NASH MARITIME

# Orbital Fall of Warness: Phase 2: NRA

## Navigational Risk Assessment

**Orbital Marine Power**

Document No: AC22-NASH-0309 | R05-00

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## PROJECT INFORMATION

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| **CLIENT** | Orbital Marine Power |
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# EXECUTIVE SUMMARY

Orbital Marine Power Limited are seeking permission to install, operate and decommission six commercial demonstrator turbines, model O2-X, at the European Marine Energy Centre (EMEC) Fall of Warness tidal test site in Eday, Orkney. The first three turbines previously secured consent under marine licenses 00009694/00009505 but a marine license variation was required and approved to modify the deployment location to the south of the site following further site investigation (marine licenses 00010450/00010451). A further three devices are now proposed, two in the northwest and one in the centre of the Fall of Warness. In order to ensure any risks to navigation are managed to tolerable levels, a revised Navigation Risk Assessment (NRA) has been conducted. This NRA updates the previously submitted Phase 1 NRA (concerning the three southern devices) to include the Phase 2 deployment in the centre and northwest of the site.

The Orbital devices are up to 85m long by 4m diameter cylindrical superstructures with two rotor turbines mounted on leg structures with a rated power of c. 2MW and secured to the seabed with spread moorings. The operational duration of the devices is anticipated to be 15 years. The Fall of Warness tidal energy test site was established by EMEC in 2005. Eight tidal test berths with pre-installed grid connected cables are located in the site.

This NRA 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 (MCA) 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 MCA, Northern Lighthouse Board, Chamber of Shipping, Orkney Marine Services, Orkney Fisheries, 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. The Phase 1 NRA (for the southern devices) concluded:

- With the devices in place, a 305m navigable channel would exist with one cable safety buffer from Muckle Green Holm 10m contour and the most westerly device. This is slightly reduced compared with the existing navigable width with the existing devices. Given the low traffic numbers of large vessels passing through the Fall of Warness, and the availability of an alternative route to the west of Muckle Green Holm, this is not considered to significantly impact upon the viability of this passage.
- The devices were located in an area utilised by Orkney Ferries when transiting during adverse weather or with significant tidal flows to minimise impacts on their operations. Whilst an 850m corridor would exist between the existing and proposed devices,

masters may choose to pass to the north where there is greater searoom, necessitating an increase in transit duration of five minutes (to a total of nine minutes) on a minority of journeys. Whilst this may delay some sailings it is not anticipated to make existing schedules unviable or impose significant impacts on navigational safety.

With the addition of the Phase 2 devices, the following additional findings were identified:

- The addition of the Phase 2 devices would have a negligible impact on commercial vessel transits given that the Phase 1 devices would limit the easterly extent of commercial ship passage and the devices were approximately parallel to the main commercial route.
- There would be 510m and 775m between the Phase 2 devices and the Seal Skerry 10m and 5m contours respectively. A corridor containing 70% of Orkney Ferries transits when navigating inshore at Seal Skerry had been safeguarded with a one cable offset from the two devices.
- The addition of the central Phase 2 device would necessitate an additional deviation of 7.1 minutes to clear this device over the existing comparable route.

Whilst the devices will have underwater infrastructure, few vessels would have a deep enough draught to be at risk of colliding with the rotors, albeit necessitating a passing distance of 14m. It is therefore unlikely that such an event would occur. A majority of other impacts identified within the EMEC site wide NRA were not considered to be significantly affected by this proposal. This included the impact on search and rescue, communications, radar and positioning systems, impact on cables.

A structured, risk assessment was conducted that identified hazards, assessed the likelihood and consequence of each, and derived a risk score. Of the 11 hazards identified for the devices once in position, four were scored as Medium Risk – Tolerable if ALARP, all of which were contact hazards between passing vessels and the devices. The highest two scoring hazards were contacts between maintenance vessels and passenger vessels with the devices. The remained were assessed to be Low Risk – Broadly Acceptable or Negligible Risk due to the low density of traffic in the study area. A suite of effective risk control measures are embedded in the project design and concluded to reduce the risks to ALARP without the need for additional risk controls. Based on comments from Orkney Ferries, Orbital have committed to exploring micrositing of the most easterly device to increase searoom from the War Ness and Seal Skerry headlands.

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 |
|---|---|
| AIS | Automatic Identification System |
| ALARP | As Low As Reasonably Practicable |
| ATBA | Area To Be Avoided |
| AtoN | Aids to Navigation |
| CCTV | Closed Circuit Television |
| COLREGS | International Regulations for Preventing Collisions at Sea |
| DSC | Digital Selective Calling |
| EIA | Environmental Impact Assessment |
| EMEC | European Marine Energy Centre |
| ERCOP | Emergency Response Cooperation Plan |
| ES | Environmental Statement |
| ESRI | Environmental Systems Research Institute |
| FSA | Formal Safety Assessment |
| GIS | Geographic Information System |
| GLA | General Lighthouse Authority |
| GMDSS | Global Maritime Distress and Safety System |
| GNSS | Global Navigation Satellite System |
| GPS | Global Positioning System |
| HSE | Health and Safety Executive |
| IALA | International Association of Marine Aids to Navigation and Lighthouse Authorities |
| IMO | International Maritime Organisation |
| INTOG | Innovation and Targeted Oil and Gas |
| LNG | Liquified Natural Gas |
| MAIB | Marine Accident Investigation Branch |
| MCA | Maritime and Coastguard Agency |
| MGN | Marine Guidance Note |
| MHWS | Mean High Water Springs |
| MSI | Marine Safety Information |
| MW | Megawatt |
| NLB | Northern Lighthouse Board |
| NRA | Navigation Risk Assessment |
| OREI | Offshore Renewable Energy Installation |
| PNT | Position, Navigation and Timing |
| PPE | Personal Protective Equipment |

| Abbreviation | Detail |
|---|---|
| RIB | Rigid Inflatable Boat |
| RNLI | Royal National Lifeboat Institute |
| RYA | Royal Yachting Association |
| SAR | Search and Rescue |
| SCADA | Supervisory, Control and Data Acquisition System |
| SOLAS | Safety Of Life At Sea |
| STCW | Standards of Training Certification and Watchkeeping for Seafarers |
| UKC | Under Keel Clearence |
| VHF | Very High Frequency |
| VMS | Vessel Monitoring System |
| VTS | Vessel Traffic Service |

# 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 O2-X floating tidal turbine devices (Devices) at the Fall of Warness European Marine Energy Centre (EMEC) project site in Orkney. This assessment was conducted in two phases:

- **Phase 1** – installation of three devices in the south of the test site between Muckle Green Holm and War Ness, Eday. This sought to modify previously awarded marine licenses (00009694/00009505). The NRA for Phase 1 was submitted accompanying Marine License Variation Applications 00010450/00010451 (https://marine.gov.scot/node/24184). This license modifications were approved in October 2023. A summary of the findings of the Phase 1 NRA are described in **Section 1.2**.
- **Phase 2** – proposed deployment of three devices, two located to the northwest of the Fall of Warness test site and one located in the centre of the test site.

This NRA updates the previous assessment undertaken during Phase 1 to account for the addition of the Phase 2 devices. The NRA study area and device locations are shown in Figure 1. The scope of the NRA includes the tow to and from EMEC's Fall of Warness test site and the installation, operation and decommissioning of the devices.

## 1.1 FALL OF WARNESS TIDAL TEST SITE

The Fall of Warness tidal test site was established in 2005 by 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. 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.

**Table 1: Status of Fall of Warness Berths.**

| Berth | Deployment | Status |
|---|---|---|
| 1 | Magallanes Ocean_2G tidal energy platform | In-situ (February 2019) |
| 2 | Unoccupied | N/A |
| 3 | Unoccupied | N/A |
| 4 | Open Hydro fixed tidal turbine | In-situ (2006). Not operational |
| 5 | Orbital Tidal Device | In-situ (July 2021) |
| 6 | Unoccupied | N/A |
| 7 | Unoccupied | N/A |

| Berth | Deployment | Status |
|---|---|---|
| 8 | Unoccupied | N/A |

## 1.2 SUMMARY OF PHASE 1 NRA

The Phase 1 NRA, undertaken during 2023, assessed the potential impacts of three devices located to the south of the EMEC test site, approximately midway between Muckle Green Holm and War Ness. The assessment included consultation with regulators and local operators, vessel traffic analysis and hazard scoring. The following key conclusions were reached regarding these three devices:

- With those devices in place, a 305m navigable channel would exist, with one cable safety buffer, from Muckle Green Holm 10m contour and the most westerly device. This is slightly reduced than the existing navigable width with the existing devices. Given the low traffic numbers of large vessels passing through the Fall of Warness, and the availability of an alternative route to the west of Muckle Green Holm, this is not considered to significantly impact upon the viability of this passage.
- Those devices were located in an area utilised by Orkney Ferries when transiting during adverse weather or with significant tidal flows to minimise impacts on their operations. Whilst an 850m corridor would exist between the existing and proposed devices, masters are likely to choose to pass to the north where there is greater searoom, necessitating an increase in transit duration of c. 6.7 minutes on a minority of journeys (3.3%). Whilst this may delay some sailings it is not anticipated to make existing schedules unviable or impose significant impacts on navigational safety.
- Whilst the devices will have underwater infrastructure, few vessels would have a deep enough draught to be at risk of colliding with the rotors, albeit necessitating a passing distance of 14m. It is therefore unlikely that such an event would occur.
- A majority of other impacts identified within the EMEC site wide NRA were not considered to be significantly affected by that proposal. These included the impact on search and rescue, communications, radar and positioning systems, impact on cables.

Following this, at the request of Orkney Ferries, Orbital agreed to modify the location of the most eastern device to increase the sea room with War Ness to improve transit during adverse weather.

It has been assumed within this NRA that Phase 1 devices are consented and installed.

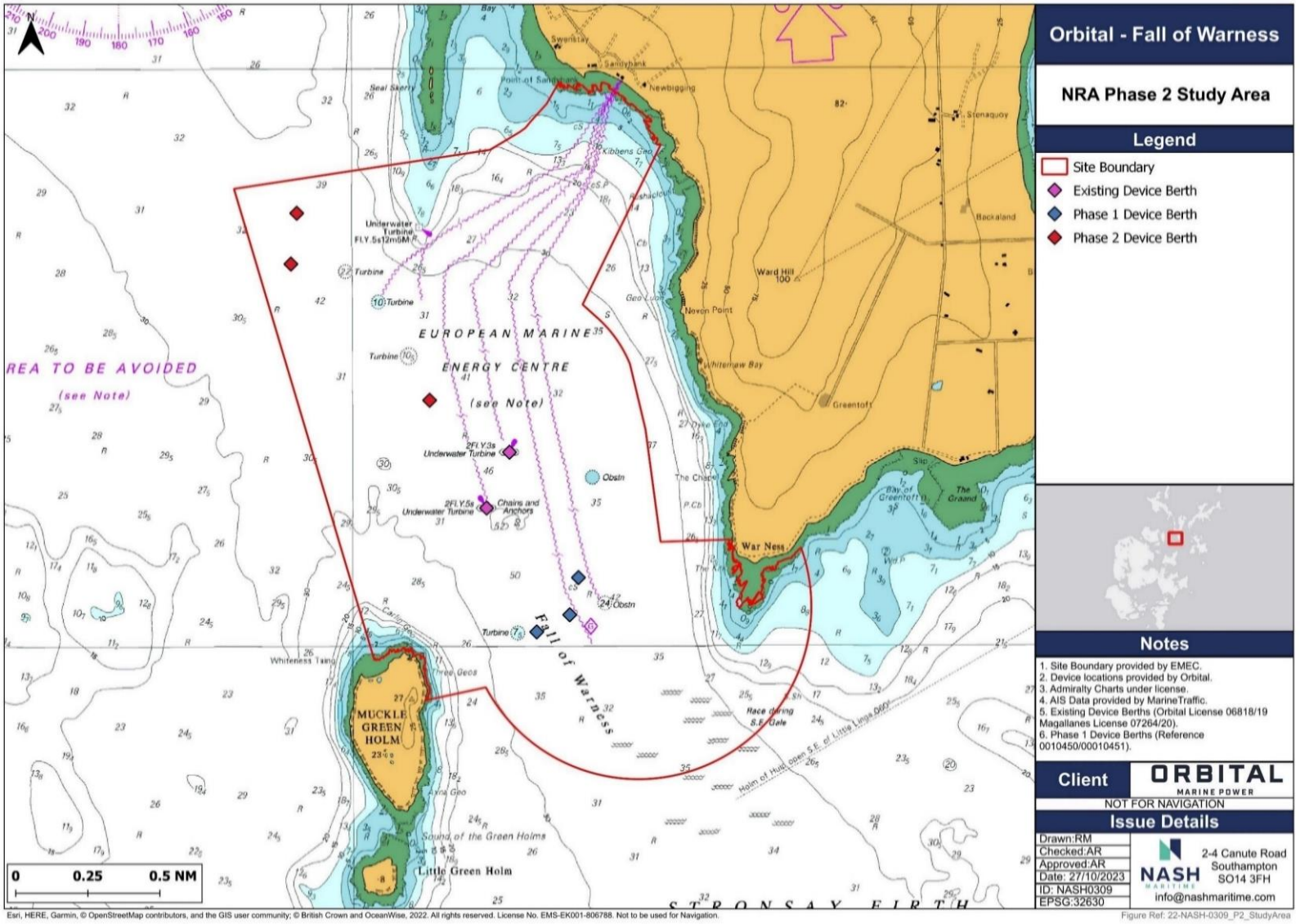


**Figure 1: Location of O2 devices.**

## 1.3 GUIDANCE AND POLICY

This assessment has been 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. In addition,<br>Annex 1 – methodology for undertaking NRAs.<br>Annex 5 – SAR considerations for OREIs. |
| 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) G1162 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 (FSA) 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. |
| Health and Safety Executive (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

EMEC maintain a site wide NRA for the Fall of Warness which, in accordance with MGN654, is updated regularly. The purpose of the site wide NRA is to assess the impacts of the test site as a whole, including a range of possible devices which fit within the envelope. Whilst each device installed at the Fall of Warness is required to submit and NRA as part of their marine

licence application, they can use the site wide NRA as a basis. In 2022, the most recent site-wide NRA review was conducted for the Fall of Warness test site[1].

The site wide NRA provides a pro-forma for how the impacts of specific devices should be assessed. Details of the NRA criteria are shown **Table 3**, including the relevant references to MGN 654 guidance.

## 1.4 SCOPE AND METHDOLOGY

In compliance with the site wide NRA and the pro-forma described in **Table 3**, the scope of this NRA is to:

1. Provide a description of the O2-X tidal turbine device, its layout, marking, construction methodology and towage to site.
2. Review the baseline activities and environment contained with the site wide NRA and ensure there have been no material changes.
3. Identify and assess impacts to shipping and navigation that may arise from the deployment of the devices.
4. Undertake stakeholder consultation to review the impacts of the aforementioned activities.
5. Undertake an NRA that identifies navigation hazards through all phases of the development and assesses these hazards, identifies risk controls to reduce risk to As Low As Reasonably Practicable (ALARP).
6. Where appropriate, make recommendations as to the safety of the development and what measures should be implemented to improve it.

[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*** | | |
| **Asset Information:** A description of the device, location, dimensions, moorings etc. | Annex 1 B3 | **Section 2.1** |
| **Schedule and Test Plan:** Programme and methods of installation, maintenance and decommissioning. | Annex 1 B3 | **Section 2.1.2** |
| **Third Party Verification:** Details of the verification and certification process the device is undergoing. | Annex 1 B3 | **Section 2.2** |
| ***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 (UKC):** 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 | **Refer to Site Wide NRA** |
| **Communications, Radar and Positioning Systems:** Does the device impact the communications, radar and positioning systems on board vessels or on land? | 4.13 | **Refer to Site Wide NRA** |
| **Moorings:** Are the moorings sufficient for the device and the conditions? | | **Refer to Site Wide NRA** |
| **Station Keeping**: What are the risks associated with the device were it to breakout? | | **Refer to Site Wide NRA** |
| **Fishing Activity:** Does the device impact upon the activity of fishing vessels? | 4.6 | **Refer to Site Wide NRA** |
| **Recreational Activity:** Does the device impact upon the activity of recreational vessels? | 4.6 | **Refer to Site Wide NRA** |
| **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 | **Refer to Site Wide NRA** |
| **Search and Rescue (SAR):** Does the device impact SAR capability and has access been considered in the design of the device? | 4.11/6.19 / Annex 5 | **Refer to Site Wide NRA** |
| **Cumulative and In Combination:** Are there nearby devices which might exacerbate the impacts discussed above? | 4.6 | **Refer to Site Wide NRA** |
| ***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 7.3** |
| **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 7.3** |
| **Marking and Lighting:** Have the marking and lighting arrangements been agreed with the MCA and Northern Lighthouse Board (NLB)? | 4.15/6 / Annex 1 E1/G1 | **Section 7.3** |

# 2. PROJECT DESCRIPTION

## 2.1 PROJECT OVERVIEW

Orbital is proposing deployment of an additional three commercial demonstrator tidal turbines at the Fall of Warness EMEC test site. The devices are model O2-X and are similar to the previous O2 devices deployed and proposed within the Fall of Warness.

