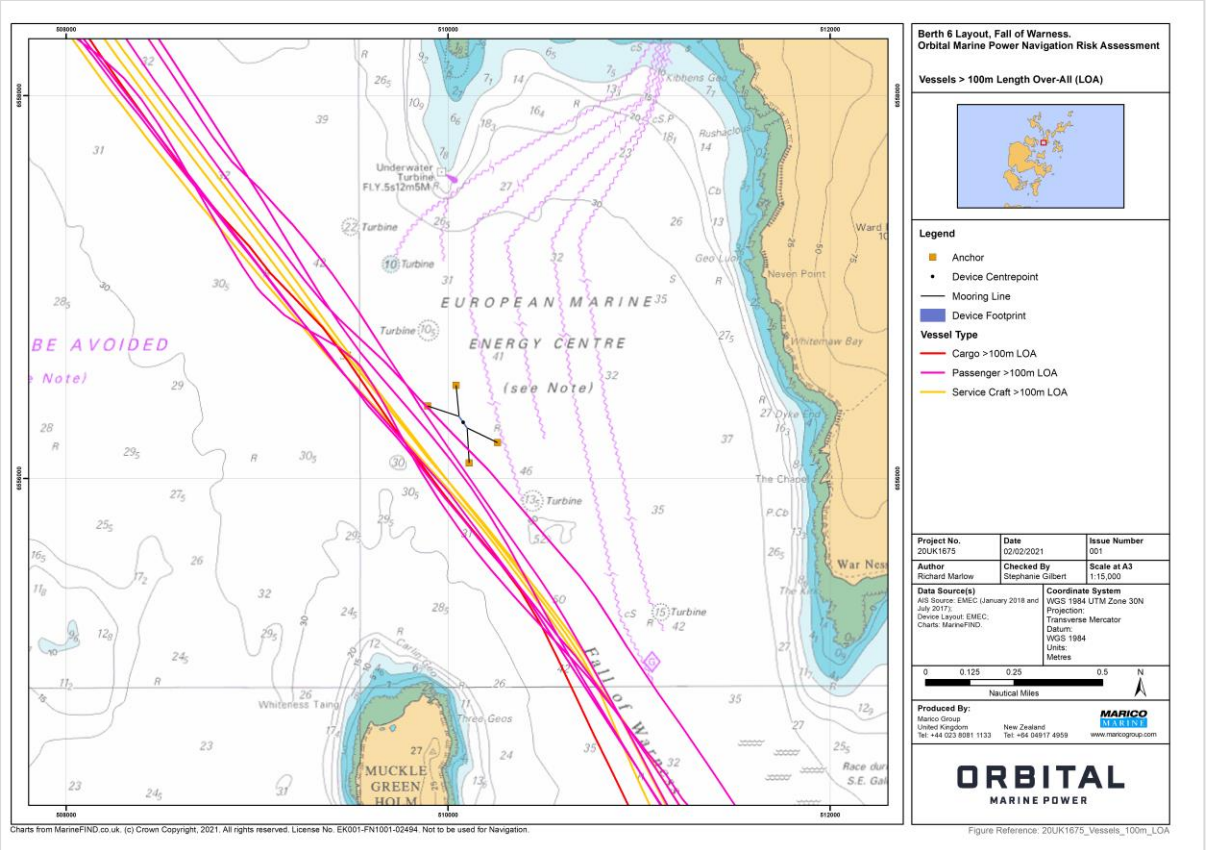


Figure 7-3: Transits of Vessels > 100m LOA.

7.1.4 Impact on Navigation during Significant Tidal Flows

Figure 7-2 and **Figure 7-3** show examples of the transits of regular runners when the tidal flows are at their peak in a north-westerly and south-easterly directions. It can be seen that vessels take advantage

of the lee behind the Muckle Green Holm when the tides are north-westerly. When the flow is from the south-east, vessels keep a wide berth from the Fall of Warness.

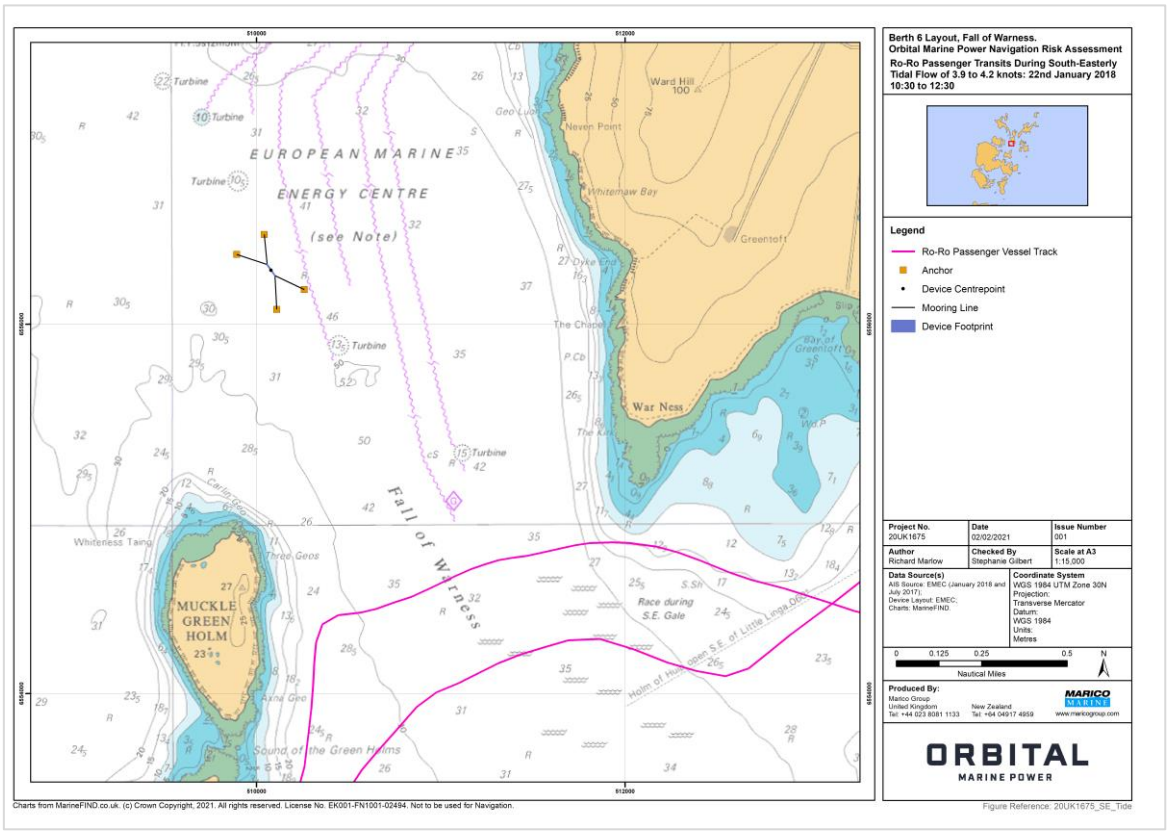


Figure 7-4: Ro-Ro Passenger Vessel transits during south-easterly tide.

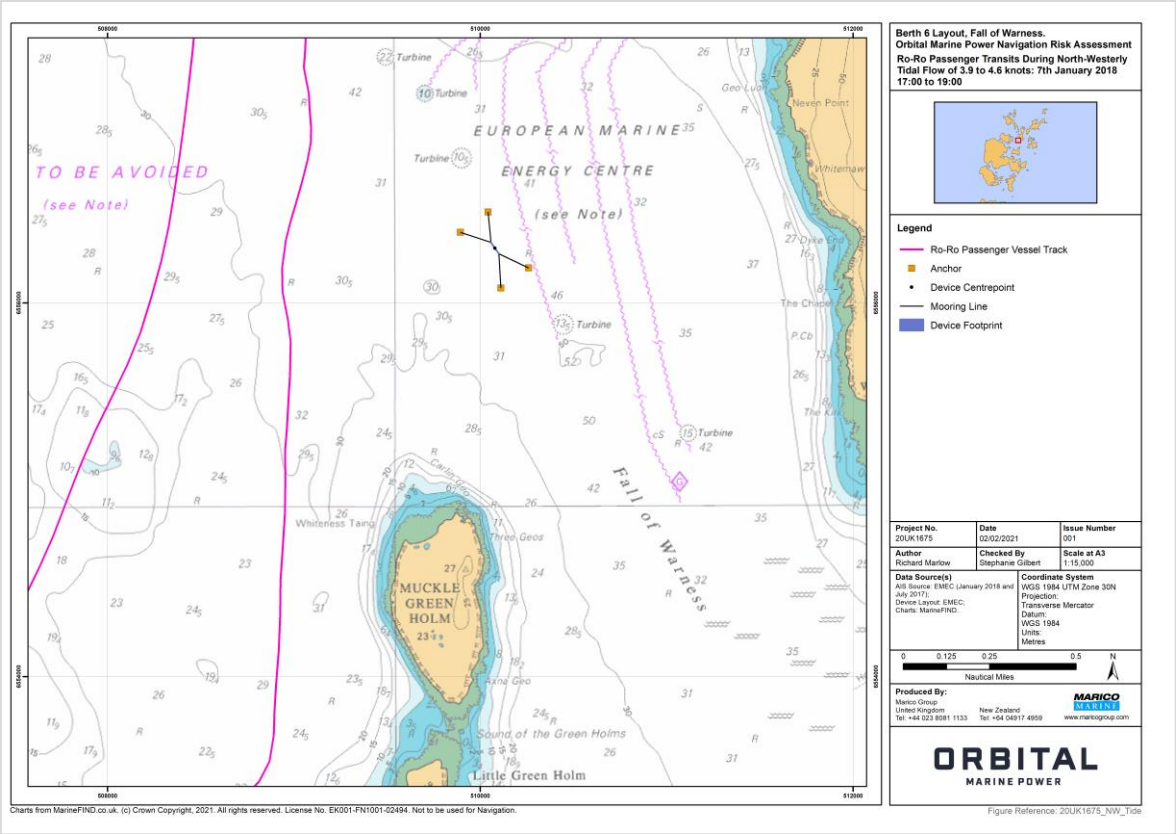


Figure 7-5: Vessel transits during sample north-westerly flows.

7.1.5 Navigating during Strong South-Easterly Winds

During consultation it was revealed the during bad weather it was common for ferries to come into the Fall of Warness site. During a strong south-easterly wind, significant overfalls, wave heights and a race can be expected to the south of Eday. Ferries would therefore pass to the east of Muckle Green Holm, come into the EMEC site passing to the north of the Orbital O2, before turning to come in close to the headland to the south-west of Eday. This allows the vessels some degree of shelter and means that they are not exposed beam on to the conditions. **Figure 7-4** shows an example of this activity.

Whilst this activity brings the vessels closer to the test berth, it was not considered a significant risk by Orkney Ferries during consultation as they are used to passing clear of the existing devices and have not previously encountered any issues.

