NASH MARITIME

O2 Floating Tidal Turbines, Berth 3 EMEC (Orkney)

Navigation Risk Assessment

Orbital Marine Power

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EXECUTIVE SUMMARY

Orbital Marine Power Limited are seeking permission to install, operate and decommission two commercial demonstrator turbines, model O2.4, at Berth 3 at the EMEC Fall of Warness tidal test site in Eday, Orkney. In order to ensure any risks to navigation are managed to tolerable levels, a Navigation Risk Assessment has been conducted.

The Orbital devices are c. 80m by 3.8m cylindrical superstructures with two rotor turbines mounted on leg structures with a rated power of c. 2.4MW and secured to the seabed with spread moorings. The operational lifespan of the device is anticipated to be 15 years. The Fall of Warness tidal energy test site was established by the European Marine Energy Centre in 2005. Eight tidal test berths with pre-installed grid connected cables are located in the site. The Orbital devices are planned to be installed in Berth 3.

This Navigation Risk Assessment seeks to identify, assess and if appropriate mitigate any significant risks to navigational safety associated with the tow-out, installation, operating and decommissioning of these devices. The work is conducted in compliance with Maritime and Coastguard Agency guidance documents and references the site wide assessment completed in 2018. Several data collection activities were undertaken.

Firstly, consultation has been undertaken and responses received from the Maritime and Coastguard Agency, Northern Lighthouse Board, Orkney Ferries and Royal Yachting Association. No significant concerns were raised. Secondly, a review has been undertaken of vessel traffic management and adjacent offshore activities at the test site. Thirdly, analysis of vessel traffic data around the site using data from the Automatic Identification System and other sources. This demonstrated that vessel traffic density in the area is light. Fourthly, analysis of historical accident data collected by the Marine Accident Investigation Branch and Royal Nautical Lifeboat Institute, for which there are limited accidents associated with the site.

From the collected data, the potential impacts identified in the site-wide assessment have been examined as relates to the proposed Orbital Devices. A structured, risk assessment was conducted that identified hazards, assessed the likelihood and consequence of each, and derived a risk score. Whilst the navigable width of the passage is reduced, the low density of traffic does not substantially increase the risk of collision, contact or grounding in the study area. The underwater infrastructure is of sufficient depth that it would not pose a significant risk to vessel traffic. There are no anticipated impacts on Search and Rescue, navigational equipment or fishing and recreational activities. A suite of effective risk control measures are embedded in the project design. All identified impacts and hazards are assessed to be Low to Negligible Risk and are therefore Tolerable.

In summary, this assessment has demonstrated that the proposed Orbital Devices at the Fall of Warness test site would not have a significant impact on navigational safety.

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ABBREVIATIONS

Abbreviation	Detail
ADCP	Acoustic Doppler Current Profiler
AHT	Anchor Handling Tug
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
ATBA	Area to be Avoided
CHA	Competent Harbour Authority
EMEC	European Marine Energy Centre
ERCOP	Emergency Response and Cooperation Plan
FSA	Formal Safety Assessment
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HMCG	Her Majesty's Coastguard
HSE	Health and Safety Executive
IALA	International Association of Lighthouse Authorities
IMO	International Maritime Organisation
MCA	Maritime and Coastguard Agency
MGN	Marine Guidance Note
MW	MegaWatt
NLB	Northern Lighthouse Board
NRA	Navigation Risk Assessment
OREI	Offshore Renewable Energy Installation
PPE	Personal Protection Equipment
RNLI	Royal Nautical Lifeboat Institute
ROV	Remotely Operated Vessel
RYA	Royal Yachting Association
SAR	Search and Rescue
SCADA	Supervisory, Control and Data Acquisition System
SOP	Standard Operating Procedures
UKC	Underkeel Clearance
VHF	Very High Frequency
VMS	Vessel Monitoring System

1. INTRODUCTION

Orbital Marine Power (Orbital) commissioned NASH Maritime to undertake this Navigation Risk Assessment (NRA) to assess impacts to navigation safety arising from the installation of two O2 floating tidal turbine devices (Devices) at the Fall of Warness EMEC project site in Orkney. Device locations are shown in Figure 1. This NRA has been undertaken in support of the marine licence application to Marine Scotland. This NRA considers two phases of the project:

1. Tow to and from Berth 3 of EMEC's Fall of Warness test site; and
2. Mooring at Berth 3 of EMEC's Fall of Warness test site, including installation, operation and decommissioning.

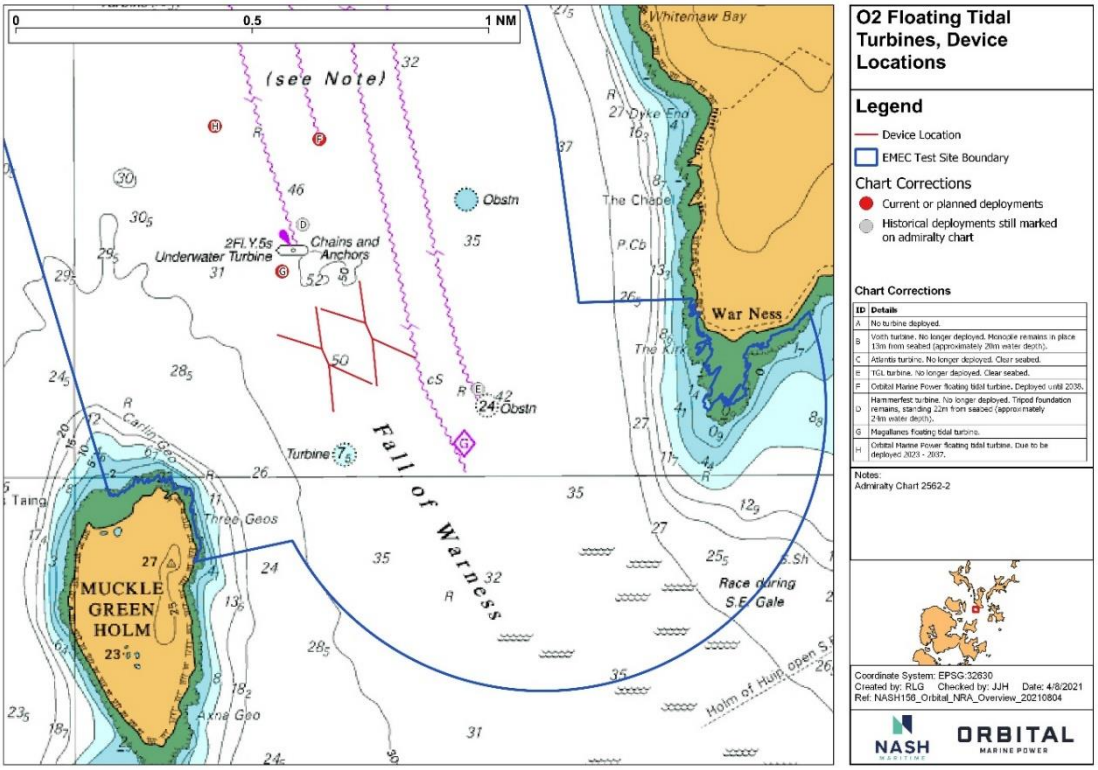

Figure 1: Location of O2 Devices.

1.1 STUDY AREA: FALL OF WARNESS TIDAL TEST SITE

The study area assessed within this NRA is shown in **Figure 3**. The Fall of Warness tidal test site was established in 2005 by the European Marine Energy Centre (EMEC). The site, located between Muckle Green Holm and Eday, has substantial tidal flows of up to 4 m/s or 7.8 knots. The site has eight grid-connected tidal test berths with depths between 12m and 50m (see **Figure 2**). In 2019, the Crown Estate Scotland extended EMEC's lease until 2040.

The test nature of the site is such that there are significant and frequent changes to the numbers and types of devices installed. At the time of completion of this NRA, the status of these berths is listed at **Table 1** and Figure 1.

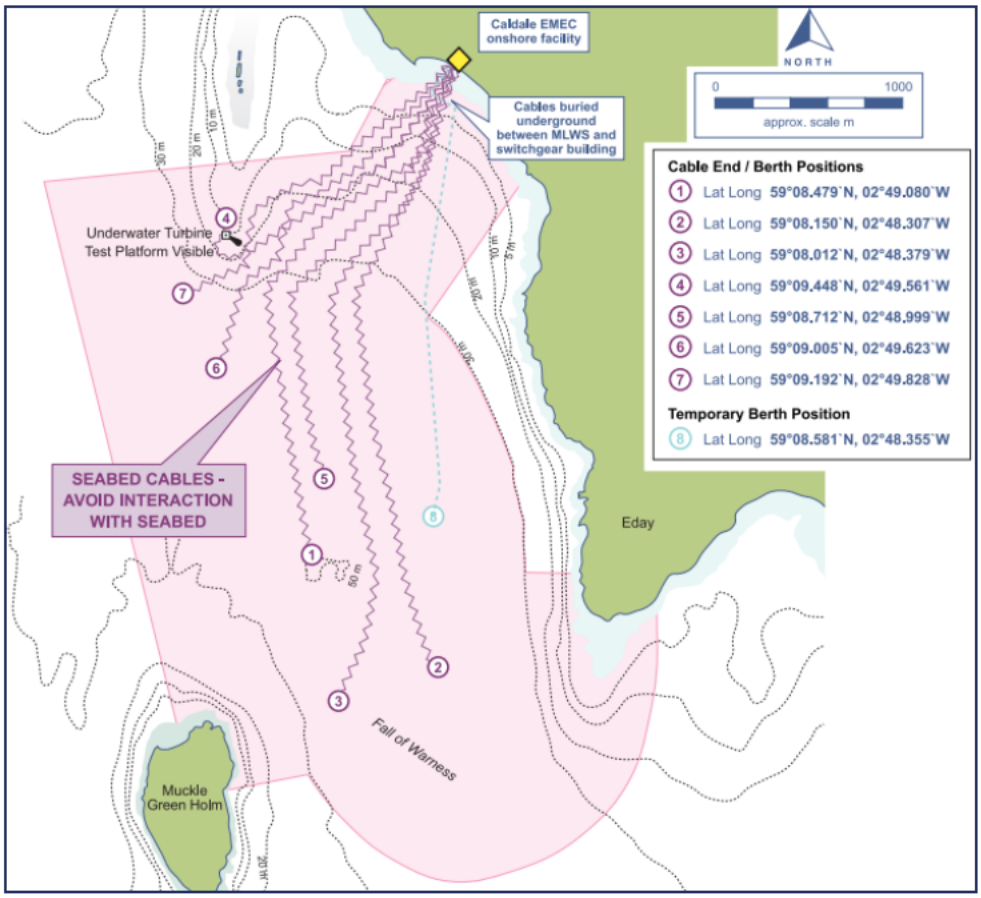

Figure 2: EMEC Fall of Warness Test Berths.

Table 1: Status of Fall of Warness Berths

Berth	Device	Status
1 (D/G)	Magallanes Ocean_2G tidal energy platform	In-situ (February 2019)
2	Unoccupied (Previous TGL)	N/A
3	Unoccupied (Previous Nautricity) Application for 2x Orbital Device	N/A Installation c. Summer 2026
4	Open Hydro fixed tidal turbine	In-situ (2006). Not operational
5 (F)	Orbital Tidal Device	In-situ (July 2021)
6 (C/H)	Unoccupied (Previous Atlantis) Application for Orbital Device	N/A Installation c. Summer 2023
7 (A/B)	Unoccupied (Previous Voith)	N/A
8 (E)	Unoccupied (Previous Scotrenewables)	N/A

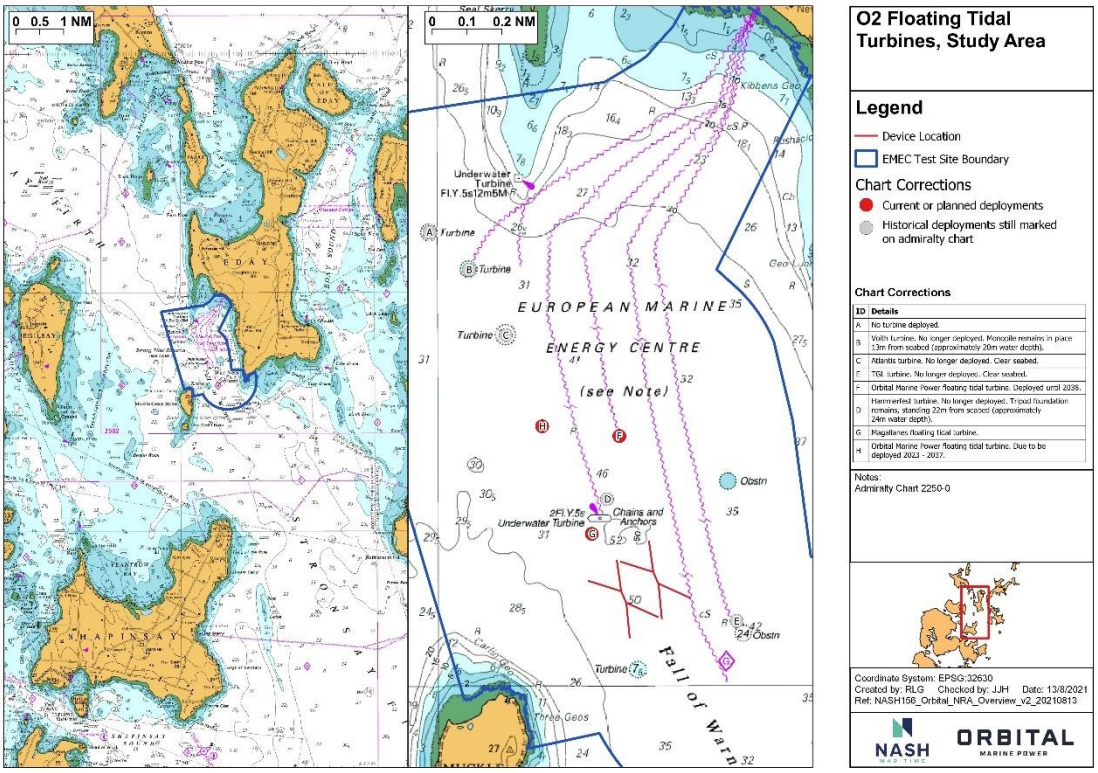

Figure 3: Study Area.

1.2 SCOPE AND METHDOLOGY

The scope of this NRA is to:

1. Provide a description of the O2.4 tidal turbine device, its layout, marking, construction methodology and towage to site.
2. Provide an overview of the baseline environment and marine activities within the study area, including:
    a. Local ports and harbours
    b. Metocean conditions
    c. Existing vessel traffic management
    d. Offshore activities in the study area
    e. Analyse the existing vessel traffic activity within the study area
    f. Describe the existing risk profile for navigational incidents
3. Identify and assess impacts to shipping and navigation that may arise from the deployment of the devices, including:
    a. Vessel traffic routeing
    b. Contact risk

c. Tides, tidal stream and weather
d. Under keel clearance
e. Visual navigation and collision avoidance
f. Communications, radar and positioning systems
g. Failure of moorings
h. Fishing activity
i. Recreational activity
j. Cable risk
k. Search and Rescue
l. Cumulative and in-combination effects

4. Undertake an NRA that identifies navigation hazards through all phases of the development and assesses these hazards, identifies risk controls to reduce 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 AND POLICY

This assessment will be undertaken primarily in accordance with the requirements of the Maritime and Coastguard Agency (MCA) Marine Guidance Note (MGN) 654 (M+F), which defines the methodological requirements for the evaluation of navigation safety for OREI's. A summary of policy and guidance relevant to shipping and navigation is provided in **Table 2**.

Table 2: Summary of policy and guidance relevant to shipping and navigation.

Guidance / Policy	Key Provision
MGN 654 (M+F) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response.	Highlights issues that need to be taken into consideration when assessing the impact on navigational safety and emergency responses caused by offshore renewable energy installation. MGN 654 provides guidance on traffic surveys, consultation, structure layout, collision avoidance, impacts on communications, radar and positioning systems and hydrography.
MCA Offshore Renewable Energy Installations: Requirements, Guidance and Operational Considerations for Search and Rescue and Emergency Response	Accompanying Annex 5 to MGN654 providing a description of MCA policy and guidance, methodology for assessment, advice and specific requirements for assessing marine navigational safety and emergency response for OREI projects.
MCA Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations	This document is incorporated into MGN 654 as Annex 1 and should be read in conjunction. Its purpose is to be used as guidance for developers in preparing their navigation risk and emergency response assessment and includes a suggested

Guidance / Policy	Key Provision
	template for preparing Navigational Risk Assessments for offshore wind farms.
MGN 372 Guidance to Mariners Operating in the Vicinity of UK OREIS	Guidance outlining the issues to be considered when planning and undertaking voyages near OREIs off the UK coast.
MCA Offshore Renewable Energy Installations: Impact on Shipping	Guidance describing how wind farms and wave and tidal energy devices can endanger navigation, emergency response operations, marine radar and Global Positioning System (GPS) communications.
International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures	Provides guidance to national authorities on the marking of offshore structures, including floating wind farms.
International Maritime Organisation (IMO) Formal Safety Assessment MSC-MEPC.2/Circ.12/Rev.2	Outlines the process for undertaking marine navigation risk assessments.
Royal Yachting Association (RYA) Position on Offshore Energy Developments	Outlines potential the recreational boating impacts and surrounding offshore renewable energy developments. Provides considerations for assessment and risk controls.
HSE and MCA Regulatory expectations on moorings for floating wind and marine devices (2017)	Provides guidance on the mooring arrangement for OREIs.

1.3.1 EMEC Site Wide Assessment

In 2018-2019, a site-wide NRA was conducted for the Fall of Warness test site (Fall of Warness Navigational Risk Assessment, EMEC, 2019)[1]. As part of the outputs of this work, a structure for device specific NRAs was developed which has been used as the basis for this assessment.

Details of the NRA criteria are shown **Table 3**, including the relevant references to MGN 654 guidance.

The site-wide NRA will be updated later this year (in accordance with the requirements of MGN 654 checklist item xi – see **Appendix A**) and thus it is recommended this NRA and the updated site-wide NRA are considered collectively once the latter has been prepared.

[1] http://www.emec.org.uk/services/consents/.

Table 3: Summary of policy and guidance requirements.

Device Specific NRA Criteria	MGN654 Section	Report signpost
	Project Description	
Description: Developer to provide a detailed description of the device, its dimension and location.	Annex 1 B3	**Section 2.1**
Mooring Arrangements: Developer to provide details of the mooring arrangements for the device and confirm that they have been independently verified as adequate to the expected MetOcean conditions and loadings	Annex 1 B3	**Section 2.1.2**
Construction Methodology: Developer to provide a description of the installation process and methodology	Annex 1 B3	**Section 2.2**
Maintenance Plans: Developer to provide outline maintenance plans and schedule	Annex 1 B3	**Section 2.2.4**
Decommissioning Plan: Developer to provide outline decommissioning methodology.	Annex 1 B3	**Section 2.2.5**
	Key Navigational Themes	
Vessel Routeing: Does the device impact the routeing of vessels in the area?	4.6/4.7/4.10 / Annex 1 B1/B2	**Section 6.1**
Contact/Allision Risk: Does the device pose a risk of contact to navigating vessels?	4.7	**Section 6.2**
Effects of Tide/Tidal Streams and Weather: Does the device influence MetOcean conditions or is at risk as a result of these conditions?	4.9	**Section 6.3**
Under Keel Clearance: Does the device compromise a vessel's UKC?	4.8	**Section 6.4**
Collision Risk and Visual Navigation: Does the device hinder visual identification of other vessels or key landmarks/aids to navigation?	4.8	**Section 6.5**
Communications, Radar and Positioning Systems: Does the device impact the communications, radar and positioning systems on board vessels or on land?	4.13	**Section 6.6**
Moorings: Are the moorings sufficient for the device and the conditions?		**Section 6.7**

Fishing Activity: Does the device impact upon the activity of fishing vessels?	4.6	**Section 6.8**
Recreational Activity: Does the device impact upon the activity of recreational vessels?	4.6	**Section 6.9**
Subsea Cables: Does the device require cables that may be at risk from snagging, what types of protection will be installed and does this compromise water depth?	6.7	**Section 6.10**
SAR: Does the device impact SAR capability and has access been considered in the design of the device?	4.11/6.19 / Annex 5	**Section 6.11**
Cumulative and In Combination: Are there nearby devices which might exacerbate the impacts discussed above?	4.6	**Section 6.12**
Risk Controls		
Site Wide Risk Controls: Are the site-wide risk controls sufficient for this type of device?	4.15/6 / Annex 1 E1/G1	**Section 7.4**
Device Specific Risk Controls: Which additional risk controls are proposed to be in place for this device?	4.15/6 / Annex 1 E1/G1	**Section 7.4**
Marking and Lighting: Have the marking and lighting arrangements been agreed with the MCA and NLB?	4.15/6 / Annex 1 E1/G1	**Section 7.4**

2. PROJECT DESCRIPTION

2.1 PROJECT OVERVIEW

Orbital is proposing deployment of two commercial demonstrator tidal turbines at EMEC Berth 3. The devices are model O2.4 and are similar to the previous O2 devices deployed and proposed within the Fall of Warness EMEC site.

The project comprises of the following components:

- 2 x Orbital Marine Power's turbine, the Orbital O2.4.
- Anchoring,mooring system and dynamic riser cables.
- 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. Full details of the project are available in the Project Information Document.

2.1.1 Orbital O2.4 Device Overview

The Device consists of the following elements (**Figure 4**):

- A cylindrical floating steel superstructure, which houses power conversion and auxiliary systems. The superstructure is c. 80m in length and 3.8m diameter.
- 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. Each turbine is rated 1.2 MW with a total rated power of c. 2.4MW.
- 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.