The project comprises of the following components:

- 3 x Orbital Marine Power's turbine, the Orbital O2-X.
- 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-X Device Overview

The device consists of the following elements (**Figure 2**):

- A cylindrical floating steel superstructure, which houses power conversion and auxiliary systems. The superstructure is up to 85m in length and 4m 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 c.1 MegaWatt (MW) with a total rated power of c. 2MW.
- 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.

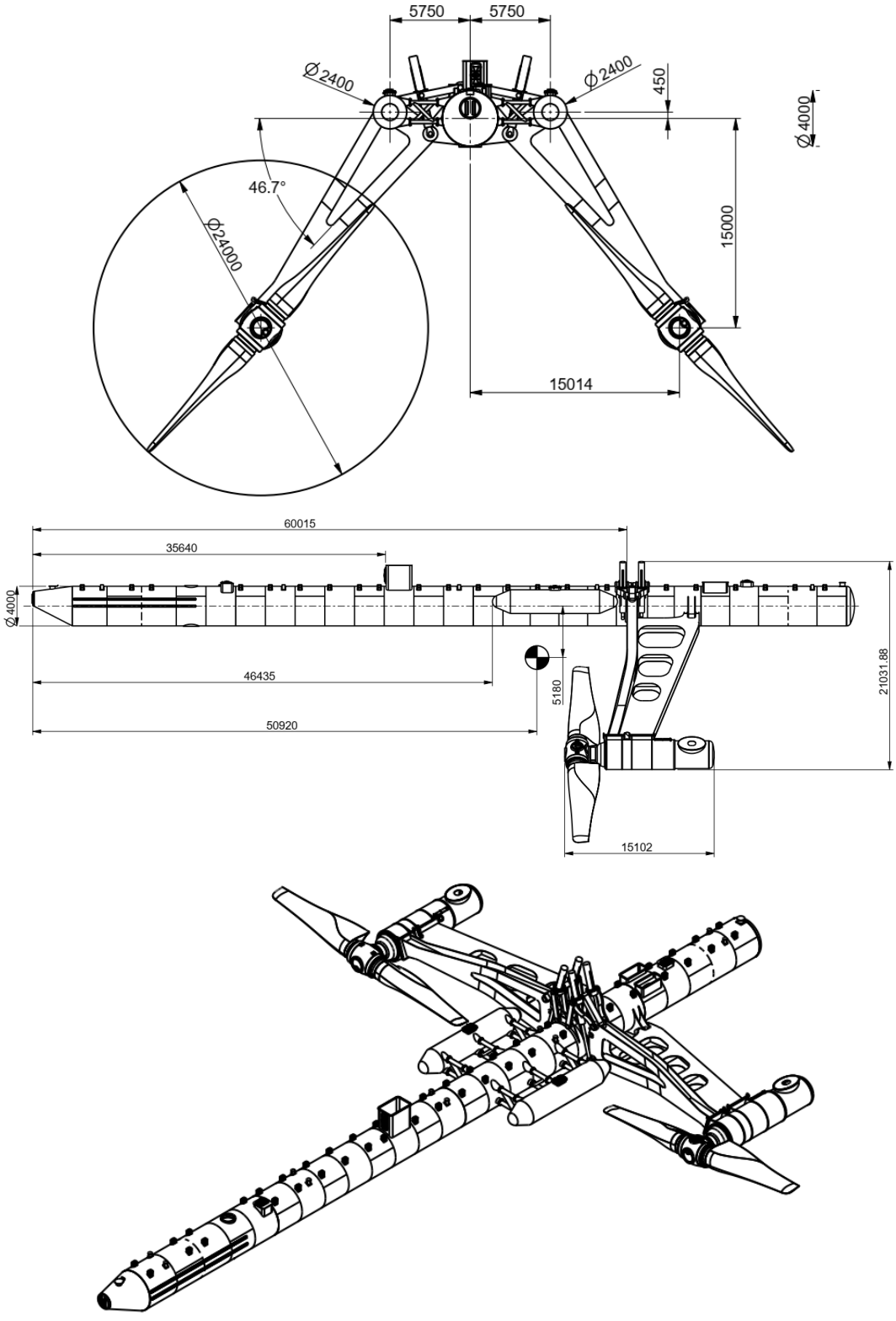


**Figure 2: Schematic of device. Measurements in mm.**

**Table 4: Orbital O2.X design parameters.**

| Device Characteristic | Dimension |
|---|---|
| Rated power | c. 2 MW |
| Displacement | 1000 metric Tonnes approx. |
| Rated current speed | 2.5 m/s |
| Cut-in current speed | 1 m/s |
| Shut down current speed | 5 m/s |
| Maximum Hull length | 85 m |
| Approximate Diameter of Hull tube | 4 m |
| Approx Depth to uppermost rotor tip during operation (rotors extended) | 3 m |
| Maximum Depth to bottom rotor tip (deepest point) during operation (rotors extended) | 27 m |
| Maximum depth of platform below waterline | 2.4 m |
| Height of hull tube exposed above the water surface | 1.6 m |
| Maximum rotation speed | 12 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-X comprises of four catenary mooring lines which are moored to the seabed via four separate anchors (see **Figure 3**). The mooring system has been designed accordance with Offshore Standard DNV-OS-E301. Each of the four lines would be connected via a single point mooring system. 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 two of these four 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.

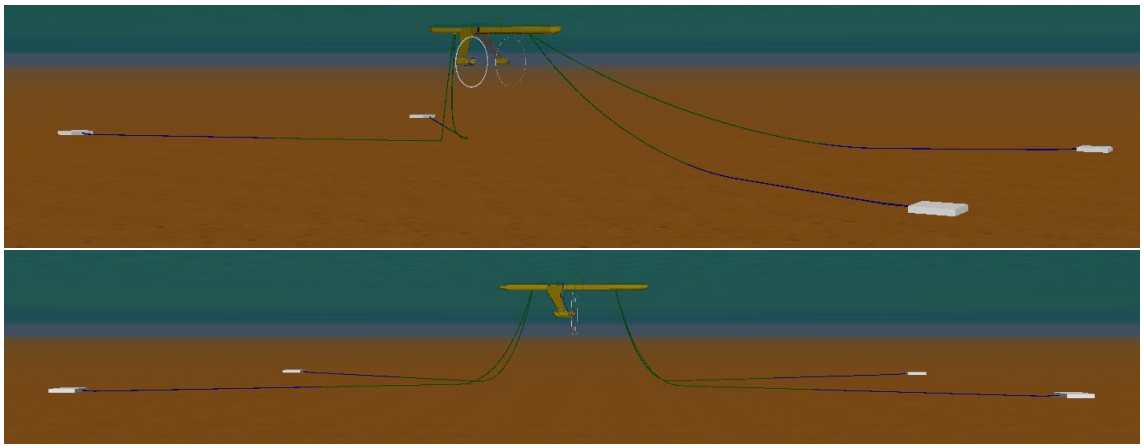

**Figure 3: Orbital O2-X mooring system.**

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

- **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 35T (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 rockbolt anchors is to use a drilling rig to insert a steel vertical bolt or bolts into the seabed to provide station keeping for the device. The bolts will provide station keeping by either being grouted in place or a groutless installation whereby a mechanical lock is used to prevent pull out. In this system, the 'cutting fingers' themselves of the drilling bit are expanded within the bolt hole to secure the anchor in place.

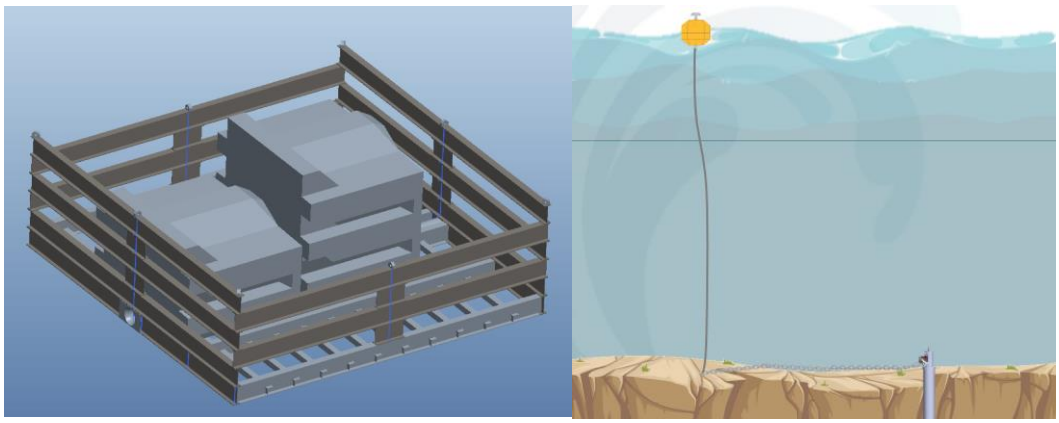

**Figure 4: Anchor basket with ballast (left) and Rockbolt in situ in seabed.**

Concrete mattresses or 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-X will have a marking and lighting schedule as advised by the NLB in the NRA consultation process. Previous Orbital devices have had the following conditions within their marine license:

- The device will be predominantly yellow in colour above the water line.
- The Orbital O2-X 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 NLB.

## 2.2 CONSTRUCTION, OPERATION AND MAINTENANCE, AND DECOMISSIONING

It anticipated that work on site at EMEC could commence in April 2028 at the earliest. A summary of the installation programme is provided in **Table 5**.

**Table 5: Installation programme.**

| Activity | Approximate duration | Approx. Timescale |
|---|---|---|
| Mooring installation | 8 weeks in 4 month window | April 2028 – July 2024 |
| Dynamic Cable installation | 1 week | April - May 2028 |
| Turbine delivery to Orkney | 5 days | March 2028 |
| Install on moorings | 2 days | April 2028 |
| First Grid connection | 2 days | May 2028 |
| Commissioning | 12 weeks | June 2028 |
| Operation | 25 years | 2028-2054 |
| Decommissioning | 6 months | 2055 |

### 2.2.1 Site Preparation and Mooring Installation

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

- Survey using Remotely Operated Vessel and Acoustic Doppler Current Profiler.
- Splicing of export cable from EMEC berths to device locations.
- Mooring system installation (Modular anchor or Rockbolts).

- Umbilical cable installation.

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

### 2.2.2 Orbital O2-X Tow to and from Fall of Warness

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-X 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 by 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 two 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 from 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 5: Indicative tow arrangement for O2-X device (Source: Orbital Marine Power).**

### 2.2.3 Orbital O2-X Platform Installation

- Following the tow, the vessel will hold the device in position during connection.

- The 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 Rigid Inflatable Boat (RIB) 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 3 months, it is intended that the Orbital O2-X turbines will be installed at the Fall of Warness for a long term project of up to 25 years operation. During the commissioning phase, outputs from the Orbital O2-X will be monitored in real time by the Orbital engineering team through a 24/7 duty manager system. The SCADA system (Supervisory, Control and Data Acquisition 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-X 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-X. 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-X 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 around 2055 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 areas located 8nm to the SE of the device locations.

## 3.1 METOCEAN CONDITIONS

A full overview of the metocean conditions within the study area is provided in the sitewide NRA (EMEC, 2022). Given that the metocean conditions would not have changed significantly since, a summary is provided below.

The prevailing wind is south/south-westerly with, 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. Average 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 10 and 11 of the sitewide NRA (EMEC, 2022).

## 3.2 EXISTING VESSEL TRAFFIC MANAGEMENT

**Figure 6** 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 Statutory Harbour Authority Areas. These extend no further north than Shapinsay Sound and Wide Firth.
- **Pilotage**: Pilotage is compulsory within the Orkney Harbour Competent Harbour Authority areas for:
    - Passenger vessels over 65m Length Overall (LOA).
    - All other vessels over 80m LOA.
    - All vessels under tow where the combined overall length of the tow is over 65m.
    - All vessels over 300GT carrying persistent oils in bulk.
- **Vessel Traffic Services (VTS)**: Orkney Islands VTS, based in Scapa Flow, do not monitor vessels near the Fall of Warness site.
- **Vessel Reporting**: The Pentland Firth is an IMO adopted voluntary ship reporting system.
- **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 5,000GT carrying oil or other hazardous cargoes in bulk should avoid the ATBA.

## 3.3 OFFSHORE ACTIVITIES IN STUDY AREA ADJACENT TO STUDY AREA

**Figure 6** shows the location of 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 3.5nm to the south.
- **Search and Rescue**: There are Royal National Lifeboat Institute (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 (D809 North). 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.
- **Subsea Cables**: Only EMEC installed subsea cables connected to the test berths exist within the study area.
- **Offshore Oil and Gas**: There is no offshore oil and gas activity in the study area.
- **Marine Aggregates**: There are no marine aggregate licence 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 1.1**), there are no other OREIs in the study area.
- **Aids to Navigation (AtoN)**: A South Cardinal located 2.7nm to the west, at Point of the Graand, and a North Cardinal 3.0nm to the east of the site, south of Eday, are the closest navigational marks. Additionally, navigation marks are fitted to the EMEC test devices, typically exhibiting an all round flashing yellow light and an AIS transponder.

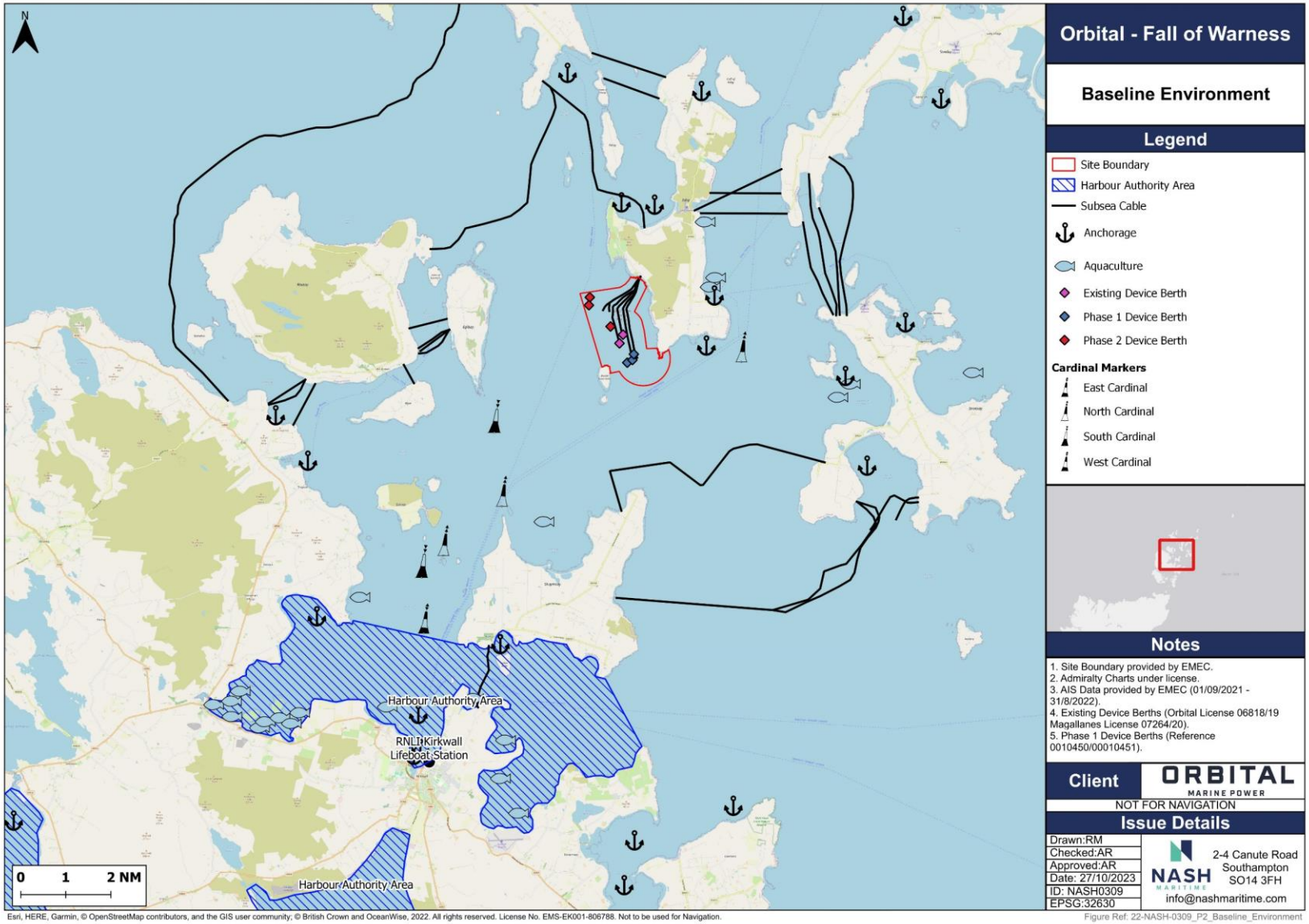


**Figure 6: Overview of the baseline environment.**

# 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.

## 4.1 PROJECT SPECIFIC CONSULTATION

Stakeholder consultation was undertaken remotely via video calls. A list of consultees and key engagement is shown in **Table 6**. Consultation during the Phase 1 NRA included a preliminary discussion on the impacts of the Phase 2 devices and therefore has been retained. Meeting minutes are contained in **Appendix B**.