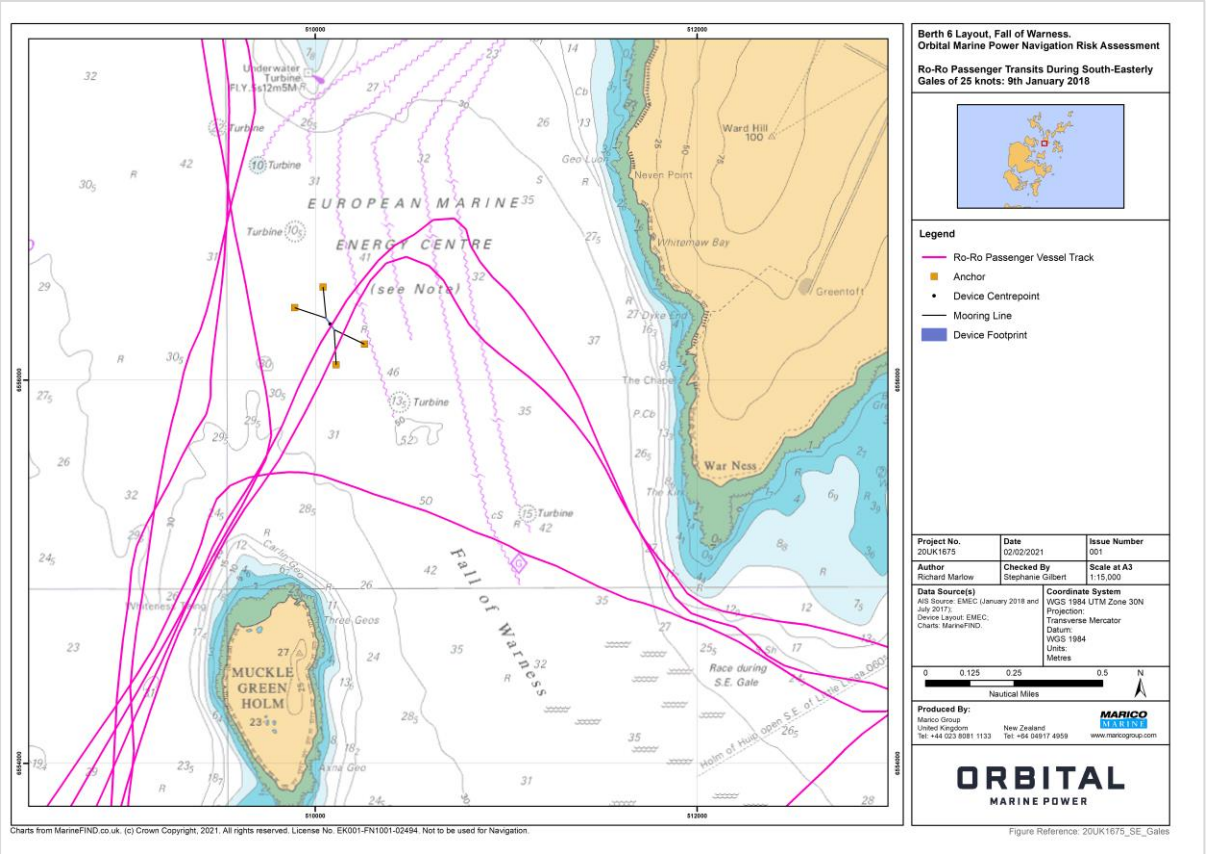


Figure 7-6: Passenger Vessels during SE gales of 25 knots - 09/01/2018

7.1.6 Recreational Craft Routeing

Recreational craft may pass through the Fall of Warness on passage in the Orkneys. The presence of the device would not restrict access to the area and a significant inshore route would remain open to pass to the east. It is not anticipated that the device would alter recreational craft routeing in any way or offset them into commercial shipping routes.

7.2 IMPACT ON CONTACT RISK

A commercial vessel may collide with the device for many reasons, principally human error or mechanical failure. The presence of the device will not increase the relative likelihood that these two causes occur, however the relative risk is increased if vessel traffic must necessarily transit closer, providing less room to correct an error should it occur. There is a low frequency of movements past the device through the Falls of Warness.

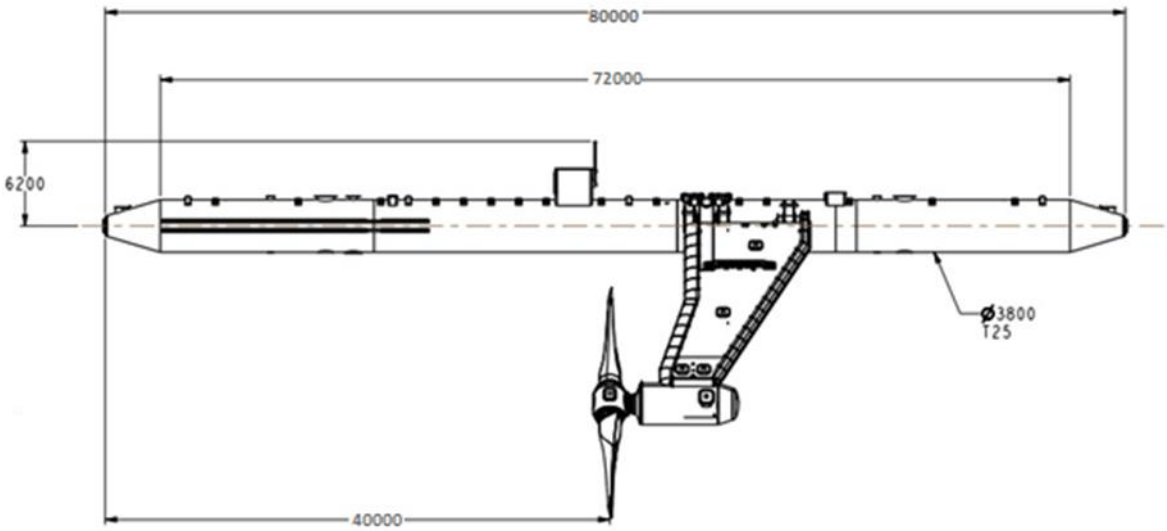
There are no historical contact incidents reported with the existing devices in the Fall of Warness. The device will be well marked and fitted with AIS and suitable radar reflecting materials to increase its visibility and lessen contact risk.

7.3 IMPACT ON COLLISION RISK

Although near to vessel traffic routes, the number of transits through the route is low. There is more than 0.5nm of navigable sea room to the east and west of the Fall of Warness devices.

There are no reported instances of collisions as a result of the presence of the devices.

7.4 IMPACT ON UNDER KEEL CLEARANCE



shows a schematic of the device and the dimensions are given in **Table 8**. The diameter of the blades is 22 metres and the depth of the rotor tips when extended is 3.2m below the surface. The EMEC Section 36 consent envelope specifies a minimum clearance of 2.5 m from the rotor tips to the water surface. When the legs are up (for transport or in order to access nacelles for maintenance), the device falls short of this requirement. However, it was noted that on these occasions (see **Section 2.5**) there would be a maintenance vessel present increasing visibility of the device, and able to provide warnings to other traffic. Such operations would be widely promulgated by Notices to Mariners, radio broadcasts and other available communication channels. Additionally, when the legs are raised, visibility of the device will increase as the majority of the legs will be resting at the water surface.

For a navigating vessel to collide with the blades while the blades are lowered, the vessel must be drawing at least 3.2 metres. A collision would, therefore, only be possible within 23m of the device. Small vessels would be unlikely to draw enough and larger vessels would have to be navigating well within the voluntary navigation exclusion zone of 500m (300m for ferries) to be capable of contacting the blades.

Table 8: Device Characteristics

Device Characteristic	Dimension (m)
Hull length Over-All	80
Beam of Hull Tube	3.8
Depth to uppermost rotor tip when rotors extended	3.2
Depth to bottom rotor tip (deepest point)	25.2
Depth of platform below waterline	2.3
Height of hull tube exposed above the water surface	1.5

7.5 IMPACT ON CABLE RISK

An umbilical and new seabed cable will be required between the device and the existing cable infrastructure of less than 600 metres.

The export cables for this device are pre-installed and, therefore, the risks will not change from the baseline environment.

7.6 IMPACT ON SEARCH AND RESCUE

The device will not alter the capability of search and rescue operations in the area or interfere with RNLI or helicopter operations.

An ERCOP plan for the site should be prepared and submitted to the MCA.

7.7 IMPACT ON VISUAL NAVIGATION AND COLLISION AVOIDANCE

Given that the device is less than 2m high above the waterline, most vessels will be visible to others over the top when navigating in the area. The exception may be small pleasure craft and maintenance vessels working on the device. Prudent mariners will provide sufficient clearance from the device when navigating and this will further reduce the chance of a hidden vessel emerging in a collision scenario.

The location is not on the leading line of any navigational aids nor will it significantly alter the visibility of other lights or buoyage. It should be marked in accordance with the requirements of the Northern Lighthouse Board and could serve as an additional aid to navigation for navigating vessels. As the rotors are subsurface, there will be minimal noise generated.

When the Orbital O2 is not on site, the moorings and cables will be marked as follows; two 1m diameter pickup buoys at the mooring ends, in addition to an A4 polyform buoy with a trailing pick up foam buoy at the cable end. Such occasions are expected to be brief and will be promulgated by Notices to Mariners in advance.

7.8 IMPACT ON COMMUNICATIONS, RADAR AND POSITIONING SYSTEMS

The hull length is 80m LOA and has an exposed hull tube height of 1.5m. Given that the generating infrastructure exists below the surface, there is no anticipated impact upon communications, radar and positioning systems.

During construction and decommissioning works, it will be likely that there will be works vessels on station in close proximity to the devices. This could cause shadowing of the device from other navigating vessels. However, it is likely that the works vessels would be in close proximity and, therefore, this would not pose a hazard to navigation.

7.9 CUMULATIVE AND IN-COMBINATION EFFECTS

As previously discussed, several other devices may be located in close proximity to the Berth 6 site. Notably, devices will be in position on Berths 1 and 5 by the time this device is installed. As discussed in **Section 7.1.3**, for those deep draught vessels whose passage is through the Fall of Warness, it is likely that they would pass to the west of all of the devices as discussed in **sections 7.1.2 and 7.1.3,** rather than in between any of them due to the limited sea room.

The Westray project described in **section 3.4.2** remains in the early stages of development and if successful will likely not be present for some years. No other nearby developments or proposals have been identified in the project area likely to lead to cumulative or in combination effects.

8 EMBEDDED RISK CONTROLS

A number of risk controls are embedded in the design of the project and have been included in the risk assessment.

Table 9: Embedded Risk Controls

ID	Name	Description
1.	Inspection and Maintenance Programme	Regular maintenance regime by developer to check the device, its fittings and any signs of wear and tear. This should identify any failings which might result in a mooring failure and therefore prevent breakout.
2.	Remote shut down including feathering of blades	Device to be fitted with ability to shut down in an emergency and feather the blades.
3.	PPE	Maintenance teams to wear suitable PPE when working on the device, including life jackets.
4.	Training of staff	Staff to be trained to required standards for their work and have suitable local knowledge of regulations and operations in the Orkneys.
5.	GPS Alerting for turbine moving	Remote monitoring of device to detect any major movements that might indicate a breakout for immediate response.
6.	ERCOP	Emergency Response and Cooperation Plan for site to be developed and issued to the MCA for comment.
7.	Layout Plan	Layout plan of the site, drawings, markings and coordinates to be issued to the MCA and NLB for comment.
8.	Marking and Lighting	Device to be lit by 2x yellow lights with synchronised flashing evert three seconds with a nominal range of 3 nautical miles mounted a minimum of 3m above the waterline.
9.	Notice to Mariners	Notice to Mariners to be issued prior to any works or deployment to Orkney Marine Services team. Distribution should also include Marina noticeboards, Fisheries Association, UKHO, Orkney Ferries and linked to on the EMEC website.
10.	Tow risk assessment and passage plan	As required under Orkney Harbours Pilotage Directions 4(3), prior to the conduct of the tow, a risk assessment and passage plan for the move to be conducted. Plan should account for the size of the tow, arrangements and met-ocean conditions.
11.	Agreed weather window for tow	Met-ocean limits to be defined prior to the tow to ensure an adequate weather window and tidal conditions are suitable.
12.	Incident monitoring and reporting	EMEC to encourage incident/near miss reporting and monitor any safety issues at the project sites. If necessary, risk control to be reviewed. Risk assessments to be reviewed following any incidents.

ID	Name	Description
13.	Site Access Application for Maintenance Vessels	All maintenance vessels should be approved before accessing the EMEC sites. EMEC to be aware of any maintenance operations before they are conducted.
14.	Hydrography	Pre-installation and post-decommissioning surveys of project site.
15.	Radar Reflectors	Orbital O2 is to be fitted with radar reflectors at a minimum of 3m above the water line improving visibility during bad weather.
16.	AIS	The device is to be fitted with an AIS transponder as specified by NLB.

9 NAVIGATION RISK ASSESSMENT

9.1 INTRODUCTION AND METHODOLOGY

This NRA was commissioned to assess the impact on navigation potentially caused by the project. The NRA is limited to identifying and quantifying any additional or increased navigational risk resulting from the project. It subsequently identifies possible mitigation measures where appropriate and makes recommendations.