Table 4 provides a summary of the device characteristics.

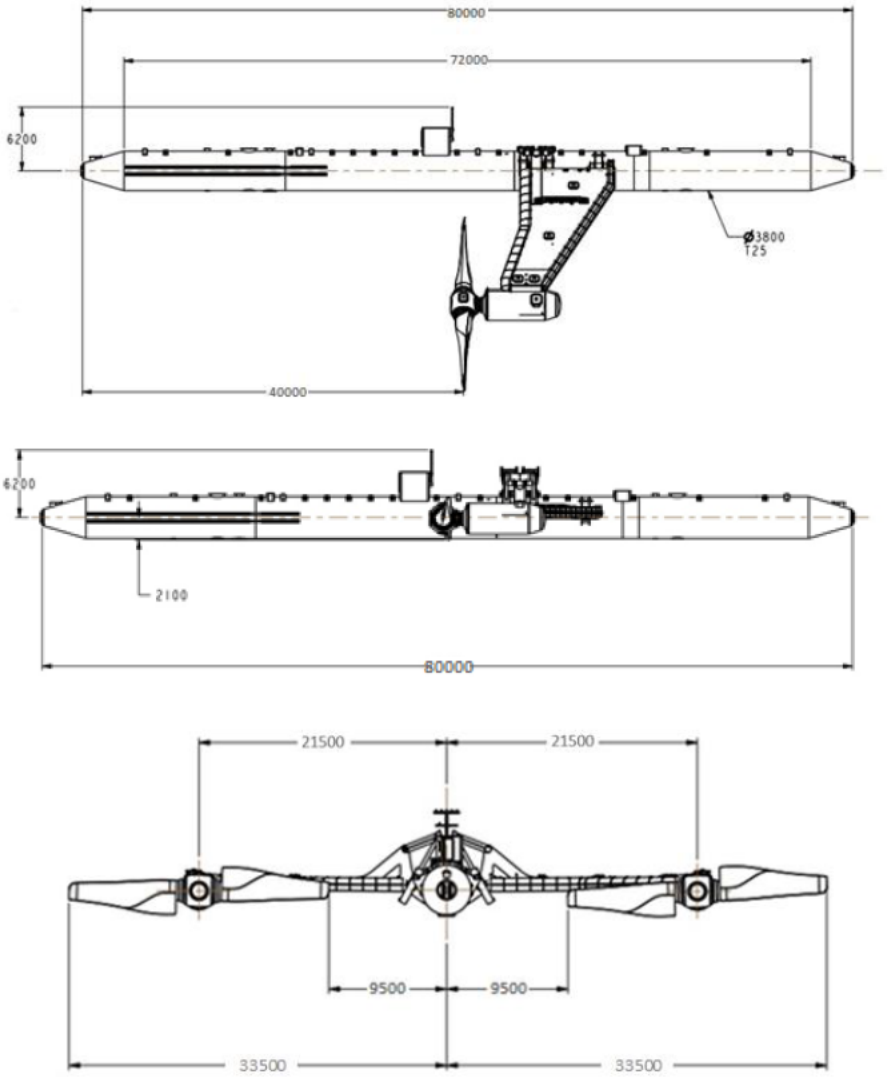

Figure 4: Schematic of Device in operational (top) and transportation modes (middle and bottom). Measurements in mm.

Table 4: Orbital O2.4 design parameters.

Device Characteristic	Dimension
Rated power	c. 2.4 MW
Displacement	600 metric Tonnes approx.
Rated current speed	2.5 m/s
Cut-in current speed	1 m/s
Shut down current speed	3.8 m/s
Maximum Hull length	80 m
Approximate Diameter of Hull tube	3.8 m
Approx Depth to uppermost rotor tip during operation (rotors extended)	3.2 m
Maximum Depth to bottom rotor tip (deepest point) during operation (rotors extended)	27.2 m
Maximum depth of platform below waterline	2.3 m
Height of hull tube exposed above the water surface	1.5 m

Device Characteristic	Dimension
Maximum rotation speed	15 rpm
Maximum Rotor diameter	24 m
Maximum Rotor swept area	2 x 452 m^2

2.1.2 Mooring Arrangements

The mooring system for the Orbital O2.4 comprises of four catenary mooring lines which are moored to the seabed via four separate anchors (see **Figure 5**). 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. Each mooring line will be predominantly studlink mooring chain with an approximate composition:

- 95mm studlink chain – 125m weighing 200kg/m
- 115mm studlink chain – 100m weighing 315kg/m

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 25m 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 area covered by each mooring spread will be approximately 420m x 220m. The spread of the moorings is indicated in Figure 1.

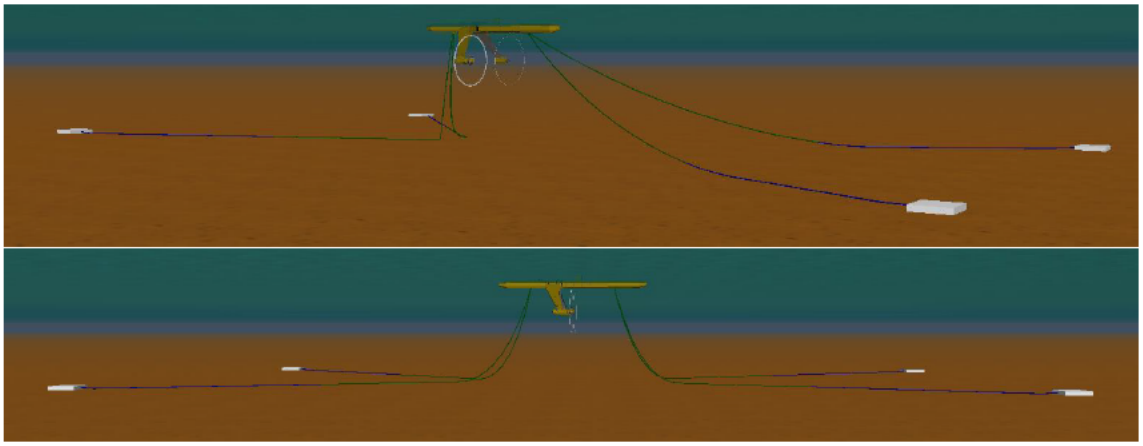

Figure 5: Orbital O2.4 mooring system operating in tidal and slack conditions (green lines are 95mm Studlink chain, blue lines are 115mm studlink).

The Orbital O2.4 will be anchored with either 4 gravity anchors or 4 rockbolt anchors subject to ground conditions and site suitability (see **Figure 6**):

- **Gravity Anchors**: The gravity anchors would 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 40T (without ballast). The ballast would consist of a scrap steel chain (approximately 76mm diameter) or steel modules (approximately 5.6m x 5.2m x 2m).

- **Rockbolt Anchors**: 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 stationkeeping 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.

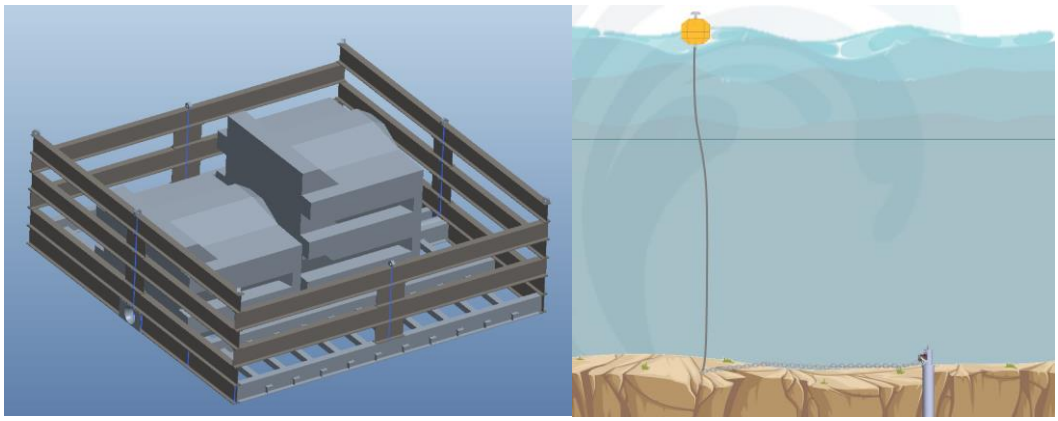

Figure 6: Anchor basket with ballast (left) and Rockbolt in situ in seabed.

Concrete mattresses or rock aggregate bags will be placed around each anchor to prevent scour. If mattresses are used, 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. If aggregate is used, it would be applied in nylon bags.

2.1.3 Device Marking and Lighting

The Orbital O2.4 will has a marking and lighting schedule as advised by the Northern Lighthouse Board in the navigation risk assessment consultation process:

- The device will be predominantly yellow in colour above the water line.
- The Orbital O2.4 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.
- The device will be fitted with a radar reflector at a similar elevation.
- A navigation aid AIS (Automated Identification System) transmitter as requested by the Northern Lighthouse Board (NLB).

2.2 CONSTRUCTION, OPERATION AND MAINTENANCE, AND DECOMISSIONING

It anticipated that work on site at EMEC could commence in April 2025 at the earliest. A summary of the installation programme is provided in **Table 5**.

Table 5: Berth 3 installation programme.

Activity	Location	Approximate duration	Approximate timescale
Mooring installation	Berth 3	8 weeks in 4 month window	April 2024 – July 2024
Dynamic Cable installation	Berth 3	1 week	May – June 2024
Turbine delivery to Orkney	N/A	5 days	July 2024
Install on moorings	Berth 3	2 days	August 2024
First Grid connection	Berth 3	2 days	August 2024
Commissioning	Berth 3	8 weeks	August – September 2024
Operation	Berth 3	15 years	September 2024 – October 2039
Decommissioning	Berth 3	3 months	2039 – March 2040

2.2.1 Site Preparation and Mooring Installation

To prepare the site for installation, several activities will be required:

- Survey using ROV and ADCP.
- Splicing of export cable from Berth 3 to Device locations.
- Mooring system installation (Modular anchor or Rock bolts).
- Umbilical cable installation.

It is anticipated that most works will necessitate a multi-cat or dynamic positioning vessel.

2.2.2 Orbital O2.4 Tow to and from Berth 3

Once construction is complete, the Device will undergo sea trials close to the construction site prior to being towed to Orkney and likely temporarily moored at a sheltered bay. Orbital Marine Power hold a marine license for temporary mooring at Deer Sound, east of Kirkwall. A range of vessel class will be able to conventionally tow the Orbital O2.4 from point A to point B, however, in consideration of close quarters movements from harbours and technical requirements associated with handling lines during pre- installation, a Multi-Cat style vessel is considered the best all-round vessel for these operations. Such a vessel will be certified to an approved classification society and coded to the area of operation and task. The vessel would have a minimum power capacity of achieving a bollard pull off 30 T through a minimum of 2 independent propulsion systems. The vessel would have a towing capability of 50 T, winch with a 90 T brake, compatible with 44mm wire, with 500m of length. There must be an approved method of restraining a tow in addition to physical barriers that prevent the tow wire moving abaft the beam, this may be in the form of towing pins and/ or a gog eye system.

The vessel must consider contingency for towing operations, this may be in the form of a second capable winch and emergency tow system. The towing vessel must have sufficient fuel capacity with contingency for the towing operation, taking due consideration for the effect of tidal stream during towing.

Figure 7: Indicative tow arrangement for O2.4 device (Source: Orbital Marine Power).

2.2.3 Orbital O2.4 Platform Installation

Following the tow, the vessel will hold the Device in position during connection. 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. Once latched and locked into position the turbine will recover the dynamic riser section of cable for installation using the same winching process. The cable end will be lifted and any temporary keep weights must be removed before passing over cable end to the turbine structure. Following connection of the turbine mechanically, the towing vessel will remove towing equipment and prepare the cable for installation. The turbine will then recover the cable into the turbine and connect to the electrical grid.

During all the installation activities an additional vessel for safety as well as line running and connecting mooring lines is required. This is expected to be a RHIB vessel selected with due consideration of the task required and area of operation.

2.2.4 Operation and Maintenance

Following an initial commissioning phase of approximately 2 months, it is intended that the Orbital O2.4 turbines be installed at Berth 3 for a long term project of up to 15 years to end 2039, with decommissioning in 2039 and early 2040. During the commissioning phase, outputs from the Orbital O2.4 will be monitored in real time by the Orbital engineering team through a 24/7 duty manager system. The SCADA system has the facility to set up user configurable alarms that can be transmitted by email, automated phone call or text message to the dedicated duty managers mobile. All parameters of the system can be monitored through the SCADA system and limits or ranges can be setup and alarms generated if the parameter goes outside this limit or range. A stationing verification system will allow the device

to be monitored with control system alerts to the duty manager. Through the use of a GPS system, this function will observe the movement of the device and provide an alert if the system strays from the predefined operational area.

The Orbital O2.4 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 O2.4. 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 a personnel transfer the Orbital O2.4 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. Any such activities at a location outwith the EMEC test site, would be subject to a separate license application.

2.2.5 Decommissioning

Decommissioning of the mooring system at the EMEC Fall of Warness site is included in the project and will take place in 2040 at the latest. As per the requirements of Section 105 of the Energy Act 2004, Orbital will prepare a Decommissioning Programme prior to the commencement of the 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. All equipment would be removed from the site, with the exception of any element of the rockbolt anchors below the seabed if they are utilised.

3. OVERVIEW OF THE BASELINE ENVIRONMENT

The Fall of Warness EMEC site lies within the Orkney Islands, which lie to the north of the Pentland Firth, NNE of the NE portion of mainland Scotland. The Orkney Islands comprise over 50 islands. The Fall of Warness is located to the west of Eday and experiences significant tidal flows. The Fall of Warness is not located within port limits, with the Orkney Harbour Competent Harbour Authority (CHA) areas located 8nm to the SE of the Device locations.

The proposed location for the two O2.4 Devices is NE of Muckle Green Holm and west of War Ness, as shown in Figure 1.

3.1 METOCEAN CONDITIONS

A full overview of the metocean conditions within the study area is provided in the sitewide NRA (EMEC, 2019). Given that the metocean conditions would not have changed significantly since, a summary is provided below.

The prevailing wind is south/south-westerly, and on average 50 days with gales each year in Kirkwall. The predominant wave direction is north-westerly and to a lesser extent, south-easterly with the significant wave heights generally below two metres. Days per year with fog is 41 in Kirkwall, ranging from two to five per month, with fog most frequent in the summer months. Tide characteristics are provided in Table 5 and 6 of the sitewide NRA (EMEC, 2019).

3.2 EXISTING VESSEL TRAFFIC MANAGEMENT

Figure 8 shows the location of all key vessel traffic management features near to the study area.

- **Harbour Areas**: The Fall of Warness site lies outside of the limits of the Orkney Islands Council Harbour Authority Area. These extend no further north than Shapinsay Sound and Wide Firth.
- **Pilotage**: Pilotage is compulsory within the Orkney Harbour Competent Harbour Authority (CHA) areas for Passenger vessels over 65m LOA, all other vessels over 80m LOA, all vessels under tow where the combine overall length of the two is over 65m and all vessels over 300GT carrying persistent oils in bulk.[2]
- **Vessel Traffic Services**: Orkney Islands VTS, based in Scapa Flow, do not routinely monitor vessels near the Fall of Warness site.
- **Vessel Reporting**: The Pentland Firth is an IMO adopted voluntary ship reporting system.

[2] https://www.orkneyharbours.com/site/assets/files/1113/the_orkney_pilotage_direction_1988_as_amended_2007-_2010_and_2016_v8_final.pdf

- **Ship Routeing Schemes**: An IMO-adopted Area To Be Avoided (ATBA) has been designated around the Orkney Islands. To avoid the risk of pollution and damage to the environment, all vessels over 5000GT carrying oil or other hazardous cargoes in bulk should avoid the ATBA.

3.3 OFFSHORE ACTIVITIES IN STUDY AREA ADJACENT TO STUDY AREA

Figure 8 shows the location of all key offshore activities near to the study area.

- **Aquaculture**: There are a significant number of marine farms around the Orkney Islands. There are none in the study area, with the closest located 2.5nm to the east, the far side of Eday, and 4.2nm to the south.
- **Search and Rescue**: There are RNLI Lifeboat Stations located at Kirkwall, Stromness and Longhope. The nearest station is RNLI Kirkwall Lifeboat Station which is approximately 10nm SW of the device locations. The Coastguard Operations Centre on Shetland coordinate SAR response in the region.
- **Firing Practice Area**: A firing practice range is located to the east of the site. No restrictions are placed on the right to transit the firing practice areas at any time. The firing practice areas are operated using clear range procedure; exercises and firing only take place when the areas are considered to be clear of all shipping.
- **Submarine Cables**: Only EMEC installed submarine cables connected to the test berths exist within the study area.
- **Offshore Oil and Gas**: There are no offshore oil and gas activity in the study area.
- **Marine Aggregates**: There are no marine aggregate license areas in the study area.
- **Disposal of Spoil or Dredging Material**: There are no disposal sites in the study area.
- **Other OREIs**: With the exception of the other EMEC devices (see **Section 1**), there are no other OREIs in the study area.
- **Aids to Navigation**: Navigation marks are fitted to the EMEC test devices, typically an all round flashing yellow light and an AIS transponder. A South Cardinal 3nm to the west, at Point of the Graand, and a North Cardinal 2.5nm to the east, south of Eday, are the closest navigational marks.

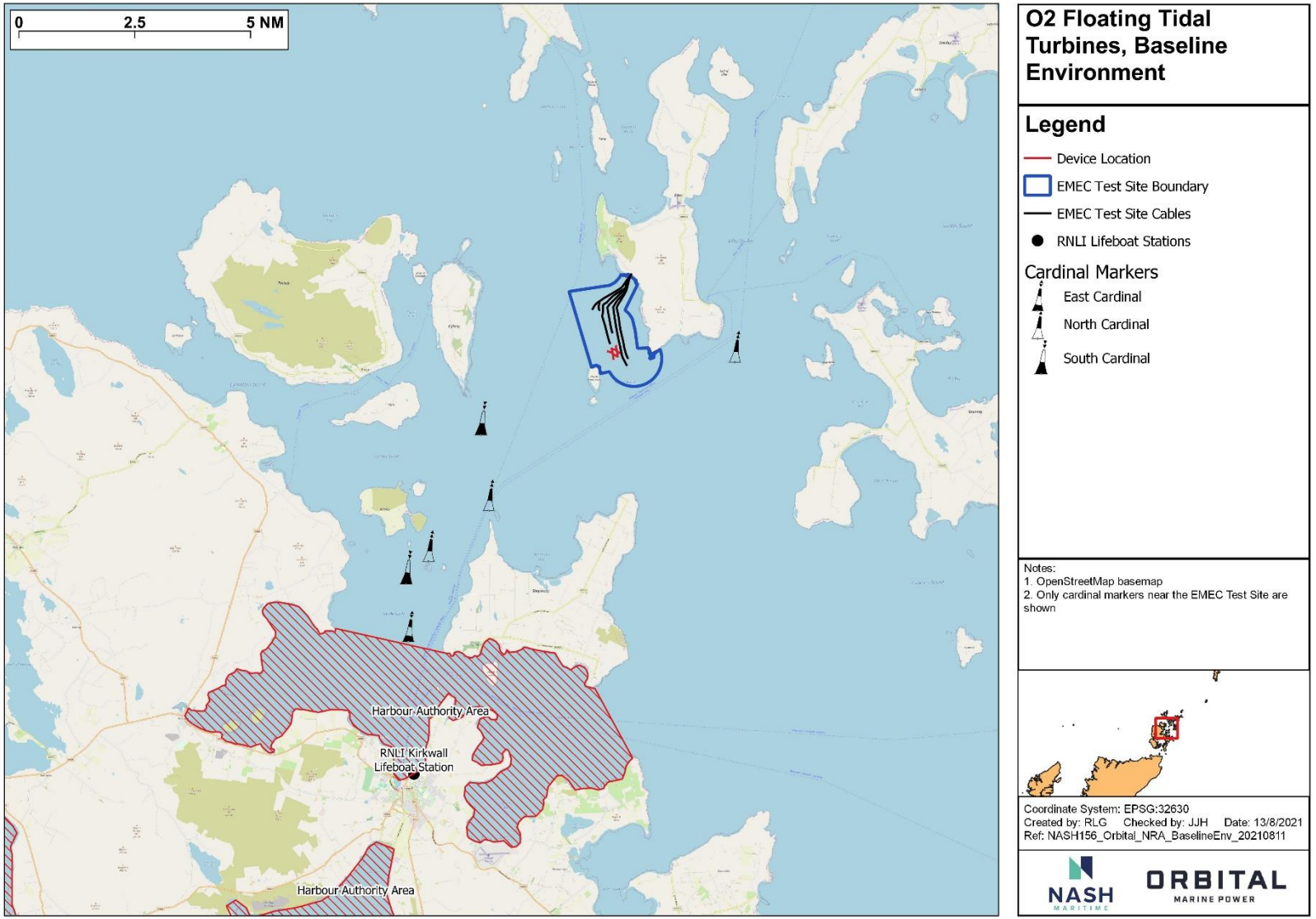

Figure 8: Overview of the baseline environment

4. STAKEHOLDER CONSULTATION

Stakeholder consultation is a key tool in the navigation risk assessment process. Consultation with marine stakeholders and regulators is fundamental to understanding existing and future vessel traffic use and navigational issues. Consultation primarily focussed on understanding:

- Existing vessel traffic use of the area, particularly by regular runners such as by inter-island ferry services.
- Any known incidents, near-misses or feedback associated with device deployment across the EMEC test site.
- Any navigation concerns or potential impacts arising from deployment of existing or future devices within the EMEC test site.
- Potential impact mitigation measures or risk control options.