**Table 6: Summary of stakeholder consultation.**

| Consultee | Date | Engagement |
|---|---|---|
| **MCA** | 27 March 2023 | Attended MS Teams workshop to discuss this and future proposed activities within the Fall of Warness. |
| **Northern Lighthouse Board** | | |
| **Orkney Ferries** | | |
| **RYA Scotland** | | |
| **RNLI** | | |
| **Orkney Marinas / Orkney Sailing Club** | | |
| **Orkney Fisheries** | | |
| **Orkney Islands Council Marine Services** | | |
| **Orkney Harbours** | 01 March 2023 | Email correspondence on impacts to Orkney Ferries. |
| **RYA Scotland** | 15-29 March 2023 | Various email correspondence on impact to recreational boaters. |
| **Orkney Marinas** | 27 March 2023 | Email Correspondence on recreational activities and marina visit numbers. |
| **Chamber of Shipping** | 07 March 2023 | Email correspondence on maintenance of navigational channel to east of Muckle Green Holm. |
| **EMEC** | 10 March 2023 | Email correspondence confirming that no other applications are known for Fall of Warness. |
| **Orkney Ferries** | 25 April 2023 | Meeting at Orkney Harbour Offices to discuss project. |

| Consultee | Date | Engagement |
|---|---|---|
| **MCA** | 20 October 2023 | MS Teams call to update stakeholders on changes to Orbital proposals and review potential impacts to navigation. |
| **NLB** | | |
| **Chamber of Shipping** | | |
| **Orkney Ferries** | 20 October 2023 | Email correspondence welcoming changes to Phase 1 locations and raising concerns on Phase 2 locations with regards to impacts on adverse weather routeing. A letter was issued by the project team in response containing further information. |
| **RYA Scotland** | 23 October 2023 | Email correspondence welcoming amendments to Project to reduce risk. |
| **Orkney Harbours** | 02 November 2023 | No additional comments. |
| **Scottish Fishermen's Federation** | 03 November 2023 | Noted contentment with NRA subject to implementation of standard procedures and notification of activities. |

## 4.2 SITE WIDE CONSULTATION

Consultation for the sitewide NRA (EMEC, 2022) was conducted with key stakeholders to better understand the activities and risks within the project site. As summary of the consultation conducted for the sitewide NRA is included in **Table 7**. Meeting minutes are provided in Annex B of the sitewide NRA (EMEC, 2022).

**Table 7: Site Wide NRA Consultation Summary (2021/2022).**

| Consultee | Date | Summary |
|---|---|---|
| **MCA** | **Teleconf 21-Dec-21** | Review of NRA Update scope and methodology. Agreed with MCA. |
| **Northern Lighthouse Board** | **Teleconf 25-Jan-22** | Review of NLB recommendations for individual devices. Review of marking and lighting arrangements per site. Identification of possible risk control measures. |
| **Royal Yachting Association and Orkney Marinas** | **Teleconf 27-Jan-22** | Review recreational activity in the Orkney Islands and around EMEC sites. Discuss experiences of recreational users navigating through sites. Identification of possible risk control measures. |
| **Orkney Ferries** | **Teleconf 27-Jan-22** | Establish baseline understanding of operations in Fall of Warness site during adverse weather. Understand experiences of bridge teams navigating through EMEC site. Identification of regions essential to Orkney Ferries navigation. Identification of possible risk control measures. |
| **Chamber of Shipping** | **Teleconf 09-Feb-22** | Review commercial shipping movements around Orkney Islands. Identify relevance of additional risk control measures. |
| **Orkney Fisheries and Scottish Fisheries Federation** | **Teleconf 15-Feb-22** | Identify locations and activities of fishing within study area. Determine impacts of site on fishing activities. |

# 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.

The primary data source for this NRA is data from AIS recorded by EMEC from 1st September 2021 to 31st August 2022. With AIS data covering a full year, seasonal variation in vessel movements and frequency can be identified and measured. AIS is required on all commercial vessels over 300GT, fishing vessels over 15m LOA, passenger vessels irrespective of size and may be voluntarily fitted to smaller recreational and fishing vessels. Therefore, to account for smaller craft which may not be carrying AIS, 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.
- Vessel Monitoring System (VMS) data.
- Almanacs.
- IMO publications.
- Metocean information sources (for weather, tidal information).
- Incident Records including Marine Accident Investigation Branch (MAIB) and RNLI.

## 5.2 VESSEL TRAFFIC OVERVIEW

**Figure 7** shows annualised vessel traffic density in the study area, demonstrating that the greatest densities of traffic are clear of the device locations. There is some use of the western and southern extents of the Fall of Warness (up to 150 vessels per year). **Figure 8** and **Figure 9** show the sizes of vessels navigating the study area by length and draught respectively. Relatively few vessels greater than 50m or 4.5m draught navigate through the Fall of Warness.

There is no material change to the sizes of vessels that navigate through the test site compared to the site-wide NRA (EMEC, 2022).

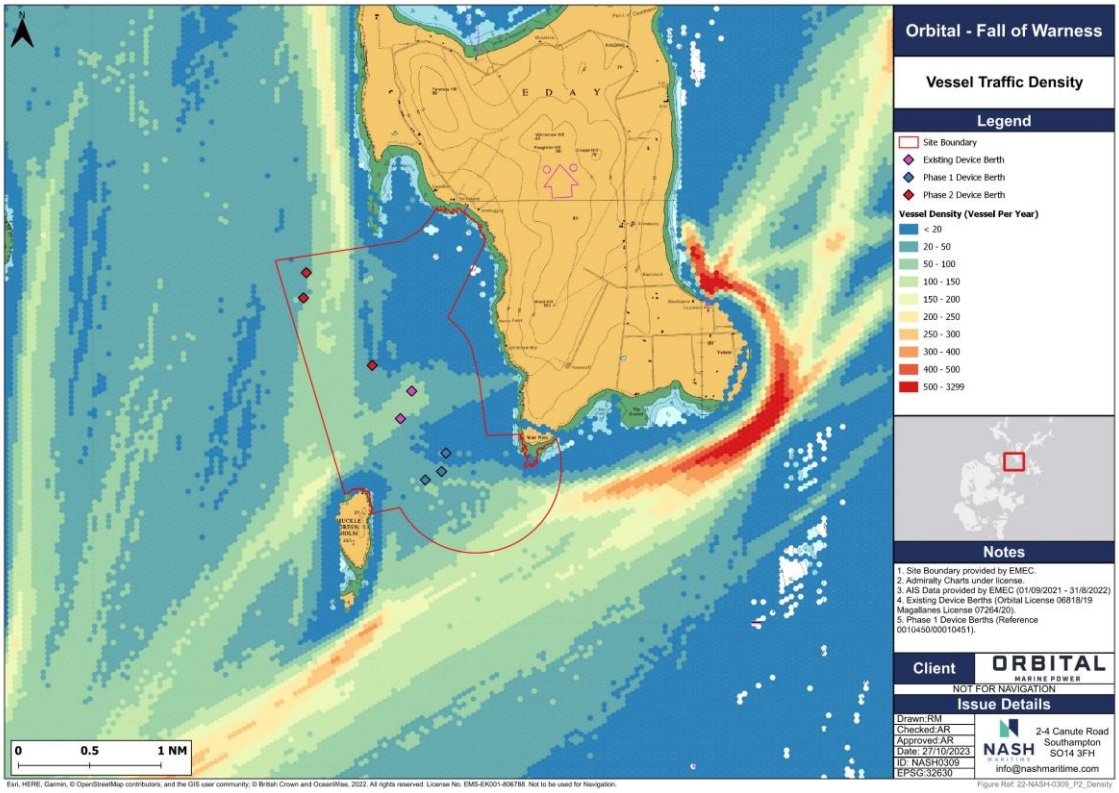


**Figure 7: Vessel density for all vessel types (grid cell size 70m).**

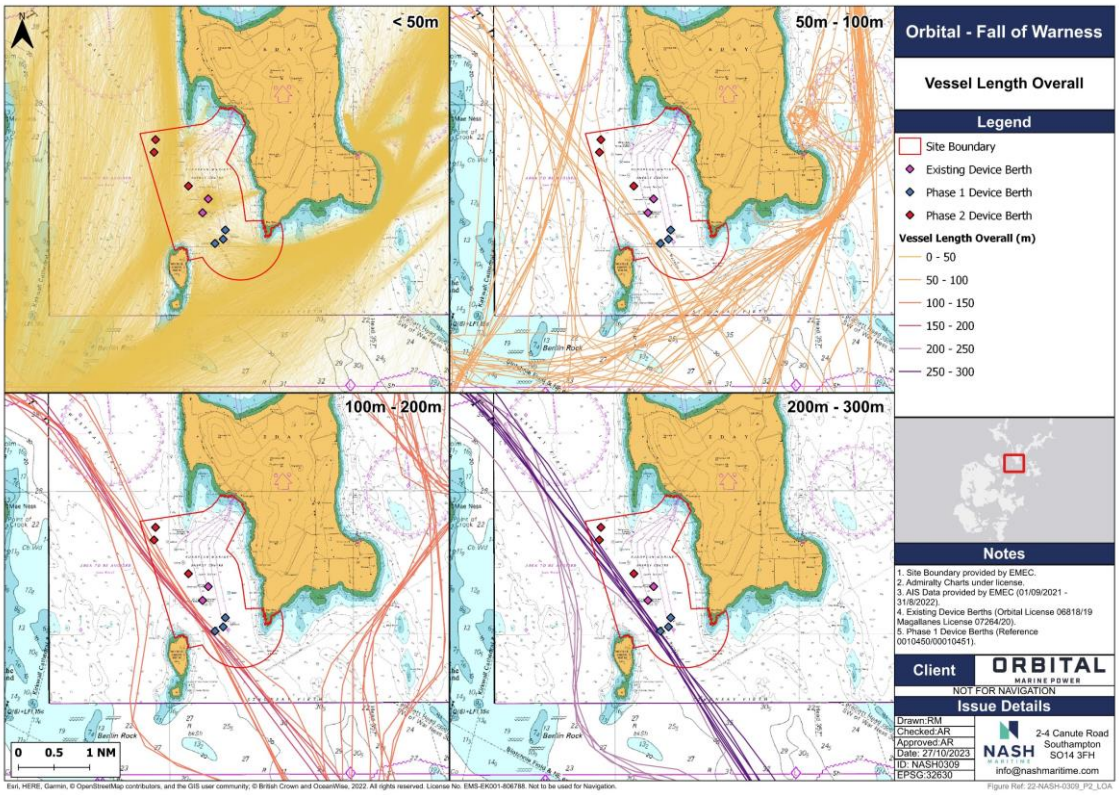


Figure 8: Vessel Tracks by Length (metres).

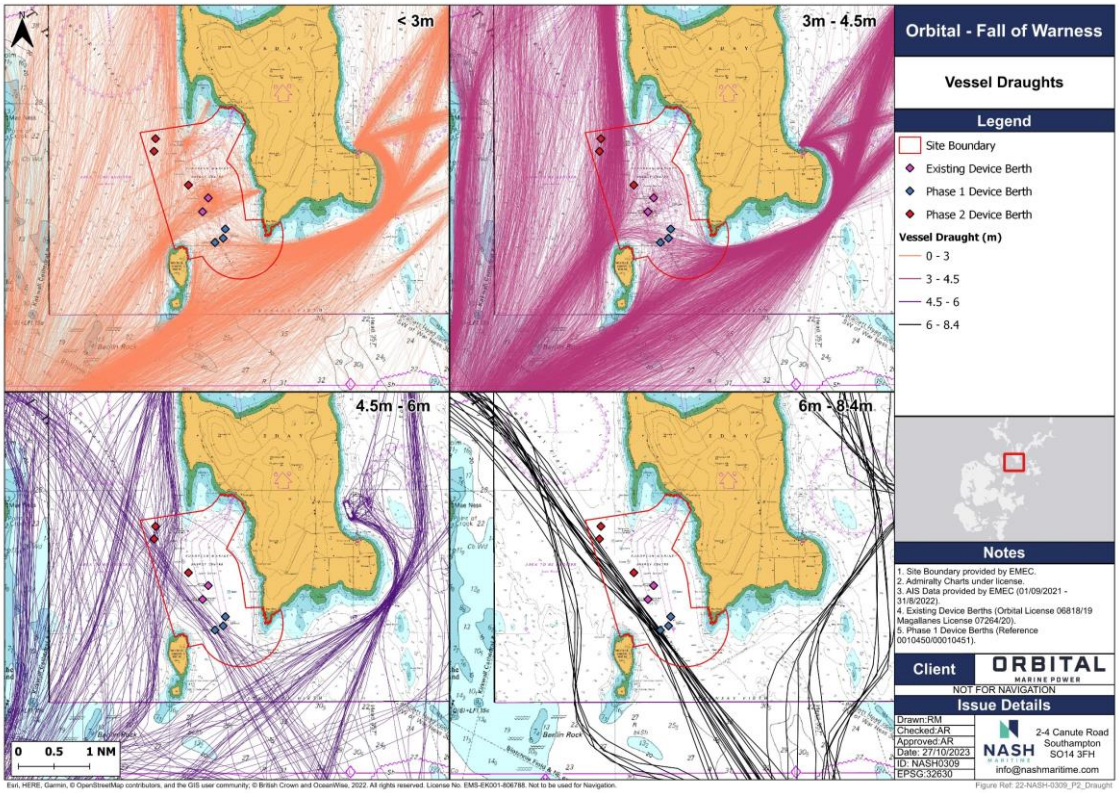


Figure 9: Vessel Tracks by Draught (metres).

### 5.2.1 Commercial Shipping

No cargo vessels or tankers were identified within the study area during the data periods (**Figure 10**). It was noted in the site-wide NRA (EMEC, 2022) that some small cargo vessel transits were recorded through the site. Large Offshore Service Vessels transited close to the test site (~130m) but never crossed the boundary during the study period.

### 5.2.2 Passenger Vessels

**Figure 11** shows the passenger vessel tracks through the study area split between ferries and cruise ships. The ferries are operated by Orkney Ferries and are the Earl Sigurd (45m LOA), Earl Thorfinn (45m LOA) and Varagen (50m LOA). The ferries operate routes that pass either to the south or the west of the Fall of Warness. The tracks shown 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. Ferries take alternative routes in different metocean and tidal conditions to minimise impacts to their operations (see **Section 6.3**).

Eight cruise ships transited the site at least once between September 2021 and August 2022, these were the Aida Luna (252m LOA), World Voyager (120m LOA), Viking Venus (186m LOA), Silver Whisper (186m LOA), Seven Seas Navigator (171m LOA), MSC Magnifica (294m LOA), Sirena (181m LOA), and the Le Champlain (132m LOA). All of these transits passed between the proposed device locations and Muckle Green Holm. Other cruise ships passed to the west of Muckle Green Holm including the Bolette (238m), Greg Mortimer (104m) and Hamburg (144m).

### 5.2.3 Fishing Vessels

**Figure 12** shows the tracks of fishing vessels within the study area obtained from AIS data. Consultation as part of the site-wide NRA (EMEC, 2022) determined that of the approximately 100 Orkney based boats, the majority were under 10m and do not carry AIS. Some creel fishing was understood to take place in and around the test site, but generally closer to shore.

Of those fishing vessels carrying AIS, all were recorded transiting through the study area and not engaged in fishing. These vessels were between 10m and 80m (The Lunar Bow being the largest). Fish farming vessels generally avoid the study site, however, there are vessel tracks transiting though the north western and south eastern site extent. There are several large fish carriers supporting the fish farming, the largest recorded were the Marsali (63m LOA) and Soerdyroey (50m LOA).

**Figure 13** shows the tracks of fish farm vessels, small workboats supporting the aquaculture industry in the Orkney Islands. These vessels tend to be clear of the project site, albeit some may be on charter to operations within the test site.