The process starts with the identification of all potential hazards. It then assesses the likelihood (frequency) of a hazard causing an incident and considers the possible consequences of that incident. It does so in respect of two scenarios, namely the "most likely" and the "worst credible". The quantified values of frequency and consequence are then combined using the Marico HAZMAN ll software to produce a risk score for each hazard. These are collated into a "Ranked Hazard List" from which the need for possible additional mitigation may be reviewed.

The hazards were scored using the collective experience of the project team and consultees, with traffic analysis, incident analysis and other available information to support the assessment. For a description of the risk assessment methodology see **Annex B**.

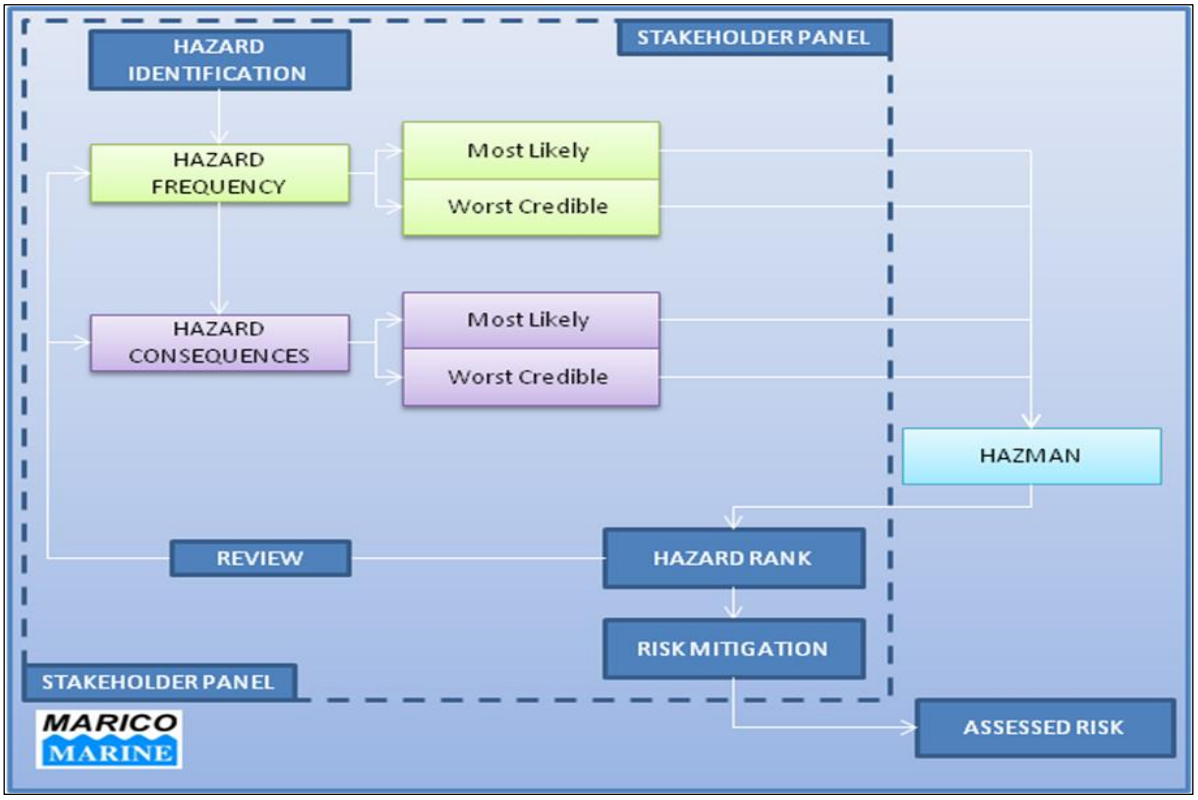


Figure 9-1: Marico Marine Risk Assessment Methodology

9.1.1 Hazard Identification

The following hazard types were identified.

- **Collision** – two navigating vessels come into contact;
- **Contact/Allision** – a navigating vessel comes into contact with a fixed or stationary object (including the Orbital O2 device);
- **Grounding** – a navigating vessel makes contact with the seabed;
- **Obstruction** – A vessel or its equipment becomes entangled with subsurface infrastructure, including moorings or cables;
- **Breakout –** Device breaks its moorings and becomes a hazard to shipping or runs aground;

Vessel categories were defined as follows:

- **Commercial Shipping** – cargo and tankers that carry cargo (including ro-ro, container, bulk or liquid).
- **Passenger Vessels** – Passenger ferries and cruise ships;
- **Fishing Vessels** – vessels of all sizes engaged in commercial fishing or trawling;
- **Recreational Vessels** – yachts and pleasure craft;
- **Tugs and Service Craft** – workboats, tugs, pilot vessels and maintenance vessels. Small craft whose primary purpose is commercial.

10 RISK ASSESSMENT RESULTS

The risk assessment was divided into the following categories:

- Device on Site (operation, maintenance, construction, decommissioning)
- Device under Tow (to and from site for installation, maintenance and decommissioning)

10.1.1 Device on Site

The device on site risk assessment was scored assuming the worst credible footprint and as such the increased footprint resulting from support vessels and raised legs during maintenance, construction and decommissioning was considered.

The summary risk assessment is given in **Table 11**. All hazards were scored as Low Risk with embedded mitigation in place, as most regular runners and fishermen are already aware of the hazards in the area. However, additional risk controls (**Table 10**) are recommended. The highest scoring hazard is 'Maintenance Vessel Contacts Device', due to the proximity of the maintenance vessels (including

vessels associated with installation and decommissioning) to the device, in comparison to the general in-transit vessel traffic.

Table 10: Summary Risk Assessment -Device on Site

ID	Hazard Title	Hazard Detail	Risk Score
5	Maintenance Vessel Contacts Device	Maintenance vessel contacts the device during installation, maintenance or decommissioning.	3.96
2	Passenger Vessel Contacts Device	A passenger vessel contacts the device, or a stationary attending project vessel during construction, maintenance or decommissioning activities	3.10
4	Recreational Vessel Contacts Device	A recreational vessel contacts the device, or a stationary attending project vessel during construction, maintenance or decommissioning activities	3.06
3	Fishing Vessel Contacts Device	A fishing vessel contacts the device, or a stationary attending project vessel during construction, maintenance or decommissioning activities	2.98
1	Commercial Ship Contacts Device	A commercial vessel contacts the device, or a stationary attending project vessel during construction, maintenance or decommissioning activities	2.93
10	Grounding Maintenance Vessel	A maintenance vessel grounds whilst on passage to/from the device for project related activities	2.86
9	Collision Maintenance Vessel	A navigating vessel collides with a tug or maintenance vessel (Including construction/decommissioning vessel).	2.71
7	Third Party Collision Due to Avoidance of Device	Two navigating vessels collide due to the presence of the device	2.54
8	Third Party Grounding Due to Avoidance of Device	A navigating vessel (all types) grounds due to the presence of the device	2.54
11	Breakout of Device from Moorings	The device's moorings fail and device becomes a hazard to navigation	2.31
6	Fishing Gear Interaction with Device	A fishing vessel's gear interacts with the device or its moorings.	1.95

10.1.2 Device Under Tow

The risk assessment for the tow of the device to Berth 6 is given in **Table 12.** All hazards were assessed to Low Risk with embedded mitigation in place. However, additional risk controls are recommended to be implemented. The most significant hazard is a contact between the device and the towing vessels, as a result of human error or mechanical failure. Vessels usually give a wide berth to a towing vessel, so the probability of a collision is low, but the proximity of the tug and the tow makes this

incident more likely. Other hazards during the passage are not considered likely, provided the tow is thoroughly planned and undertaken during suitable met-ocean conditions.

Table 11: Tow Summary Risk Assessment.

ID	Hazard Title	Hazard Detail	Risk Score
2	Contact between device and tugs	Towing vessel and the device come into contact during the tow operation.	2.71
1	Grounding of device	Tug and/or device runs aground	2.61
4	Collision during tow	Tug and/or device collides with another navigating vessel	2.61
5	Contact during tow	Tug and/or device come into contact with an obstacle. E.g. other EMEC devices, harbour infrastructure, navigation aids.	2.61
6	Third party collision	Third Party Collision due to avoidance of device during tow	2.57
7	Third party grounding	Third Party Grounding due to avoidance of device during tow	2.49
3	Breakout of device while under tow	The tow fails resulting in device breakout	1.37

Full hazard logs are contained in **Annex D** and **Annex E.**

11 POSSIBLE ADDITIONAL RISK CONTROLS

Further possible additional risk controls identified during the assessment are as below.

It is noted that items 1 and 2 are likely to be embedded in operational plans but are stated here for clarity.

Table 12: Possible Additional Risk Controls

ID	Name	Description
1.	Heightened monitoring in adverse met-ocean conditions	During gale force winds, periodic monitoring of the device is recommended to ensure excessive forces are not acting on the moorings which might cause a breakout.
2.	Pre-planning with Orkneys Harbour prior to deployment and tow	Prior to the project tow, Orkney Marine Services Harbourmaster to be informed of the programme and towage plan. If considered necessary, safety information will be broadcast to other vessels on Channel 16.

12 CONCLUSIONS AND RECOMMENDATIONS

12.1 CONCLUSIONS

- The Incident rate is low with only 9 incidents recorded between 1997 and 2018.
- Few vessels transit past the Fall of Warness site, with 76 transits recorded within 0.5nm of the device within winter and 85 in summer.
- Fishing vessels are the most common vessel type within close proximity to the device location.
- The contact and collision risk is low with 0.45nm of navigable room to the west of the Fall of Warness site.
- All hazards were scored as low risk.
- The highest scoring hazards were associated with project vessels (maintenance and towing), due to the proximity of the vessels to the device. The risk however, was scored as low, due to the experience and awareness of the project vessel team.
- Consultation confirmed that the majority of local marine users are used to navigating around the existing berths /devices within the area and as such, were not concerned with the presence of the new device.
- A review of the impacts of the devices shows little impact on collision and contact risk, search and rescue or communications, radar and position systems.
- Two additional risk control measures have been identified, implementation of which is recommended.
- The risk assessment considered the increase in risk when the legs are raised in order to access nacelles for maintenance and while in transport. The risk was scored as low due to, the infrequent occurrence of such scenario, the increased visibility of the device and the presence of a maintenance vessel with the ability to provide warnings to other traffic. Such operations would be widely promulgated by Notices to Mariners, radio broadcasts and other available communication channels.

12.2 RECOMMENDATIONS

- Heightened monitoring during adverse weather conditions is recommended to ensure excessive forces are not acting on the moorings which might cause a breakout.
- Prior to project tows, Orkney Marine Services Harbourmaster to be informed of the programme and towage plan. If considered necessary, safety information should be broadcast to other vessels.
- Procedures for dialogue between EMEC / Developers and the UKHO should be reviewed to ensure that all devices and obstructions on the test site are accurately charted through timely issue of Notices to Mariners and chart corrections.

12.3 SUMMARY

- In summary, the increase in risk to navigating vessels as a result of the installation, operation (including maintenance) and decommissioning of the Orbital O2 device is Low.