Stakeholder consultation was undertaken remotely via video calls due to COVID-19 restrictions and precautions. A list of consultees and key engagement is shown in **Table 6**. A summary of the key issues raised and where they are addressed within this NRA is provided in **Table 7**.

It should be noted that all of the consultees contacted and listed in **Table 6** (apart from the Chamber of Shipping) have previously been consulted during the NRA for the site-wide EMEC Fall of Warness test site, in addition to device-specific NRAs within the test site.

Table 6: Summary of stakeholder consultation.

Consultee	Consultation Letter	Engagement
MCA	A consultation letter providing details of the project and device locations was sent on 26-Jul-2021.	Email received on 29-Jul-2021 confirming that the MCA have no comments on the proposed locations.
Northern Lighthouse Board		Consultation meeting held on 05-Aug-2021, see **Appendix B** for meeting minutes.
Orkney Ferries		Consultation meeting held on 07-Jul-2021, see **Appendix B** for meeting minutes.
RYA		Formal letter outlining RYA position received on 30-Jul-2021, which is provided in **Appendix B**.
Orkney Marinas		No response received.
Orkney Fisheries		Email received on 13-Aug-2021 confirming that Orkney Fisheries have no further comments to those provided for the previous device consultation.
Orkney Islands Council Marine Services		No response received.

Table 7: Summary of key issues raised during stakeholder consultation.

	Key issues raised
MCA	No comments.
Northern Lighthouse Board	Light should be brighter and higher than earlier devices, like the newer devices. Concern raised over the number of AIS markers in the area and highlighted possibility of using dormant AIS devices. Highlighted need to consider deeper draught vessels, such as cruise ships, that occasionally transit through the area.
Orkney Ferries	Potential to impact ferry route which is taken to avoid bad sea states.
RYA	No comments. Position has not changed since previous consultation, see minutes of the Teams video conference of 07-Jan-2021 to discuss the O2 berth 6 NRA consultation.
Orkney Marinas	No response.
Orkney Fisheries	No response.
Orkney Islands Council Marine Services	No response.

5. VESSEL TRAFFIC AND RISK PROFILE

5.1 DATA SOURCES

Whilst MGN 654 mandates the need for an offshore traffic survey, including both visual observations and radar tracking, the site-wide NRA established that radar surveys would not be required for individual devices. The principal reasons include:

- The devices are small in scale, changing frequently, and therefore the survey would not be proportionate.
- The Fall of Warness EMEC test site is long established, familiar to all local users and regular runners and there have been no significant incidents.
- Previous applications for deployment of devices within the EMEC test site have not been considered to have a significant impact upon navigational safety by national and local stakeholders.

Therefore, the primary data source for this NRA is data from the Automatic Identification System (AIS) recorded by EMEC for the following periods (a total of 103 days) in order to ensure seasonally representative coverage for a period prior to any COVID-19 influence on vessel navigation (June 2019 and January 2020) as well as more recent periods (March and April 2021):

- 18th to 29th June 2019 (11 days)
- January 2020 (31 days)
- March 2021 (31 days)
- April 2021 (30 days)

AIS is required on all larger commercial vessels over 300GT, fishing vessels over 15m LOA, passenger vessels and may be voluntarily fitted to smaller recreational and fishing vessels. Therefore, to account for smaller craft, additional data sources reviewed and considered within this assessment:

- Stakeholder consultation.
- General Directions, Regulations, Guidelines, Byelaws, Codes of Practice for applicable navigation authorities.
- Nautical Publications.
- Charts (project licence to be provided).
- VMS data.
- Almanacs.
- IMO publications.
- Metocean information sources (for weather, tidal information).
- Incident Records including MAIB and RNLI.

5.2 VESSEL TRAFFIC OVERVIEW

The Devices are located within the Fall of Warness site, approximately 600m east of Muckle Green Holm and 1200m southwest of War Ness (Figure 1). **Figure 9** shows that a majority of vessels navigating within the study area transit northeast to southwest, south of War Ness and Muckle Green Holm. Vessels also transit along a north to south orientation west of Muckle Green Holm. **Figure 11** indicates that a majority of vessels navigating within the area are vessels less than 100m. Vessels over 100m navigate from the northwest of the study area, through the Fall of Warness.

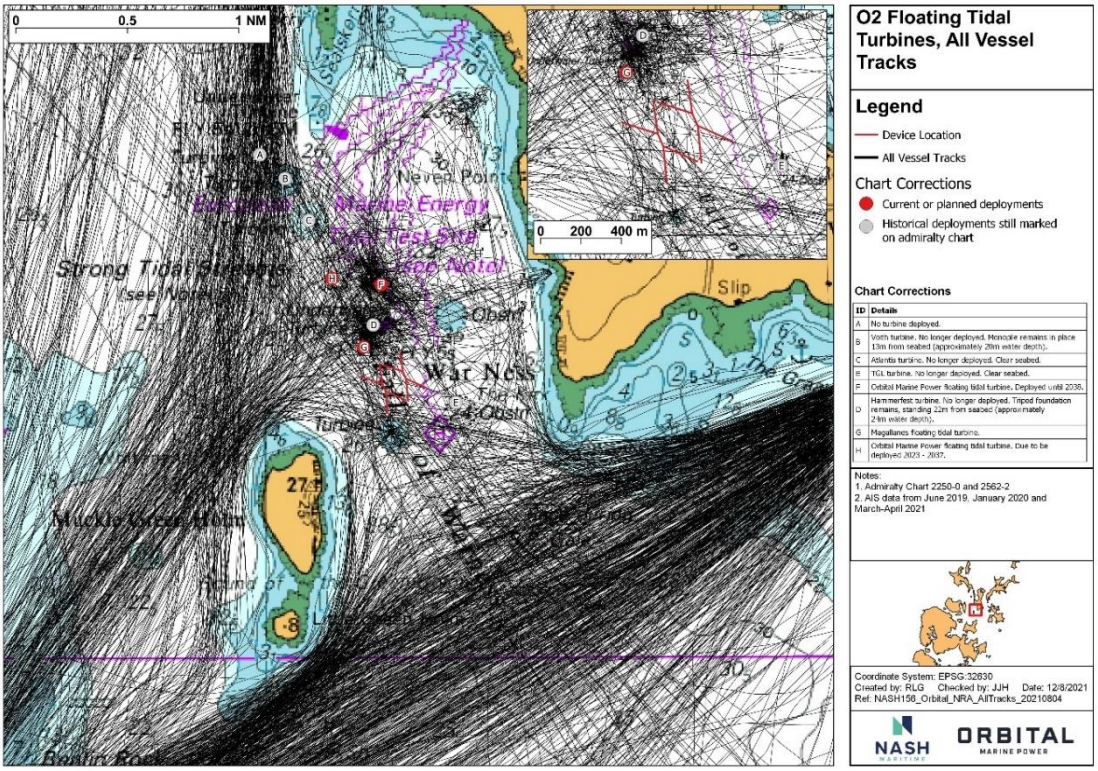

Figure 9: All Vessel Tracks.

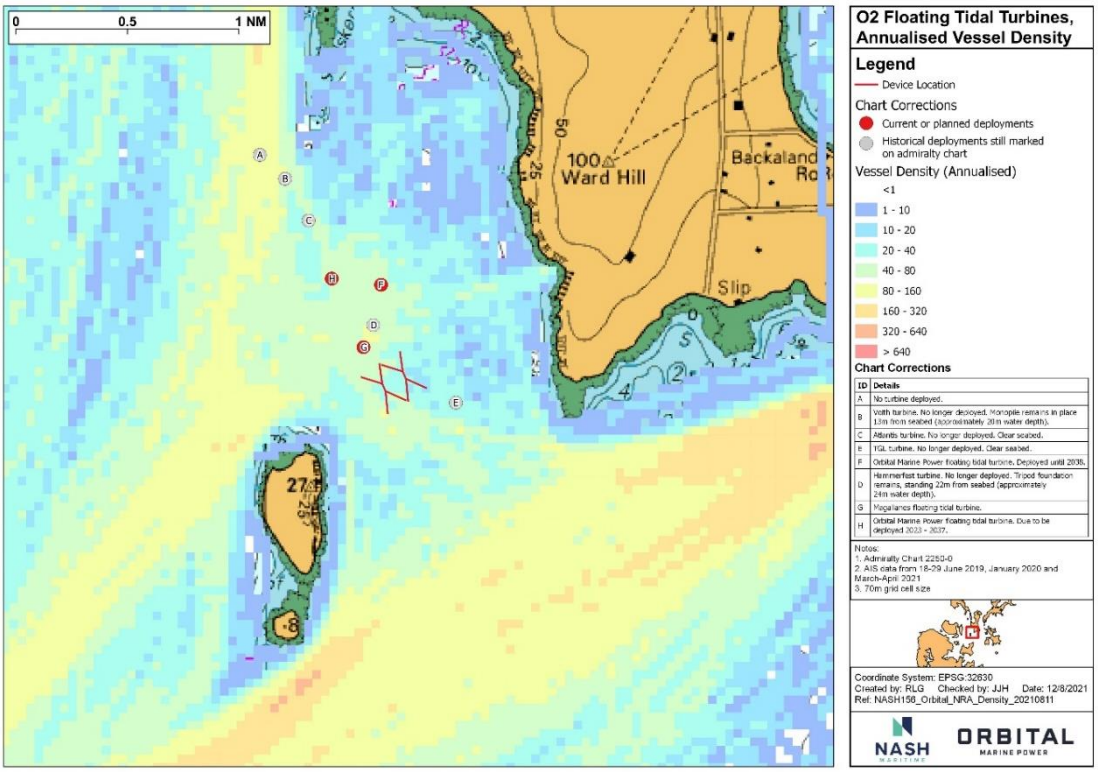

Figure 10: Annualised vessel density for all vessel types (grid cell size 70m).

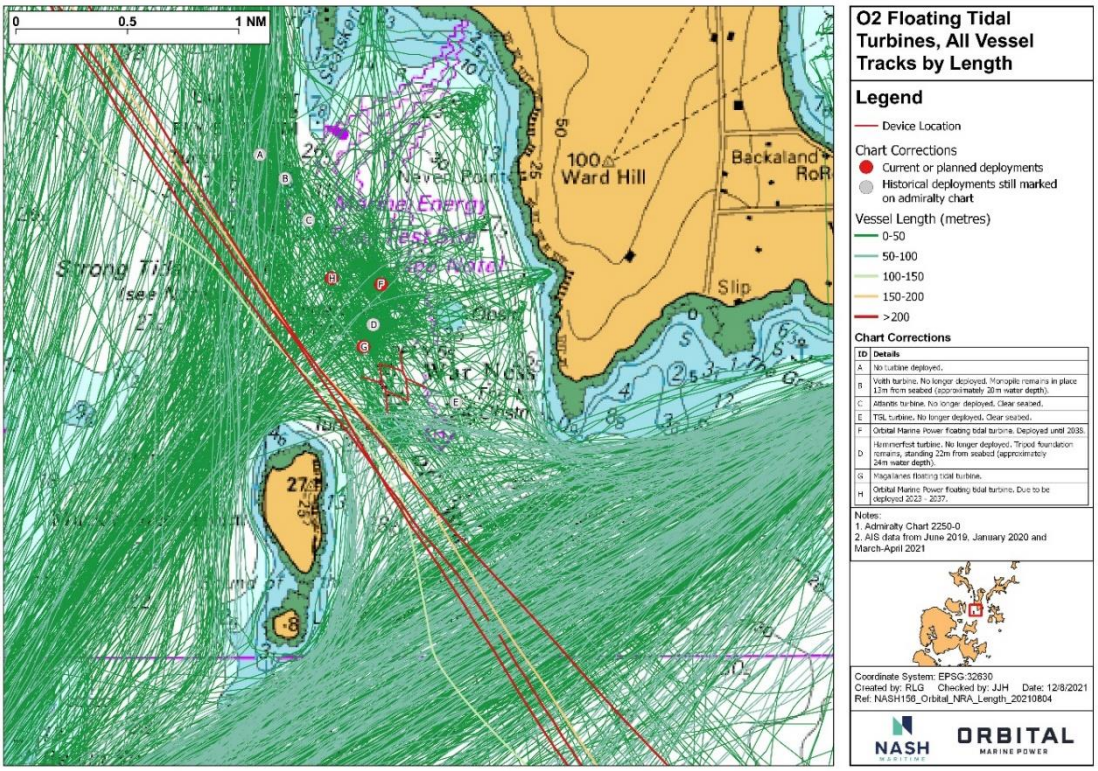

Figure 11: Vessel Tracks by Length (metres).

5.2.1 Commercial Shipping

No cargo vessels or tankers were identified within the study area during the data periods. It was noted in the site-wide NRA (EMEC, 2019) that some small cargo vessel transits were recorded through the site. The designation of an IMO-adopted Area To Be Avoided (ATBA) around the Orkney Islands likely accounts for the lack of commercial vessels observed. The ATBA stipulates that to avoid the risk of pollution and damage to the environment, all vessels over 5000GT carrying oil or other hazardous cargoes in bulk should avoid the ATBA.

5.2.2 Passenger Vessels

Figure 11 shows that passenger vessels transit via two primary routes. Orkney Ferries provide services that navigate from the NE to the SW of the study area, south of Warness and Muckle Green Holm. The main ferries are the Earl Sigurd (45m LOA), Earl Thorfinn (45m LOA) and Varagen (50m LOA), operated by Orkney Ferries. Tracks to the south of the Fall of Warness are transits between Kirkwall, Eday, Sanday and Stronsay. Tracks to the west of the site are transits between Kirkwall and Westray, Papa Westray and North Ronaldsay.

In addition, five transits of cruise ships were recorded during the June 2019 dataset; namely the Black Watch (205m LOA), Boudicca (205m LOA), Star Breeze (169m LOA) and Sea Cloud II (117m LOA). All of these transits passed between the Device location and Muckle Green Holm.

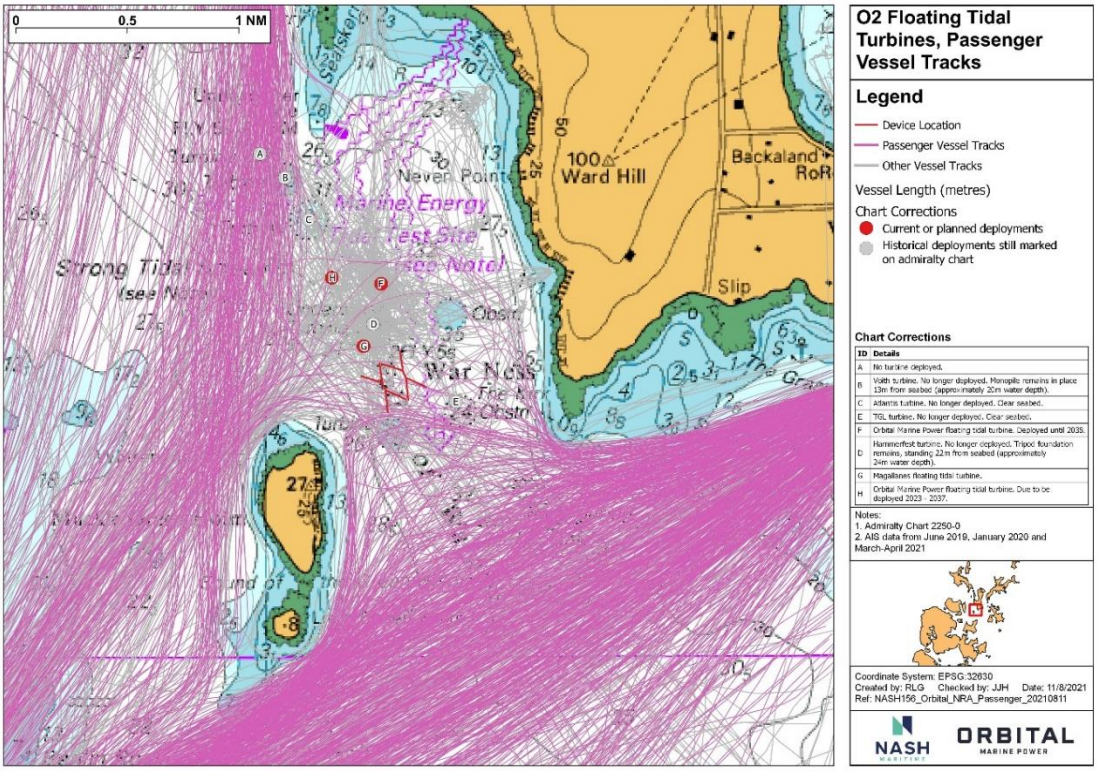

Figure 12: Passenger vessel tracks

5.2.3 Fishing Vessels

Figure 13 shows fishing vessels activity within the study area. Of those fishing vessels carrying AIS, all were recorded transiting through the study area and not engaged in fishing. These vessels were between 24m and 40m. In addition, several large fish carriers were recorded including the Marsali (63m) and Aqua Senior (48m).

Consultation conducted as part of the site-wide NRA (EMEC, 2019), suggested that some small day boats may engage in potting closer to Eday. Whilst 2019 MMO VMS data was reviewed, no data was recorded within the study area.

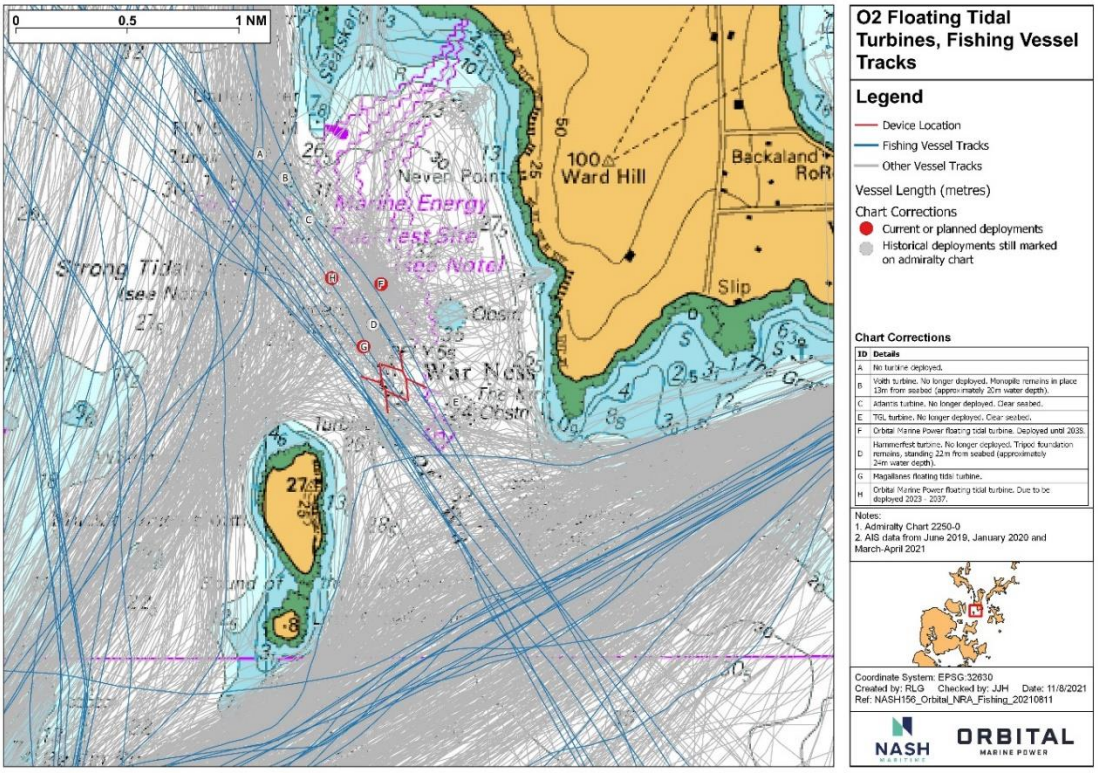

Figure 13: Fishing vessel tracks

5.2.4 Recreational Vessels

Figure 14 shows that few recreational vessels transit within the study area. The Orkneys is a popular cruising destination, particularly during the summer months. The RYA boating atlas does not identify the area as having a high density of traffic. Not all recreational craft are required to carry AIS and therefore the figure likely underrepresents these activities. The three principal marinas in the Orkneys are located at Stromness, Kirkwall and Westray, well clear of the Fall of Warness site.

5.2.5 Tug and Service Vessels

Figure 15 shows tug and service tracks within the study area. A variety of the different multicat and work vessels are recorded active around the Fall of Warness site. The majority of the vessel tracks navigating from the NE to the SW of the study area, south of Warness and

Muckle Green Holm, are made by NUGG BAY, which has been identified as a harbour master vessel.