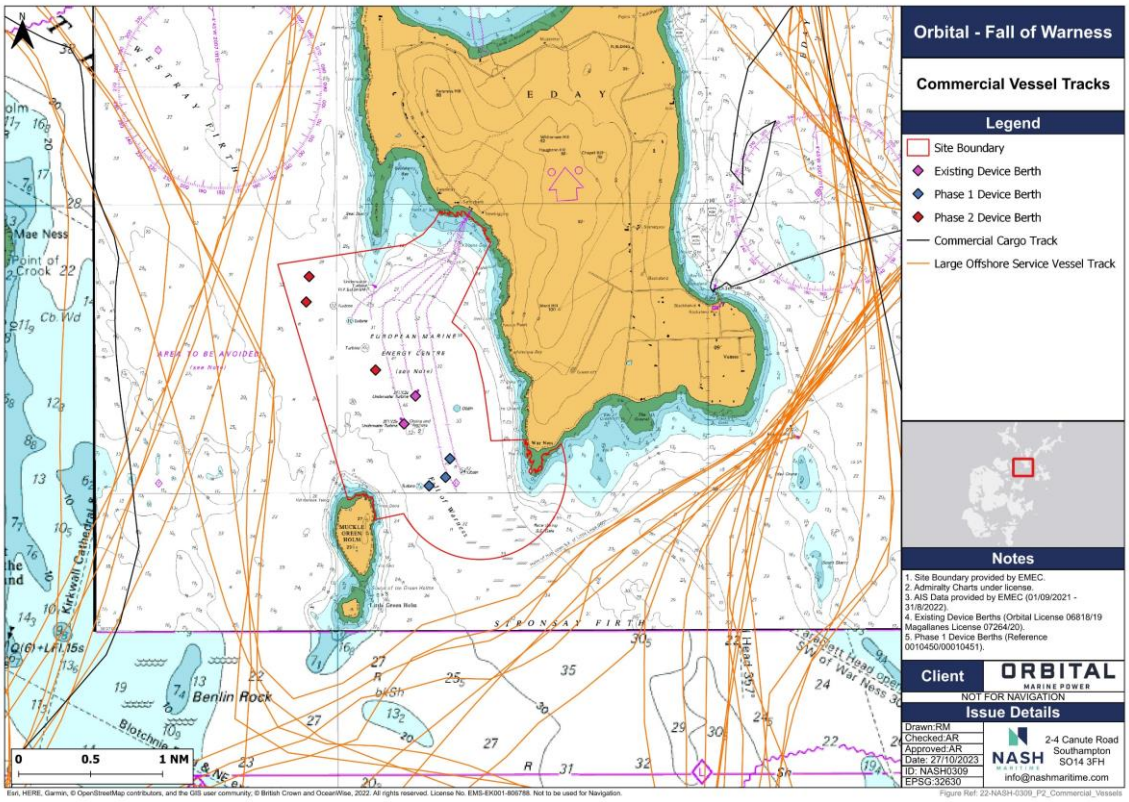


Figure 10: Commercial vessel tracks.

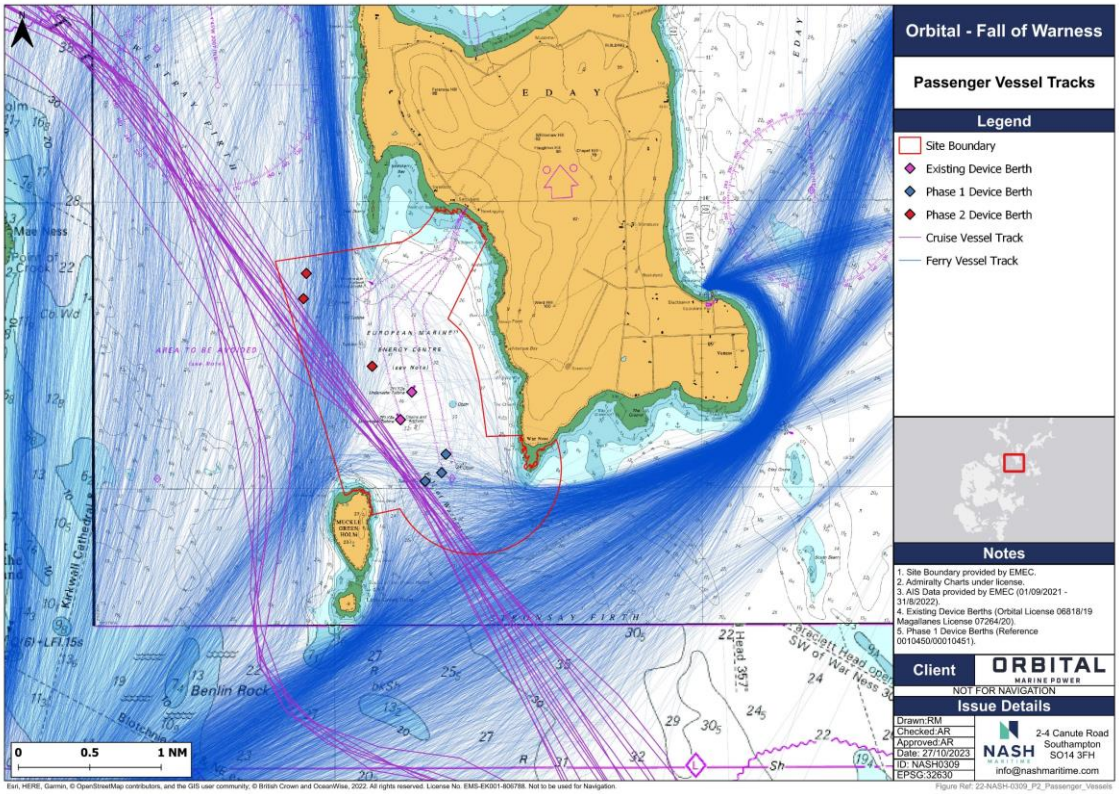


Figure 11: Passenger vessel tracks.

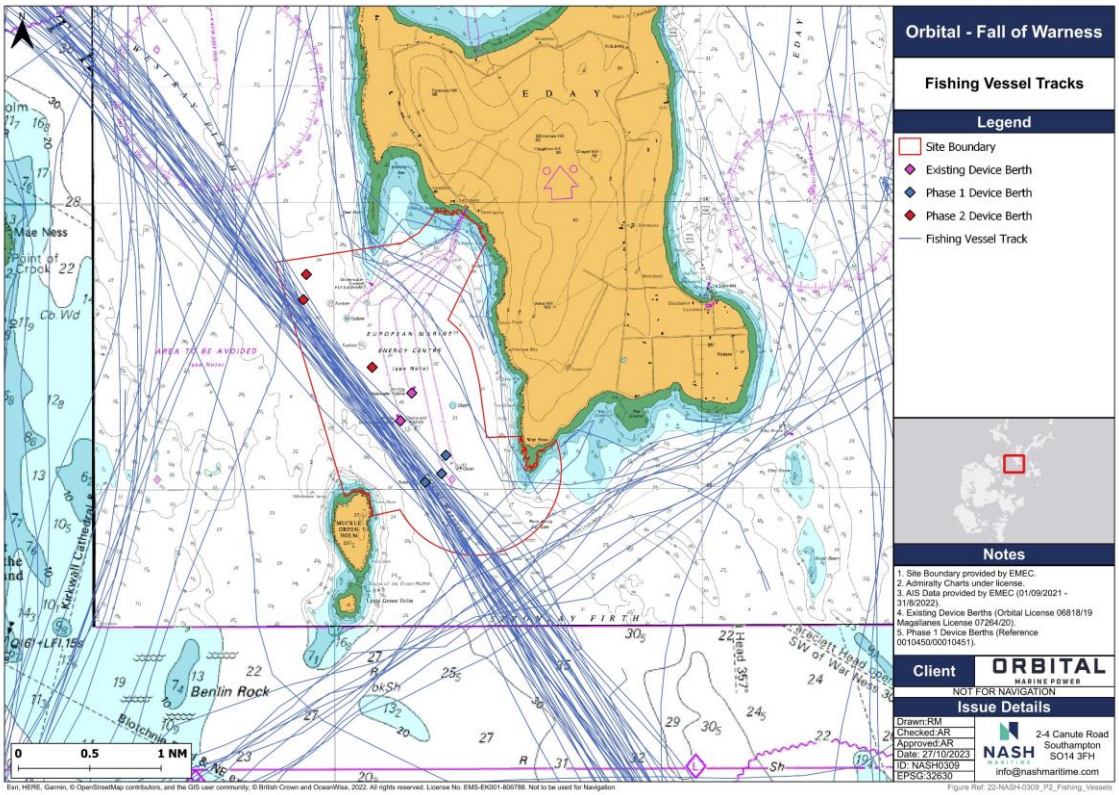


Figure 12: Fishing vessel tracks.

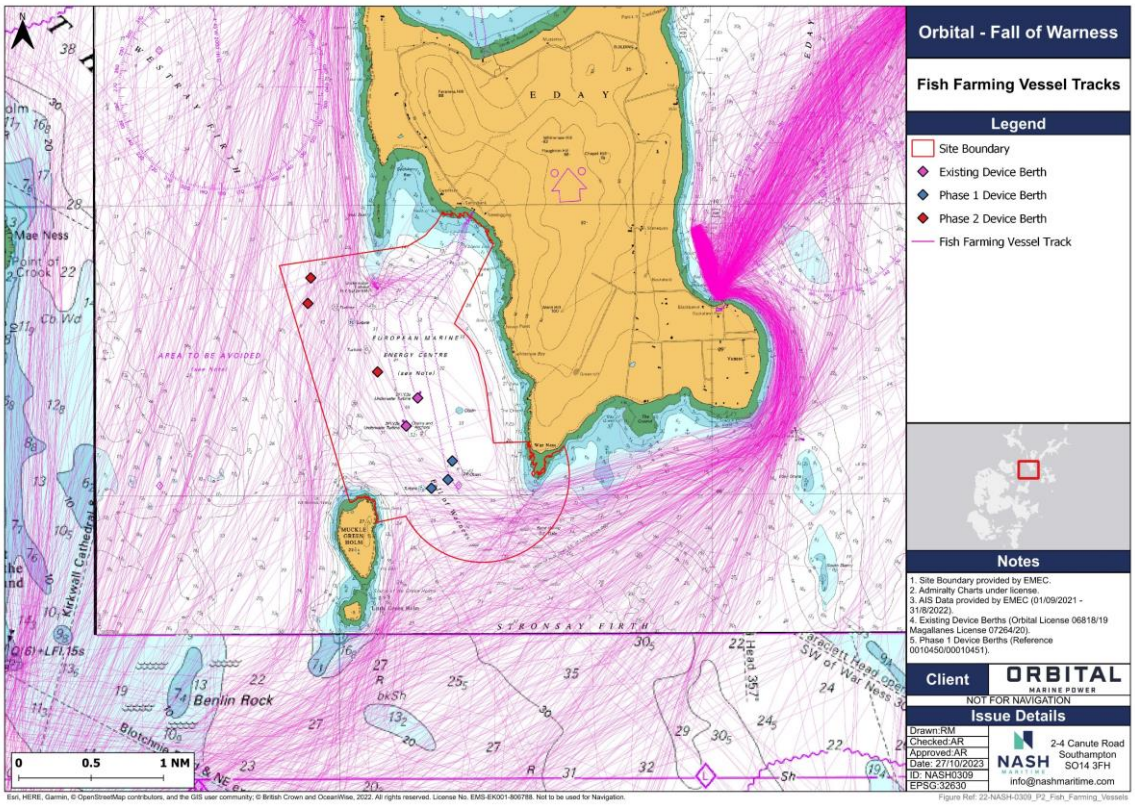


Figure 13: Fish farm vessel tracks.

### 5.2.4 Recreational Vessels

**Figure 14** shows that few recreational vessel transits were recorded by AIS within the study area. Not all recreational craft are required to carry AIS and therefore the figure likely underrepresents these activities. The Orkney Islands area a popular cruising destination, particularly during the summer months of May to August. The three principal marinas in the Orkney Islands are located at Stromness, Kirkwall and Westray, well clear of the Fall of Warness site. The area is not understood to routinely be used for organised events such as regattas or club racing.

### 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. Most of the vessel tracks navigating inside the study area are due to the vessel Nigg Bay, which has been identified as a harbour master vessel, and the C-Spartan, a safety vessel supporting the Fall of Warness renewable projects. Other vessels are providing maintenance support to devices operating within the test site by transferring engineers and parts onto the devices.

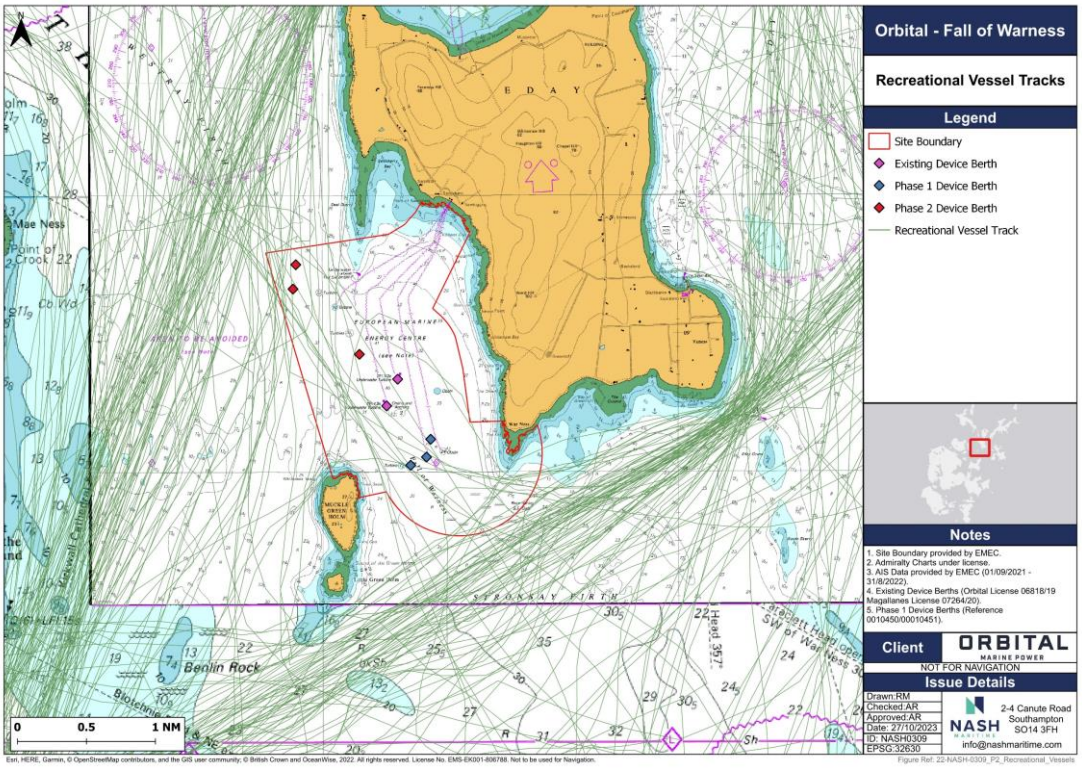


Figure 14: Recreational vessel tracks.

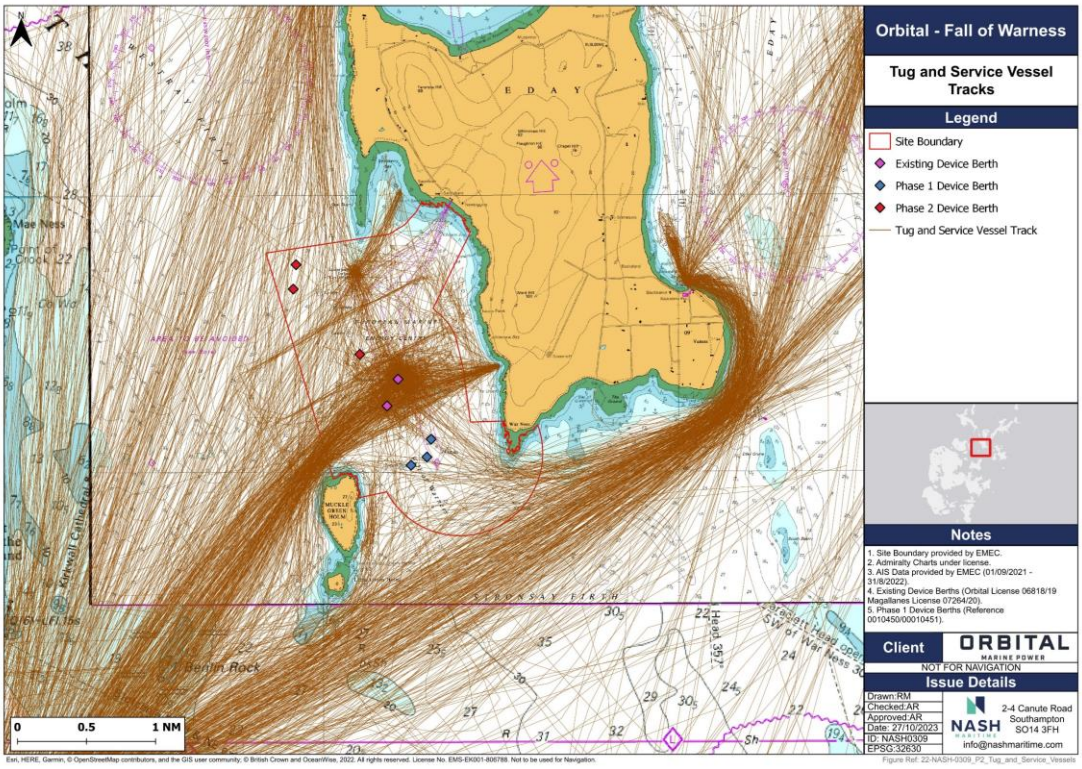


Figure 15: Tug and service vessel tracks.