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Annex A MGN 543 Checklist

MGN 543 (M+F) Safety of Navigation: Offshore Renewable Energy Installations –

Guidance on UK Navigational Practice, Safety and Emergency Response

Issue: OREI Response	Yes/No	Comments
Annex 1 : Considerations on Site Position, Structures and Safety Zones		
3. 1. Site and Installation Co-ordinates: Developers are responsible for ensuring that formally agreed co-ordinates and subsequent variations of site perimeters and individual OREI structures are made available, on request, to interested parties at relevant project stages, including application for consent, development, array variation, operation and decommissioning. This should be supplied as authoritative Geographical Information System (GIS) data, preferably in Environmental Systems Research Institute (ESRI) format. Metadata should facilitate the identification of the data creator, its date and purpose, and the geodetic datum used. For mariners' use, appropriate data should also be provided with latitude and longitude coordinates in WGS84 (ETRS89) datum.		
4. Traffic Survey – includes:		
All vessel types	✓	**Section 5**
At least 28 days duration, within either 12 or 24 months prior to submission of the Environmental Statement	✓	**Section 5 –** AIS Only
Multiple data sources	✓	**Section 5 –** AIS Only
Seasonal variations	✓	**Section 5 –** January and July
MCA consultation	✓	**Section 4 and Annex C**
General Lighthouse Authority consultation	✓	**Section 4 and Annex C** - NLB
Chamber of Shipping consultation	**X**	
Recreational and fishing vessel organisations consultation.	✓	**Section 4 and Annex C –** Orkney Marinas and Orkney Fisheries Association
Port and navigation authorities consultation, as appropriate	✓	**Section 4 and Annex C -** Orkney Islands Council Marine Services
Assessment of the cumulative and individual effects of (as appropriate):		
i. Proposed OREI site relative to areas used by any type of marine craft.	✓	**Section 5 and Section 7.1**
ii. Numbers, types and sizes of vessels presently using such areas	✓	**Section 5**

iii. Non-transit uses of the areas, e.g. fishing, day cruising of leisure craft, racing, aggregate dredging, etc.	✓	**Section 5**
iv. Whether these areas contain transit routes used by coastal or deep-draught vessels on passage.	✓	**Section 5**
v. Alignment and proximity of the site relative to adjacent shipping lanes	✓	**Section 5 and Section 7.1**
vi. Whether the nearby area contains prescribed routeing schemes or precautionary areas	✓	**Section 3.2**
vii. Whether the site lies on or near a prescribed or conventionally accepted separation zone between two opposing routes	✓	**Section 3.2**
viii. Proximity of the site to areas used for anchorage, safe haven, port approaches and pilot boarding or landing areas.	✓	**Section 3.2**
ix. Whether the site lies within the jurisdiction of a port and/or navigation authority.	✓	**Section 3.2**
x. Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds.	✓	**Section 5**
xi. Proximity of the site to offshore firing/bombing ranges and areas used for any marine military purposes.	✓	**Section 3.4**
xii. Proximity of the site to existing or proposed offshore oil / gas platform, marine aggregate dredging, marine archaeological sites or wrecks, Marine Protected Area or other exploration/exploitation sites.	✓	**Section 3.4**
xiii. Proximity of the site to existing or proposed OREI developments, in co-operation with other relevant developers, within each round of lease awards.	✓	**Section 3.4**
xiv. Proximity of the site relative to any designated areas for the disposal of dredging spoil or other dumping ground	✓	**Section 3.4**
xv. Proximity of the site to aids to navigation and/or Vessel Traffic Services (VTS) in or adjacent to the area and any impact thereon.	✓	**Section 3.2**
xvi. Researched opinion using computer simulation techniques with respect to the displacement of traffic and, in particular, the	✓	**Section 7.3**

creation of 'choke points' in areas of high traffic density and nearby or consented OREI sites not yet constructed.		
xvii. With reference to xvi. above, the number and type of incidents to vessels which have taken place in or near to the proposed site of the OREI to assess the likelihood of such events in the future and the potential impact of such a situation.	✓	**Section 5.4**
3. OREI Structures – the following should be determined:		
a. Whether any feature of the OREI, including auxiliary platforms outside the main generator site, mooring and anchoring systems, inter-device and export cabling could pose any type of difficulty or danger to vessels underway, performing normal operations, including fishing, anchoring and emergency response.	✓	**Section 7**
b. Clearances of wind turbine blades above the sea surface are *not less than 22 metres* above MHWS.		**N/A**
c. Underwater devices i. changes to charted depth ii. maximum height above seabed iii. Under Keel Clearance	✓	**Section 7.4**
d. The burial depth of cabling and changes to charted depths associated with any protection measures.	✓	**Section 7.5**
4. Assessment of Access to and Navigation Within, or Close to, an OREI to determine the extent to which navigation would be feasible within the OREI site itself by assessing whether:		
a. Navigation within or close to the site would be safe:		
i. by all vessels, or ii. by specified vessel types, operations and/or sizes. iii. in all directions or areas, or iv. in specified directions or areas. **v.** in specified tidal, weather or other conditions	✓	**Section 7**
b. Navigation in and/or near the site should be:		
i. prohibited by specified vessels types, operations and/or sizes. ii. prohibited in respect of specific activities, iii. prohibited in all areas or directions, or iv. prohibited in specified areas or directions, or v. prohibited in specified tidal or weather conditions, or simply	✓ ✓ ✓ ✓	**Section 7** and **Section 11**

vi. recommended to be avoided.	✓	
c. Exclusion from the site could cause navigational, safety or routeing problems for vessels operating in the area e.g. by preventing vessels from responding to calls for assistance from persons in distress.	✓	**Section 8.2**
Relevant information concerning a decision to seek a safety zone for a particular site during any point in its construction, extension, operation or decommissioning should be specified in the Environmental Statement accompanying the development application	✓	**Section 11–** No Safety Zone
Annex 2 : Navigation, collision avoidance and communications		
5. The Effect of Tides and Tidal Streams : It should be determined whether:		
a. Current maritime traffic flows and operations in the general area are affected by the depth of water in which the proposed installation is situated at various states of the tide i.e. whether the installation could pose problems at high water which do not exist at low water conditions, and vice versa.	✓	**Section 3.1** and **Section 7.1**
b. The set and rate of the tidal stream, at any state of the tide, has a significant effect on vessels in the area of the OREI site.	✓	**Section 3.1** and **Section 7.1**
c. The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect.	✓	**Section 3.1** and **Section 7.1**
d. The set is across the major axis of the layout at any time, and, if so, at what rate.		**Section 3.1** and **Section 7.1**
e. In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream.	✓	**Section 3.1**
f. The structures themselves could cause changes in the set and rate of the tidal stream.	✓	**Section 2.1** and **Section 3.1**
g. The structures in the tidal stream could be such as to produce siltation, deposition of sediment or scouring, affecting navigable water depths in the OREI or adjacent to the area	✓	**Section 7.4**
2. Weather: It should be determined whether:		

a. The site, in normal, bad weather, or restricted visibility conditions, could present difficulties or dangers to craft, including sailing vessels, which might pass in close proximity to it.	✓	**Section 2.1** and **Section 3.1**
b. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	✓	**Section 2.1** and **Section 3.1**
c. In general, taking into account the prevailing winds for the area, whether engine failure or other circumstances could cause vessels to drift into danger, particularly if in conjunction with a tidal set such as referred to above.	✓	**Section 2.1, Section 3.1** and **Section 9**
3. Collision Avoidance and Visual Navigation: It should be determined whether:		
a. The layout design will allow safe transit through the OREI by SAR helicopters and vessels.	✓	**Section 7.6**
b. The MCA's Navigation Safety Branch and Maritime Operations branch will be consulted on the layout design and agreement will be sought.	✓	**Section4** **Section 8**
c. The layout design has been or will be determined with due regard to safety of navigation and Search and Rescue.	✓	**Section 7.6**
d.i. The structures could block or hinder the view of other vessels under way on any route.	✓	**Section 7.7**
d.ii. The structures could block or hinder the view of the coastline or of any other navigational feature such as aids to navigation, landmarks, promontories, etc.	✓	**Section 7.7**
6. **4. Communications, Radar and Positioning Systems -** To provide researched opinion of a generic and, where appropriate, site specific nature concerning whether:		
a. The structures could produce radio interference such as shadowing, reflections or phase changes, and emissions with respect to any frequencies used for marine positioning, navigation and timing (PNT) or communications, including GMDSS and AIS, whether ship borne, ashore or fitted to any of the proposed structures, to: i. Vessels operating at a safe navigational distance	✓ ✓	**Section 7.8**

ii. Vessels by the nature of their work necessarily operating at less than the safe navigational distance to the OREI, e.g. support vessels, survey vessels, SAR assets. iii. Vessels by the nature of their work necessarily operating within the OREI.	✓ ✓	
b. The structures could produce radar reflections, blind spots, shadow areas or other adverse effects: i. Vessel to vessel; ii. Vessel to shore; iii. VTS radar to vessel; iv. Racon to/from vessel.	✓ ✓ ✓ ✓ ✓	**Section 7.8**
c. The structures and generators might produce sonar interference affecting fishing, industrial or military systems used in the area.	✓	**Section 7.8**
d. The site might produce acoustic noise which could mask prescribed sound signals.	✓	**Section 7.7** and **Section 7.8**
e. Generators and the seabed cabling within the site and onshore might produce electro-magnetic fields affecting compasses and other navigation systems.	✓	**Section 7.8**
5. Marine Navigational Marking: It should be determined:		
a. How the overall site would be marked by day and by night throughout construction, operation and decommissioning phases, taking into account that there may be an ongoing requirement for marking on completion of decommissioning, depending on individual circumstances.	✓	**Section 2.2.2** and **Section 8**
b. How individual structures on the perimeter of and within the site, both above and below the sea surface, would be marked by day and by night.	✓	**Section 2.2.4** and **Section 8**
c. If the specific OREI structure would be inherently radar conspicuous from all seaward directions (and for SAR and maritime surveillance aviation purposes) or would require passive enhancers.	✓	**Section 2.2.4** and **Section 8**

d. If the site would be marked by additional electronic means e.g. Racons	✓	**Section 2.2.4** and **Section 8**
e. If the site would be marked by an AIS transceiver, and if so, the data it would transmit.	✓	**Section 2.2.4** and **Section 8**
f. If the site would be fitted with audible hazard warning in accordance with IALA recommendations	✓	**Section 2.2.4** and **Section 8**
g. If the structure(s) would be fitted with aviation lighting, and if so, how these would be screened from mariners or guarded against potential confusion with other navigational marks and lights.	✓	**Section 2.2.4** and **Section 8**
h. Whether the proposed site and/or its individual generators complies in general with markings for such structures, as required by the relevant GLA in consideration of IALA guidelines and recommendations.	✓	**Section 2.2.4** and **Section 8**
i. The aids to navigation specified by the GLAs are being maintained such that the 'availability criteria', as laid down and applied by the GLAs, is met at all times.	✓	**Section 2.2.4** and **Section 8**
j. The procedures that need to be put in place to respond to casualties to the aids to navigation specified by the GLA, within the timescales laid down and specified by the GLA.	✓	**Section 2.2.4** and **Section 8**
k. The ID marking will conform to a spreadsheet layout, sequential, aligned with SAR lanes and avoid the letters O and I.	✓	**Section 2.2.4** and **Section 8**
l. Working lights will not interfere with AtoN or create confusion for the Mariner navigating in or near the OREI.	✓	**Section 2.2.4, Section 8**and **Section 7.7**
7. **6. Hydrography -** In order to establish a baseline, confirm the safe navigable depth, monitor seabed mobility and to identify underwater hazards, detailed and accurate hydrographic surveys are included or acknowledged for the following stages and to MCA specifications:		
i. Pre-consent: The site and its immediate environs extending to 500m outside of the development area shall be undertaken as part of the licence and/or consent application. The survey shall include all proposed cable route(s).	✓	**Section 8**
ii. Post-construction: Cable route(s)	✓	**Section8**