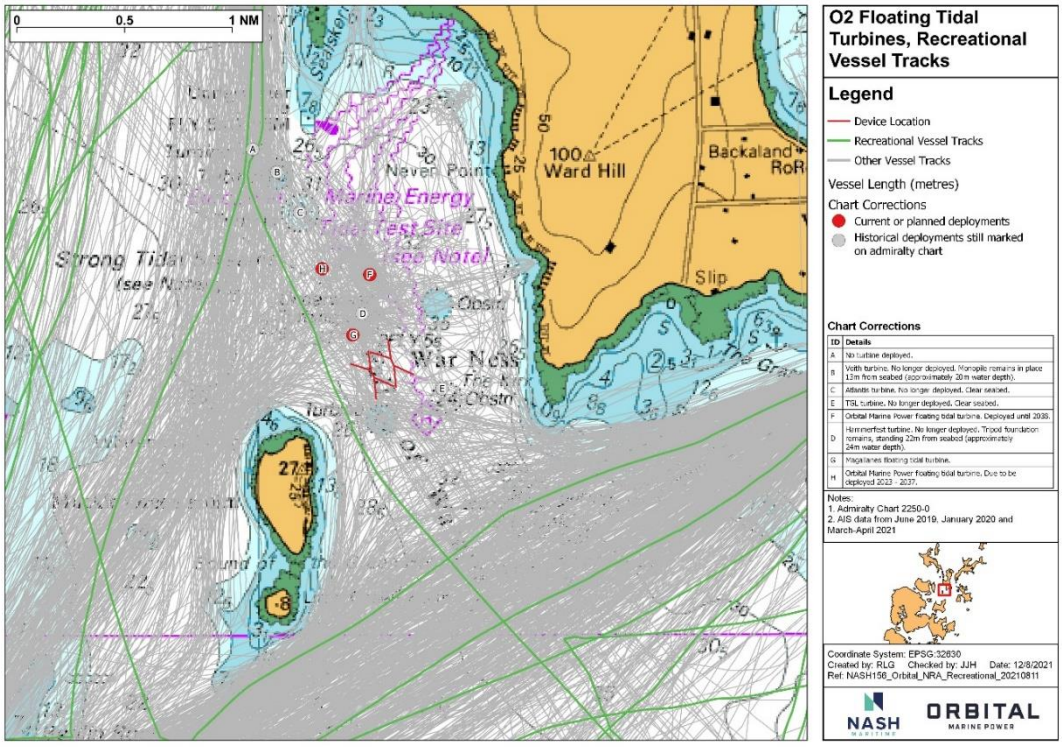

Figure 14: Recreational vessel tracks.

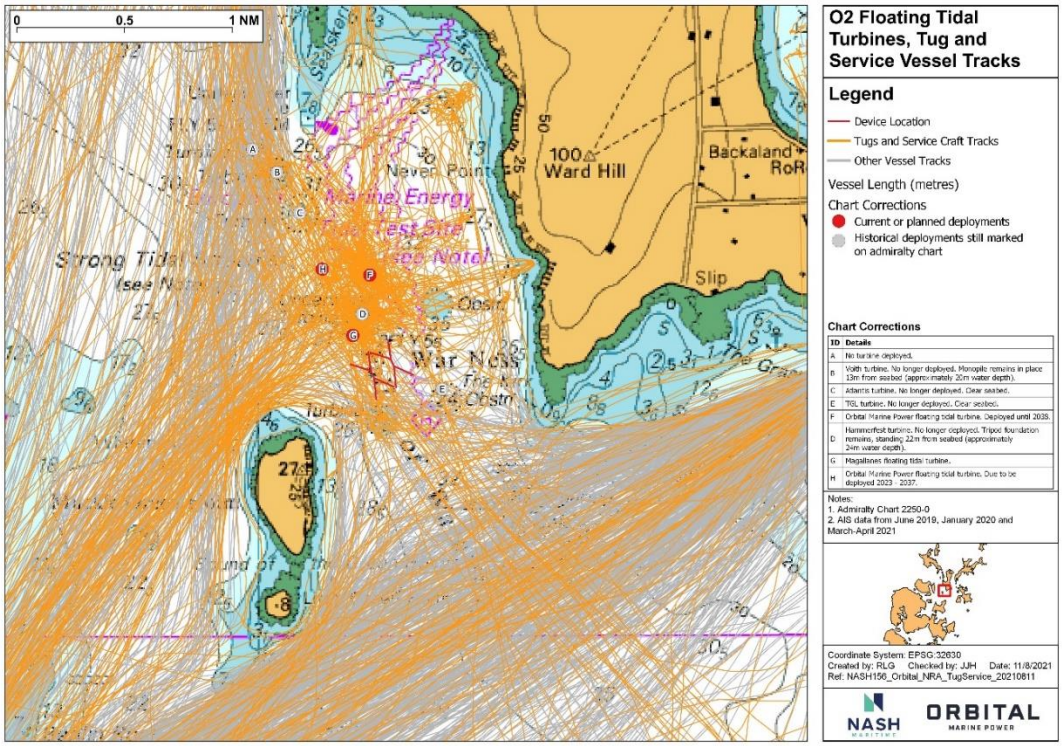

Figure 15: Tug and service vessel tracks.

5.3 TRANSITS THROUGH EMEC TEST SITE

Figure 16 identifies all vessel tracks that intersect the EMEC Test Site. **Figure 17** shows the number of vessel transits intersecting the EMEC Test Site by time of day.

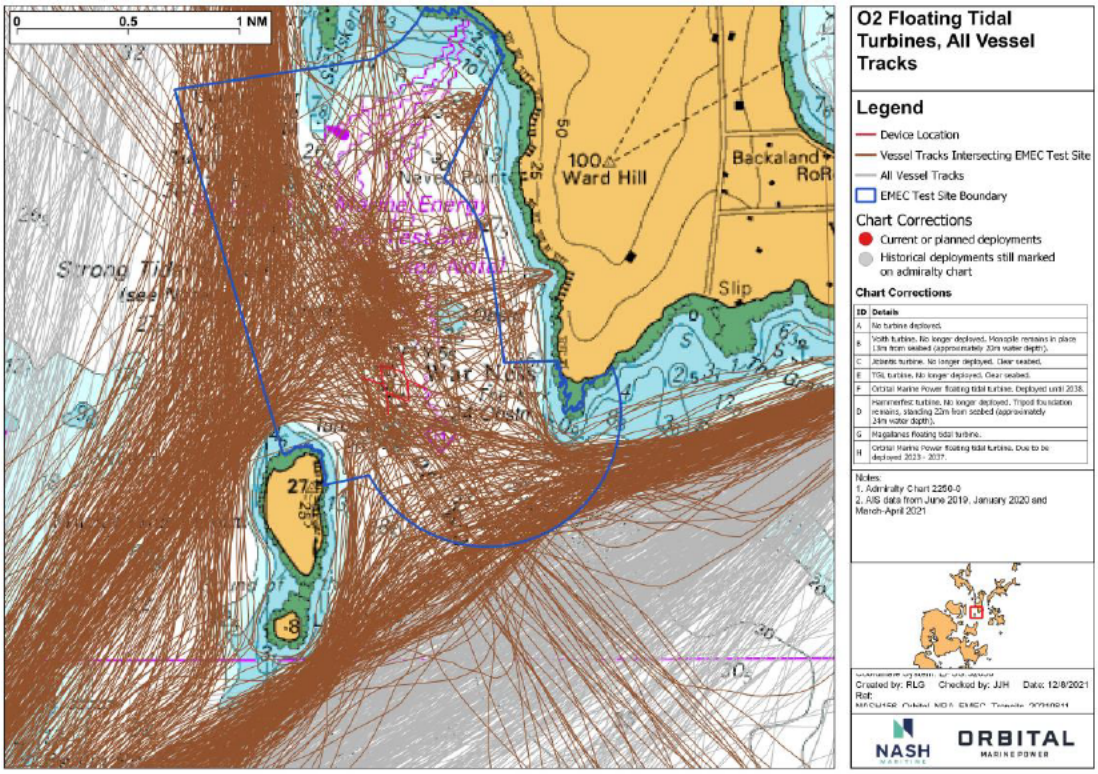

Figure 16: All vessel tracks transiting through the EMEC Test Site.

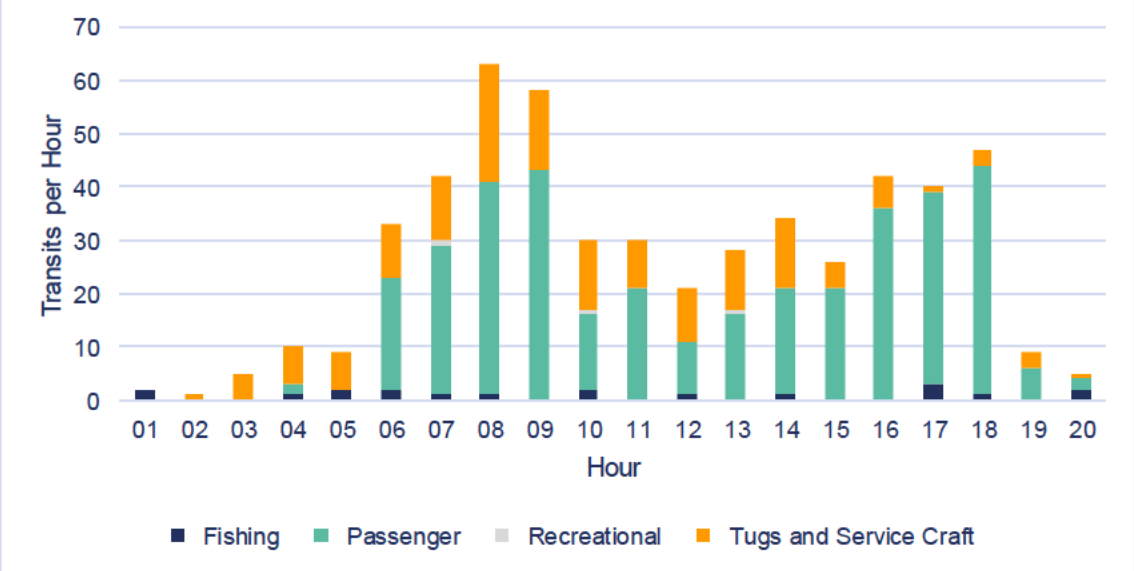

Figure 17: Vessel transits by time of day through the EMEC Test Site.

5.4 BENCHMARKING

Figure 18 shows the number of vessel transits intersecting the EMEC Test Site by month and by vessel type. An average month from the EMEC sitewide NRA (EMEC, 2019) has also been included for comparison. June 2019 data has been scaled to 30 days. The results suggest that whilst there has been some downturn in traffic, potentially related to COVID-19, the updated analysis is relatively consistent with the site-wide NRA.

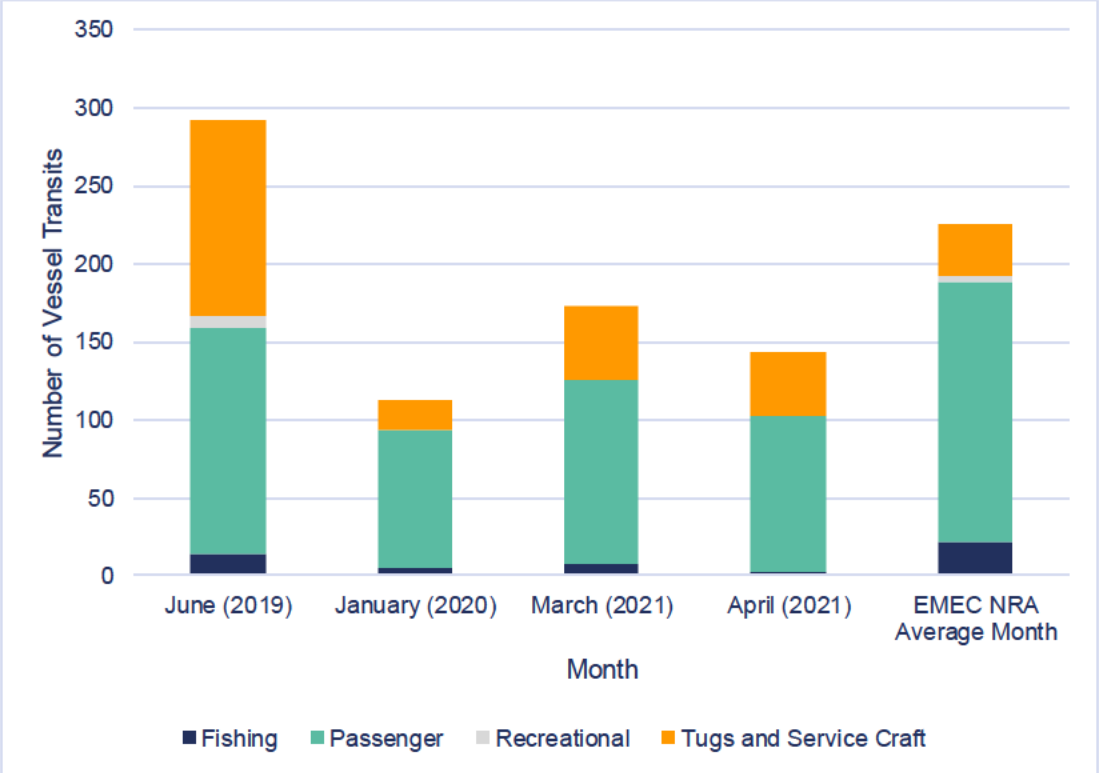

Figure 18: Count of vessel transits through EMEC Test Site.

5.5 HISTORICAL INCIDENTS

Historical accident data from the RNLI (2008-2020) and MAIB (2010-2020) were analysed to better understand the risk profile of the Fall of Warness site. **Figure 19** shows that there are two reported incidents within the EMEC Test Site boundary. These include an altercation between two fishing vessels in 2016 and an accident to person onboard a floating jack up barge in 2010. The nearest incident outside of the EMEC Test Site boundary was the grounding of a fishing vessel in Sealskerry Bay in 2014. Other incidents have been responded to by the RNLI within the study area, all of which involve mechanical failure aboard a vessel.

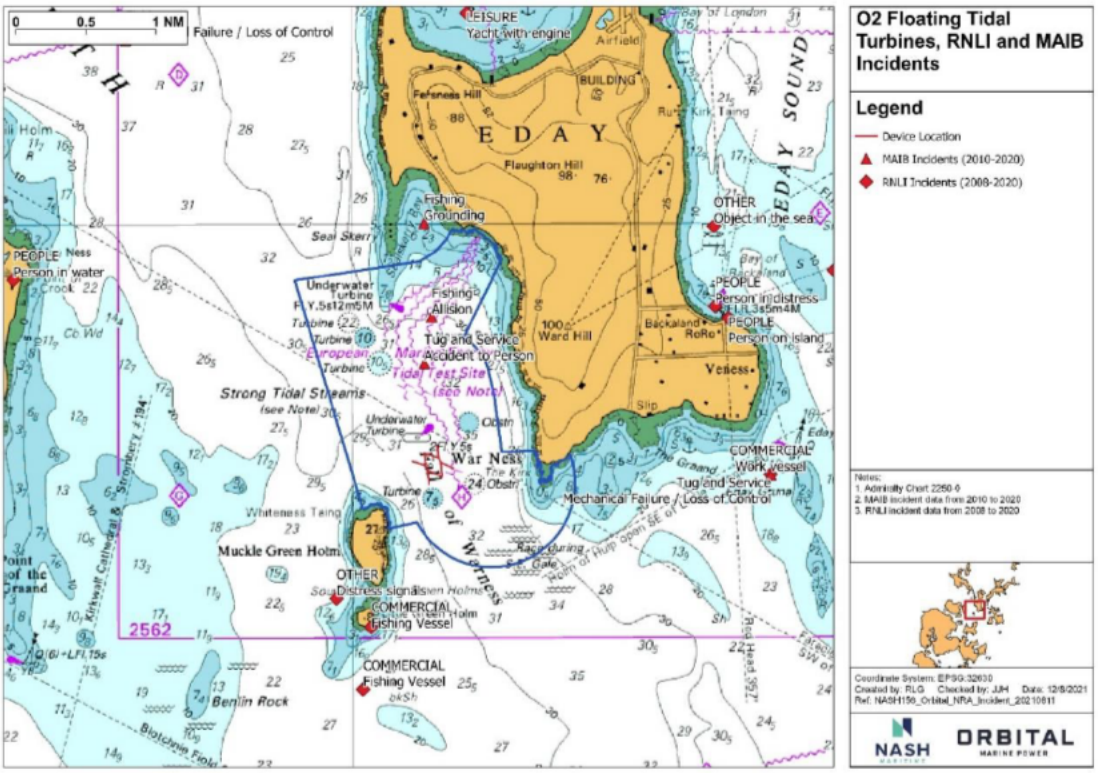

Figure 19: Locations of RNLI and MAIB reported incidents

5.6 FUTURE TRAFFIC PROFILE

5.6.1 Orkney Commercial Traffic

The Orkney Islands Council Marine Services Annual Report (2019-2020) provides a statement of current and future activity, which is summarised in this section.

Pilotage movements to all facilities continue to follow an upward trend, increasing by 185 between 2017 and 2020 (see **Table 8**).

Table 8: Total acts of pilotage between 2017 and 2020

Year	Total pilotage movements
2017-18	708
2018-19	835
2019-20	893

Oil related activity in the Scapa Flow Oil Port has commenced a slow decline that will continue over the next decade. The diversification into Ship to Ship (STS) operations and offshore platform moorings therefore remains an essential area of business development. The expansion and introduction of more business in Scapa Flow is reflected in its status as National Strategic Infrastructure. Introduced activity includes LNG operations, more deep-

water anchoring, and further growth in STS business. The Harbour Authority is pursuing LNG storage and bunkering in Scapa Flow.

Cruise activity is anticipated to maintain strong growth. 165 cruise ships were booked for 2020 and that level of port calls is expected to be maintained. Berth space continues to come under pressure during the summer season.

5.6.2 Renewable Energy Related Traffic

Devices deployed within the EMEC Test Site are maintained by vessels from Kirkwall. The construction, maintenance and decommissioning of Orbital O2 devices will increase the number of small project vessel activity within the area. During the lifetime of the O2.4 devices proposed, there will be other EMEC devices operating or decommissioned within the EMEC Test Site, this will result in a combined increase in small vessel activity and in-combination effects.

The Westray project is unlikely to be progressed for some years, and even then, traffic related to this project is unlikely to transit within the EMEC Test Site.

The Orkney Islands Council Marine Services Annual Report (2019-2020) anticipates that the area will continue to attract programmes to commercialise marine renewables, providing new opportunities around carbon free fuels and continued growth.

The Harbour Authority is involved in the EU Horizon 2020 for HYSEAS III for a hydrogen powered RoRo ferry and in EU ERDF funds for a low carbon and active transport and travel hub in Stromness.

5.6.3 Fishing and Recreational Traffic

A review of the Scottish Sea Fisheries Statistics (2019) shows that the number of voyages by Scottish fishing vessels in the Orkney region has remained fairly consistent (see **Figure 20**). The number of registered fishing vessels has declined from 142 in 2012 to 127 in 2019.

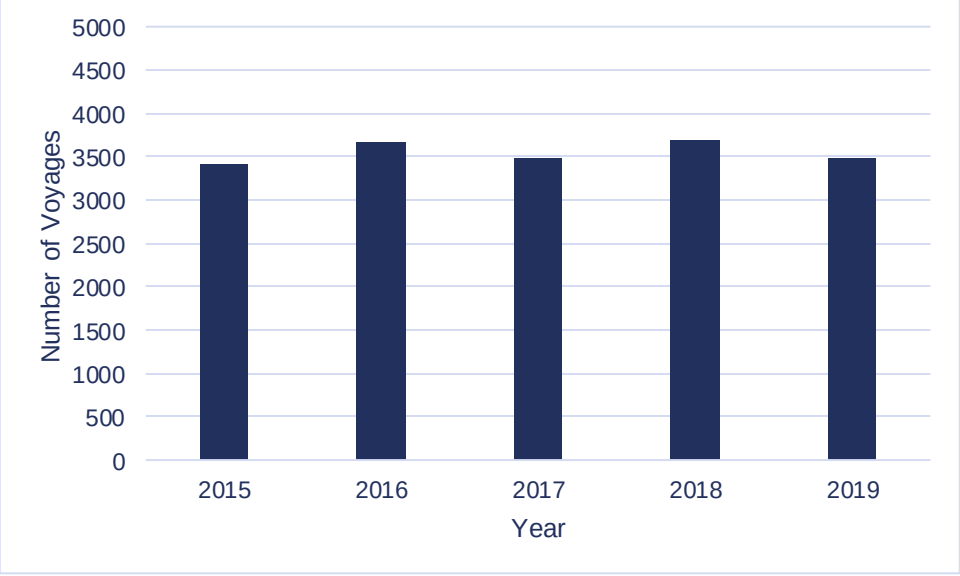

Figure 20: Fishing vessel voyages through Orkney

No updated figures for recreational traffic are available. The EMEC (2019) site-wide NRA identified that the number of marina visits between 2008 and 2017 had increased steadily, with most activity to Stromness and Kirkwall and therefore generally clear of the project site.

5.6.4 Summary

It is not anticipated that the changes in vessel traffic discussed will materially change the risk profile assessed for the two O2.4 devices at EMEC Berth 3.

6. IMPACTS TO NAVIGATION

The site wide Fall of Warness NRA identified 12 key impacts that should be addressed in each device specific NRA, these are summarised in **Table 9** and detailed in the following section below.

Table 9: Key impacts to navigation (Source: Site Wide Risk Assessment).

Number	Impact
1	Impact on Vessel Traffic Routeing
2	Impact on Contact/Allision Risk
3	Effect of the Tides, Tidal Streams and Weather
4	Impact on Under Keel Clearance
5	Impact on Collision Risk, Visual Navigation and Collision Avoidance
6	Impact on Communications, Radar and Positioning Systems
7	Impact of Failure of Moorings
8	Impact on Fishing Activity
9	Impact on Recreational Activity
10	Impact on Subsea Cables
11	Impact on Search and Rescue and Emergency Response
12	Cumulative and In-Combination Effects

6.1 IMPACT ON VESSEL TRAFFIC ROUTEING

The Fall of Warness is a navigable waterway utilised by a variety of vessels (see **Section 5**). In particular, a route exists through the Orkney Islands between Stronsay Firth to the south-east and Westray Firth to the north-west, passing directly through the Fall of Warness. The width of this waterway, between Muckle Green Holm and War Ness is approximately 2.1km (1.13nm). Both the Admiralty Chart 2250 and Sailing Directions draw attention to the presence of the tidal device testing site. Principally this route is utilised by:

- Cruise Ships.
- Fishing boats and trawlers.
- Large offshore service vessels (oil and gas supply boats).
- Occasional recreational craft.
- No commercial traffic.