## 5.3 TRANSITS THROUGH STUDY SITE

**Figure 16** shows the number of vessel transits intersecting the EMEC Test Site by time of day. **Figure 17** shows the number of vessel transits intersecting the EMEC Test Site by month and by vessel type. Vessel transits are higher in the summer months and fewer in the winter.

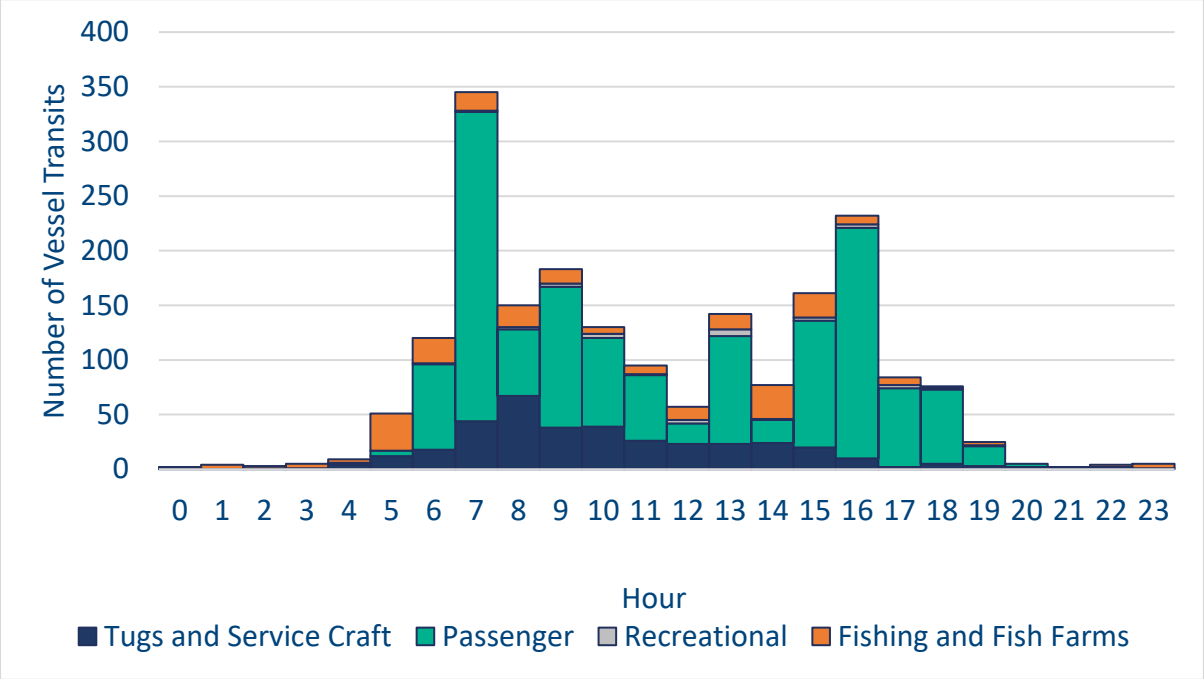


**Figure 16 Vessel transits by time of day through the EMEC Test Site.**

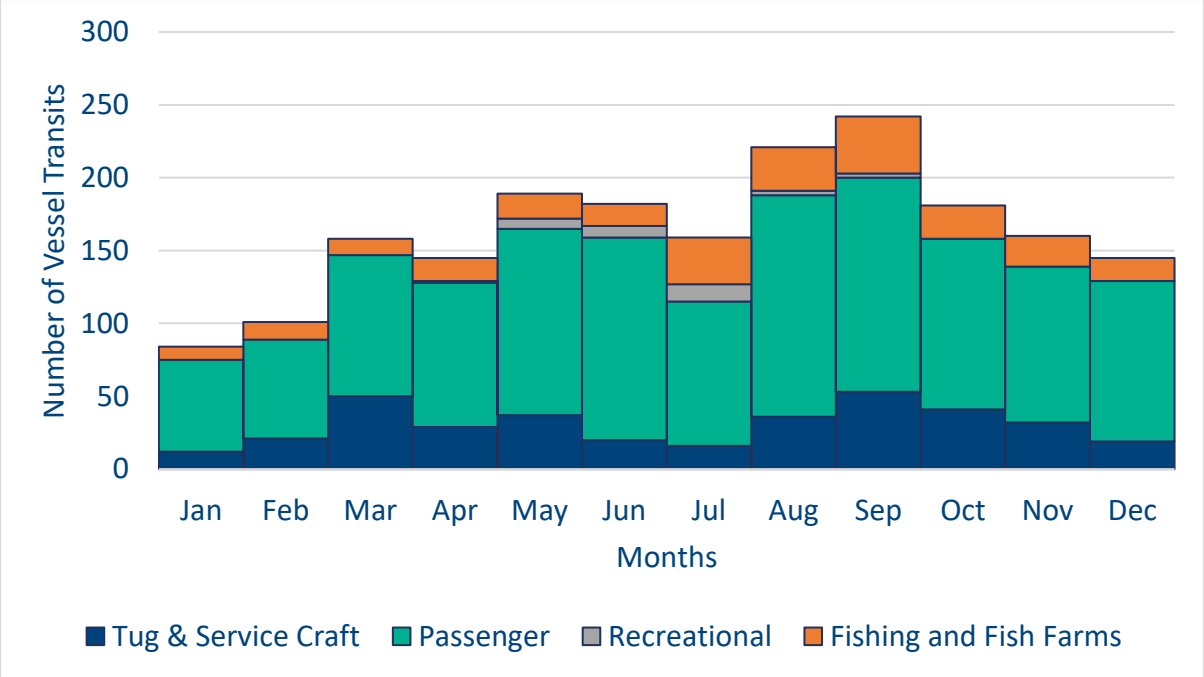


**Figure 17 Count of vessel transits through EMEC Test Site.**

## 5.4 HISTORICAL INCIDENTS

Historical accident data from the RNLI (2008-2022) and MAIB (2010-2021) were analysed to better understand the risk profile of the Fall of Warness site. **Figure 18** shows that there are two reported incidents within the EMEC Test Site boundary. These were 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 site boundary was the grounding of a fishing vessel in Sealskerry Bay in 2014. There have been no substantial incidents since the site wide NRA was undertaken.

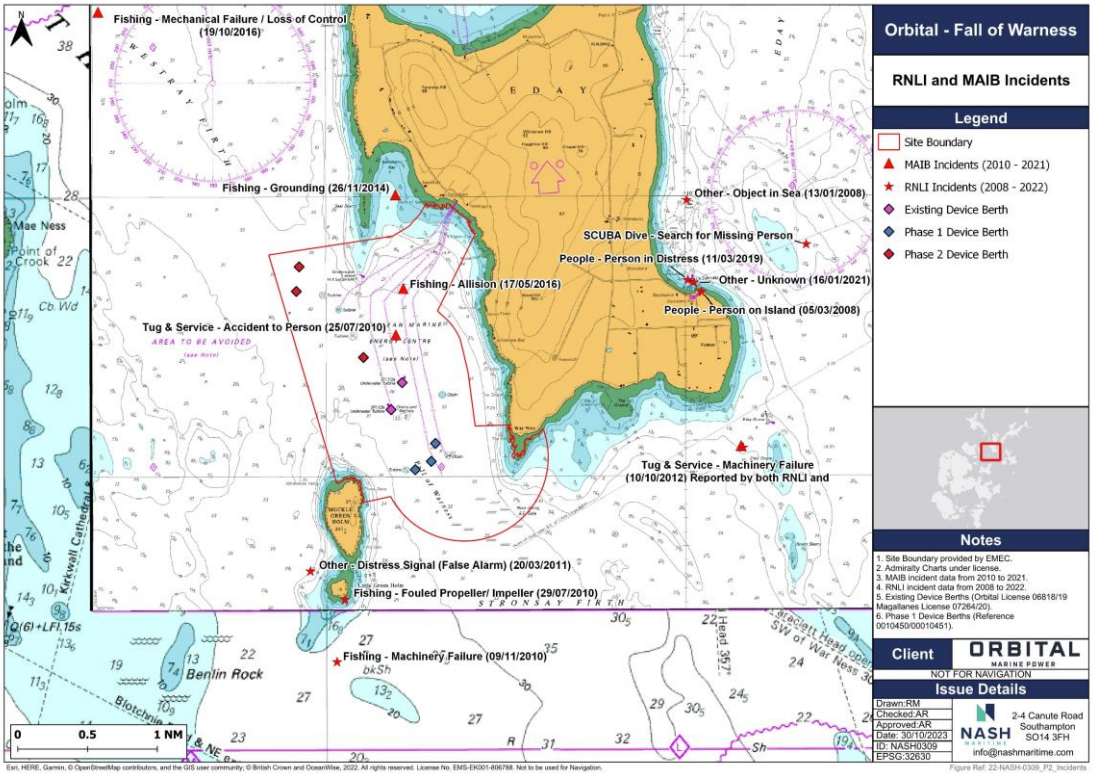


**Figure 18: Locations of RNLI and MAIB reported incidents.**

## 5.5 FUTURE TRAFFIC PROFILE

The site wide NRA (EMEC, 2022) contains detailed long term analysis of activities within the Orkney Islands, which have been reviewed, updated and summarised below.

The Orkney Islands Council Marine Services Annual Reports[2] provide a statement of current and future activity. Pilotage movements to all facilities follow an upward trend, increasing by 185 between 2017 and 2020, before falling by 260 between 2020 and 2021 (see **Table 8**), likely impacted by the effects of COVID. The majority of these movements are to Scapa Flow where there are significant growth plans around Liquified Natural Gas (LNG), deep-water anchoring and Ship to Ship operations.

**Table 8: Total acts of pilotage between 2017 and 2021**

| Year | Total pilotage movements |
|---|---|
| 2017-18 | 708 |
| 2018-19 | 835 |
| 2019-20 | 893 |
| 2020-21 | 633 |
| 2021-22 | 630 |

Cruise activity has grown since 2010 from 79 calls in 2014/2015 to 156 in 2019/2020 before a significant impact of COVID-19 for the years 2020/2021 (0 and 25 respectively). However, 204 cruise ships were booked for 2023.

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-X 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.

In January 2022, Crown Estate Scotland announced Options Agreements for ScotWind Leasing for 17 project sites. Orkney Islands Council has been in discussions with potential developers over a number of months with a view to the successful bidders using Scapa Flow as a base for operations. Alongside this, the Council has also been developing plans to provide improved infrastructure to support this work – known as the Scapa Flow Deep Water Quay project. Sites to the west and east of Orkney were awarded including the proposed 'West of Orkney Windfarm' which involves a consortium of companies headed by Offshore Wind Power, MacQuaries, Green Investment Group – for which the Council already has an agreement in place to work together. The 'West of Orkney Windfarm' project also includes the Flotta Hydrogen Hub - which could see hydrogen produced in Flotta for export.

In early 2022, Crown Estate Scotland released details of its Innovation and Targeted Oil and Gas (INTOG) offshore wind leasing process. Whilst the potential locations are being

[2] https://www.orkneyharbours.com/documents

considered in the ongoing Marine Scotland sectoral planning process, there is potential that this may include areas in vicinity of Orkney and that this may also lead to further use of Orkney marine infrastructure during construction and operations and maintenance.

The Orkney Islands Council Marine Services Annual Report (2020-2021) 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 European Regional Development Fund funds for a low carbon and active transport and travel hub in Stromness.

A review of the Scottish Sea Fisheries Statistics (2021) shows that the number of voyages by Scottish fishing vessels in the Orkney region has remained fairly consistent. The number of registered fishing vessels in Orkney has declined from 142 in 2012 to 125 in 2021.

The EMEC (2022) 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. Whilst tickets reduced significantly during the pandemic in 2020, correspondence with Orkney Marinas (see **Section 4**) noted that 825 visiting yachts in 2022 compared to approximately 700 in 2019.

It is not anticipated that the changes in vessel traffic discussed will materially change the risk profile assessed for the three O2-X devices at Fall of Warness.

# 6. IMPACTS TO NAVIGATION

The site wide Fall of Warness NRA (EMEC,2022) 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 highlighted in Site Wide NRA (EMEC 2022).**

| Number | Impact | Orbital Fall of Warness Discussion | Assessed |
|---|---|---|---|
| 1 | Impact on Vessel Traffic Routeing | The three devices at Fall of Warness would limit the navigable width to the east of Muckle Green Holm and could make this passage unnavigable to large shipping. | Yes |
| 2 | Impact on Contact/Allision Risk | The three devices at Fall of Warness reduces the available searoom and could result an increased risk of contact/allision between the device and a navigating vessel. | Yes |
| 3 | Effect of the Tides, Tidal Streams and Weather | The significant tidal flows effect the navigation of vessels in vicinity of Fall of Warness which could impact their navigation or safety, and in particular Orkney Ferries. | Yes |
| 4 | Impact on Under Keel Clearance | The devices have subsurface rotors which are not visible to navigating vessels and therefore pose an underwater hazard. | Yes |
| 5 | Impact on Collision Risk, Visual Navigation and Collision Avoidance | The Orbital devices have a sufficiently low visual profile that they would not pose a visual risk to vessels (see **Section 2.1**). Furthermore, the density of traffic is low (see **Section 5**) that there a low collision risk. | No |
| 6 | Impact on Communications, Radar and Positioning Systems | The EMEC site wide NRA (2022) highlights that previous similar devices have been easily detectable by radar and AIS. Furthermore, previous studies have demonstrated that there is a negligible effect from OREIs on Very High Frequency (VHF), AIS, Global Navigation Satellite System (GNSS) and other navigational aids. | No |
| 7 | Impact of Failure of Moorings | Orbital devices are installed to DNV-OS-E301 standard. Furthermore, controls are in place to monitor the integrity of the devices (e.g. radar, AIS, SCADA).<br>Therefore, the risks of breakout are considered low, and given the low density of traffic the likelihood of posing a hazard to navigation is negligible. | No |
| 8 | Impact on Fishing Activity | Analysis and consultation (see **Section 5.2.3**) suggest negligible fishing is undertaken at the specific location of the devices, with most vessels in transit, with sufficient searoom to avoid the devices. | No |
| 9 | Impact on Recreational Activity | Analysis and consultation (see **Section 5.2.4**) suggest some recreational activity in the area but there is sufficient searoom to avoid the devices. | No |
| 10 | Impact on Subsea Cables | The EMEC test site has had underwater cables installed for several years, is well charted and it is not likely that vessels would anchor or fish in a manner to snag the cables. This specific proposal would have a negligible impact upon this risk. | No |
| 11 | Impact on Search and Rescue and Emergency Response | It is unlikely that the devices would materially impact SAR, with no impact on helicopters. The devices could serve as places of refuge. A site wide Emergency Response and Cooperation Plan (ERCOP) managed by EMEC is in place. | No |
| 12 | Cumulative and In-Combination Effects | Whilst there are likely future proposals for the Fall of Warness site, these are insufficient detail to be properly assessed. The Site Wide NRA provides additional information (EMEC, 2022). This Phase 2 NRA includes an assumption of Phase 1 device deployment. | No |

## 6.1 IMPACT ON COMMERCIAL SHIP 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), or 1,800m between the 10m contours. 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 recreational craft, fishing boats and trawlers, occasional cruise ships, occasional large offshore service vessels (oil and gas supply boats). No commercial cargo or tanker traffic was recorded utilising this route.

Of the Phase 1 and Phase 2 device locations, consultees agreed that the Phase 1 device locations were most limiting on passages east of Muckle Green Holm, given its proximity. With the Phase 1 southern devices in position, a 710m passage exists to the east (up to the 10m contour) and 675m passage to the west (up to the 10m contour). Both of these passages are sufficiently wide to enable small craft such as fishing and recreational to pass safely through the site, clearing the devices and natural hazards.

During the 2021-2022 data period, 25 vessels greater than 50m took these passages, including the 294m cruise ship MSC Magnifica. Analysis of historical data suggests that most large ships navigating through the test site do so towards Muckle Green Holm so would be likely to pass to the west of the devices. **Figure 19** shows the swept paths of the four cruise ships over 200m which transited the Fall of Warness. The swept paths of these eight transits occupy an approximately 230m corridor (see **Figure 20**), 520m to the east of from Muckle Green Holm. The closest transit to the existing devices was a 200m pass by the 294m MSC Magnifica.