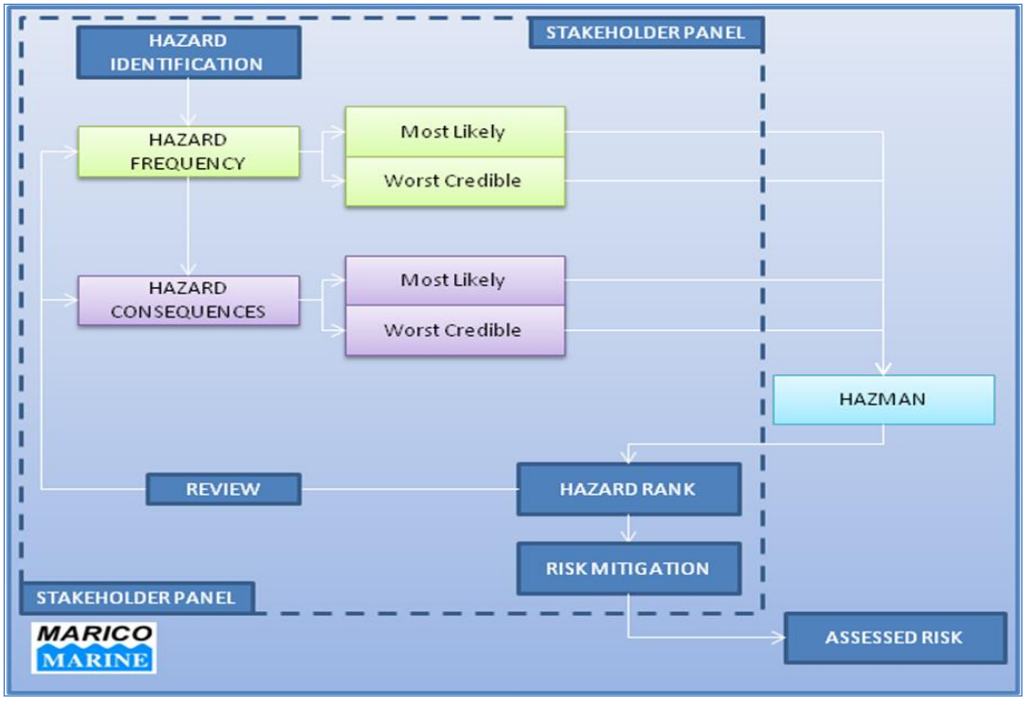
iii. Post-decommissioning of all or part of the development: Cable route(s) and the area extending to 500m from the installed generating assets area.	✓	**Section 8**
Annex 3: MCA template for assessing distances between OREI boundaries and shipping routes		
"Shipping Route" template and Interactive Boundaries – where appropriate, the following should be determined:		
a. The safe distance between a shipping route and turbine boundaries.	✓	**Section 7**
b. The width of a corridor between sites or OREIs to allow safe passage of shipping.	✓	**Section 7**
Annex 4: Safety and mitigation measures recommended for OREI during construction, operation and decommissioning.		
Mitigation and safety measures will be applied to the OREI development appropriate to the level and type of risk determined during the EIA. The specific measures to be employed will be selected in consultation with the Maritime and Coastguard Agency and will be listed in the developer's Environmental Statement (ES). These will be consistent with international standards contained in, for example, the SOLAS Convention - Chapter V, IMO Resolution A.572 (14)3 and Resolution A.671(16)4 and **could include any or all** of the following:	✓	**Section 8** **Section 11**
i. Promulgation of information and warnings through notices to mariners and other appropriate maritime safety information (MSI) dissemination methods.	✓	**Section 8** **Section 11**
ii. Continuous watch by multi-channel VHF, including Digital Selective Calling (DSC).		
iii. Safety zones of appropriate configuration, extent and application to specified vessels		
iv. Designation of the site as an area to be avoided (ATBA).	✓	**Section8** **Section 11**
v. Provision of AtoN as determined by the GLA	✓	**Section8**

		Section 11
vi. Implementation of routeing measures within or near to the development.	✓	**Section8** **Section 11**
vii. Monitoring by radar, AIS, CCTV or other agreed means	✓	**Section8** **Section 11**
viii. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of safety zones.	✓	**Section8** **Section 11**
ix. Creation of an Emergency Response Cooperation Plan with the MCA's Search and Rescue Branch for the construction phase onwards.	✓	**Section8** **Section 11**
x. Use of guard vessels, where appropriate	✓	**Section8** **Section 11**
xi. Any other measures and procedures considered appropriate in consultation with other stakeholders.	✓	**Section8** **Section 11**
Annex 5: Standards, procedures and operational requirements in the event of search and rescue, maritime assistance service counter pollution or salvage incident in or around an OREI, including generator/installation control and shutdown.		
The MCA, through HM Coastguard, is required to provide SAR and emergency response within the sea area occupied by all offshore renewable energy installations in UK waters. To ensure that such operations can be safely and effectively conducted, certain requirements must be met by developers and operators.		
a. An ERCoP will be developed for the construction, operation and decommissioning phases of the OREI.	✓	**Section 8**
b. The MCA's guidance document *Offshore Renewable Energy Installation: Requirements, Advice and Guidance for Search and Rescue and Emergency Response* for the design, equipment and operation requirements will be followed.	✓	**Section 8**

Annex B NRA Methodology

Methodology

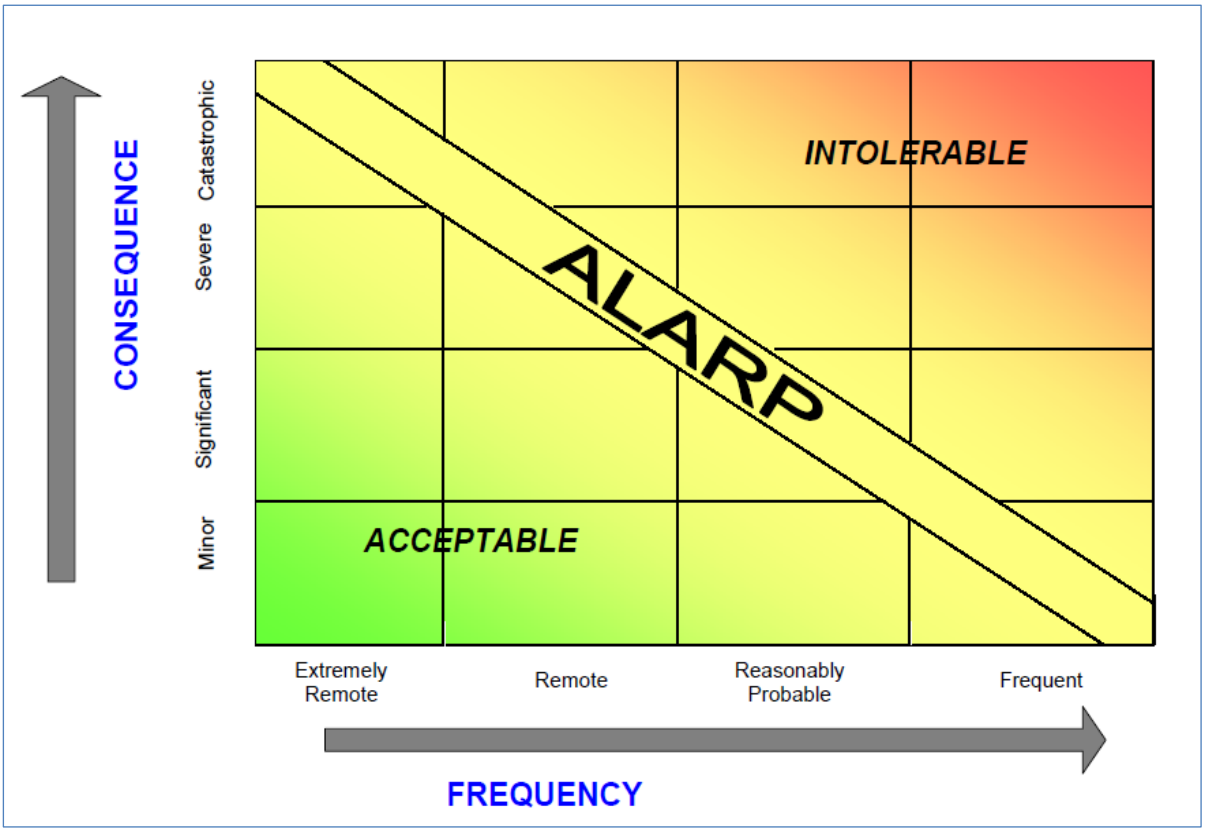
This Navigation Risk Assessment (NRA) was commissioned to assess the impact on navigation potentially caused by each of the phases of the project. The NRA is limited to identifying and quantifying any additional or increased navigational risk resulting from the project. It subsequently identifies possible mitigation measures where appropriate and makes recommendations. The process starts with the identification of all potential hazards. It then assesses the likelihood (frequency) of a hazard causing an incident and considers the possible consequences of that incident. It does so in respect of two scenarios, namely the "most likely" and the "worst credible". The quantified values of frequency and consequence are then combined using the Marico HAZMAN software to produce a Risk Score for each hazard. These are collated into a "Ranked Hazard List" from which the need for possible additional mitigation may be reviewed.



Marico Marine Risk Assessment Methodology.

Criteria for Navigational Risk Assessment

Risk is the product of a combination of consequence of an event and the frequency with which it might be expected to occur. In order to determine navigational risk a Formal Safety Assessment (FSA) approach to risk management is used. International Maritime Organisation (IMO) Guidelines define a hazard as "something with the potential to cause harm, loss or injury", the realisation of which results in an accident. The potential for a hazard to be realised can be combined with an estimated or known consequence of outcome. This combination is termed "risk". Risk is therefore a measure of the frequency and consequence of a particular hazard.



General risk matrix.

The combination of consequence and frequency of occurrence of a hazard is combined using a risk matrix which enables hazards to be ranked and a risk score assigned. The resulting scale can be divided into three general categories:

- Acceptable;
- As Low as Reasonably Practicable (ALARP); and
- Intolerable.

At the low end of the scale, frequency is extremely remote and consequence minor, and as such the risk can be said to be “acceptable”, whilst at the high end of the matrix, where hazards are defined as frequent and the consequence catastrophic, then risk is termed “intolerable”. Every effort should be made to mitigate all risks such that they lie in the “acceptable” range. Where this is not possible, they should be reduced to the level where further reduction is not practicable. This region, at the centre of the matrix is described as the ALARP region. It is possible that some risks will lie in the “intolerable” region, but can be mitigated by measures, which reduce their risk score and move them into the ALARP region, where they can be tolerated, albeit efforts should continue to be made when opportunity presents itself to further reduce their risk score.

The FSA methodology used in this NRA, determines where to prioritise risk control options for the navigational aspects of a project site. The outcome of this risk assessment process should then act as the basis for a Navigation Safety Management System, which can be used to manage navigational risk.

Hazard Identification

Hazard identification is the first and fundamental step in the risk assessment process. It was undertaken for this project by three Marico Marine specialists using the results of the analysis and feedback from local stakeholders. In order to ensure that the process was both structured and comprehensive, potential hazards were reviewed under the following headings;

- Project phase;
- Incident category; and
- Vessel type.

The two project phases have been assessed individually due to their different navigational risk exposure and magnitude, i.e. the different nature of the operations, the vessels involved, and the potential cost of any consequences. The five incident categories identified as being relevant to this study are:

- **Collision** – two navigating vessels come into contact;
- **Contact** – a navigating vessel comes into contact with a fixed or stationary object;
- **Grounding** – a navigating vessel makes contact with the seabed;
- **Interaction** – A vessel or its equipment becomes entangled with subsurface infrastructure, including moorings or cables;
- **Breakout –** Device breaks its moorings and becomes a hazard to shipping or runs aground;

The vessel types considered were:

- **Commercial Shipping** – cargo and tankers that carry cargo (including ro-ro, container, bulk or liquid).
- **Passenger Vessels** – Passenger ferries and cruise ships;
- **Fishing Vessels** – vessels of all sizes engaged in commercial fishing or trawling;
- **Recreational Vessels** – yachts and pleasure craft;
- **Tugs and Service Craft** – workboats, tugs, pilot vessels and maintenance vessels. Small craft whose primary purpose is commercial – including project vessels.

Risk Matrix Criteria

As indicated earlier, frequency of occurrence and likely consequence were both assessed for the "most likely" and "worst credible" scenario. Frequencies were assessed according to the levels set out below.

Frequency criteria.

Scale	Description	Definition	Operational Interpretation
F5	Frequent	An event occurring in the range once a week to once an operating year.	One or more times in 1 year
F4	Likely	An event occurring in the range once a year to once every 10 operating years.	One or more times in 10 years 1 - 9 years
F3	Possible	An event occurring in the range once every 10 operating years to once in 100 operating years.	One or more times in 100 years 10 – 99 years
F2	Unlikely	An event occurring in the range less than once in 100 operating years.	One or more times in 1,000 years 100 – 999 years
F1	Remote	Considered to occur less than once in 1,000 operating years (e.g. it may have occurred at a similar site, elsewhere in the world).	Less than once in 1,000 years >1,000 years

Using the assessed notional frequency for the "most likely" and "worst credible" scenarios for each hazard, the probable consequences associated with each were assessed in terms of damage to:

- People - Personal injury, fatalities – project and third party personnel;
- Property – Damage and losses incurred to third party property;
- Environment - Oil pollution and other environmental damage; and
- Business - Reputation, financial loss (property and loss of business), negative public relations etc, incurred by the project.