Figure 21 shows the possible routeing scenarios with the device in place with historical vessel traffic (2017). The historical transits are directly through the location of Berth 3, the Magallanes device (G) and close to the location of the proposed second Orbital device (H). For vessels to safely navigate clear, they must pass to the west (green) or east (red). The eastern passage requires a significant alteration of course due east of the installed Orbital device (F) in order to pass to the west of the fixed device to the south of Seal Skerry. Given the proximity to the shore and occasional significant tidal flows and metocean conditions, this is unlikely to be the preferred option.

The western passage enables a direct transit between the two Firths. During consultation it was determined that a minimum passing distance both from Muckle Green Holm and the Orbital devices would be at least one cable (185m). **Figure 21** marks this corridor, and at its

minimum width would be approximately 420m wide. In Spring 2019, the Magallanes device was installed at site G. Five cruise ship transits in June 2019 are marked, all of which lie within the marked green corridor and with the Magallanes device in place.

Whilst this passage is narrower than is currently available, there are several mitigating factors. All transits through this passage would be direct without any significant alterations of course. In addition, the prevailing tidal flows would be in line with the direction of transit and therefore the expected leeway would not be significant. Furthermore, the reduced distance with the Orbital devices as compared to the baseline with the Magallanes device in place is not significant, nor have there been concerns or incidents as a result of that device. Finally, for those vessels concerned with making this passage, twice the searoom is available to the west of Muckle Green Holm with only a minor increase in distance travelled.

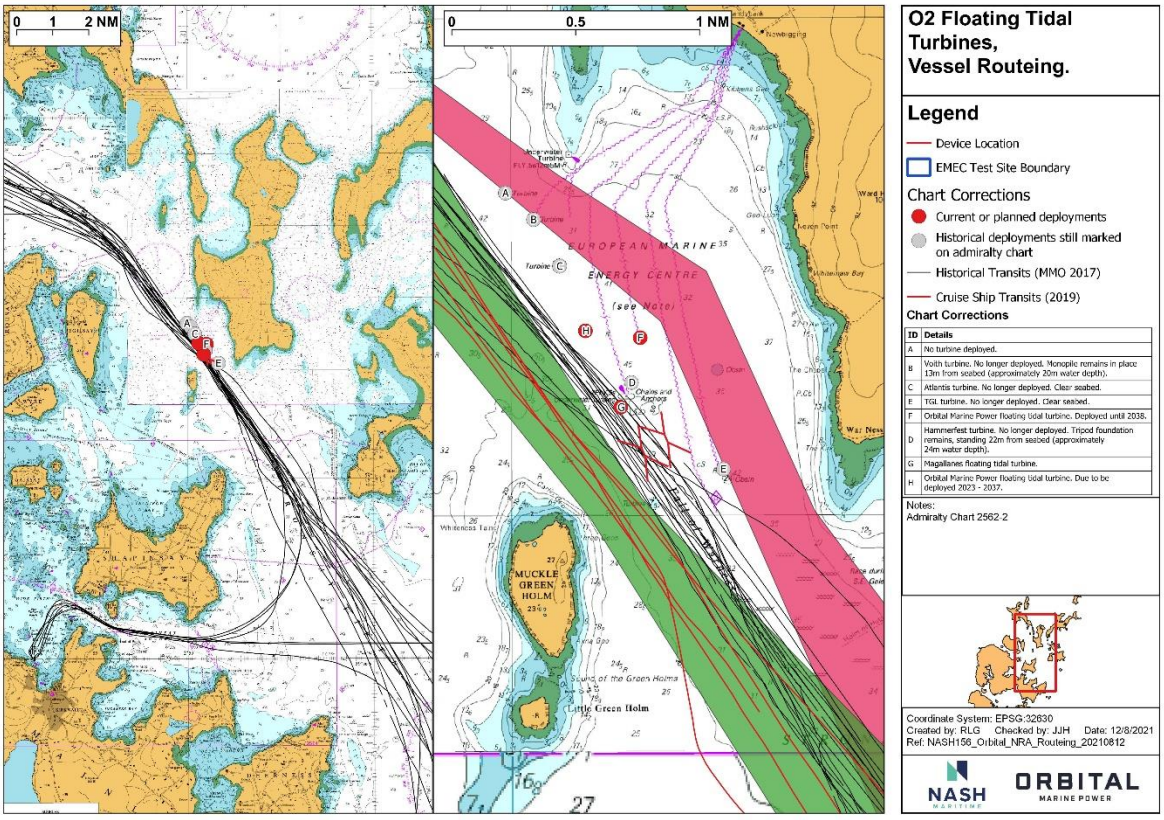

Figure 21: Vessel Routeing Options.

During consultation with the NLB, it was discussed whether there might need to be a future requirement to install a navigational aid on Muckle Green Holm to support mariners in making this passage.

6.2 IMPACT ON CONTACT RISK

The contact of a navigating vessel with an Orbital Device can occur for numerous reasons. These might include insufficient lookout, inadequate passage planning, fatigue, mechanical failure, poor visibility or adverse weather amongst other factors. An allision with a device could cause significant damage to both the vessel and device, pollution and injuries.

The likelihood of an allision occurring with a device is not considered significant due to the following factors:

- Analysis of historical incident data (see **Section 5.5**) and consultation has identified no previous occurrence since the site was established in 2005.
- The absolute numbers of vessels transiting through the site are not significant (see **Section 5**).
- The Devices are well marked with lights, radar reflectors, AIS, charted and promulgated to local users. Therefore, there is a heightened awareness of their presence to most transiting vessels.
- Modelling undertaken in the Site Wide NRA estimated an allision risk of less than once in 100 years.

Given the much more frequent movements of maintenance vessels in close proximity to the Devices, a contact involving these vessels is more likely. However, the incidents are likely to happen at slow speed without significant damage or injuries. The local knowledge, training and experience of the skippers of these vessels reduces the likelihood of occurrence.

6.3 IMPACT OF THE TIDES, TIDAL STREAM AND WEATHER

The Fall of Warness has a significant tidal rate (see **Section 3.1**) that impacts upon the navigation of certain vessel types. In particular, analysis of historical traffic movements has identified that during specific conditions, passenger ferries re-route through the Fall of Warness (see **Section 5.6** and **Figure 22**).

Firstly, when the tides are north-westerly, ferries can be seen passing further north in order to take advantage of the reduced flow rate behind both Muckle Green Holm and Eday. For the majority of these transits, the vessels are more than five cables (925m) from the proposed Device locations. However, on three occasions, the ferries passed within one cable (185m) of the proposed Device location. Therefore, there is significant sea room for ferries to continue this manoeuvre with the devices in situ.

Secondly, during strong south-easterly winds the ferries will occasionally pass to the north of Muckle Green Holm and inshore at War Ness (Eday). This improves passenger comfort by avoiding beam on conditions but brings their transits closer to the Device locations. During consultation, no concerns were raised about continuing this manoeuvre with the proposed Devices in situ.

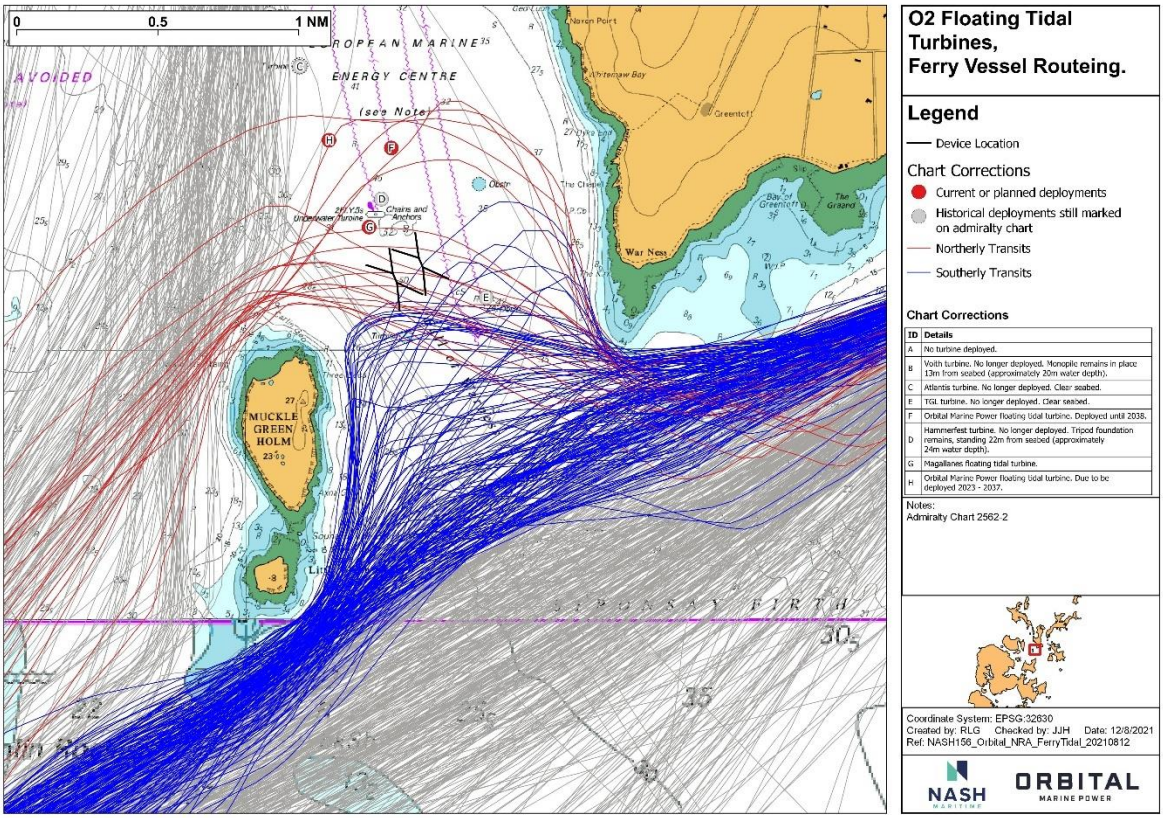

Figure 22: Comparison of Ferry Transits.

6.4 IMPACT ON UNDER KEEL CLEARANCE

The Device would include significant subsurface infrastructure that could pose a risk to navigating vessels. The rotor blades have a diameter of up to 24m and when operational would have a minimum depth of 3.2m, occurring at 14m from the device's centre. Therefore, in order to collide with the device, a vessel with a draft greater than 3.2m must be within 14m of the device. During operation, the maximum extent of the blades would extend to 14m plus the length of blade, which is up 12m. The draught at the maximum extent of 26m from the centre of the device would be 14.3m. Vessels further than 26m from the device would not be at risk from the rotor blades.

The most frequent vessels to transit the area are the Orkney Island Ferries, with draughts of 3.16m, and maintenance vessels such as the C-Odyssey, with a draught of 2.5m. These draughts would be greater given dynamic action of waves or heeling action and so a safety factor of 30% is recommended by the MCA.

The analysis of vessel transits in Section 5 show that only six deep draught transits occurred. The cruise ships Black Watch (7.3m), Boudicca (7.5m), Star Breeze (5.4m) and Sea Cloud II (6m), and the Marsali fish carrier (6m). It is unlikely that any of these vessels would transit within 33.5m of the device.

6.5 IMPACT ON VISUAL NAVIGATION AND COLLISION AVOIDANCE

OREIs have the potential to disrupt traffic flows and obscure other navigating vessels which has the potential to result in a collision. The Device has a height above the waterline of under 2m and therefore vessels either side would be able to visually identify one another. Furthermore, analysis of historical AIS data estimates that between 150 and 250 vessels make passage through the Fall of Warness. Therefore, the likelihood that two vessels would navigate the passage at the same time, and make a human or mechanical error that result in a collision is not significant.

6.6 IMPACT ON COMMUNICATIONS, RADAR AND POSITIONING SYSTEMS

MGN 654 notes that an OREI may have adverse impacts on the equipment used for navigation, collision avoidance or communications. Whilst several studies have considered the impacts from offshore wind turbines, the research into other OREI devices is limited. However, these are anticipated to be less than for offshore wind farms due to their reduced scale. Reference is therefore made to the studies of QinetiQ (2004) and BWEA (2007). **Table 10** provides a summary of these potential impacts, for which there are not anticipated to be any significant effects.

Table 10: Summary of impacts on equipment.

Impact on	Overview
VHF	VHF is essential for the communication between vessels and shore. VHF radio waves could be blocked or interfered with by an OREI. The QinetiQ study found no noticeable effect on VHF communications both ship-shore and ship-ship within or adjacent to the wind farm. The small size of the Devices makes this impact negligible.
AIS	AIS enhances the identification between vessels for collision avoidance. AIS signal could be blocked or interfered with by the presence of devices. The QinetiQ study found no noticeable effect on AIS reception. The small size of the Devices makes this impact negligible.
GNSS	GNSS (such as GPS) is used for satellite positioning systems and navigation. Satellite reception could be impacted by the presence of devices. The QinetiQ study found no noticeable effect on GPS reception. The small size of the Devices makes this impact negligible.
Marine Radar	Marine radar is used for both collision avoidance and vessel navigation and could be impacted by the devices. Whilst this is observed from offshore wind turbines, the small size of the Devices makes this impact negligible. It is possible that maintenance vessels alongside the Devices would not be discernible on radar, however they would be identifiable visually or through AIS.
Noise	The sound generated by the device could mask navigational sound signals from vessels or aids to navigation. Whilst Devices can make an audible sound whilst rotating, the low density of shipping and distance to other navigational marks makes this potential impact negligible.
Compass	Compasses are used for vessel navigation. These are potentially impacted by electromagnetic interference from the turbines or cable. The degree of this impact is related to the depth of water, cable design and alignment with the earth's magnetic field. Whilst this has impact has not been directly observed in studies, it is possible that small vessel compasses could be impacted near to cable landfall. However, navigation through this passage is anticipated to be predominantly visual.

During consultation, the NLB questioned whether the increased number of devices, all fitted with AIS, lights and radar reflectors, might overwhelm the navigator in making the passage. In particular, it would be more difficult to identify any one particular device. However, given the current arrangement, the majority of vessels would transit to the west of the Orbital devices and therefore would focus on the most westerly navigation aids.

If the site becomes more developed with more devices, it may become necessary to develop a coherent aids to navigation plan such that the most easterly and westerly devices are marked with AIS. Dormant AIS could be fitted to all of the devices such that they can be activated only either if other devices are moved for maintenance or the device breaks free from its moorings.

6.7 IMPACT OF FAILURE OF MOORINGS

A breakout of a Device during extreme weather conditions could pose a hazard to other navigating vessels. The likelihood of this hazard occurring is not considered significant for the following reasons:

- The proposed mooring arrangements of each Device (see **Section 2.1**) has been designed in accordance with Offshore Standard DNV-OS-E301. In the unlikely event of any mooring line failure, any single remaining mooring line is capable of holding the platform in place.
- During such conditions, the density of traffic would be low and therefore it is unlikely that it would meet another vessel.
- Several risk control measures are in place to detect an excursion from the site including EMEC's SCADA system, GPS and AIS monitoring and observations.

6.8 IMPACT ON FISHING ACTIVITY

Most fishing vessels recorded through AIS are on transit through the area and not engaged in fishing (see **Section 5**). However, consultation through the site wide NRA identified that some smaller local boats operate around the test site but close to shore. Given their local knowledge of the potential hazards of entanglement with the tidal devices, most avoid fishing near to the devices. Therefore, the impact on fishing activity is not considered significant.

6.9 IMPACT ON RECREATIONAL ACTIVITY

The Orkney Islands are a popular cruising destination, particularly during the summer. The vessel traffic analysis identified only one yacht making the passage through the Fall of Warness (see **Section 5**), however it is likely other yachts and pleasure craft not carrying AIS make the passage.

Given the sufficient sea room and low numbers of transits, the impact on recreational vessels is not anticipated to be significant.

6.10 IMPACT ON CABLE RISK

Subsea cables can pose hazards to navigating vessels through snagging anchors or fishing gear that might result in a capsize. Given the depths of water, the likelihood of anchoring near the device are remote and few fishing vessels would engage in fishing in close proximity to a snagging hazard. Furthermore, the export cables are pre-installed and therefore the risks of this development are not increased.

6.11 IMPACT ON SEARCH AND RESCUE

Larger OREIs can both limit the effectiveness of conducting search and rescue and pose hazards for accessing the area in an emergency. The small size of the Devices and significant sea room would enable RNLI lifeboats to gain entry to the site and conduct a rescue. Furthermore, there is no significant overhead infrastructure that could impact upon HMCG helicopter operations. Furthermore, the Devices could serve as both landmarks and temporary places of refuge that support SAR operations. An ERCOP will be developed to support emergency cooperation at the Fall of Warness.

6.12 CUMULATIVE AND IN-COMBINATION EFFECTS

The number of devices installed at the Fall of Warness has recently increased that has a cumulative effect on navigation through the site. Given the nature of this site, these impacts have been considered through **Section 6**. During consultation, the MCA recommended a site wide review of the Fall of Warness test site.

There are few potential cumulative and in-combination effects of other projects. The Westray South Tidal Project, located to the northwest of the Fall of Warness, was awarded an Agreement for Lease in 2010 for 200 1MW turbines. However, there has been limited further activity towards gaining consent since 2014. A Scotwind leasing round was launched in 2020 to develop new offshore wind farms in Scottish waters. This may result in changes to the vessel traffic through the Fall of Warness, however, this is not considered to be significant.

7. NAVIGATION RISK ASSESSMENT

7.1 INTRODUCTION AND METHODOLOGY

This assessment is based on the IMO Formal Safety Assessment process (FSA) as approved in 2002 and most recently amended in 2018 by MSC-MEPC.2/Circ.12/Rev.2. This methodology is also endorsed through MCA guidance documents MGN 654 and associated annexes. The methodology consists of five stages:

1. Hazard Identification.
2. Risk Scoring.
3. Risk Control Options.
4. Cost-Benefit Assessment.
5. Recommendations for Decision Making.

7.2 HAZARD IDENTIFICATION

Hazard identification was conducted during the site-wide NRA through consultation with local users and regulators (EMEC, 2019):

- Hazards included Collisions, Contacts (Allisions), Groundings and Breakout.
- Vessel Types included Commercial Shipping, Passenger Vessels (including ferries), Fishing Vessels, Recreational Craft and Maintenance Vessels.
- Two assessments were conducted for the tow-out and for the Device in situ.

The identified hazards are listed below in **Table 11** and

Table 12.

Table 11: Tow-out Hazards.

Hazard ID	Hazard Type	
1	Collision	Two project vessels collide during tow
2	Collision	Device collides with towing vessel
3	Collision	Project vessels collide with other Large Vessels (Commercial/Passenger)
4	Collision	Project vessels collide with other Small Vessels (Fishing/Recreational)
5	Allision	Project tow contacts other infrastructure (Harbour/Other Devices)
6	Grounding	Project tow grounds
7	Breakout	Tow breaks out

Table 12: Device On Station Hazards.

Hazard ID	Hazard Type	
1	Contact / Allision	Commercial Ship Contacts a Device
2	Contact / Allision	Passenger Vessel Contacts a Device
3	Contact / Allision	Fishing Vessel Contacts a Device
4	Contact / Allision	Recreational Vessel Contacts a Device
5	Contact / Allision	Maintenance Vessel Contacts a Device
6	Obstruction	Fishing Gear Interaction with Device
7	Collision	Collision Due to Avoidance of Site
8	Grounding	Grounding Due to Avoidance of Site
9	Collision	Collision with Site Maintenance Vessel
10	Grounding	Grounding of Maintenance Vessel
11	Breakout	Breakout of a Device from Moorings

The identified hazards were reviewed and considered appropriate for use in this NRA.

7.3 RISK SCORING

The identified hazards are assessed in terms of their likelihood and consequence in order to derive a risk score. The scoring is conducted using a risk matrix (Table 14) that has five categories for both likelihood and consequence. By multiplying these scores together, an overarching risk score is given.

The likelihood categories are described in **Table 13**. For the assessment of the device on station, the likelihoods are the expected return periods between hazard occurrences. For the tow-out of the device, as this occurs only once, the probability of occurrence is utilised. Consequence categories are given in **Table 14** and are scored for the risks to people (injuries or fatalities), property (damage to the vessel), environment (pollution) and business (reputation and damage to Device). These four consequence scores are averaged into a single value.

Hazards are assessed twice, with a most likely event and a worst credible event. This reflects the range of possible outcomes with more frequent and lower consequence events and less frequent but higher consequence events. Finally, the interpretation of the risk scores is described below the risk matrix in **Table 14**.

Table 13: Likelihood Value Interpretations.

Value	Berth 3 Interpretation	Tow Interpretation
1	Occurring less than once in 1,000 years.	Rare – has not occurred for similar projects within wider industry (<0.1%).
2	Occurring between once in 100 and once in 1,000 years.	Has occurred elsewhere in industry but infrequently (>0.1%).
3	Occurring between once in 10 and once in 100 years.	Could occur during tow but unlikely with adopted risk control measures (>1%).
4	Occurring between yearly and once in 10 years.	Reasonably probable that it could occur during a tow (>10%).
5	Yearly.	Almost Certain to occur during tow (>50%).

Table 14: Risk Matrix.