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), which is consistent for the above analysis. However, larger, less manoeuvrable vessels may choose to take an alternative route, such as to the west of Muckle Green Holm where greater searoom exists. **Figure 20** shows how this route might be affected by the three devices. Assuming a 185m minimum passing distance from Muckle Green Holm and the Orbital devices, a 305m corridor would exist for vessel transits.

Whilst this passage is narrower than is currently available, and closer to Muckle Green Holm, 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.

Having passed to the west of the Phase 1 device locations and with all large vessels transiting northwest out of the Orkney Islands, it is likely that their track would be offset to the west of the current swept paths shown in **Figure 19**. Therefore, given that the Phase 1, existing and Phase 2 devices are approximately aligned with the route and tidal flow direction, ships will naturally pass clear to the west of the Phase 2 device locations and no additional impact on navigation is anticipated above that attributable to the Phase 1 devices in isolation.

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. A 0.73nm corridor exists between Benlin Rock and Muckle Green Holm, albeit requiring more alterations of course than a passage to the east of Muckle Green Holm. During the 2021-2022 data period, 11 vessels greater than 50m took this passage, including the 238m cruise ship Bolette. It was noted in the site wide NRA that since the grounding of the Octopus in 2006 (MAIB 18/2007), the nautical charts for this passage have been greatly improved.

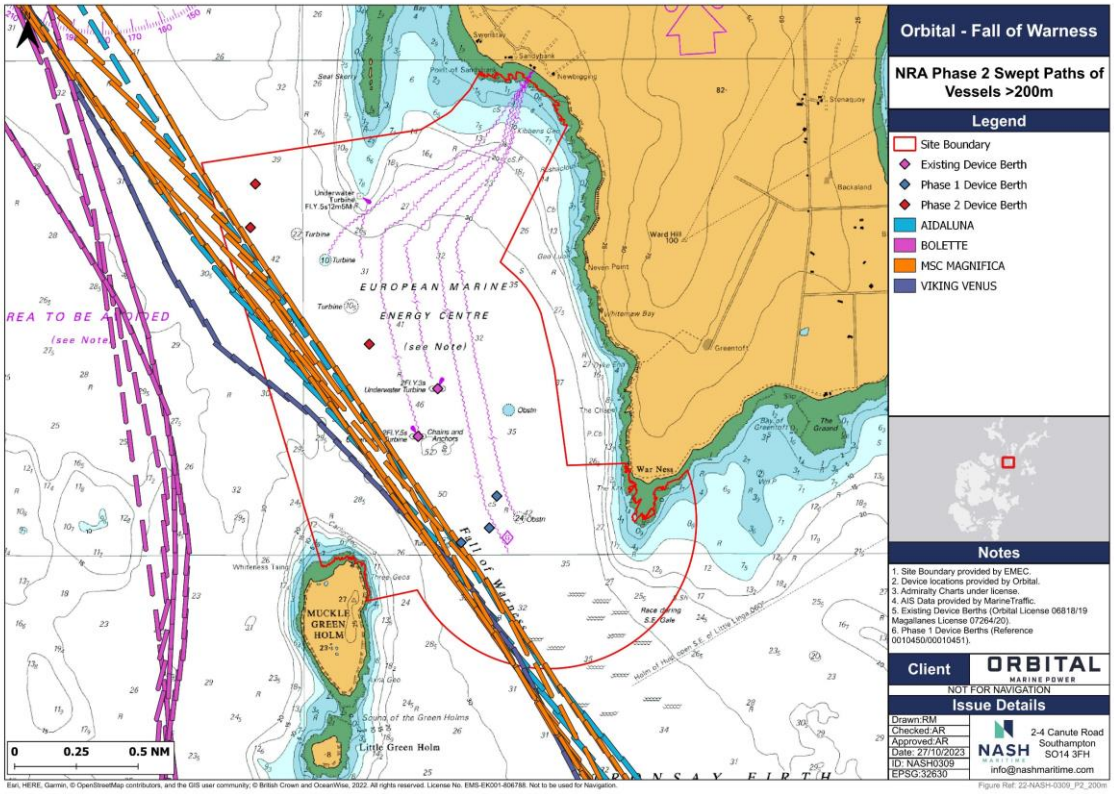


**Figure 19: Swept Paths of >200m Cruise Ships.**

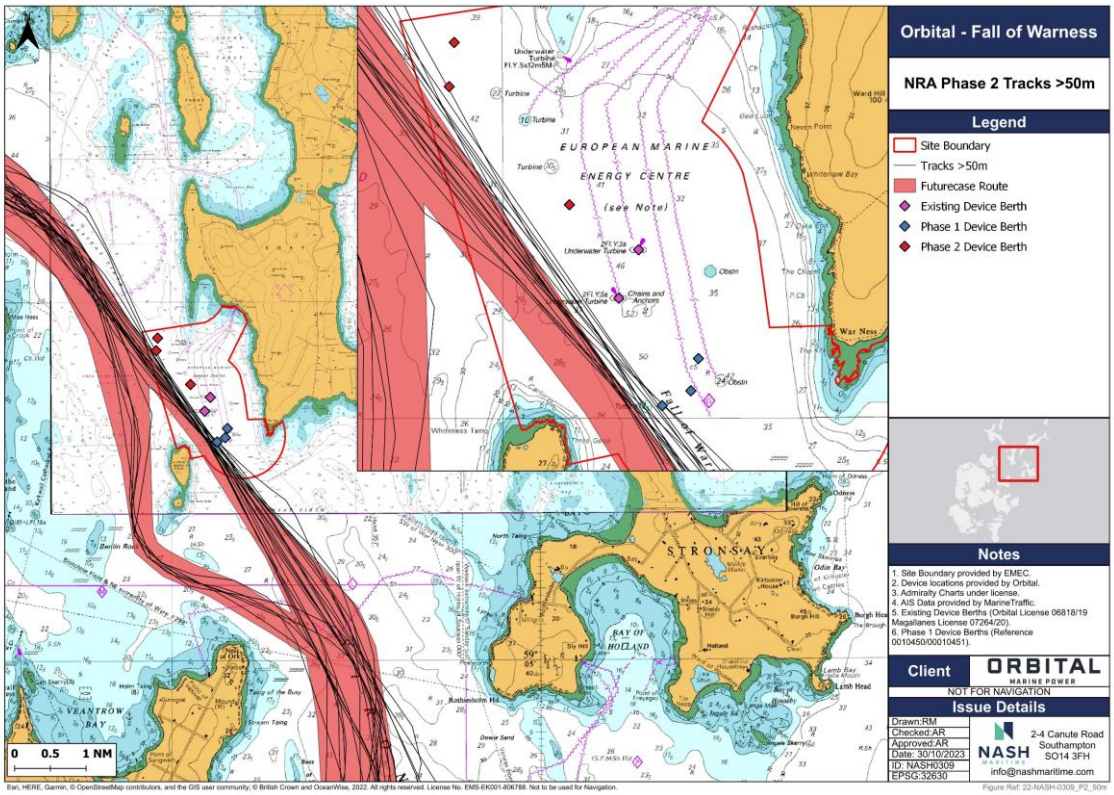


**Figure 20: Vessel Routeing Options.**

## 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. This is exacerbated given the impacts on vessel routeing described above with reduced searoom. 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 5.4**) 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 (EMEC, 2022) estimated an allision risk with a device of less than once in 100 years.

Due to the nature of their operations, a contact between an installation vessel and a device is much more likely to occur than with another passing vessel. The vessel operators at the EMEC site have significant experience and local knowledge of operating in that area and are governed by a variety of procedures to maintain safe operation. This mitigates the risk of incidents.

## 6.3 IMPACT OF THE ROUTEING OF ORKNEY FERRIES

The Fall of Warness has a significant tidal flow rate which, in combination with strong southeasterly/northwesterly wind and waves, impacts upon the navigation of Orkney Ferries routes adjacent to the test site. These are shown in **Figure 21** and described in **Table 10**. Scotland's Marine Plan TRANSPORT 3, notes that "Ferry routes and maritime transport to island and remote mainland areas provide essential connections and should be safeguarded from inappropriate marine development and use that would significantly interfere with their operation. Developments will not be consented where they will unacceptably interfere with lifeline ferry services."

The Phase 1 NRA considered the impact of the southern device locations on adverse weather transits between Muckle Green Holm and War Ness. Following a request by Orkney Ferries, the most easterly device was subsequently moved to the northwest to increase the sea room available for these manoevures.

During consultation as part of the Phase 1 NRA, Orkney Ferries highlighted the reduced searoom between the War Ness headland and the most easterly device and the device was subsequently relocated to address this. During Phase 2 NRA consultation, Orkney Ferries welcomed this change (see **Section 4**). As a result, there would be 860m separation (measured due east) to the 10m contour. Based off historical AIS data, this constitutes a 520m and 715m separation (measured due east) from the most westerly track and median track respectively of the relevant adverse weather tracks. Therefore, all previous transits by Orkney Ferries have at least two cables separation from the most easterly device, and generally navigate much closer into the headland to avoid the adverse conditions. Whilst it is unlikely that the device would interfere with this routeing pattern, it would reduce contingency to respond to an emergency in the unlikely event that it was to occur.

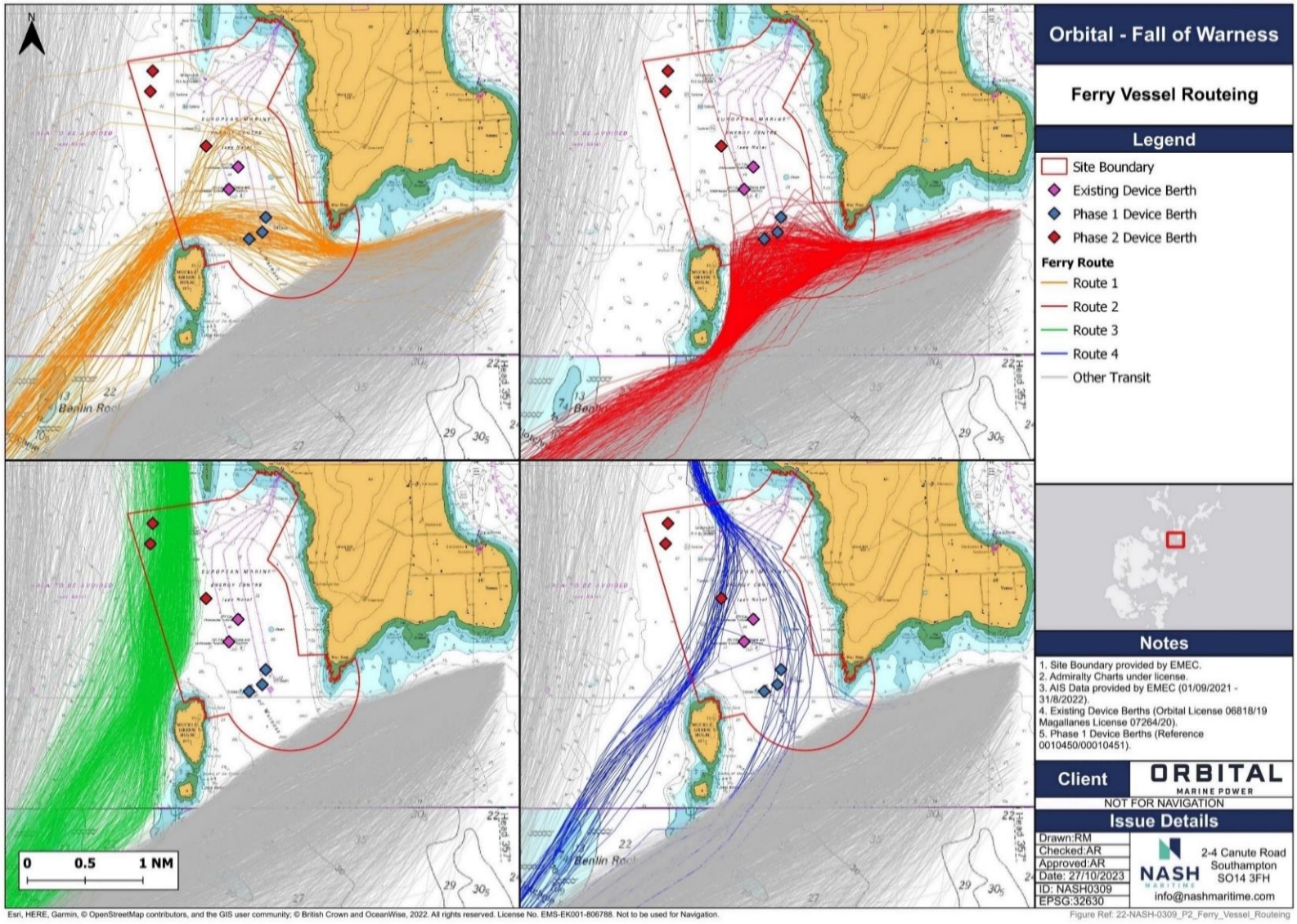


**Figure 21: Comparison of Ferry Routes.**

**Table 10: Impact on Orkney Ferries operations.**

| Route | Activity | Purpose | Impact Pathway |
|---|---|---|---|
| Kirkwall-Eday (approximately 2,558 movements per year) | Direct route between Kirkwall and Eday. | The most direct and shortest route between harbours. | No impact. |
| | Passage to the north of Muckle Green Holm (c.103 movements or 4% per year). | During strong southeasterly winds and a flood tide running northwest to southeast, adverse conditions are encountered southeast of War Ness which can be hazardous to both passengers and damage vehicles. Both east and westbound ferries will choose to pass to the north of Muckle Green Holm and transit close inshore to War Ness to better align with, or avoid, the worst of these conditions. | Combination of Phase 1, existing and Phase 2 central device could require a greater a deviation to the north (into the Fall of Warness site) when undertaking these manoevures to pass clear of tidal generators. |
| | Deviation to the north between Muckle Green Holm and War Ness (c.391 movements or 15% per year). | Where the conditions are not quite so severe as the route above, vessels may pass south of Muckle Green Holm but undertake similar route to minimise vessel motions. Furthermore, where the tides are flooding northwest to southeast, passing close inshore to Muckle Green Holm and Eday takes advantage of a tidal eddy that avoids adverse tidal currents. | No impact. |
| Kirkwall-Westray (approximately 1,634 movements per year) | Deviation to the west passing close to Egilsay (c.512 movements or 31% per year). | Vessels north and southbound may choose to pass close inshore to Egilsay to minimise tidal currents experienced in the centre of the channel. | No impact. |
| | Deviation to the east passing close to Muckle Green Holm and Seal Skerry (c.666 movements or 41% per year). | Vessels north and southbound may choose to pass close inshore to Seal Skerry to minimise tidal currents experienced in the centre of the channel. Furthermore, aligning with Muckle Green Holm reduces the tidal effects experienced within the Fall of Warness. Northbound vessels may route towards the Fall of Warness to take advantage of the significant flows. | Phase 2 northern devices reduce the searoom available to Seal Skerry. Were this searoom not sufficient, this could increase the risk of allision or grounding, and could require alternative routeing which takes a greater duration. |
| | Passage inshore of OpenHydro device close to Seal Skerry (c.48 movements or 3% per year). | As above, albeit a more extreme route taken by southbound vessels to avoid or benefit from the most significant tidal conditions. | Minor impact on a subset of these transits by altering the approach into the Fall of Warness site, however, no constraint on passage inshore of OpenHydro. |

The feasibility of navigating between the existing turbines and the three Phase 1 devices was also discussed (see **Figure 22**). This is approximately an 850m area of sea, and whilst it would enable at least one cable (185m) passing from both devices, ferries take this route during more challenging metocean/tidal conditions and greater searoom may be desired. Therefore, an alternative route to the north of the existing devices, similar to the most extreme transits shown in **Figure 21**, may be preferred. This additional distance may impact upon ferry schedules between Kirkwall and Eday.