The magnitude of each was then assessed using the consequence categories given below. These have been set such that the consequences in respect of property, environment and business have similar monetary outcomes.

Consequence categories and criteria.

Cat.	People	Property	Environment	Business
C1	**Negligible** Possible very minor injury (e.g. bruising)	**Negligible** Costs <£10k	**Negligible** No effect of note. Tier1 may be declared but criteria not necessarily met. Costs <£10k	**Negligible** Costs <£10k
C2	**Minor** (single minor injury)	**Minor** Minor damage Costs £10k – £100k	**Minor** Tier 1 – Tier 2 criteria reached. Small operational (oil) spill with little effect on environmental amenity Costs £10K–£100k	**Minor** Bad local publicity and/or short-term loss of revenue Costs £10k – £100k
C3	**Moderate** Multiple minor or single major injury	**Moderate** Moderate damage Costs £100k - £1M	**Moderate** Tier 2 spill criteria reached but capable of being limited to immediate area within site Costs £100k -£1M	**Moderate** Bad widespread publicity Temporary suspension of operations or prolonged restrictions to project Costs £100k - £1M
C4	**Major** Multiple major injuries or single fatality	**Major** Major damage Costs £1M -£10M	**Major** Tier 3 criteria reached with pollution requiring national support. Chemical spillage or small gas release Costs £1M - £10M	**Major** National publicity, Temporary closure or prolonged restrictions on project operations Costs £1M -£10M
C5	**Catastrophic** Multiple fatalities	**Catastrophic** Catastrophic damage Costs >£10M	**Catastrophic** Tier 3 oil spill criteria reached. International support required. Widespread shoreline contamination. Serious chemical or gas release. Significant threat to environmental amenity. Costs >£10M	**Catastrophic** International media publicity. Project site closes. Operations and revenue seriously disrupted for more than two days. Ensuing loss of revenue. Costs >£10M

Hazard Data Review Process

Frequency and consequence data was assessed for each hazard drawing on the knowledge and expertise of the Marico Marine specialists supported i by the views and experience of the stakeholders consulted, as well as historic incident where available. It should be noted that the hazards were scored on the basis of the "status quo" i.e. with all existing mitigation measures taken into consideration. The outcome of this process was then checked for consistency against the assessments made in previous and similar risk assessments.

Having decided in respect of each hazard which frequency and consequence criteria are appropriate for the four consequence categories in both the "most likely" and "worst credible" scenarios, eight risk scores were obtained using the following matrix.

Risk factor matrix used for hazard assessment.

Consequences	Cat 5	5	6	7	8	10
	Cat 4	4	5	6	7	9
	Cat 3	3	3	4	6	8
	Cat 2	1	2	2	3	6
	Cat 1	0	0	0	0	0
	Frequency	**>1,000 years**	**100-1,000 years**	**10-100 years**	**1 to 10 years**	**Yearly**

Where:

Risk Number	*Risk*
0 to 1.9	*Negligible*
2 to 3.9	*Low Risk*
4 to 6.9	*As Low as Reasonably Practical*
7 to 8.9	*Significant Risk*
9 to 10.0	*High Risk*

It should be noted that occasionally, a "most likely" scenario will generate a higher risk score than the equivalent "worst credible" scenario; this is due to the increased frequency often associated with a "most likely" event. For example, in the case of a large number of small contact events, the total damage might be of greater significance than a single heavy contact at a much lesser frequency.

Hazard Ranking

The risk scores obtained from the above process were then analysed further to obtain four indices for each hazard as follows:

- The average risk score of the four categories in the "most likely" set;
- The average risk score of the four categories in the "worst credible" set;
- The maximum risk score of the four categories in the "most likely" set; and
- The maximum risk score of the four categories in the "worst credible" set.

These scores were then combined in Marico Marine's hazard management software "HAZMAN" to produce a single numeric value representing each of the four indices. The hazard list was then sorted in order of the aggregate of the four indices to produce a "Ranked Hazard List" with the highest risk hazards prioritised at the top.

Mitigation

Mitigation measures that could be employed to reduce the likelihood or consequence of the hazards occurring are then identified.

Annex C Consultation Minutes

Minutes – Falls of Warness: Orbital - O2 Berth 6 NRA Consultation– 20UK1675

MCA

Client:	Orbital Marine	
Project:	20UK1675	
Attendees:	William Heaps (WH)	Marico Marine
	James Murray (JM)	Orbital Marine Programme Manager
	Paul Tait (PT)	EMEC Environment and Consents Manager
	Nick Salter (NS)	MCA Offshore Renewables Lead
Venue:	"Teams" video conference	
Date of Meeting:	14:00 to 14:25 7 January 2021	

Item	Action item / Notes for the record	Action
1	**Introductions**	
1.1	Nick Salter explained his role in the MCA and his responsibility for renewables. He stated he was familiar with EMEC and the Orkney test sites. [NS took the opportunity to clarify relevant contacts at EMEC with PT]. James Murray – Orbital Consents Manager. Paul Tait – EMEC Environment and Consents Manager (In post for 6 months) providing maternity cover for Caitlin Long. William Heaps – Principal Consultant Marico Marine.	
2	**Overview of device and location**	
2.1	JM provided an overview of the proposed O2 device, which is similar to the existing SR 2000 device, but slightly larger. In particular the rotor diameter is increased by 2m, which while not sounding a lot, significantly increases generating potential. This application is for a single device at berth 6 within the test site. Anticipated programme is to Install anchors during summer 2022, followed by device installation during summer 2023. This will be a long-term deployment, anticipated to be for 15 years. Drilled rather than gravity anchors are the preferred mooring solution. Orbital has18 years' experience in this specialised field and currently employs 35 staff. JM also mentioned the rationale for selecting berth 6 – most suitable for floating devices and preferred by local ferries (ferry operator has been consulted).	
2.2	NS asked about the proposed application time frame. JM responded that the intention was to apply for a marine licence within the next couple of months (after NRA completed). This will allow funding finalisation to commence in time for anchor installation during 2022.	
3	**Overview of marine traffic in the area**	
3.1	NS asked for confirmation of berth location. This was provided by showing a chart extract. NS also asked about the anchor spread – JM explained the spread would	

Item	Action item / Notes for the record	Action
	be about 440m x 220m with two catenary cables from the bow and stern of the device respectively connected to the preferred rock drilled anchors (4 in total). In this case the anchors themselves would be very small, but they may have to be larger (approx. 11x 11m) gravity anchors. JM noted that in case of cable failure only one cable would be able to maintain device on station.	
3.2	NS enquired about cable depth. Each cable is attached to the device at about 2.5m below the water surface and would fall away steeply at the surface at the top of the catenary towards the anchor. (No surface obstruction.	
4	**Any known incidents in area since previous NRA**	
4.1	None known by MCA – but Marico will be checking further (see RYA meeting notes).	
5	**Any other changes in the area or future "developments" known to consultee**	
5.1	None	
6	**Any other information relevant to safety of navigation**	
6.1	NS requested that the assessment refers to third party verification of mooring arrangements	
6.2	NS requested that all risks at all stages of installation, operation and decommissioning be assessed.	

Minutes – Fall of Warness: Orbital - O2 Berth 6 NRA Consultation– 20UK1675

Orkney Harbours

Client:	Orbital Marine	
Project:	20UK1675	
Attendees:	William Heaps (WH)	Marico Marine
	Rebecca Worbey (RW)	Marico Marine
	Paul Tait (PT)	EMEC Environment and Consents Manager
	Richard Wild (RI)	OIC Harbours
Venue:	"Teams" video conference	
Date of Meeting:	09:00 to 09:30 14 January 2021	

Item	Action item / Notes for the record	Action
1	**Introductions**	
2	**Overview of device and location**	
2.1	PT provided an overview of the proposed O2 device, which is similar to the existing SR 2000 device, but slightly larger. In particular the rotor diameter is increased by 2m, which while not sounding a lot, significantly increases generating potential. This application is for a single device at berth 6 within the test site. Anticipated programme is to Install anchors during summer 2022, followed by device installation during summer 2023. This will be a long-term deployment, anticipated to be for 15 years. Drilled rather than gravity anchors are the preferred mooring solution. Berth 6 was chosen due to its proximity to the proposed floating tidal energy device at Berth 5 and avoiding the southern berths which were identified through prior consultation to be less preferable for floating devices.	
3	**Overview of marine traffic in the area**	
3.1	RI noted that the FOW site is well outside of the harbour area and is also not on its approach.	
3.2	Most large vessels will avoid the FOW area and the sailing directions warn against transiting through the site. Most vessels will therefore take a longer route avoiding the site. Ferries transit through the site during certain met-ocean conditions / states of tide.	
4	**Any known incidents in area since previous NRA**	
4.1	None	
5	**Any other changes in the area or future "developments" known to consultee**	
5.1	Ferries may increase in size in the future. There is an aspiration to increase cruise traffic to the north isles.	

Item	Action item / Notes for the record	Action
	A west side pier at Eday has been discussed, however, nothing has been confirmed. Orkney Harbours Masterplan document is available online which contains further details. Phase 2 of the masterplan which will review small harbours and small vessels has been delayed.	
6	**Any other information relevant to safety of navigation**	
6.1	RI queried how often devices will be towed from site for maintenance.	Marico to confirm with Orbital

Minutes – Falls of Warness: Orbital - O2 Berth 6 NRA Consultation– 20UK1675

RYA Scotland / Orkney Marinas

Client:	Orbital Marine	
Project:	20UK1675	
Attendees:	William Heaps (WH)	Marico Marine
	Graham Russell (GR)	RYA Planning and Environment Officer, RYA Scotland
	Brian Kynoch (BK)	RYA (Orkney) and Orkney Marinas
	James Murray (JM)	Orbital Marine Programme Manager
	Paul Tait (PT)	EMEC Environment and Consents Manager
Venue:	"Teams" video conference	
Date of Meeting:	10:00 to 10:30 7 January 2021	

Item	Action item / Notes for the record	Action
1	**Introductions**	
1.1	Graham Russell – RYA Scotland Good knowledge of process, but less local knowledge. Brian Kynoch – Local RYA "coast watcher" with extensive local knowledge of leisure industry, also representing Orkney Marinas, former commodore of local sailing club and active leisure sailor. James Murray – Orbital Consents Manager. Paul Tait – EMEC Environment and Consents Manager (In post for 6 months) providing maternity cover for Caitlin Long. William Heaps – Principal Consultant Marico Marine.	
2	**Overview of device and location**	
2.1	JM provided an overview of the proposed O2 device, which is similar to the existing SR 2000 device, but slightly larger. In particular the rotor diameter is increased by 2m, which while not sounding a lot, significantly increases generating potential. This application is for a single device at berth 6 within the test site. Anticipated programme is to Install anchors during summer 2022, followed by device installation during summer 2023. This will be a long-term deployment, anticipated to be for 15 years. Drilled rather than gravity anchors are the preferred mooring solution. Orbital has18 years' experience in this specialised field and currently employs 35 staff.	