Consequence					Likelihood				
					1	2	3	4	5
Score	People	Property	Environment	Business	Negligible	Extremely Unlikely	Remote	Reasonably Probable	Frequent
1	None	Less than £10,0000	No Impact	No Impact	1	2	3	4	5
2	Slight injury(s)	£10,000-£100,000	Tier 1 Local assistance required	Local negative publicity Minor damage to device	2	4	6	8	10
3	Multiple minor or single serious injury	£100,000-£1million	Tier 2 Limited external assistance required	Widespread negative publicity Moderate damage to device	3	6	9	12	15
4	Multiple serious injury or single fatality	£1million-£10million	as Tier 2 Regional assistance required	National negative publicity Major damage to device	4	8	12	16	20
5	More than one fatality	>£10million	Tier 3 National assistance required	International negative publicity Major damage to device	5	10	15	20	25

Risk Definitions	
1-3.99: Negligible 4-8.99: Low Risk	Broadly Acceptable - Current controls to be monitored
9-14.99: Medium Risk	Tolerable (if ALARP) - further controls to be considered and existing controls monitored.
15-19.99: Significant 20-25: High Risk	Unacceptable - Activity not to proceed and controls to be immediately implemented to reduce risk

7.4 EMBEDDED RISK CONTROLS

The hazard scoring has been conducted assuming the inclusions of a number of risk controls. These are either standard industry requirements, specified within the Project Information Document or required by EMEC for all devices in the Fall of Warness. These risk controls are listed in **Table 15**.

Table 15: Embedded Risk Controls

N.	Category	Title	Description
1	Standards and Procedures	Construction Method Statement	Complete and promulgate a construction method statement to navigation authorities prior to commencement of works or provide construction details as part of notice to mariners bulletins
2		ERCOP	In consultation with MCA, complete an Emergency Response Co-Operation Plan for construction and operation of site. A copy of the plan should be submitted to navigation authorities prior to commencement of works.
3		Vessel Standards	All project related vessels meet both IMO conventions for safe operation as well as Health, Safety and Environment (HSE) requirements, where applicable. This shall include the following good practice: • Works vessels will comply with International Maritime Regulations (e.g. COLREGS/SOLAS) • Carriage of AIS • All vessels engaged in activities will comply with relevant regulations for their size and class of operation and will be assessed on whether they are "fit for purpose" for activities they are required to carry out • All marine operations will be governed by operational limits, tidal conditions, weather conditions and vessel traffic information.
4		Compliance with EMEC site procedures	EMEC has a number of standard operating procedures (SOPs) and standards in place to reduce navigation risks, such as: • Task Risk Assessment • Permit to Work • Permit to Access Site • Hazard Identification Reporting • Maritime Safety Information
5		Personal Protective Equipment (PPE)	All personnel will wear the correct PPE suitable for the location and role at all times, as defined by the relevant Quality, Health, Safety and Environment (QHSE) documentation.
6		Incident Reporting	Report any near misses or incidents at the project site to support continuous learning and identify any trends that warrant additional mitigation measures.
7	Promulgation and Marking	Site Survey	Prior to installation - the site will be surveyed using ROV and ADCP measurements will be taken.
8		Charting	Notify the UKHO prior to the commencement of works of the locations and marking arrangements of the devices for inclusion on new editions of Admiralty Charts.
9		Marking and Lighting	Devices to be marked in accordance to MCA and NLB requirements following guidance from International Association of Lighthouse Authorities (IALA) Recommendations O-139. To include: • The device be predominantly yellow in colour above the waterline • Two lit yellow poles with a yellow flashing light with a nominal range of 3nm, synchronised.

			• Fit with radar reflectors • AIS fitted (Message 21)
10		Notice to Mariners	Promulgate the works and device layout through Notices to Mariners, specifically: • UKHO • MCA • NLB • HMCG • Orkney Islands Council • Orkney Ferries • Orkney Fisheries Association • Scottish Fisheries Association • RYA • Marina Noticeboards
11		Promulgation to Fishermen	Provide promulgation through Kingfisher Fortnightly Bulletin to inform the Sea Fish Industry of the activities at the site.
12		Radio Navigation Warnings	During construction activities, provide regular navigation warnings using VHF radio.
13	Device Monitoring and Control	Design, Inspection and Maintenance Programme	The design & construction of the structure adheres to a number of DNV-GL and other relevant offshore design standards. The structure is designed to survive rare extreme environmental conditions that occur with a very low probability, such as a 1 in 100-year wave. The mooring system has been designed accordance with Offshore Standard DNV-OS-E301. Remote monitoring of system information such as structural forces and load shackles will ensure device operates inside safe operational limits. Monthly maintenance of the device is anticipated.
14		Remote Control and Monitoring of Site	EMEC's SCADA system provides real-time status information, trends, alarms and remote-control access to site.
15		Geofencing using GPS	GPS Monitoring of Device position to determine breakouts.
16		Emergency Shut Down	Fully automated and remote-controlled device shut down in an emergency.
17	Tow Specific	Tow Risk Assessment and Passage Plan	Tow risk assessment and passage plan to be developed to account for vessel characteristics and hazards of planned tow route.
18		Agreed Tow Weather Window	Tow and installation to be undertaken during agreed weather window to minimise risk.
19		Appropriate Tow Vessel	Tow vessel should meet required standards, have sufficient bollard pull and have contingent towing apparatus.

7.5 RISK ASSESSMENT RESULTS

7.5.1 Tow Risk Assessment

Table 16 describes the results of the tow risk assessment, full hazard logs are contained in **Appendix C**. Once constructed, the Device will be towed to a sheltered bay in the Orkneys for which Orbital hold a marine license for (Deer Sound)[3]. The distance of this tow is approximately 12.3nm and would likely be undertaken by a Multi-Cat style vessel.

The results of the risk assessment identified that all hazards are assessed to be Low Risk to Negligible. Of these, the highest relates to the breakout of the tow from the Device. The vessel will have sufficient bollard pull, capability and contingency for the task and therefore the risks have been reduced. Secondly, the collision between the towing vessel and the Device or two project vessels could occur during preparation for the tow but would likely result in minor damage only. Thirdly, the grounding of the project tow is unlikely given the significant depths of water and short distance between Deer Sound the Fall of Warness. The most likely cause would be mechanical failure resulting in the tow drifting ashore with minor damage. Finally, a collision between the project tow and other vessels or other devices is not likely given the low traffic volume in the area, sufficient sea room and promulgation activities (such as Notice to Mariners).

Table 16: Tow Risk Assessment.

ID	Rank	Hazard title	Risk Score	Risk Rating
7	1	Tow breaks out	7.1	Low Risk - Broadly Acceptable
2	2	Device collides with towing vessel	6.6	Low Risk - Broadly Acceptable
1	3	Two project vessels collide during tow	6.1	Low Risk - Broadly Acceptable
6	4	Project tow grounds	6.0	Low Risk - Broadly Acceptable
5	5	Project tow contacts other infrastructure (Harbour/Other Devices)	4.8	Low Risk - Broadly Acceptable
4	6	Project vessels collide with other Small Vessels (Fishing/Recreational)	4.2	Low Risk - Broadly Acceptable
3	7	Project vessels collide with other Large Vessels (Commercial/Passenger)	3.8	Negligible Risk - Broadly Acceptable

[3] Marine Licence - New Mooring - Deer Sound, Orkney – 07168. Granted 2020-08-01.

7.5.2 Berth 3 Risk Assessment

Table 17 describes the results of the Berth 3 risk assessment, full hazard logs are contained in **Appendix C**. The results of the risk assessment identified that all hazards are assessed to be Low Risk to Negligible.

The four highest hazards relate to a contact or allision between navigating vessels and the installed Devices. Firstly, by the nature of their operations, maintenance vessels will be most likely to navigate close to the Devices. Therefore, there is a risk of a hard contact when manoeuvring within the Fall of Warness site which could cause both damage and injuries. These risks can be mitigated by the training and experience of the maintenance vessel skippers, as well as sufficient marking of each Device. Secondly, the analysis has identified that of the other principal vessel categories, passenger ferries had the highest risk of contacting the deployed Devices. This is associated with the occasional transits through the test site during adverse weather conditions and the high consequence potential of accidents involving these vessels. Fishing and recreational vessels occasionally transit the site and were assessed as equivalent risks. Given the rarity at which commercial shipping transit the passage, the risks of contact are assessed as very low.

Thirdly, maintenance vessels are the most active vessel category in the study area and therefore a collision with a site maintenance vessel is a potential hazard. The density of traffic in the area is shown to be low (see **Section 5**) and this reduces the likelihood of a collision occurring. Similarly, the risk of a collision between vessels due to the presence of the device reducing the available searoom is low for the same reason.

Fourthly, groundings of maintenance vessels on passage to the site are more likely than other vessel types given their greater activity within the site. Finally, the risks of a breakout of a Device are extremely low due to the high standards of the moorings and redundant capabilities. Furthermore, if a Device were to break out, the low density of vessel traffic means that the risk of it colliding with another transiting vessel is remote.

Table 17: Berth 3 Risk Assessment.

ID	Rank	Hazard title	Risk Score	Risk Rating
5	1	Maintenance Vessel Contacts a Device	8.9	Low Risk - Broadly Acceptable
2	2	Passenger Vessel Contacts a Device	7.5	Low Risk - Broadly Acceptable
4	3	Recreational Vessel Contacts a Device	7.2	Low Risk - Broadly Acceptable
3	3	Fishing Vessel Contacts a Device	7.2	Low Risk - Broadly Acceptable
9	5	Collision with Site Maintenance Vessel	6.1	Low Risk - Broadly Acceptable
10	6	Grounding of Maintenance Vessel	5.5	Low Risk - Broadly Acceptable
1	7	Commercial Ship Contacts a Device	5.4	Low Risk - Broadly Acceptable
7	8	Collision Due to Avoidance of Site	4.4	Low Risk - Broadly Acceptable
6	9	Fishing Gear Interaction with Device	3.6	Negligible Risk - Broadly Acceptable
8	10	Grounding Due to Avoidance of Site	3.2	Negligible Risk - Broadly Acceptable
11	11	Breakout of a Device from Moorings	2.9	Negligible Risk - Broadly Acceptable

7.6 POSSIBLE ADDITIONAL RISK CONTROLS

In addition to those risk controls embedded in the project (**Table 15**), three possible additional risk controls are identified in **Table 18** that would further reduce the risk. Given that all hazards are assessed as Low or Negligible Risk, it is not considered necessary to implement these.

Table 18: Possible Additional Risk Controls.

N	Title	Description
1	Advisory Safety Distances	An advisory safe passing distance of up to 500m around work areas during construction and installation works. These are advisory and are not enforceable; however vessels will also be displaying Restricted in Ability to Manoeuvre lights under COLREGs (IMO, 1972 as amended).
2	Provision of Guard Vessel	Provision of guard vessel in vicinity of the construction and installation activities to monitor 3rd party vessel traffic and intervene with warnings as necessary.
3	Installation scheduling	Installation to avoid peak fishing and recreational seasons.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

This NRA has considered the impacts on navigational safety of the installation of two Orbital Devices within the EMEC Fall of Warness test site. The following conclusions have been reached:

1. The Fall of Warness test site, established in 2005, is well known to local navigators and has been utilised by a variety of devices without incident.
2. The site is an area of general navigation, outside of the Orkney Islands Council harbour and pilotage areas. With the exception of the other EMEC test devices, there are no other major constraints or activities in the study area.
3. Consultation with regulators and local users did not identify any specific navigational concerns associated with these devices.
4. Vessel traffic analysis using AIS data identified several marine users:
    a. Maintenance vessels, based in Kirkwall, associated with the EMEC test site account for much of the activity within the site.
    b. Passenger ferries pass to the south and west of the site on normal passage. During specific metocean and tidal conditions, they can transit into the site and close to the device locations.
    c. Limited fishing and recreational transits passed through the test site. It is likely that some smaller fishing vessels operate near the study area, but clear of the devices themselves.
    d. There are no commercial shipping transits recorded through the site during the data period.
5. No serious accidents have been reported associated with the EMEC test site and devices.
6. There are not anticipated to be any significant increases in vessel activity in the test site.
7. With the Devices in place, a 420m navigable channel would exist with one cable safety buffer from Muckle Green Holm and the most westerly Device. Given the low traffic density in the area and that no concerns were raised by stakeholders, this is considered sufficient.
8. Contact risks are most likely to involve maintenance vessels coming alongside the Device and would have a minor consequence. The contact of a passenger ferry is less likely but might result in a more serious outcome. These risks were assessed and found to be Low Risk.
9. Whilst the Devices will have underwater infrastructure, only six transits were recorded that had draughts deep enough to contact the rotors, albeit necessitating a passing distance of 14m. It is therefore unlikely that such an event would occur.

10. The density of traffic in the study area is low, the devices are low in statute and therefore the impact on collision risk is not significant.
11. No impact on communications, radar and positioning equipment is anticipated.
12. The Devices are installed to a high standard and continuously monitored and therefore a breakout is unlikely. Were such an event to occur, the low density of traffic makes the risk to passing vessels remote.
13. Fishing and recreational users have coexisted with the test site for more than 15 years. No additional impact on their activities is anticipated associated with these Devices.
14. No impact on search and rescue capability is anticipated.
15. A suite of embedded risk controls are identified that collectively manage all hazards to Tolerable levels.

8.2 RECOMMENDATIONS

On the basis that all key risk control measures are implemented, no further recommendations are made.

This NRA has been undertaken on the basis of the site-wide NRA that was conducted for the Fall of Warness test site in 2019 which is still valid. The site-wide NRA will be updated later this year and it is therefore recommended that this NRA and the updated site-wide NRA are considered collectively once the latter has been prepared.

8.3 SUMMARY

This NRA has demonstrated that the proposed Orbital Devices at the Fall of Warness test site would not have a significant impact on navigational safety.

REFERENCES

BWEA (2007). Investigation of Technical and Operational Effects on Marine Radar Close to Kentish Flats Offshore Wind Farm.

EMEC (2019). Fall of Warness Navigational Risk Assessment. Available at: http://www.emec.org.uk/services/consents/.

QinetiQ (2004). Results of the electromagnetic investigations and assessments of marine radar, communications and positioning systems undertaken at the North Hoyle wind farm by QinetiQ and the Maritime and Coastguard Agency.

Appendix A
MGN 654 Checklist

MGN 654 (M+F) Safety of Navigation: Offshore Renewable Energy Installations – Guidance on UK Navigational Practice, Safety and Emergency Response

MGN Section	Yes/No	Comments
4. Planning Stage – Prior to Consent		
4.5 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.		
4.6 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 Impact Assessment Report	✓	Section 5
Multiple data sources	✓	Section 5 – AIS only
Seasonal variations	✓	Section 5 – January, March, April, June
MCA consultation	✓	Section 4 – MCA confirmed no further comments additional to those received in consultation for previous devices.
General Lighthouse Authority consultation	✓	Section 4 – Consultation meeting held with NLB, minutes available in Appendix B.
Chamber of Shipping and shipping company consultation	✗	
Recreational and fishing vessel organisations consultation	✓	Section 4 – Letter received from RYA and provided in Appendix B. Consultation letter was sent to Orkney Fisheries.
Port and navigation authorities consultation, as appropriate	✓	Section 4 – Consultation letter sent to Orkney Islands Council Marine Services.
4.6.d Assessment of the cumulative and individual effects of (as appropriate):		
i. Proposed OREI site relative to areas used by any type of marine craft.	✓	Sections 5 and 6
ii. Numbers, types and sizes of vessels presently using such areas	✓	Sections 5
iii. Non-transit uses of the areas, e.g. fishing, day cruising of leisure craft, racing, aggregate dredging, personal watercraft etc.	✓	Sections 5
iv. Whether these areas contain transit routes used by coastal, deep-draught or international scheduled vessels on passage.	✓	Sections 5
v. Alignment and proximity of the site relative to adjacent shipping routes	✓	Sections 5 and 6.1
vi. Whether the nearby area contains prescribed routeing schemes or precautionary areas	✓	Section 3.2
vii. Proximity of the site to areas used for anchorage (charted or uncharted), safe haven, port approaches and pilot boarding or landing areas.	✓	Section 3.2

MGN Section	Yes/No	Comments
viii. Whether the site lies within the jurisdiction of a port and/or navigation authority.	✓	Section 3.2
ix. Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds.	✓	Section 5
x. Proximity of the site to offshore firing/bombing ranges and areas used for any marine military purposes.	✓	Section 3.2
xi. Proximity of the site to existing or proposed submarine cables or pipelines, offshore oil / gas platform, marine aggregate dredging, marine archaeological sites or wrecks, Marine Protected Area or other exploration/exploitation sites	✓	Section 3
xii. Proximity of the site to existing or proposed OREI developments, in co-operation with other relevant developers, within each round of lease awards.	✓	Section 3.3
xiii. Proximity of the site relative to any designated areas for the disposal of dredging spoil or other dumping ground	✓	Section 3.3
xiv. 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
xv. Researched opinion using computer simulation techniques with respect to the displacement of traffic and, in particular, the creation of 'choke points' in areas of high traffic density and nearby or consented OREI sites not yet constructed.	✓	Section 6.1 and Section 6.2.
xvi. With reference to xv. 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 5.5
xvii. Proximity of the site to areas used for recreation which depend on specific features of the area		Recreational analysis is contained in Section 5.2.4 and impacts considered in Section 6.9.
4.7 Predicted Effect of OREI on traffic and Interactive Boundaries – where appropriate, the following should be determined:		
a. The safe distance between a shipping route and OREI boundaries.	✓	The width of the corridor is considered in Section 6.1.
b. The width of a corridor between sites or OREIs to allow safe passage of shipping.	✓	The width of the corridor is considered in Section 6.1.

MGN Section	Yes/No	Comments
4.8. 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 6 considers impacts to navigation. Specifically, impacts to fishing activity are considered in section 6.8 and impacts to search and rescue are discussed in section 6.11.
b. Clearances of fixed or floating wind turbine blades above the sea surface are *not less than 22 metres (*above MHWS for fixed). Floating turbines allow for degrees of motion.	✓	The project does not include any wind turbines. A description of the devices is provided in section 2.
c. Underwater devices i. changes to charted depth ii. maximum height above seabed iii. Under Keel Clearance	 ✓ ✓ ✓	A description of the project and mooring system is provided in section 2. The device will utilise an existing cable at Berth 3.
d. Whether structure block or hinder the view of other vessels or other navigational features.	✓	Impacts on visual navigation and collision avoidance are considered within section 6.5.
4.9 The Effect of Tides, Tidal Streams and Weather: 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.	✓	Impacts of the tides, tidal stream and weather are considered in section 6.3.
b. The set and rate of the tidal stream, at any state of the tide, has a significant affect on vessels in the area of the OREI site.	✓	Impacts of the tides, tidal stream and weather are considered in section 6.3.
c. The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect.	✓	Impacts of the tides, tidal stream and weather are considered in section 6.3.
d. The set is across the major axis of the layout at any time, and, if so, at what rate.	✓	Impacts of the tides, tidal stream and weather are considered in section 6.3.
e. In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream, including unpowered vessels and small, low speed craft.	✓	Impacts of the tides, tidal stream and weather are considered in section 6.3.
f. The structures themselves could cause changes in the set and rate of the tidal stream.	✓	Impacts of the tides, tidal stream and weather are considered in section 6.3.
g. The structures in the tidal stream could be such as to produce siltation, deposition of sediment or scouring, affecting navigable water depths in	✓	Impacts of the tides, tidal stream and weather are considered in section 6.3.

MGN Section	Yes/No	Comments
the wind farm area or adjacent to the area		
h. 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.	✓	Impacts of the tides, tidal stream and weather are considered in section 6.3.
i. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	✓	Impacts of the tides, tidal stream and weather are considered in section 6.3.
j. 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.	✓	Impacts of the tides, tidal stream and weather are considered in section 6.3.
4.10 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. for all vessels, or ii. for 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	✓	Impacts are discussed in section 6 and hazards are scored in section 2.
b. Navigation in and/or near the site should be prohibited or restricted: i. for specified vessels types, operations and/or sizes. ii. in respect of specific activities, iii. in all areas or directions, or iv. in specified areas or directions, or v. in specified tidal or weather conditions.	✓	Embedded risk controls are outlined in section 7.4.
c. Where it is not feasible for vessels to access or navigate through the site it 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	✓	Impacts to search and rescue are considered within section 6.11.

MGN Section	Yes/No	Comments
d. Guidance on the calculation of safe distance of OREI boundaries from shipping routes has been considered	✓	Impact on vessel routeing is contained in Section 6.1.
4.11 Search and rescue, maritime assistance service, counter pollution and salvage incident response.		
The MCA, through HM Coastguard, is required to provide Search and Rescue 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.	✓	Impacts to search and rescue are considered within section 6.11. Embedded risk controls are outlined in section 7.4
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.	✓	Impacts to search and rescue are considered within section 6.11.
c. A SAR checklist will be completed to record discussions regarding the requirements, recommendations and considerations outlined in the above document (to be agreed with MCA)		Site wide ERCOP already exists.
4.12 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-construction: The proposed generating assets area and proposed cable route	✓	Embedded risk controls are outlined in section 7.4
ii. On a pre-established periodicity during the life of the development	✓	Embedded risk controls are outlined in section 7.4
ii. Post-construction: Cable route(s)	✓	Embedded risk controls are outlined in section 7.4
iii. Post-decommissioning of all or part of the development: the installed generating assets area and cable route	✓	Embedded risk controls are outlined in section 7.4
4.13 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 ii. Vessels by the nature of their work necessarily operating at less than	✓	Impact on communications, radar and positioning systems are considered within section 6.6.