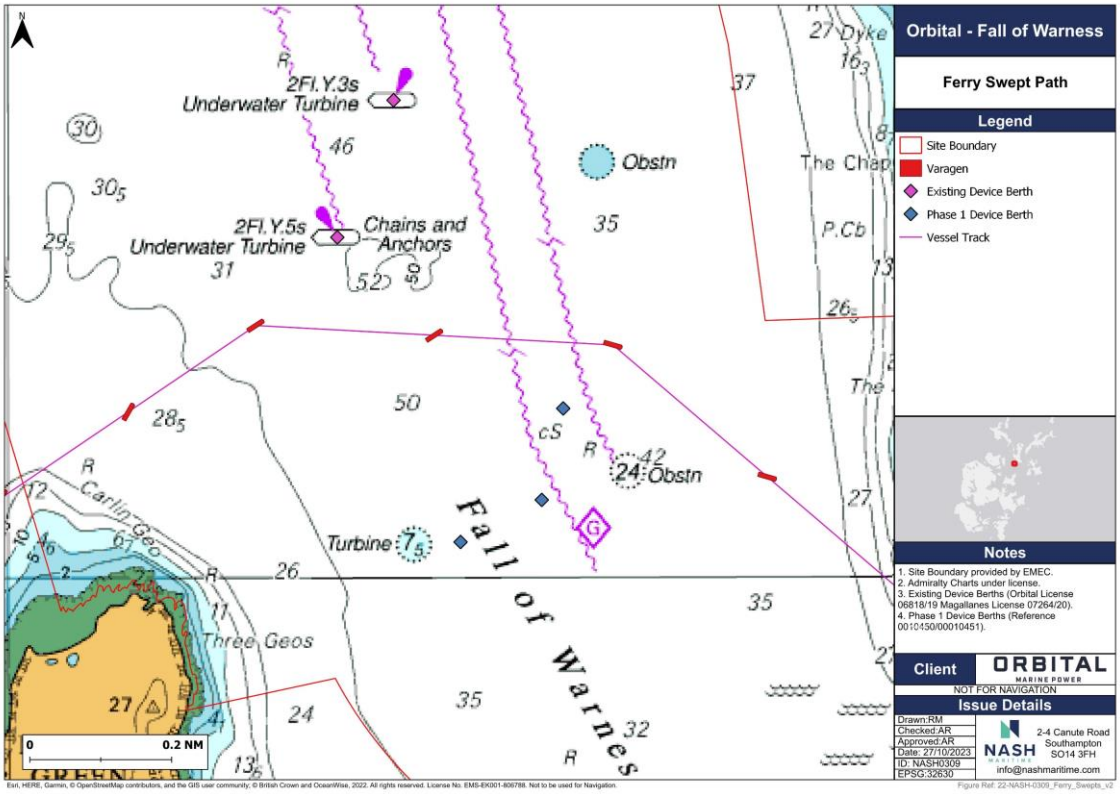


**Figure 22: Swept path of Varagen to scale (08:00 15/05/2022).**

**Table 11** shows the impact on schedule for a 1hr15min journey berth-berth between Kirkwall and Eday with the existing, Phase 1 and Phase 2 devices in place (see **Figure 23**). Approximately 103 vessels per year pass to the north of Muckle Green Holm, with 19 of these passing well to the north of the existing devices and therefore relatively unaffected by these proposed devices and 84 passing to the south of the existing devices. Were all of these transits to pass to the north of the existing devices, as indicated by Orkney Ferries during consultation, this would necessitate a further 7.1 minutes of steaming for approximately 84 journeys.

Whilst these increases are not substantial, they could reduce contingency in existing timetables and impacting schedule reliability on a minority of occasions. It is unlikely to substantially impact on the safety of navigation through increased fatigue or impact hours of rest requirements for bridge teams.

**Table 11: Approximate impact on ferry schedules for 1hr15minute journey.**

| ID | Route | Number of transits per year | Distance[1] | Speed[2] | Additional duration on equivalent route[3] |
|---|---|---|---|---|---|
| **Basecase (Routes taken today)** | | | | | |
| 1 | Direct | 2,046 | 13.75nm | 11.7kts | N/A |
| 2 | North of Muckle Green Holm / South of existing | 84 | 14.45nm | 11.4kts | +3.7 minutes (on route 1) |
| 3 | North of existing | 19 | 15.43nm | 11.3kts | +8.9 minutes (on route 1) |
| **Phase 1 devices (Additional deviation on routes taken today)** | | | | | |
| 4 | North of Muckle Green Holm / South of existing | 103* | 14.61nm | 11.4kts | +0.8 minutes (on route 2) |
| 5 | North of existing | | 15.43nm | 11.3kts | +0.0 minutes (on route 3) |
| **Phase 1 and Phase 2 devices (Additional deviation on routes taken today** | | | | | |
| 6 | North of Muckle Green Holm / South of existing | 103* | 15.79nm | 11.3kts | +7.1 minutes (on route 2) |
| 7 | North of Phase 2 central device | | 15.79nm | 11.3kts | +1.9 minutes (on route 3) |

*Notes:*

*[1] Distance calculated from berth to berth following revised passage plan.*

*[2] Average speed derived from a review of AIS data.*

*[3] The existing routes, such as that North of Muckle Green Holm offer some tidal advantage under certain conditions and therefore in some cases there was a minimal difference in transit duration as compared to the direct route in the AIS data.*

With reference to the Phase 2 positions, during early consultation with Orkney Ferries, it was noted that vessels would routinely route close to Seal Skerry when passing north/south through Westray Firth. **Figure 24** shows the position of the northern Phase 2 devices from the Orkney Ferries route when transiting inshore of Seal Skerry, Eday. These are positioned approximately parallel to a route which contains 70% of all Orkney Ferries traffic (excluding the eastern most 5% and westernmost 25%) plus a one cable (185m) offset. This would maintain 510m between the most westerly device and 10m contour of Seal Skerry and 775m off the 5m contour. Therefore, given that this route contains the majority of Orkney Ferries traffic and that there is a suitable offset from the Phase 2 devices, the impact on navigation safety is not considered significant.

Given that the majority of existing transits are unaffected by the Orbital devices and that there is a small impact on a minority of adverse weather routes, with sufficient searoom available for these manoeuvres, it is not considered that that such interference is unacceptable.

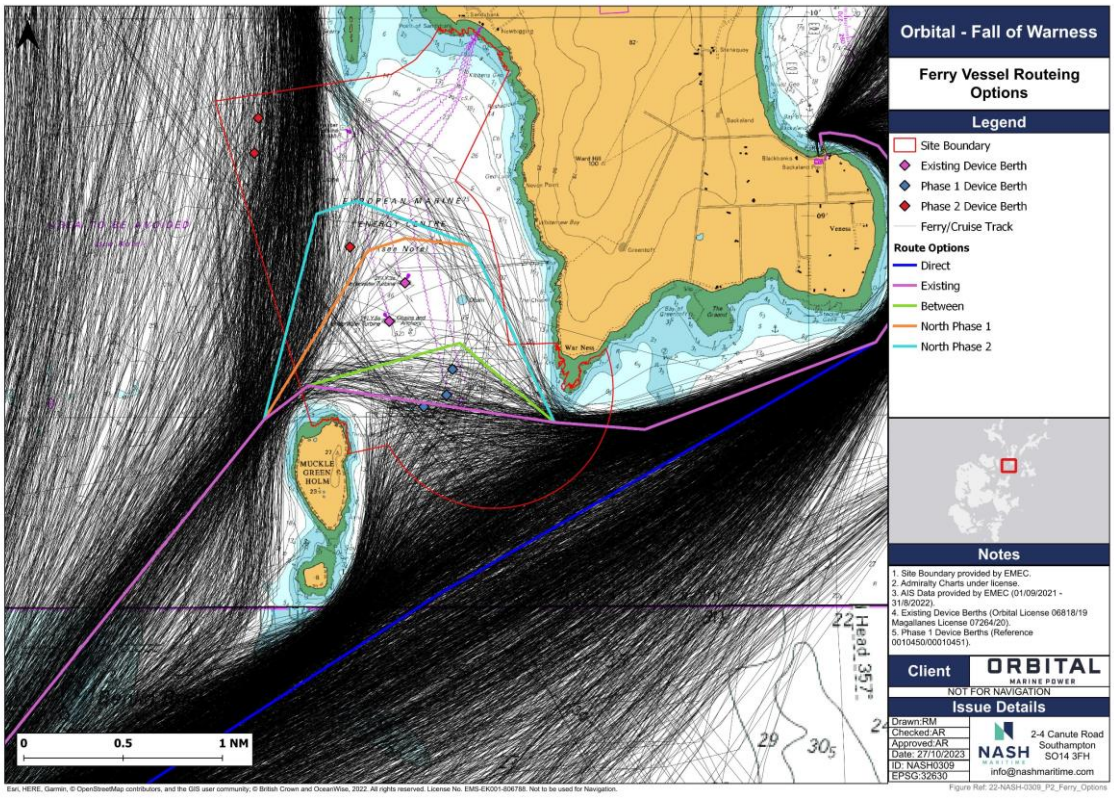


**Figure 23: Alternative routes with Devices in Position.**

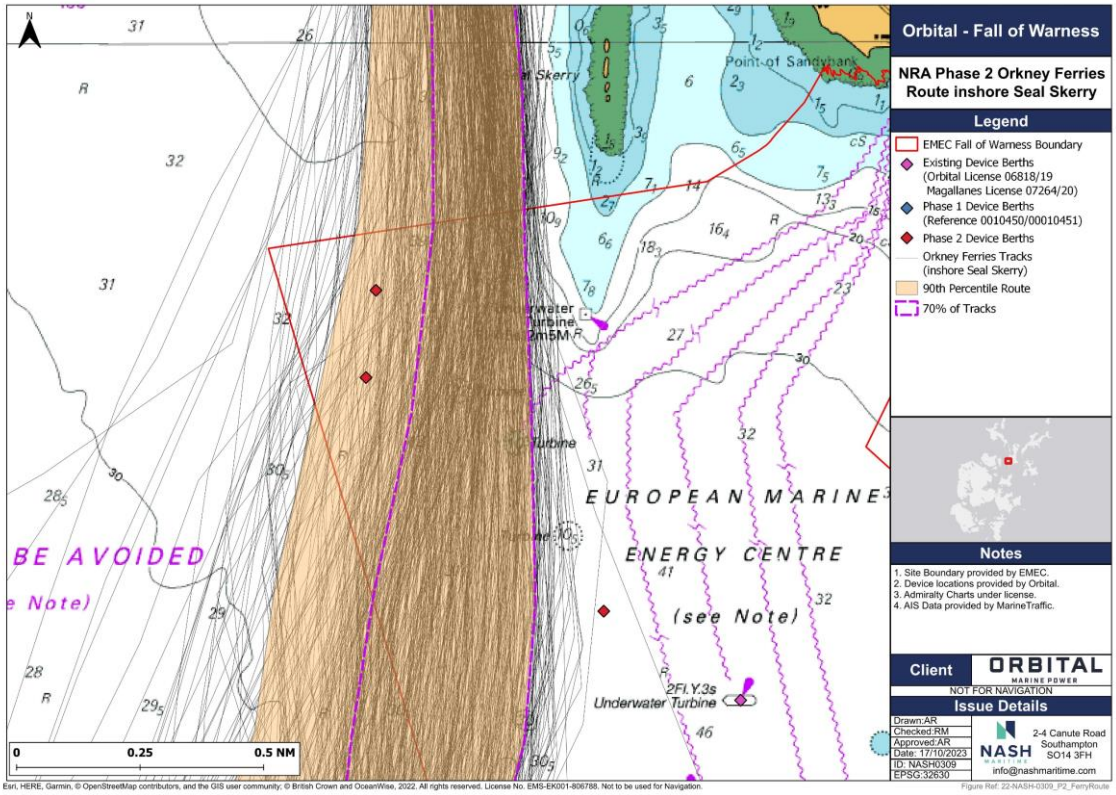


**Figure 24: Position of Phase 2 devices from Orkney Ferries route.**

## 6.4 IMPACT ON UNDER KEEL CLEARANCE

The Orbital devices 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 3m, occurring at 15m from the device's centre. Therefore, in order to collide with the device, a vessel with a draft greater than 3m must be within 15m of the device. During operation, the maximum extent of the blades would extend to 15m plus the length of blade, which is up 12m. The draught at the maximum extent of 27m from the centre of the device would be 14.3m. Vessels further than 27m 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 there 23 transits of vessels with draughts greater than 5m. These include cruise ships and fish carriers with a maximum draught of 8.5m. It is unlikely that any of these vessels would transit within 33.5m of the device.

# 7. NAVIGATION RISK ASSESSMENT

## 7.1 HAZARD IDENTIFICATION

Hazard identification was conducted during the site-wide NRA through consultation with local users and regulators (EMEC, 2022):

- 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 12** and **Table 13**. The identified hazards were reviewed and considered appropriate for use in this NRA.

**Table 12: 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 13: Device On Station Hazards.**

| Hazard ID | Hazard Type | Title |
|---|---|---|
| 1 | Contact / Allision | Large 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 | Third Party 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 |

## 7.2 RISK SCORING

The assessment methodology is based on the IMO's FSA as approved in 2002 and most recently amended in 2018 by MSC-MEPC.2/Circ.12/Rev.2. The identified hazards are scored given their likelihood and consequence against a defined scale, to produce a risk score. The risk assessment constitutes the risks with existing risk controls in place. The risk assessment

process aims to ascertain risk levels and specify the requirement to apply measures to mitigate risk to lower levels. The methodology consists of four aspects:

- Likelihood parameters– the expected frequency for which hazards occur, presented as a return rate per year. Five likelihood bands were chosen from between once in one year to once in less than 1,000 years.
- Severity parameters – the expected consequence of each hazard were it to occur. This has been scored separately for consequences to people (loss of life), environment (pollution), property (damage) and business (reputational/economic impacts).
- Risk matrix – based on the likelihood and each of the four severity scorings, risk scores were derived using a risk matrix.
- Risk classification - based on the resulting risk score, the risk was classified from 'Negligible' and 'Acceptable' through to 'High Risk' and 'Unacceptable'.

Each hazard was scored for the likelihood of occurrence and expected consequence (in terms of people, property, environment and business) for both a 'most likely' and 'worst credible' occurrence. Some hazards occur frequently with low consequence (minor injuries or damage), and less frequently with high consequence (loss of life/major pollution). The overall risk score was then the average of all the 'most likely' risk scores, all the 'worst credible' risk scores and the highest individual scores from the most likely and worst credible assessments.

The scorings were conducted following a review of all the data collected, historical incident record, feedback from consultees and the expertise of the project team. The primary mitigation measure against the hazard of vessels colliding with one another is the International Regulations for Preventing Collisions at Sea, 1972 (COLREGS) and Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1995. This risk assessment, in considering measures to minimise the risk of hazards in respect of navigation within the study area, assumes that vessels will be compliant with the COLREGS and STCW.

### Table 14: Risk Matrix.

| | Consequence | | | | Likelihood | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | People | Property | Environment | Stakeholders | 1: Remote | 2: Extremely Unlikely | 3: Unlikely | 4: Reasonably Probable | 5: Frequent |
| | | | | | *<1 in 1,000 years* | *1 in 1,000 years* | *1 in 100 years* | *1 in 10 years* | *Yearly* |
| 1: Negligible | Single minor injury - first aid or minor treatment required. | Superficial damage (Less than £10,000). | Minor spill - no long term impact or assistance required. | Minimal impact on services/ operations. | 1 | 2 | 3 | 4 | 5 |
| 2: Minor | Multiple minor injuries or single major injury. Medical intervention required. | Minor damage requiring repairs (£10,000 to £100,000). | Tier 1 - limited/local impact. Local assets sufficient. | Local negative publicity. Short term interruption of services/ operations. | 2 | 4 | 6 | 8 | 10 |
| 3: Moderate | Multiple major injuries requiring hospital stay. | Loss of small craft or moderate damage (£100,000 to £1million). | Tier 2 - medium-term impact. Limited external assistance required. | Widespread negative publicity. Temporary suspension of services/ operations. | 3 | 6 | 9 | 12 | 15 |
| 4: Serious | Single fatality/fatalities (<10). | Serious damage requiring extensive repairs (£1million to £10million). | Tier 2 - major/long term impact to ecosystem. National assistance required. | National negative publicity. Prolonged closure or restrictions of services/ operations. | 4 | 8 | 12 | 16 | 20 |
| 5: Major | Mass fatalities (>10). | Total loss of ship or catastrophic damage (>£10million). | Tier 3 - catastrophic long term impact to ecosystem. International assistance required. | International negative publicity. Serious and long-term disruption of services/ operations. | 5 | 10 | 15 | 20 | 25 |

| Tolerability and Risk Ratings | | | |
|---|---|---|---|
| **Risk Score** | **Risk Rating** | **Tolerability** | **Description** |
| 0 - 4 | Negligible Risk | **Broadly Acceptable** | Generally regarded as not significant and adequately mitigated. Additional risk reduction should be implemented if reasonably practicable and proportionate. |
| 4.1 - 6 | Low Risk | | |
| 6.1 - 12 | Medium Risk | **Tolerable (if ALARP)** | Risks may be Tolerable provided that best practice has been followed and all appropriate and proportionate risk controls have been implemented to reduce the risks to As Low As Reasonably Practicable. |
| 12.1 to 20 | High Risk | **Unacceptable** | Generally regarded as significant and unacceptable for project to proceed without further mitigation or design modification. |
| 20.1 to 25 | Extreme Risk | | |

## 7.3 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 are summarised in **Table 15** with further details of the site wide controls contained within EMEC's site wide NRA (EMEC, 2022).