Item	Action item / Notes for the record	Action
2.2	BK asked about rock anchors – who is providing the system? JM explained that the rock anchors are 300mm dia. "rods" drilled several meters in to the seabed, and if viable, this methodology will be considerable cheaper and much less invasive than mass gravity anchors (typically about 11m square). O2 will be working with Leask Marine to finalise the methodology for the drilled anchors. It is intended that small locally based vessels (multicast) will be used for installation. However, if not viable, the project may have to revert to gravity anchors.	
3	**Overview of marine traffic in the area**	
3.1	WH explained that traffic patterns were established and confirmed during the 2019 site wide NRA, but we are anxious to confirm that the situation described then has not changed, and no changes are anticipated in the future. WH noted that 2020 was not a representative year due to Covid, and that the NRA would be based on "normal" traffic levels.	
3.2	GR had no site-specific comments but asked for re-assurance that the NRA would use the latest traffic information provided by the RYA. WH agreed to ensure this was so. * See report commentary.	WH/PT*
3.3	BK – emphasised the importance of maintaining the inshore route. BK was not aware of any recent, or likely future, changes to leisure use of the study area. The test site is already well known locally, and well charted / promulgated. BK enquired about any known incursions or other incidents in the area but felt it unlikely there had been any that either he or EMEC did not know about (neither party aware of any). PT undertook to check with EMEC colleagues, and WH will check during consultation with MCA and OIC (Harbour Authority) *PT has subsequently confirmed EMEC have no records of incidents in the Falls of Warness site limits. WH confirmed incident data with MCA / OIC (none).	PT / WH*
3.4	GR – suspected local leisure sailors would only use inshore route as they are familiar with area, and that visitors would keep clear of the charted / visible obstructions. BK concurred.	
4	**Any known incidents in area since previous NRA**	
4.1	None. See discussion in 3.3 above	
5	**Any other changes in the area or future "developments" known to consultee**	
5.1	GR – nothing known at present and difficult to envisage any significant changes. Publicity about the test sites and devices is key to ensuring local and visiting leisure users avoid conflict and this has been very successful – all visitors to the Islands inevitably visit Kirkwall or Stromness where plenty of information is displayed and available.	
6	**Any other information relevant to safety of navigation**	
6.1	GR considered that as this device is visible and marked; it is of less concern than subsurface devices where UKC concerns are relevant. This device is more akin to a ship which all competent leisure users are used to encountering and avoiding.	

Item	Action item / Notes for the record	Action
6.2	GR enquired about the next operational phase after testing – where might that happen? JM explained financing now more challenging for commercial arrays due to changes in public funding, and there is currently less activity as a result. So, developers are currently focussing on reducing generation costs rather than immediately going into full scale operation (The O2 device is designed to reduce costs). JM considered that full scale generation would be more likely to be outside Orkney due to current grid capacity unless that changes with improved interconnectivity to the mainland.	

Minutes – Fall of Warness: Orbital - O2 Berth 6 NRA Consultation– 20UK1675

Orkney Fisheries

Client:	Orbital Marine	
Project:	20UK1675	
Attendees:	William Heaps (WH)	Marico Marine (MM)
	Rebecca Worbey (RW)	Marico Marine (MM)
	Paul Tait (PT)	EMEC Environment and Consents Manager (EM)
	James Murray (JM)	Orbital Marine Programme Manager (OM)
	Hannah Fennell (HF)	Orkney Fisheries (OF)
Venue:	"Teams" video conference	
Date of Meeting:	10:00 to 10:30 14 January 2021	

Item	Action item / Notes for the record	Action
1	**Introductions**	
2	**Overview of device and location**	
2.1	JM provided an overview of the proposed O2 device, which is similar to the existing SR 2000 device, but slightly larger. In particular the rotor diameter is increased by 2m, which while not sounding a lot, significantly increases generating potential. This application is for a single device at berth 6 within the test site. Anticipated programme is to Install anchors during summer 2022, followed by device installation during summer 2023. This will be a long-term deployment, anticipated to be for 15 years. Drilled rather than gravity anchors are the preferred mooring solution. Berth 6 was chosen due to its proximity to the proposed floating tidal energy device at Berth 5 and avoiding the southern berths which were identified through prior consultation to be less preferable for floating devices.	
3	**Overview of marine traffic in the area**	
3.1	No anticipated increase in fishing levels in the vicinity of FOW as far as HF is aware. Fishing activity should return to normal post COVID-19.	
3.2	OF and its members has not noticed any recent changes in vessel traffic levels, but HF undertook to seek further views from members. Post meeting note: HF confirmed no further feedback from members.	HF
4	**Any known incidents in area since previous NRA**	
4.1	None	
5	**Any other changes in the area or future "developments" known to consultee**	
5.1	None	
6	**Any other information relevant to safety of navigation**	

Item	Action item / Notes for the record	Action
6.1	HF requested that Notice to Mariners continue to be issued. HF requested that further information about the site layout and proposed installation be issued for circulation to members for comment. HF noted that the site is well established and, therefore, members are already mindful of it.	Marico (completed)

Minutes – Falls of Warness: Orbital - O2 Berth 6 NRA Consultation– 20UK1675

Northern Lighthouse Board (NLB)

Client:	Orbital Marine	
Project:	20UK1675	
Attendees:	William Heaps (WH)	Marico Marine
	James Murray (JM)	Orbital Marine Programme Manager
	Paul Tait (PT)	EMEC Environment and Consents Manager
	Peter Douglas (PD)	Navigation Manager NLB
	Gillian Burns (GB)	Navigation Officer NLB
	Adam Lewis (AL)	Coastal Inspector NLB
Venue:	"Teams" video conference	
Date of Meeting:	11:00 to 11:30 13 January 2021	

Item	Action item / Notes for the record	Action
1	**Introductions**	
1.1	Peter Douglas - experienced in all aspects of marine project consenting / long experience with EMEC. Has influenced IALA renewable policy. Gillian Burns - Navigation Officer, ports and harbours specialist for NLB Adam Lewis - Coastal Inspector for NLB, specialising in offshore energy James Murray – Orbital Consents Manager. Paul Tait – EMEC Environment and Consents Manager (In post for 6 months) providing maternity cover for Caitlin Long. William Heaps – Principal Consultant Marico Marine.	
2	**Overview of device and location**	
2.1	JM provided an overview of the proposed O2 device, which is similar to the existing SR 2000 device, but slightly larger. In particular the rotor diameter is increased by 2m, which while not sounding a lot, significantly increases generating potential. This application is for a single device at berth 6 within the test site. Anticipated programme is to Install anchors during summer 2022, followed by device installation during summer 2023. This will be a long-term deployment, anticipated to be for 15 years. Drilled rather than gravity anchors are the preferred mooring solution. Orbital has18 years' experience in this specialised field and currently employs 35 staff.	
2.2	PD expressed surprise regarding the duration of the proposed deployment – JM explained that the intention is to move on to a more commercial test deployment – needs long term operation. JM summarised issues surrounding alternative sites and government funding, which makes long term deployment at this test site the most sensible option at present.	

Item	Action item / Notes for the record	Action
2.3	AL asked about the status of the Berth 5 application. JM confirmed that a similar orbital device will be installed this summer as all licences are in place. This is not the SR2000, but the O2 v2.1 device. The device proposed for Berth 6 is O2 v2.2 (as described above) A discussion ensued regarding current status of all devices currently on site / decommissioned and the chart status. PT undertook to clarify status.	PT (complete)
2.4	GB reminded JM about the need to notify NLB and apply for Statutory Sanction for the AtoN before deployment at Berth 5 this year. JM confirmed that this was in hand.	
3	**Overview of marine traffic in the area**	
3.1	PD mentioned occasional use of the area by cruise ships, and potentially offshore support vessels, but traffic levels low, and no significant increase expected. He noted Ongoing works at Scrabster	
3.2	PD drew attention to the Orkney Ports Master Plan which describes potential Kirkwall expansions	
4	**Any known incidents in area since previous NRA**	
4.1	None	
5	**Any other changes in the area or future "developments" known to consultee**	
5.1	PD mentioned the proposed Westray development. He also noted the OIC plans to encourage offshore windfarms (See ports master plan)	
6	**Any other information relevant to safety of navigation**	
6.1	PD discussed lighting and marking requirements – no change in previous views. A Light column at each end of hull required, with 3mile range special marks (synchronised). AtoN AIS transponder, radar reflectors. NLB asked about construction of device. JM confirmed steel hull approximately 500tonnes. Will be predominantly yellow above waterline. WH mentioned ferry masters had asked if lighting could have different characteristics per device, and possibly even different characteristics between bow and stern. PD confirmed differences per device would be possible, but not on each device. (Lights at each end of device to be synchronised in case of failure of one set). PD mentioned the NLB *might* consider lateral marking, especially with multiple devices, but this was new ground. IALA O-139 gives latitude for such marking. PD asked that there should be a mooring contingency plan (in case of complete mooring failure (= breakout))	
6.2	AL asked about the Berth 5 device AIS status – has an Ofcom licence been applied for as process takes a long time. JM confirmed a license has already been issued.	

Minutes – Fall of Warness: Orbital - O2 Berth 6 NRA Consultation– 20UK1675

Orkney Ferries

Client:	Orbital Marine	
Project:	20UK1675	
Attendees:	William Heaps (WH)	Marico Marine
	Rebecca Worbey (RW)	Marico Marine
	James Murray (JM)	Orbital Marine Programme Manager
	Paul Tait (PT)	EMEC Environment and Consents Manager
	Andrew Blake (AB)	Orkney Ferries
Venue:	"Teams" video conference	
Date of Meeting:	11:00 to 11:45 11 January 2021	

Item	Action item / Notes for the record	Action
1	**Introductions**	
2	**Overview of device and location**	
2.1	JM provided an overview of the proposed O2 device, which is similar to the existing SR 2000 device, but slightly larger. In particular the rotor diameter is increased by 2m, which while not sounding a lot, significantly increases generating potential. This application is for a single device at berth 6 within the test site. Anticipated programme is to Install anchors during summer 2022, followed by device installation during summer 2023. This will be a long-term deployment, anticipated to be for 15 years. Drilled rather than gravity anchors are the preferred mooring solution. Orbital has18 years' experience in this specialised field and currently employs 35 staff. JM also mentioned the rationale for selecting berth 6 due to its proximity to the proposed floating tidal energy device at Berth 5 and avoiding the southern berths which were identified through prior consultation to be less preferable for floating devices.	
3	**Overview of marine traffic in the area**	
3.1	No changes in ferry operations/ timetables in the area since the previous NRA. While there is little short-term scope for changes to the ferry services, the opportunity for a future increase in ferry services is currently under review to explore a longer window of operation (from 5am to 11pm) and use of an additional ferry totalling four. It was noted that any new ferry will have enhanced seakeeping abilities / navigation equipment.	
3.2	It was noted that while the route through the FOW site is utilised infrequently, there has been a marginal increase in utilisation.	
3.3	AB questioned which berths ae currently operational and the decommissioning status of berths that are no longer in operation.	PT to issue updated

Item	Action item / Notes for the record	Action
		FOW layout
4	**Any known incidents in area since previous NRA**	
4.1	None	
5	**Any other changes in the area or future "developments" known to consultee**	
5.1	AB questioned whether the DP Energy Westray tidal array was still planned to the north-west of the FOW as this project would have the potential to squeeze ferry traffic further. Post – meeting note. Marico has established that while not currently progressing, the Westray scheme has not been formally shelved.	Marico to check Westray project status.
6	**Any other information relevant to safety of navigation**	
6.1	AB suggested that the decommissioning of out of use devices should be accelerated as much as possible, where possible. Decommissioning to be planned as much as possible to occur when ferries are unlikely to require transit within the FOW.	
6.2	AB suggested that marking and lighting is key. The device should be appropriately lit, perhaps with different flashing lights at either end for distinction. RADAR reflectors should also be utilised. RACON probably not required given position within a sheltered bay. AIS is additionally always helpful. WH confirmed that Marico will be speaking with the NLB.	
6.3	WH requested that ferry master's comments be forwarded to Marico for input into the risk assessment. (Post meeting note: these comments have been received and are appended below)	

1. My personal thoughts regarding this proposed development are that it will impact on our normal route when we are outbound to the East side with a flood tide and South Easterly motion. The area detailed in the chartlet would be in the same area we would normally transit from the North of the Green Holm to seek shelter close to Eday within the bay, whilst the motion is on our Starboard quarter. This would consequently result in either coming around further to the North of the area between the device and Seal Skerry, delaying us by a further 10 minutes (on top of the normal delay with going North of the Green Holms) or possibly on occasions having to avoid the area altogether and transit North of Eday through Calf Sound and adding a further 50 minutes on to the outbound journey.It should not cause any delays to the return journey coming back into Kirkwall.
2. Reviewing the proposed installation of the new tidal device at Emec Berth 6, the location is directly in the passage of our bad weather route heading out towards the East side islands with bad South East weather however there still remains navigable water to the West and

North of the device. We would guess occasionally an extra 15 mins or so on an outward journey would be expected. As with the Megallanes installation consultation a couple of years ago, as long as the device has the appropriate lights, radar reflector and AIS transponder, I don't think we should have too much concerns.