MGN Section	Yes/No	Comments
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	✓	Impact on communications, radar and positioning systems are considered within section 6.6.
c. The structures and generators might produce sonar interference affecting fishing, industrial or military systems used in the area.	✓	Impact on communications, radar and positioning systems are considered within section 6.6.
d. The site might produce acoustic noise which could mask prescribed sound signals.	✓	Impact on communications, radar and positioning systems are considered within section 6.6.
e. Generators and the seabed cabling within the site and onshore might produce electro-magnetic fields affecting compasses and other navigation systems.	✓	Impact on communications, radar and positioning systems are considered within section 6.6.
4.14 Risk 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 Environmental Impact Assessment (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 Safety of Life at Sea (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:		
i. Promulgation of information and warnings through notices to mariners and other appropriate maritime safety information (MSI) dissemination methods.	✓	Embedded risk controls are outlined in section 7.4
ii. Continuous watch by multi-channel VHF, including Digital Selective Calling (DSC).	✓	Embedded risk controls are outlined in section 7.4
iii. Safety zones of appropriate configuration, extent and application to specified vessels[4]	✓	Embedded risk controls are outlined in section 7.4
iv. Designation of the site as an area to be avoided (ATBA).	✓	Embedded risk controls are outlined in section 7.4
v. Provision of AtoN as determined by the GLA	✓	Embedded risk controls are outlined in section 7.4

[4] As per SI 2007 No 1948 "The Electricity (Offshore Generating Stations) (Safety Zones) (Application Procedures and Control of Access) Regulations 2007.

MGN Section	Yes/No	Comments
vi. Implementation of routeing measures within or near to the development.	✓	Embedded risk controls are outlined in section 7.4
vii. Monitoring by radar, AIS, CCTV or other agreed means	✓	Embedded risk controls are outlined in section 7.4
viii. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of safety zones.	✓	Embedded risk controls are outlined in section 7.4
ix. Creation of an Emergency Response Cooperation Plan with the MCA's Search and Rescue Branch for the construction phase onwards.	✓	Embedded risk controls are outlined in section 7.4
x. Use of guard vessels, where appropriate	✓	Embedded risk controls are outlined in section 7.4
xi. Update NRAs every two years e.g. at testing sites.		N/A
xii. Device-specific or array-specific NRAs	✓	Full NRA is contained in Section 7
xiii. Design of OREI structures to minimise risk to contacting vessels or craft	✓	Embedded risk controls are outlined in section 7.4
xiv. Any other measures and procedures considered appropriate in consultation with other stakeholders.	✓	Embedded risk controls are outlined in section 7.4

Annex 1 Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations

The following content is included:	Section	Compliant Yes/No	Comments
A risk claim is included that is supported by a reasoned argument and evidence	7	✓	Section 8.3
Description of the marine environment	B3	✓	Section 3
Search and Rescue overview and assessment	3.3	✓	Section 6.11
Description of the OREI development and how it changes the marine environment	B3	✓	Section 2 and Section 6
Analysis of the marine traffic, including base case and future traffic densities and types.	B1 B2	✓	Section 5
Status of the hazard log • Hazard Identification • Risk Assessment • Influences on level of risk • Tolerability of risk • Risk matrix	C1 & F1 C2 C3 C4 C5	✓	Section 7.1: Introduction and methodology Section 7.2: Hazard Identification Section 7.5: Risk Assessment Results
Navigation Risk Assessment • Appropriate risk assessment • MCA acceptance for assessment techniques and tools • Demonstration of results • Limitations	D1 D2 D3 D4	✓	Section 7: Navigation Risk Assessment
Risk control log	E1 & G1	✓	Section 7.4: Embedded Risk Controls

Appendix B
Stakeholder Consultation

NASH Maritime Ltd

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Ref: 21-NASH-0156-0200-001

26-Jul-2021

By Email

Navigational Risk Assessment: O2 Floating Tidal Turbines at the EMEC site.

Dear Stakeholder,

NASH Maritime is undertaking the Shipping and Navigation (S&N) assessment as part of the marine license application from Marine Scotland for the proposed deployment of two O2 floating tidal turbine devices at the Fall of Warness EMEC project site, Orkney, on behalf of Orbital Marine. The proposed locations for the two devices are shown in **Figure 1**.

Orbital Marine Power's Tidal Technology is a floating tidal stream energy generator, shown in **Figure 2**. The device comprises a cylindrical floating steel superstructure and two leg structures with power generating nacelles mounted at their ends. The superstructure will be up to 80m in length and 3.8m in diameter and each power generating nacelle will support a c. 1MW rated turbines of up to a 24m rotor diameter. Station keeping will be provided via four catenary mooring lines which will be moored to the seabed via four separate anchors. The project would operate for approximately 15 years commencing c. 2026.

We are writing to advise you of the proposals and, as a marine stakeholder, invite your input and feedback as part of the S&N assessment which is being undertaken.

We understand that you previously participated in consultation in August/September 2018 for the Fall of Warness Navigational Risk Assessment, which can be downloaded here, and more recently in January 2021 for the Fall of Warness Berth 6 Orbital O2 Device.

We would be grateful for any comments or feedback on the proposed locations by Friday 30-Jul-2021. If you would like to attend a meeting (by telephone/video conference) to discuss the project further, please let us know by Friday 30-Jul-2021 and advise on your availability for a meeting the week commencing Monday 02-Aug-2021.

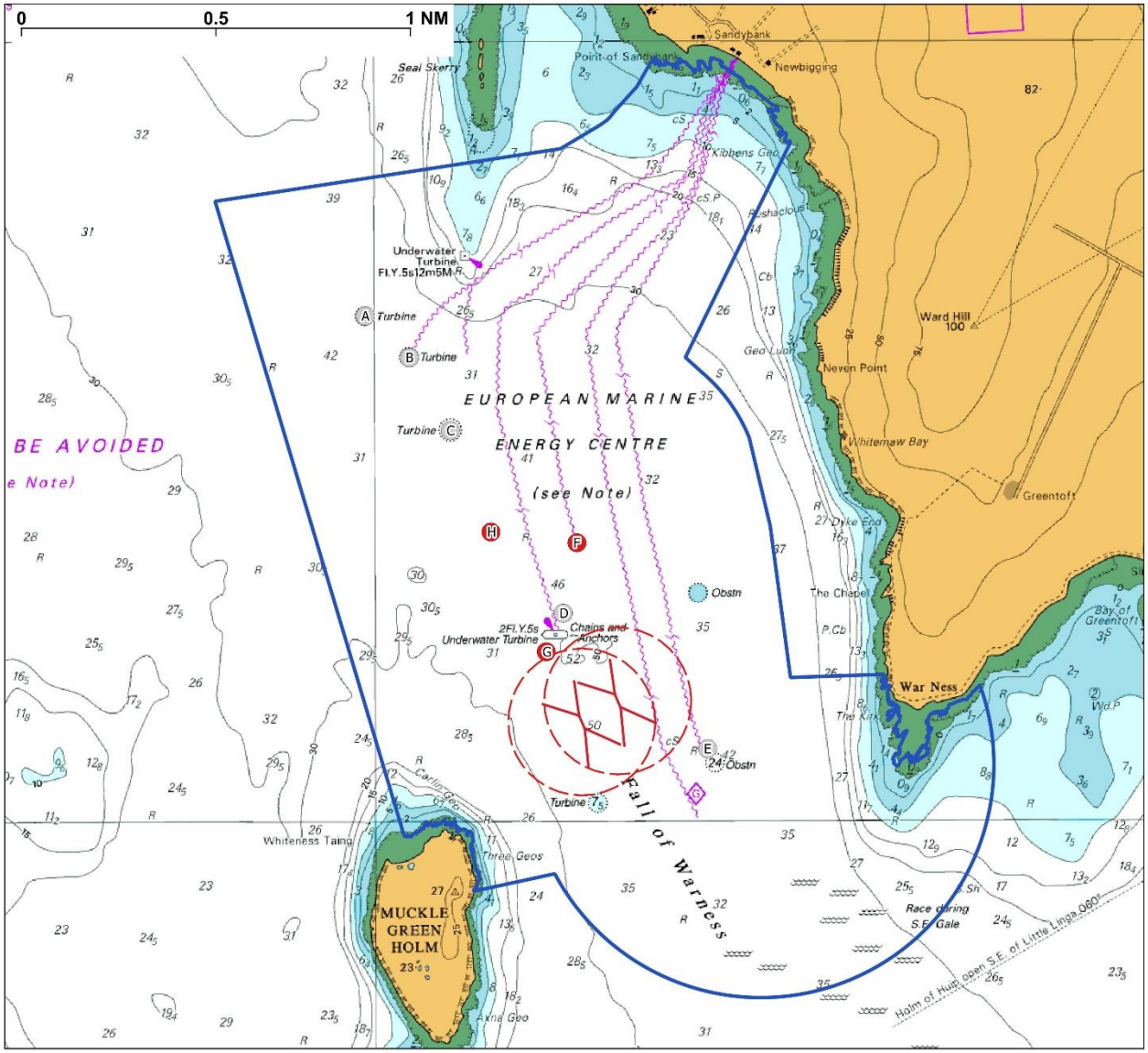
Yours sincerely,

NASH Maritime Ltd

Enclosures:

Figure 1: Proposed location of the O2 floating tidal turbine devices.

Figure 2: Indicative O2 floating tidal turbine device.



O2 Floating Tidal Turbines, Device Locations (14/07/2021)

Legend

- Device Location
- 350m Buffer (from device centrepoint)
- Test Site Boundary

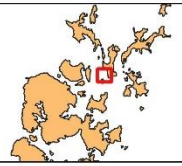
Chart Corrections

- Current or planned deployments
- Historical deployments still marked on admiralty chart

Chart Corrections

ID	Details
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.
E	TGL turbine. No longer deployed. Clear seabed.
F	Orbital Marine Power floating tidal turbine. Deployed until 2038.
D	Hammerfest turbine. No longer deployed. Tripod foundation remains, standing 22m from seabed (approximately 24m water depth).
G	Magallanes floating tidal turbine.
H	Orbital Marine Power floating tidal turbine. Due to be deployed 2023 - 2037.

Data Sources:
Admiralty Chart 2562-2 and 2250 under license EK001-FN800-003862.



Coordinate System: EPSG:32630
Created by: RLG Checked by: JJH Date: 20/7/2021
Ref: NASH156_Orbital_NRA_Overview_202107014

NASH MARITIME ORBITAL MARINE POWER

Figure 1 Proposed Device Locations.

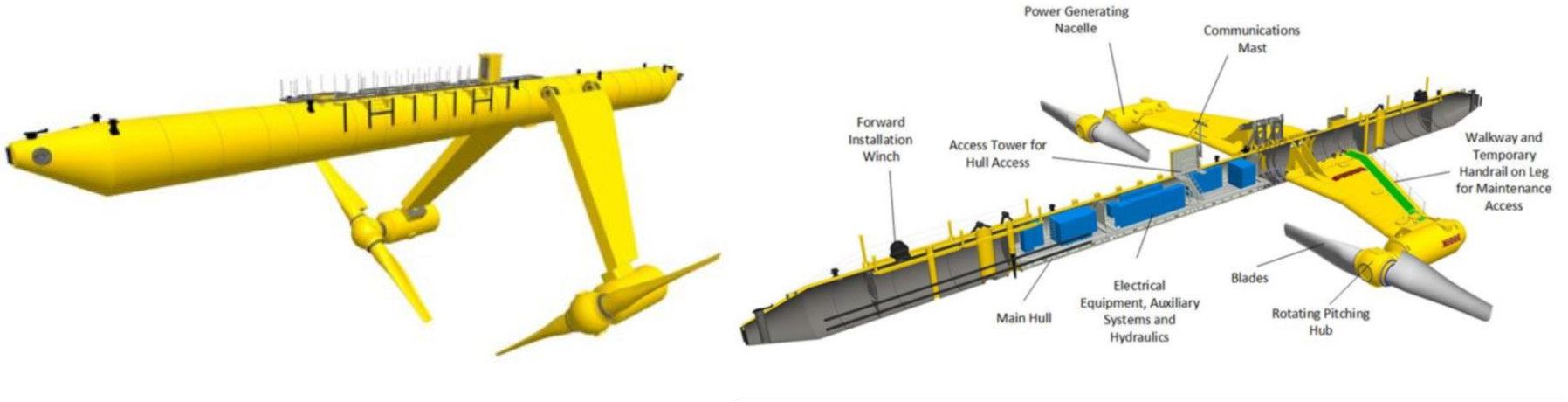


Figure 2 Indicative O2 floating tidal turbine device.

O2 FLOATING TIDAL TURBINES AT EMEC

Project Title	O Floatin Tida Turbine a EME
Project Number	21-NASH-0156
Meeting subject / purpose	Orkne Ferries Consultation
Revision	R02-00
Date of meeting	30-Jun-2021
Start time	14:00 BST
Finish time	15:00 BST
Client	Orbital M rine Po er
Location	MS Teams

DOCUMENT CONTROL

Revision	Date of Issue	Description	Approved
R01-00	07-Jul-2021	I su d to Or ita for review	JJH
R02-00	21-Jul-2021	I su d to me ting attendees	JJH

ATTENDEES

Organisation	Attendee	Role	Initial
NASH Maritime	Jamie Holmes Andrew Rawson Raffi Gracie	Director Principal Consultant Graduate Consultant	JJH ADR RLG
EMEC	Caitlin Long	Environment & Consents Specialist	CL
Orbital	James Murray Oliver Wragg	Programme Manager Commercial Director	JM OW
Orkney Ferries	Andrew Blake	Ferry Services Manager	AB

APOLOGIES

Organisation	Attendee	Role	Initial
-	-	-	-

AGENDA

1. Intro (all)
2. Project update, status, and context across wider site (Orbital)
3. Overview of proposed device and location/options (N & S) (Orbital)
4. Overview of marine traffic in area with focus on ferry operations based on previous work, recent data and project team understanding (NASH)
5. Any future ferry options/changes to vessel, operations or timetables planned (Orkney ferries)
6. Any known incidents, near misses or relevant feedback from Masters associated with deployment across the site (Orbital/NASH)
7. Any navigation concerns/impacts around device deployment at proposed locations (N & S)
8. Discussion on potential impact mitigation / risk control options for consideration (all)
9. Any other relevant information (all)
10. AOB

NOTES OF MEETING

1	**Introductions**	**Action**
1.1	All gave introductions and reintroduced team and roles.	
2	**Project update, status, and context across wider site (Orbital)**	
2.1	JM provided an overview of previous consultation and an update on the status of the devices within the area: • Devices F, G and H are operational or planned and there are no other devices currently in situ. • This project is seeking up to two additional sites for deployment of two O2 devices. • Expectation that new revenue support for tidal energy will be available in the near future with bidding anticipated to be held in December. • Marine Licences for the sites would need to be in place prior to bidding in December.	
3	**Overview of proposed device and location/options (N & S) (Orbital)**	
3.1	JM discussed site options whilst showing the proposed site locations on a chart. Areas shown by red circles indicate two potential sites for deploying the two additional devices, these include a northern and southern site location (two devices could be deployed at same site or separate sites). JM noted that: • There are existing cables at these sites • Devices would be commissioned around 2025-26 • Project lifetime would be approximately 15 years	

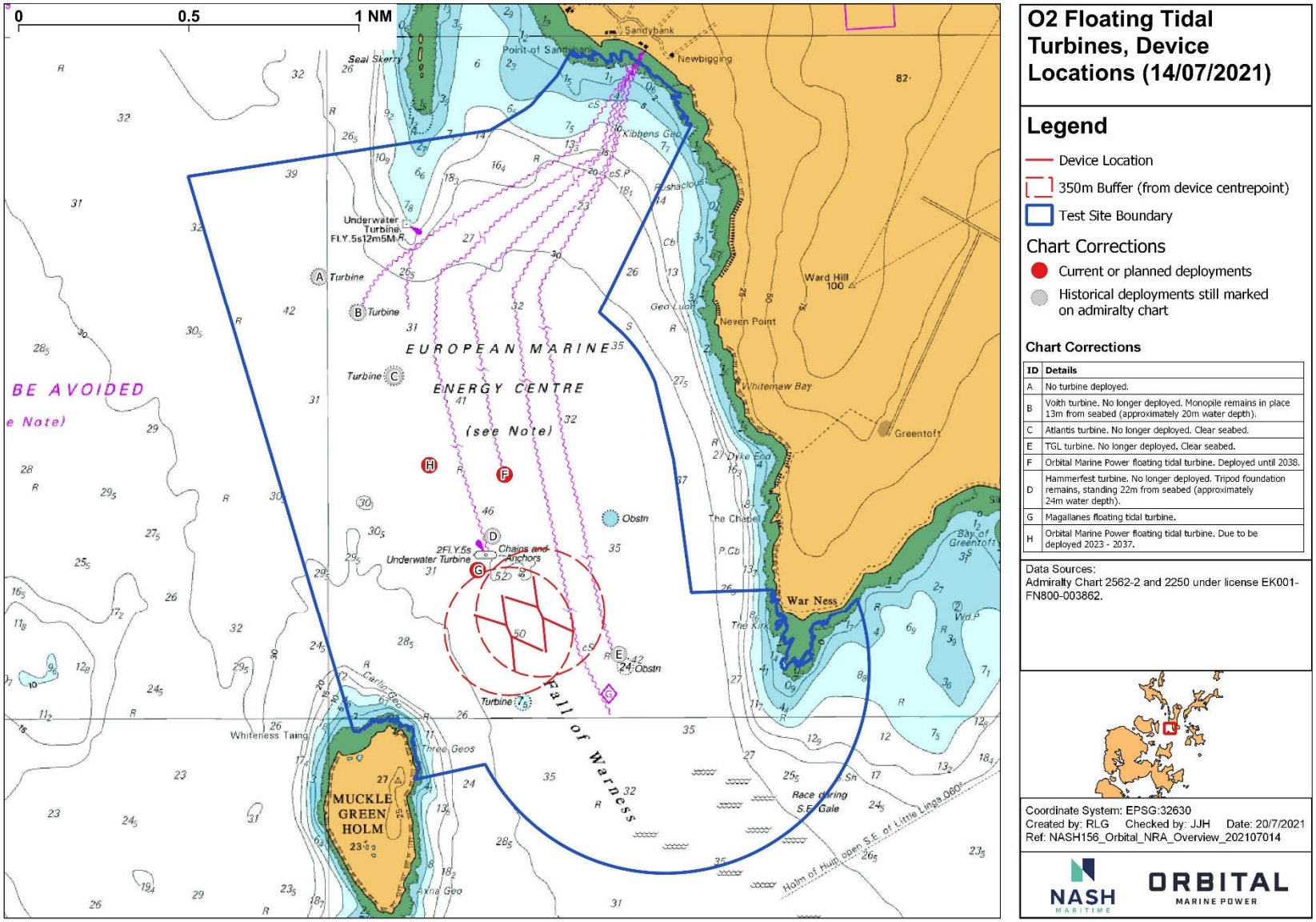
	• The device would be like those presented during previous consultation, approximately 75m in length and 3.8m in width and height • The device would be held in position with catenary moorings
4	**Overview of marine traffic in area with focus on ferry operations based on previous work, recent data and project team understanding (NASH)**
4.1	• JH explained that NASH Maritime had obtained AIS data via EMEC for Jun-2019, Jan-2020, Mar-2021 and Apr-2021 in order to obtain data representative of seasonal variation and prior/during the COVID-19 pandemic to ensure any variances (such as reduced timetable operations) were incorporated. • AB noted that with regards to representativeness of the AIS data during the COVID-19 pandemic, operation is largely representative although a slightly reduced service has been run during periods over the last year akin to a winter timetable (since Mar-2020). • JH presented a figure showing AIS ferry transits in the area • AB noted that the ferries do not use the route near the northern site as frequently as the route adjacent to the southern site, and therefore expected to see fewer ferry AIS tracks around the northern site.
5	**Any future ferry options/changes to vessel, operations or timetables planned (Orkney ferries)**
5.1	• JH/AR queried whether there have been any changes to ferry vessels, operation, or timetables since they were last consulted with by Orbital in Jan-2021 • AB indicated that no planned changes to the routeing or schedule are planned in the foreseeable future. However, there is a possibility that should funding become available, new ferries would be procured enabling a 4 ship service. In this instance, the new vessels would be able to run fewer trips and would likely be specified to operate in more adverse conditions.
6	**Any known incidents, near misses or relevant feedback from Masters associated with deployment across the site (Orbital/NASH)**
6.1	AB noted that there were no relevant near misses or incidents relevant to shipping and navigation in the period.
6.2	AB noted that the Masters would likely not be opposed by the new devices once habituated to their presence
7	**Any navigation concerns/impacts around device deployment at proposed locations (N & S)**
7.1	• AB noted that whilst the northern site does not raise any concern, the southern site lies within an area used by the ferries during poor sea states, to avoid overfalls and optimise heading in relation to the sea state to reduce vessel roll and improve passenger comfort. • AB pointed out the 'looping' ferry tracks south west of War Ness. Ferries loop north in rough weather in order to avoid poor sea state further south. • AB raised concern that the presence of the device in the southern location could hinder the willingness and ability of the ferries to take this route and avoid rough sea states. • JH/AR/AB discussed whether the ferries could still loop north around the southern site if needed, and AB considered that there was adequate sea room to pass between the site and War Ness.

	• AB queried that appropriate aids to navigation would be preferred including radar reflector AtoNS and potentially AIS beacons. The location should also be communicated to Masters. • AR noted that it would be useful to understand how comfortable the Masters are with navigating close to War Ness and appropriate passing distances – noting they appear to consistently operate up to the 5m CD contour and relatively close to the shallow water. Discussion that the mariners are highly familiar with the area and comfortable doing so in the conditions • It was concluded by AB that both the northern and southern sites are feasible, although the preference would be to move the southern site approximately 300m to the west / southwest. • JM noted that micro-siting within the southern site (e.g. to the south wester corner) and potential to move southern site would be considered in order to increase the sea room between War Ness and the site.	
3.2	***Meeting Postscript*** *JM provided AB with alternative device locations for review. AB and JM confirmed that the locations shown in **Figure 1** (via email correspondence on 14-Jul-2021) are suitable and do not raise any additional concerns other than those discussed during the meeting and included within these minutes.*	
8	**Discussion on potential impact mitigation / risk control options for consideration (all)**	
8.1	JH introduced discussion on potential risk controls and mitigation measures that would be useful for the Masters. AB noted that it would be useful to have a short risk mitigation consultation document specific to Orkney Ferries that could be shared with the Masters. Document to include figure similar to those shared in this meeting. JH noted the need to provide consultation material that is concise and easy to understand. CL noted that discussion with the UKHO has indicated that an update to the electronic charts is not confirmed. All discussed other potential ways of disseminating information to mariners: • AB suggested figure (similar to those shared within this meeting) without AIS tracks showing locations and status of devices, that could be shared regularly with the Masters to provide a 'current status' information sheet. CL to discuss with EMEC to see if this could be implemented. • AR noted issue with making information available to non-regular users of the area.	1
9	**Any other relevant information (all)**	
9.1	AR queried the status of the proposal for development of the site to the west. JM to provide update for cumulative assessment.	2
10	AOB	
10.1	None.	