Annex D Device On Site Risk Assessment

Risk Assessment – Device on Site

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Embedded Risk Controls	Risk Score
1	Commercial Ship Contacts Device	A commercial vessel contacts the device, or a stationary attending project vessel during construction, maintenance or decommissioning activities	Insufficient lookout; Human error; Equipment or mechanical failure; Navigational aid failure; Adverse environmental conditions; Poor visibility; Avoidance of other vessel;	Commercial vessel strikes device with glancing blow: Minor damage to device and its moorings; Negligible damage to vessel; No injuries; No pollution; Minor operational downtime;	Commercial vessel overruns device: Single fatality or multiple major injuries; Loss of Device; Moderate damage to Vessel; Moderate pollution; Moderate adverse publicity;	Remote shutdown; ERCOP; Marking and lighting; Notice to Mariners; Incident monitoring and reporting; Radar reflector; PPE; AIS	2.93
2	Passenger Vessel Contacts Device	A passenger vessel contacts the device, or a stationary attending project vessel during construction, maintenance or decommissioning activities	Insufficient lookout; Human error; Equipment or mechanical failure; Navigational aid failure; Adverse environmental conditions; Poor visibility; Avoidance of other vessel;	Passenger vessel strikes device with glancing blow: Minor damage to device and its moorings; Negligible damage to vessel; No injuries; No pollution; Minor operational downtime;	Passenger vessel overruns device: Single fatality or multiple major injuries; Loss of Device; Major damage to Vessel; Moderate pollution; Major adverse publicity;	Remote shutdown; ERCOP; Marking and lighting; Notice to Mariners; Incident monitoring and reporting; Radar reflector; PPE; AIS	3.10
3	Fishing Vessel Contacts Device	A fishing vessel contacts the device, or a stationary attending project vessel during construction, maintenance or decommissioning activities	Insufficient lookout; Human error; Equipment or mechanical failure; Navigational aid failure; Adverse environmental conditions; Poor visibility; Avoidance of other vessel;	Fishing vessel strikes device with glancing blow: Minor Damage to device and its moorings; Negligible damage to vessel; Minor Injuries; No pollution; Minor operational downtime;	Fishing vessel strikes device head on and becomes entangled, seriously damaged: Single fatality or multiple major injuries; Moderate damage to Device; Loss of Vessel; Minor pollution; Moderate adverse publicity;	Remote shutdown; ERCOP; Marking and lighting; Notice to Mariners; Incident monitoring and reporting; Radar reflector; PPE; AIS	2.98
4	Recreational Vessel Contacts Device	A recreational vessel contacts the device, or a stationary attending project vessel during construction, maintenance or decommissioning activities	Insufficient lookout; Human error; Equipment or mechanical failure; Navigational aid failure; Adverse environmental conditions; Poor visibility; Avoidance of other vessel;	Recreational vessel strikes device with glancing blow: Minor Damage to device and its moorings; Negligible damage to vessel; Minor Injuries; No pollution; Minor operational downtime;	Recreational vessel strikes device head on and becomes entangled, seriously damaged: Single fatality or multiple major injuries; Moderate damage to Device; Loss of Vessel; Minor pollution; Moderate adverse publicity;	Remote shutdown; ERCOP; Marking and lighting; Notice to Mariners; Incident monitoring and reporting; Radar reflector; PPE; AIS	3.06

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Embedded Risk Controls	Risk Score
5	Maintenance Vessel Contacts Device	Maintenance vessel contacts the device during installation, maintenance or decommissioning.	Insufficient lookout; Human error; Poor operating Procedures; Equipment or mechanical failure;; Navigational aid failure; Adverse environmental conditions; Poor visibility; Avoidance of other vessel;	Minor contact during routine operations: Minor Damage to device and its moorings; Negligible damage to vessel; Minor Injuries; No pollution; Minor operational downtime;	Heavy uncontrolled contact during operations or passage: Single fatality or multiple major injuries; Major damage to Device; Moderate damage to Vessel; Minor pollution; Moderate adverse publicity;	Remote shutdown; ERCOP; Marking and lighting; Notice to Mariners; Incident monitoring and reporting; Radar reflector; PPE; AIS	3.96
6	Fishing Gear Interaction with Device	A fishing vessel's gear interacts with the device or its moorings.	Insufficient lookout; Human error; Equipment or mechanical failure;; Adverse environmental conditions;	Fishing gear over-runs mooring cables / anchor system: Minor Damage to moorings; Minor Damage to fishing gear; No injuries; No pollution; Minor operational downtime;	Fishing gear entangles anchorage system, capsize and sinking of fishing vessel: Single Major Injury; Loss of gear; No Pollution; Moderate Operational Downtime;	Remote shutdown; ERCOP; Marking and lighting; Notice to Mariners; Incident monitoring and reporting;	1.95
7	Third Party Collision Due to Avoidance of Device	Two navigating vessels collide due to the presence of the device	Insufficient lookout; Human error; Equipment or mechanical failure; Adverse environmental conditions; Poor visibility;	Two recreational vessels alter course to avoid device, and collide with light glancing blow: Minor injuries; Minor damage to vessels; No pollution; Minor adverse publicity;	Large and small vessels avoiding device collide and major damage to smaller vessel: Single fatality or multiple major injuries; Major damage to Vessels; Moderate pollution; Moderate adverse publicity;	Notice to Mariners; Marking and lighting; Radar reflector	2.54
8	Third Party Grounding Due to Avoidance of Device	A navigating vessel (all types) grounds due to the presence of the device	Insufficient lookout; Human error; Equipment or mechanical failure; Adverse environmental conditions; Poor visibility;	A third party grounds due to navigation error while avoiding device: Minor injuries; Minor damage to vessels; No pollution; Minor adverse publicity;	A larger vessel grounds due to navigation error while avoiding device, resulting in significant damage: Single fatality or multiple major injuries; Major damage to Vessel; Minor pollution; Moderate adverse publicity;	Notice to Mariners; Marking and lighting; Radar reflector	2.54
9	Collision Maintenance Vessel	A navigating vessel collides with a tug or maintenance vessel (Including construction/decommissioning vessel).	Insufficient lookout; Increased Vessel Activity; Human error; Equipment or mechanical failure;; Adverse environmental conditions; Poor visibility;	A small vessel collides with a project vessel engaged in works on site. Glancing blow, minimal damage: Minor Injuries; Negligible damage to vessel; No pollution; Minor adverse publicity;	A large vessel collides with a project vessel engaged in works on site. Heavy contact, significant damage: Single fatality or multiple major injuries; Loss of Vessel; Minor pollution; Moderate adverse publicity;	PPE; Training; ERCOP; Site access application;	2.71

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Embedded Risk Controls	Risk Score
10	Grounding Maintenance Vessel	A maintenance vessel grounds whilst on passage to/from the device for project related activities	Insufficient lookout; Human error; Equipment or mechanical failure; Adverse environmental conditions; Poor visibility;	Vessel briefly touches bottom, no damage: Minor damage to vessel; Minor Injuries; No pollution; Minor operational downtime;	Grounding resulting in stranding, or damage to vessel hull: Multiple minor or single major injury; Major damage; Minor pollution; Minor adverse publicity;	PPE; Training; ERCOP; Site access application;	2.86
11	Breakout of Device from Moorings	The device's moorings fail and device becomes a hazard to navigation	Equipment Failure; Adverse environmental conditions; Device struck by another object (e.g. large flotsam, disabled vessel, etc)	A partial breakout - not all cables fail, device remains on station: Minor damage to device and its moorings; No injuries; No pollution; Minor adverse publicity;	Full breakout, all moorings fail, device drifts off station: No Injuries; Loss of Device; Minor Pollution; Moderate Adverse Publicity;	Inspection and maintenance; Mooring design; Remote shutdown; GPS monitoring; ERCOP; Incident monitoring and reporting;	2.31

Annex E Device Under Tow Risk Assessment

Risk Assessment – Device Under Tow

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Embedded Risk Controls	Risk Score
1	Grounding of device	Tug and/or device runs aground	Insufficient lookout; Human error; Equipment or mechanical failure; Adverse environmental conditions; Poor visibility;	Minor grounding on leaving departure port, No damage; Minor damage to tug and/or device; Minor injuries; No pollution; Minor operational downtime;	Grounding on passage, stranding or significant damage to tug or device: Major damage to device and/or tug; Multiple minor or single major injury; Minor pollution; Major operational downtime;	Training; ERCOP; Tow risk assessment and passage plan; PPE; Tow weather window	2.61
2	Contact between device and tugs	Towing vessel and the device come into contact during the tow operation.	Human error; Equipment or mechanical failure; Adverse environmental conditions;	Minor contact during routine operations: Minor damage to tug and device; Minor injuries; No pollution; Minor operational downtime;	Significant uncontrolled contact during towage operation: Moderate damage to device and/or tug; Multiple minor or single major injury; Minor pollution; Moderate operational downtime;	Training; ERCOP; Tow risk assessment and passage plan; PPE; Tow weather window	2.71
3	Breakout of device while under tow	The tow fails resulting in device breakout	Equipment or mechanical failure; Adverse environmental conditions;	Tow line failure, swiftly recovered: No damage; No Injuries; No pollution; No downtime;	Catastrophic towline failure, leading to injury and damage, difficulty regaining control of device: Loss of device; No Injuries; Minor pollution; Major operational downtime;	Training; ERCOP; Tow risk assessment and passage plan; PPE; Tow weather window	1.37
4	Collision during tow	Tug and/or device collides with another navigating vessel	Insufficient lookout; Human error; Equipment or mechanical failure; Adverse environmental conditions; Poor visibility;	Small vessel impedes tug and tow, light contact: Minor damage; Minor injuries; No pollution; Minor operational downtime;	Tug and tow overrun small vessel, or large vessel overruns tug and tow: Major damage; Multiple minor or single major injury; Minor pollution; Major operational downtime;	ERCOP; Notice to Mariners; Training; Tow risk assessment and passage plan; Site access application; AIS; Radar reflectors Tow weather window;	2.61
5	Contact during tow	Tug and/or device come into contact with an obstacle. E.g. other EMEC devices, harbour infrastructure, navigation aids.	Insufficient Lookout; Human error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility;	Minor contact during routine operations: Minor damage to tug and tow; Minor injuries; No pollution; Minor operational downtime;	Heavy uncontrolled contact: Major damage; Multiple minor or single major injury; Minor pollution; Major operational downtime;	ERCOP; Notices to Mariners; Training; Tow risk assessment and passage plan; Tow weather window;	2.61

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Embedded Risk Controls	Risk Score
6	Third party collision	Third Party Collision due to avoidance of device during tow	Insufficient lookout; Human error; Equipment or mechanical failure; Adverse environmental conditions; Poor visibility;	Two vessels alter course to avoid tow, and collide with light glancing blow: Minor damage to third party vessels; Minor injuries; No pollution; No downtime;	Large and small vessels avoiding tow collide and major damage to smaller vessel: Major damage to third party vessels; Multiple major injuries or single fatality; Minor pollution; Major operational downtime;	ERCOP; Notices to Mariners; Lighting and marking of tow; Tow risk assessment and passage plan; Tow weather window;	2.57
7	Third party grounding	Third Party Grounding due to avoidance of device during tow	Insufficient lookout; Human error; Equipment or mechanical failure; Adverse environmental conditions; Poor visibility;	A third party grounds due to navigation error while avoiding tow: Minor damage to third party vessels; Minor injuries; No pollution; No downtime;	A larger vessel grounds due to navigation error while avoiding tow, resulting in significant damage: Major damage to third party vessels; Multiple minor or single major injury; Minor pollution; Major operational downtime;	ERCOP; Notices to Mariners; Lighting and marking of tow; Tow risk assessment and passage plan; Tow weather window;	2.49