MEETING ACTIONS

Number	Owner	Action	Status

1	CL	To provide feedback on what information could be shared with mariners if there is no chart update.	
2	JM	To provide update on cumulative site to the west	



O2 Floating Tidal Turbines, Device Locations (14/07/2021)

Legend

- Device Location
- 350m Buffer (from device centrepoint)
- Test Site Boundary

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Coordinate System: EPSG:32630
Created by: RLG Checked by: JJH Date: 20/7/2021
Ref: NASH156_Orbital_NRA_Overview_202107014

NASH MARITIME ORBITAL MARINE POWER

Figure 1 Propo ed dev ce locations.

O2 FLOATING TIDAL TURBINES AT EMEC BERTH 3

Project Title	O2 Floating Tidal Turbines at EMEC Berth 3
Project Number	21-NASH-0156
Meeting subject / purpose	NLB Consultation
Revision	R01-00
Date of meeting	05-Aug-2021
Start time	14:00 BST
Finish time	14:30 BST
Client	Orbital Marine Power
Location	Microsoft Teams

DOCUMENT CONTROL

Revision	Date of Issue	Description	Approved
R01-00	10-Aug-2021	Issued to attendees for comment	ADR

ATTENDEES

Organisation	Attendee	Role	Initial
NASH Maritime	Andrew Rawson	Principal Consultant	ADR
	Raffi Gracie	Graduate Consultant	RLG
Northern Lighthouse Board	Peter Douglas	Navigation Manager	PD
	Gillian Burnes	Navigation Officer	GB
	Adam Lewis	Coastal Inspector	AL
	Fingal McKiernan	Coastal Inspector	FM

AGENDA

1. Intro
2. Overview of proposed device and location
3. Any known incidents, near misses or relevant feedback associated with deployment across the site
4. Any navigation concerns/impacts around device deployment at proposed locations
5. Discussion on potential impact mitigation / risk control options for consideration
6. AOB

NOTES OF MEETING

1	Introduction	Action
1.1	All made introductions and outlined roles at NLB and NASH Maritime. AR introduced meeting purpose and explained the role of NASH Maritime in the project, which is to undertake the Navigation Risk Assessment (NRA) for the deployment of two O2 tidal turbine devices at EMEC Berth 3.	
2	**Project Overview and Device Locations**	
2.1	AR shared figures showing the locations and status of existing devices within the EMEC site, and the proposed locations of the two O2 tidal turbine devices at EMEC Berth 3. AR noted that NLB has been consulted earlier this year on the deployment of a device at location 'H' on the Figure presented and provided within the consultation letter. AR summarised the project overview sent by Orbital Marine via email on 05-Aug-2021: • The project is looking to obtain a Marine License for two O2 tidal turbine devices, that will be similar to the devices previously deployed at EMEC Berth 5. The devices may be marginally longer, with longer blades and rate at approximately 2.5MW per device. • The locations presented have been agreed with Orkney Ferries to prevent any disruption to their inter island services. It is also driven by suitable tidal resource, sufficient water depths to fit our turbine blades in the water column and there being less boulders/rubble than other parts of the EMEC site, making it more suitable for anchoring. • The devices would be connected to the EMEC Berth 3 cable. • A marine license is aimed to be secured by the end of 2021 for eligibility to bid for revenue support from the UK government. • If successful in a bid for revenue support, the project would commission around 2025-26 and operate for 15 years. AR provided an overview of the device structure. • GB queried the proximity and interaction of moorings between the devices and the possibility of cables being used.	

	• AR confirmed that the devices will be similar to the O2 previously deployed. • The devices will have separate mooring systems • It is anticipated that the devices will connect to the existing cable at EMEC Berth 3. • The mooring will spread 400 x 200m. • AR confirmed that it is anticipated that vessels would navigate around both devices, rather than in between. PD queried the emergence of more devices and developments (such as the project to the West) and the shift from a test site to a commercial 'farm'. AR anticipates future devices will be deployed within the site, especially if revenue support becomes available, and noted the importance of assessing cumulative impacts. AR also noted the Scotwind developments, which could influence the traffic profile of the area in the next decade. GB queried the timeline of the marine license application and noted the long turnaround times for obtaining a marine licence.
2.2	AR and PD discussed the most appropriate markings for the two O2 devices: • Markings used for the previous device would be suitable for the two proposed O2 devices at EMEC Berth 3 (i.e. painted yellow, 2x yellow flashing lights with 3nm nominal range, including radar reflectors etc.).
3	**Any known incidents, near misses or relevant feedback associated with deployment across the site**
3.1	PD confirmed that there have been no known incidents relevant to the project. PD provided feedback from local marine users that the lights of earlier devices needed to be brighter and higher. However, it was noted the newer devices have incorporated this into their design and no further known comments have been received.
4	**Any navigation concerns/impacts around device deployment at proposed locations**
4.1	PD noted that the expectation is that the test site would accommodate shorter term deployment of devices, lasting 1-2 years and that the expected operation of 15 years for the proposed O2 devices seems long. AR explained that due to the technology being in its infancy, and considering the nature of the marine environment being tested, 15 years is a suitable test period to ensure the device is tested throughout its lifetime. PD noted that the two proposed O2 devices are in close proximity to each other, and whether both devices would need to be marked with AIS. PD noted that UKHO chart updates may not be published for every device, and therefore not all devices may be charted. PD highlighted need to consider larger cruise ships and deep draught vessels transiting through the area. AR confirmed that changes to vessel traffic due to COVID-19, particularly cruise ships, will be considered within the assessment and a precautionary approach will be taken. AIS data will be analysed pre- and post-COVID to ensure any recent changes in activity are accounted for.
4.2	AL noted that there will be 4+ devices with AIS units in the area, which will appear on vessel displays and make the area look 'busy'. Is there potential to amend the

	AIS / marking strategy to better mark the devices in the area, especially given there may be more devices deployed in the future. AR confirmed that this would be considered and discussed similarities and differences to Billa Croo site where the test area is surrounded by Cardinal Marks. It was agreed that the nature of the devices at Falls of Warness did not warrant the use of a marked area.
5	**Discussion on potential impact mitigation / risk control options for consideration**
5.1	PD suggested that a navigation light on Muckle Green Holm might be appropriate given narrowing of channel between War Ness and Muckle Green Holm. In the case that AIS is not required on all devices, GB and PD suggested the potential use of dormant AIS devices that could be activated in one of the devices leaves its station, either through breakout or for maintenance. Unsure if this technology is already being used, but it is anticipated to be available in the near future and possibly being used for Kincardine wind farm.
6	**AOB**
6.1	In summary, PD confirmed that NLB are happy with the marking and lighting arrangements proposed (i.e. same as the previous device). PD confirmed that there are no foreseeable risks relating to vessel traffic that won't be manageable.

MEETING ACTIONS

Number	Owner	Action	Status
1	AR/RG	Provide clarification from Orbital Marine on: • Operation lifetime of Magallanes • Mooring spread and interaction between devices • Confirm Marine License timescales	• The testing plan for the device is given as 12-18 months with decommissioning planned for 2022.[1] • Mooring spread is 400x200m per device. • Marine license submission tbc Autumn 2021.

[1] https://marine.gov.scot/sites/default/files/project_environmental_monitoring_programme1.pdf

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30 July 2021

Raffi Gracie
NASH Maritime Ltd,
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SO14 3FH

Dear Raffi,

O2 Floating Tidal Turbines at EMEC site - Consultation

I have read your letter on behalf of RYA Scotland. Due to your very short time scale, I have not had time to contact our local representative. We have been involved with the EMEC Falls of Warness site since its beginning. May I draw your attention to the minutes of the Teams video conference of 7 January 2021 to discuss the O2 berth 6 NRA consultation? James Murray (OM) and Paul Tait (EMEC) were present. Our position has not changed since then.

The new (2020) Orkney and Shetland volume of the Clyde Cruising Club *Sailing Directions and Anchorages* publication notes the position of the EMEC site but does not state that recreational craft should avoid the area. Indeed, low powered vessels on passage from Fersness Bay to Kirkwall may hug the coast of Eday before cutting across from War Ness to the north end of Muckle Green Holm. However, this route would avoid the Orbital devices. Nevertheless, the devices should be clearly marked. Note that about 25% of recreational craft in this area transmit an AIS signal.

Yours sincerely

[redacted]

Dr G Russell FRMetS MCIEEM

Planning and Environment Officer, Royal Yachting Association Scotland

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Appendix C
Hazard Logs

Tow Out:

Hazard ID	Hazard Rank	Hazard title	Hazard type	Designed in Mitigation	Possible causes	Realistic Most Likely Consequences	Realistic Most Likely Scores					Realistic Worst Credible Consequences	Realistic Worst Credible Scores					Overall Risk Score	Overall Risk Rating	Possible Additional Mitigation
							People	Property	Environment	Business	Frequency		People	Property	Environment	Business	Frequency			
1	3	Two project vessels collide during tow	Collision	Vessel Standards PPE Tow Risk Assessment and Passage Plan Tow Weather Window ERCOP	Insufficient Lookout Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints	Minor injuries Negligible damage No pollution No impact on schedule Negligible adverse publicity	**2**	**1**	**1**	**1**	**4**	Multiple injuries Moderate damage Minor pollution Installation aborted. Moderate adverse publicity	**3**	**3**	**2**	**3**	**2**	6.1	Low Risk - Broadly Acceptable	
2	2	Device collides with towing vessel	Collision	Vessel Standards PPE Tow Risk Assessment and Passage Plan Tow Weather Window Appropriate Tow Vessel ERCOP	Equipment or Mechanical Failure on Vessel Reduced Seakeeping due to Tidal or Weather Constraints	Minor injuries Minor damage No pollution Minor impact on schedule Local adverse publicity	**2**	**2**	**1**	**2**	**4**	Multiple injuries Serious damage Minor pollution Loss of Device. Major adverse publicity	**3**	**3**	**2**	**3**	**2**	6.6	Low Risk - Broadly Acceptable	
3	7	Project vessels collide with other Large Vessels (Commercial/Passenger)	Collision	Vessel Standards PPE Tow Risk Assessment and Passage Plan Notice to Mariners Tow Weather Window ERCOP	Insufficient Lookout Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints	Minor injuries Minor damage No pollution Minor impact on schedule Local adverse publicity	**2**	**2**	**1**	**2**	**2**	Fatality/Multiple injuries Moderate damage Minor pollution Loss of Device. Major adverse publicity	**4**	**4**	**2**	**4**	**1**	3.8	Negligible Risk - Broadly Acceptable	Advisory Safety Distances Provision of Guard Vessel
4	6	Project vessels collide with other Small Vessels (Fishing/Recreational)	Collision	Vessel Standards PPE Tow Risk Assessment and Passage Plan Notice to Mariners Promulgation to Fishermen Tow Weather Window ERCOP	Insufficient Lookout Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints	Minor injuries Negligible damage No pollution No impact on schedule Negligible adverse publicity	**2**	**1**	**1**	**1**	**2.5**	Multiple injuries Moderate damage Minor pollution Installation aborted. Moderate adverse publicity	**3**	**3**	**2**	**3**	**1.5**	4.2	Low Risk - Broadly Acceptable	Advisory Safety Distances Installation Scheduling Provision of Guard Vessel
5	5	Project tow contacts other infrastructure (Harbour/Other Devices)	Allision	Vessel Standards PPE Tow Risk Assessment and Passage Plan Tow Weather Window Appropriate Tow Vessel ERCOP	Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints	Minor injuries Negligible damage No pollution Minor impact on schedule Negligible adverse publicity	**2**	**1**	**1**	**2**	**3**	Multiple injuries Moderate damage Minor pollution Installation aborted. Moderate adverse publicity	**3**	**3**	**2**	**3**	**1.5**	4.8	Low Risk - Broadly Acceptable	
6	4	Project tow grounds	Grounding	Vessel Standards PPE Tow Risk Assessment and Passage Plan Tow Weather Window Appropriate Tow Vessel ERCOP	Insufficient Lookout Inadequate Passage Planning Human Error/Fatigue Equipment or Mechanical Failure on Vessel Reduced Seakeeping due to Tidal or Weather Constraints Poor Visibility	Minor injuries Minor damage No pollution Minor impact on schedule Negligible adverse publicity	**2**	**2**	**1**	**2**	**2.5**	Multiple injuries Serious damage Minor pollution Installation aborted. Moderate adverse publicity	**3**	**4**	**2**	**4**	**2**	6.0	Low Risk - Broadly Acceptable	

Hazard ID	Hazard Rank	Hazard title	Hazard type	Designed in Mitigation	Possible causes	Realistic Most Likely Consequences	Realistic Most Likely Scores					Realistic Worst Credible Consequences	Realistic Worst Credible Scores					Overall Risk Score	Overall Risk Rating	Possible Additional Mitigation
							People	Property	Environment	Business	Frequency		People	Property	Environment	Business	Frequency			
7	1	Tow breaks out	Breakout	Vessel Standards PPE Tow Risk Assessment and Passage Plan Tow Weather Window Appropriate Tow Vessel ERCOP	Severe metocean conditions Insufficient towage arrangements	No injuries Negligible damage No pollution Minor impact on schedule Negligible adverse publicity	1	2	1	2	4	Serious injury Loss of Device Minor pollution Installation aborted. Moderate adverse publicity	3	4	2	4	2	7.1	Low Risk - Broadly Acceptable	

Berth 3:

Hazard ID	Hazard Rank	Hazard title	Hazard type	Designed in Mitigation	Possible causes	Realistic Most Likely Consequences	Realistic Most Likely Scores					Realistic Worst Credible Consequences	Realistic Worst Credible Scores					Overall Risk Score	Overall Risk Rating	Possible Additional Mitigation
							People	Property	Environment	Business	Frequency		People	Property	Environment	Business	Frequency			
1	7	Commercial Ship Contacts a Device	Contact / Allision	Charting Marking and Lighting Notice to Mariners Radio Navigation Warnings ERCOP	Insufficient Lookout Inadequate Passage Planning Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints Failure of Navigational Aids on Device Charts not up to date Confusion on Site Layout	No injuries Minor damage to vessel No pollution Moderate damage to device Moderate adverse publicity	1	2	1	3	3	Multiple injuries Moderate damage to vessel Tier 2 Pollution Possible Major damage to device Widespread adverse publicity	4	3	3	4	1	5.4	Low Risk - Broadly Acceptable	Advisory Safety Distances Provision of Guard Vessels
2	2	Passenger Vessel Contacts a Device	Contact / Allision	Charting Marking and Lighting Notice to Mariners Radio Navigation Warnings ERCOP	Insufficient Lookout Inadequate Passage Planning Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints Failure of Navigational Aids on Device Charts not up to date Confusion on Site Layout	Minor injuries Minor damage to vessel No pollution Moderate damage to device Moderate adverse publicity	2	2	1	3	2.5	Multiple fatalities possible Serious damage to vessel Minor pollution Serious damage to device Widespread adverse publicity	5	4	2	4	2	7.5	Low Risk - Broadly Acceptable	Advisory Safety Distances Provision of Guard Vessels
3	3	Fishing Vessel Contacts a Device	Contact / Allision	Charting Marking and Lighting Notice to Mariners Radio Navigation Warnings Promulgation to Fishermen ERCOP	Insufficient Lookout Inadequate Passage Planning Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints Failure of Navigational Aids on Device Charts not up to date Confusion on Site Layout	Minor injuries Negligible damage to vessel No pollution Minor damage to device Minor adverse publicity	2	1	1	2	3	Single fatality/Multiple injuries Moderate damage to vessel Minor pollution Serious damage to device Widespread adverse publicity	4	3	2	4	2.5	7.2	Low Risk - Broadly Acceptable	Advisory Safety Distances Provision of Guard Vessels
4	3	Recreational Vessel Contacts a Device	Contact / Allision	Charting Marking and Lighting Notice to Mariners Radio Navigation Warnings ERCOP	Insufficient Lookout Inadequate Passage Planning Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints Failure of Navigational Aids on Device Charts not up to date Confusion on Site Layout	Minor injuries Negligible damage to vessel No pollution Minor damage to device Minor adverse publicity	2	1	1	2	3	Single fatality/Multiple injuries Moderate damage to vessel Minor pollution Major damage to device Widespread adverse publicity	4	3	2	4	2.5	7.2	Low Risk - Broadly Acceptable	Advisory Safety Distances Provision of Guard Vessels

Hazard ID	Hazard Rank	Hazard title	Hazard type	Designed in Mitigation	Possible causes	Realistic Most Likely Consequences	Realistic Most Likely Scores					Realistic Worst Credible Consequences	Realistic Worst Credible Scores					Overall Risk Score	Overall Risk Rating	Possible Additional Mitigation
							People	Property	Environment	Business	Frequency		People	Property	Environment	Business	Frequency			
5	1	Maintenance Vessel Contacts a Device	Contact / Allision	Charting Marking and Lighting Construction Method Statement Vessel Standards Compliance with EMEC Procedures PPE ERCOP	Insufficient Lookout Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints Failure of Navigational Aids on Device	Minor injuries Negligible damage to vessel No pollution Minor damage to device Minor adverse publicity	2	1	1	2	4	Single fatality/Multiple injuries Moderate damage to vessel Minor pollution Major damage to device Widespread adverse publicity	4	3	2	4	3	8.9	Low Risk - Broadly Acceptable	
6	9	Fishing Gear Interaction with Device	Obstruction	Charting Marking and Lighting Notice to Mariners Radio Navigation Warnings Promulgation to Fishermen ERCOP	Insufficient Lookout Unawareness of device layout Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints Failure of Navigational Aids on Device Charts not up to date Confusion on Site Layout	Minor injuries Negligible damage to vessel No pollution Minor damage to device Minor adverse publicity	2	1	1	2	2	Single fatality/Multiple injuries Moderate damage to vessel Minor pollution Major damage to device Widespread adverse publicity	4	3	2	4	1	3.6	Negligible Risk - Broadly Acceptable	Advisory Safety Distances Provision of Guard Vessels
7	8	Collision Due to Avoidance of Site	Collision	Charting Marking and Lighting Notice to Mariners	Reduced searoom with device Increased maintenance traffic Human Error/Fatigue Equipment or Mechanical Failure on Vessel Reduced Seakeeping due to Tidal or Weather Constraints Poor Visibility	Minor injuries Minor damage to vessel No pollution Minor adverse publicity	2	1	1	2	2	Single fatality/Multiple injuries Moderate damage to vessel Minor pollution Moderate adverse publicity	4	3	2	3	1.5	4.4	Low Risk - Broadly Acceptable	
8	10	Grounding Due to Avoidance of Site	Grounding	Charting Marking and Lighting Notice to Mariners	Reduced searoom with device Human Error/Fatigue Equipment or Mechanical Failure on Vessel Reduced Seakeeping due to Tidal or Weather Constraints Poor Visibility	Minor injuries Minor damage to vessel No pollution Minor adverse publicity	2	1	1	2	2	Single fatality/Multiple injuries Moderate damage to vessel Minor pollution Moderate adverse publicity	3	3	2	3	1	3.2	Negligible Risk - Broadly Acceptable	
9	5	Collision with Site Maintenance Vessel	Collision	Construction Method Statement Vessel Standards Compliance with EMEC Procedures PPE ERCOP	Insufficient Lookout Human Error/Fatigue Equipment or Mechanical Failure on Vessel Poor Visibility in Area Reduced Seakeeping due to Tidal or Weather Constraints	Minor injuries Negligible damage to vessel No pollution Minor adverse publicity	2	1	1	2	3	Single fatality/Multiple injuries Moderate damage to vessel Minor pollution Moderate adverse publicity	4	3	2	3	2	6.1	Low Risk - Broadly Acceptable	
10	6	Grounding of Maintenance Vessel	Grounding	Construction Method Statement Vessel Standards PPE ERCOP	Insufficient Lookout Inadequate Passage Planning Human Error/Fatigue Equipment or Mechanical Failure on Vessel Reduced Seakeeping due to Tidal or Weather Constraints Poor Visibility	Minor injuries Minor damage No pollution Minor adverse publicity	2	1	1	2	3	Multiple injuries Moderate damage Minor pollution Moderate adverse publicity	3	3	2	3	2	5.5	Low Risk - Broadly Acceptable	

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							People	Property	Environment	Business	Frequency		People	Property	Environment	Business	Frequency			
11	11	Breakout of a Device from Moorings	Breakout	Design, Inspection and Maintenance Programme Remote Control and Monitoring of Site Geofencing Using GPS Emergency Shut Down ERCOP	Severe metocean conditions Insufficient mooring arrangements Installation failure	Minor injuries Negligible damage No pollution Moderate damage to device Minor adverse publicity	2	1	1	3	1	Multiple injuries Moderate damage to vessel Minor pollution Major damage to moorings. Widespread adverse publicity	3	3	2	4	1	2.9	Negligible Risk - Broadly Acceptable	

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