**Table 15: Risk Controls included in assessment.**

| ID | Risk Control |
|---|---|
| Device Specific | |
| 1 | Device will be predominantly yellow in colour above the waterline (or as per NLB requirements). |
| 2 | A navigation aid AIS (Message 21) (or as per NLB requirements). |
| 3 | Radar reflectors (or as per NLB requirements). |
| 4 | 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 (or as per NLB requirements). |
| 5 | Device Monitoring |
| 6 | Notice to Mariners will be issued before commencement of any construction or major maintenance activities. |
| 7 | Emergency shutdown capability by duty manager if there is an indication of an incident with a device on-site. |
| 8 | Devices will be marked on nautical charts. |
| 9 | Device monitoring including position, operational capacity and AtoNs. |
| Site Wide (EMEC) | |
| 1 | Emergency Response and Incident Investigation:<br>• ERCOP<br>• Periodic Exercises.<br>• Incident Investigation and Reporting. |
| 2 | Operational Management:<br>• Control of Work (Permit to Work/Access Site/Method Statements).<br>• Marine Operating Guidelines.<br>• Control of SimOps.<br>• Vessel Standards.<br>• Personal Protective Equipment (PPE).<br>• Guard Vessels.<br>• Inspection and Maintenance Programme.<br>• Training. |
| 3 | Promulgation:<br>• Notice to Mariners.<br>• Consultation.<br>• Site Marking and Charting.<br>• 500m Advisory Area to be Avoided. |
| 4 | Site Monitoring:<br>• Closed Circuit Television (CCTV), Radar and AIS Monitoring.<br>• Use of SCADA. |

## 7.4 RISK ASSESSMENT RESULTS

### 7.4.1 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 Orkney Islands for which Orbital hold a marine license for (Deer Sound)[3], before being towed to the Fall of Warness site. The distance of this tow is approximately 12.3nm and would likely be undertaken by a Multicat style vessel.

Seven hazards were identified for the tow, three of which were assessed to be Medium Risk – Tolerable if ALARP and four of which were 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 and 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).

Once the tow vessel, route and method statement are developed, a tow risk assessment should be updated to support the passage planning, with appropriate risk controls identified. On the basis that all legislative requirements and industry best practice risk controls are in place, those Medium Risk hazards are concluded to be ALARP and no additional risk controls are required.

**Table 16: Tow Risk Assessment.**

| ID | Rank | Hazard title | Risk Score | Risk Rating |
|---|---|---|---|---|
| 7 | 1 | Tow breaks out | 7.1 | Medium Risk - Tolerable (if ALARP) |
| 2 | 2 | Device collides with towing vessel | 6.6 | Medium Risk - Tolerable (if ALARP) |
| 1 | 3 | Two project vessels collide during tow | 6.1 | Medium Risk - Tolerable (if ALARP) |
| 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.

### 7.4.2 Phase 1 and Phase 2 Risk Assessment

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

The four highest hazards relate to a contact or allision between navigating vessels and the installed devices and have been scored as Medium Risk – Tolerable if ALARP. By the nature of their operations, maintenance vessels will be most likely to navigate close to the devices and so have the highest risk score in the risk assessment. 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. Furthermore, maintenance is typically limited to periods of good weather and slack tides improving manoeuvrability around the devices.

During consultation and through analysis it was determined that passenger ferries had the second highest risk of contacting the deployed devices. As described in **Section 6.3**, on a minority of transits the vessels choose to navigate through the Fall of Warness and in close proximity to the device locations in order to minimise the effects of weather and tide. Whilst there is 850m between the device locations and the existing devices to the north, masters may choose to take the ferries further north to minimise the risk of striking the devices, increasing journey time. The familiarity of masters with the site and visibility of the devices reduces the risk of contact. Passenger vessels inherently have a high potential loss of life and therefore increases hazard scores.

Fishing and recreational vessels occasionally transit the site and were assessed as equivalent risks. Both these vessel types are small craft which typically have lower power than other vessel types and are at risk of being swept onto the devices, particularly if the rotors are raised out of the water. In such an incident, the vessel could be capsized putting the person or persons into the water which may cause a fatality. Given the rarity at which commercial shipping transit the passage, as shown in the AIS data (see **Section 5.2.1**), the risk of contact are assessed as very low.

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 therefore the likelihood of two vessels meeting near to the devices is low. Furthermore, the availability of searoom to avoid a collision is relatively high 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 reasons.

Groundings of maintenance vessels on passage to the site are more likely than other vessel types given their greater activity within the site, however, groundings rarely result in significant damage and loss of life, and skippers are familiar with the area.

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.

On the basis that appropriate risk controls have been identified, those hazards scored as Medium Risk are concluded to be ALARP without the need for additional risk controls.

**Table 17: Phase 2 Risk Assessment.**

| ID | Rank | Hazard title | Risk Score | Risk Rating |
|---|---|---|---|---|
| 5 | 1 | Maintenance Vessel Contacts a Device | 9.1 | Medium Risk - Tolerable (if ALARP) |
| 2 | 2 | Passenger Vessel Contacts a Device | 8.4 | Medium Risk - Tolerable (if ALARP) |
| 4 | 3 | Recreational Vessel Contacts a Device | 7.3 | Medium Risk - Tolerable (if ALARP) |
| 3 | 3 | Fishing Vessel Contacts a Device | 7.3 | Medium Risk - Tolerable (if ALARP) |
| 9 | 6 | Collision with Site Maintenance Vessel | 5.8 | Low Risk - Broadly Acceptable |
| 10 | 7 | Grounding of Maintenance Vessel | 5.7 | Low Risk - Broadly Acceptable |
| 1 | 5 | Commercial Ship Contacts a Device | 5.9 | Low Risk - Broadly Acceptable |
| 7 | 8 | Collision Due to Avoidance of Site | 4.6 | Low Risk - Broadly Acceptable |
| 8 | 9 | Grounding Due to Avoidance of Site | 4.5 | Low Risk - Broadly Acceptable |
| 6 | 10 | Fishing Gear Interaction with Device | 3.6 | Negligible Risk - Broadly Acceptable |
| 11 | 11 | Breakout of a Device from Moorings | 2.9 | Negligible Risk - Broadly Acceptable |

## 7.5 POSSIBLE ADDITIONAL RISK CONTROLS

In addition to those risk controls embedded in the project (see **Section 7.3**), 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 but they would further reduce risk and manage the site.

**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. |
| 4 | Update of Clyde Cruising Club Sailing Directions | During consultation (Section 4) it was recommended that contact is made with Clyde Cruising Club to expand the entry and advice for recreational boaters navigating the Fall of Warness. |
| 5 | Installation of AtoNs to mark passage east of Muckle Green Holm | To provide alternative routeing additional buoys or fixed posts could be used to assist mariners in avoiding the Fall of Warness. |
| 6 | Micrositing | • Orkney Ferries had requested that the most easterly turbine location for Phase 1 was reconsidered to increase searoom from the War Ness headland. Orbital have committed to |

| N | Title | Description |
|---|---|---|
| | | undertaking micrositing to move this device further northwest to safeguard this route.<br>• Orkney Ferries had requested that the most easterly turbine location for Phase 2 at the north of the test site be moved to increase the sea room off Seal Skerry. Orbital have committed to undertaking micrositing to safeguard this route.<br>• Orkney Ferries had requested that the central Phase 2 device could be moved to minimize disruption of their adverse weather route. Orbital have committed to undertaking further studies of wake effects to determine feasibility of moving this device closer to the existing berths. |

During consultation with the Northern Lighthouse Board as part of the Phase 2 NRA. It was discussed whether amendments to the marking and lighting arrangements may be required given similar light characteristics were to be required on up to eight devices. It was confirmed that similar requirements would be placed on the additional six devices, but that this would be constantly kept under review and they would respond to any feedback from passing mariners.

# 8. CONCLUSIONS AND RECOMMENDATIONS

## 8.1 CONCLUSIONS

This NRA has considered the impacts on navigational safety of the installation of three additional 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. An Orbital device, or similar design, has operated within the Fall of Warness for several years and the existing mitigation has been considered to be sufficient.
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. The majority of recreational traffic passes to the west or south of the device locations. It is likely that some smaller fishing vessels operate near the study area, but clear of the devices themselves.
    d. There were no commercial shipping transits recorded through the site during the one year duration data period. 18 large cruise ships passed through the site during the same time 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 EMEC test site.
7. For the Phase 1 southern device positions:
    a. With the devices in place, a 305m navigable channel would exist with one cable safety buffer from Muckle Green Holm 10m contour and the most westerly device. This is slightly reduced compared with the existing navigable width with the existing devices. Given the low traffic numbers of large vessels passing through the Fall of Warness, and the availability of an alternative route to the west of Muckle Green Holm, this is not considered to significantly impact upon the viability of this passage.
    b. The devices were located in an area utilised by Orkney Ferries when transiting during adverse weather or with significant tidal flows to minimise impacts on their operations. Whilst an 850m corridor would exist between the existing and proposed

devices, masters may choose to pass to the north where there is greater searoom, necessitating an increase in transit duration of five minutes (to a total of nine minutes) on a minority of journeys. Whilst this may delay some sailings it is not anticipated to make existing schedules unviable or impose significant impacts on navigational safety.

8. For the Phase 2 device positions:

    a. The addition of the Phase 2 devices would have a negligible impact on commercial vessel transits given that the Phase 1 devices would limit the easterly extent of commercial ship passage and the devices were approximately parallel to the main commercial route.

    b. There would be 510m and 775m between the Phase 2 devices and the Seal Skerry 10m and 5m contours respectively. A corridor containing 70% of Orkney Ferries transits when navigating inshore at Seal Skerry had been safeguarded with a one cable offset from the two devices.

    c. The addition of the central Phase 2 device would necessitate an additional deviation of 7.1 minutes to clear this device over the existing comparable route.

9. Whilst the devices will have underwater infrastructure, few vessels would have a deep enough draught to be at risk of colliding with the rotors, albeit necessitating a passing distance of 15m. It is therefore unlikely that such an event would occur.

10. A majority of other impacts identified within the EMEC site wide NRA were not considered to be significantly affected by this proposal. This included the impact on search and rescue, communications, radar and positioning systems, impact on cables.

11. A risk assessment was conducted which determined that:

    a. 11 hazards were identified associated with the proposed device installations within the Fall of Warness. Four of these, allision hazards, were scored as Medium Risk – Tolerable if ALARP. The remainder scored as Low Risk to Negligible.

    b. 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. However, both of these risks were assessed and found to be within the Medium Risk category.

    c. 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. These hazards were scored as Low Risk.

    d. 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.

    e. The risks associated with a tow out were scored as Medium Risk – Tolerable if ALARP to Low Risk – Broadly Acceptable. On the basis that this is an isolated operation and that industry best practice is followed, no further risk controls are recommended and these risks are concluded to be ALARP.

f. A suite of embedded risk controls are identified that collectively manage all hazards to Tolerable levels and therefore all Medium Risk hazards are concluded to be ALARP without the need for additional risk controls.

## 8.2 RECOMMENDATIONS

On the basis that all key risk control measures are implemented, no further recommendations are made. Additional risk controls are identified which could be considered to further manage navigational safety.

## 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

EMEC (2022). Fall of Warness Navigational Risk Assessment. Available at: http://www.emec.org.uk/services/consents/.

HSE and MCA (2017). Regulatory Expectations on Moorings for Floating Wind and Marine Devices. Available at: https://www.gov.uk/guidance/offshore-renewable-energy-installations-impact-on-shipping.

IALA (2021). G1162: The Marking of Offshore Man-Made Structures.

IMO (2018). Formal Safety Assessment. MSC-MEPC.2/Circ.12/Rev.2.

MCA (2021). MGN654. Available: https://www.gov.uk/guidance/offshore-renewable-energy-installations-impact-on-shipping.

MCA (2022). MGN372: Guidance to Mariners Operating in the Vicinity of UK OREIs. Available: https://www.gov.uk/guidance/offshore-renewable-energy-installations-impact-on-shipping.

RYA (2019). RYA Position of Offshore Renewable Developments: Wind Energy.

# 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** – One full year |
| MCA consultation | ✓ | **Section 4** – Consultation meeting held, minutes available in Appendix B. |
| General Lighthouse Authority consultation | ✓ | **Section 4** – Consultation meeting held, minutes available in Appendix B. |
| Chamber of Shipping and shipping company consultation | ✘ | **Section 4** – Consultation meeting held, minutes available in Appendix B. |
| Recreational and fishing vessel organisations consultation | ✓ | **Section 4** – Consultation meeting held, minutes available in Appendix B. |
| Port and navigation authorities consultation, as appropriate | ✓ | **Section 4** – Consultation meeting held, minutes available in Appendix B. |
| **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 **Section 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 **Section 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 5.4** analyses historical incident data. |
| 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**. |
| **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. |
| 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<br>i. changes to charted depth<br>ii. maximum height above seabed<br>iii. Under Keel Clearance | <br>✓<br>✓<br>✓ | A description of the project and mooring system is provided in **Section 2**. The device will utilise an existing cable at Fall of Warness . |
| 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**. Refer to site wide NRA. |
| **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**<br>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:<br>i. for all vessels, or<br>ii. for specified vessel types, operations and/or sizes.<br>iii. in all directions or areas, or<br>iv. in specified directions or areas.<br>v. in specified tidal, weather or other conditions | ✓ | Impacts are discussed in **Section 6** and hazards are scored in **Section 7**. |
| b. Navigation in and/or near the site should be prohibited or restricted:<br>i. for specified vessels types, operations and/or sizes.<br>ii. in respect of specific activities,<br>iii. in all areas or directions, or<br>iv. in specified areas or directions, or<br>v. in specified tidal or weather conditions. | ✓ | Embedded risk controls are outlined in **Section 7.3**. |
| 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**. |

| 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. Embedded risk controls are outlined in **Section 7.3**. Refer to site wide NRA. |
| 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.** Refer to site wide NRA. |
| 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 7.3.** |
| ii. On a pre-established periodicity during the life of the development | ✓ | Embedded risk controls are outlined in **Section 7.3.** |
| ii. Post-construction: Cable route(s) | ✓ | Embedded risk controls are outlined in **Section 7.3.** |
| 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 7.3.** |
| **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:<br>i. Vessels operating at a safe navigational distance<br>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**. Refer to site wide NRA. |

| MGN Section | Yes/No | Comments |
|---|---|---|
| the safe navigational distance to the OREI, e.g. support vessels, survey vessels, SAR assets.<br>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:<br>i. Vessel to vessel;<br>ii. Vessel to shore;<br>iii. VTS radar to vessel<br>iv. Racon to/from vessel | ✓ | Impact on communications, radar and positioning systems are considered within **Section 6**. Refer to site wide NRA. |
| 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**. Refer to site wide NRA. |
| 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**. Refer to site wide NRA. |
| 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**. Refer to site wide NRA. |
| **4.14 Risk mitigation measures recommended for OREI during construction, operation and decommissioning.**<br>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 7.3.** |
| ii. Continuous watch by multi-channel VHF, including Digital Selective Calling (DSC). | ✓ | Embedded risk controls are outlined in **Section 7.3.** |
| iii. Safety zones of appropriate configuration, extent and application to specified vessels[4] | ✓ | Embedded risk controls are outlined in **Section 7.3.** |
| iv. Designation of the site as an area to be avoided (ATBA). | ✓ | Embedded risk controls are outlined in **Section 7.3.** |
| v. Provision of AtoN as determined by the GLA | ✓ | Embedded risk controls are outlined in **Section 7.3.** |

[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 7.3.** |
| vii. Monitoring by radar, AIS, CCTV or other agreed means | ✓ | Embedded risk controls are outlined in **Section 7.3.** |
| viii. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of safety zones. | ✓ | Embedded risk controls are outlined in **Section 7.3.** |
| 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 7.3.** |
| x. Use of guard vessels, where appropriate | ✓ | Embedded risk controls are outlined in **Section 7.3.** |
| 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 7.3.** |
| xiv. Any other measures and procedures considered appropriate in consultation with other stakeholders. | ✓ | Embedded risk controls are outlined in **Section 7.3.** |

## 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 | ✓ | See site wide NRA. |
| 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<br>B2 | ✓ | **Section 5** |
| Status of the hazard log<br>Hazard Identification<br>Risk Assessment<br>Influences on level of risk<br>Tolerability of risk<br>Risk matrix | C1 & F1<br>C2<br>C3<br>C4<br>C5 | ✓ | **Section 7** |
| Navigation Risk Assessment<br>Appropriate risk assessment<br>MCA acceptance for assessment techniques and tools<br>Demonstration of results<br>Limitations | D1<br>D2<br><br>D3<br>D4 | ✓ | **Section 7** |
| Risk control log | E1 & G1 | ✓ | **Section 7.3** and **Section 7.5**. |

# Appendix B
# Stakeholder Consultation

| Meeting Minutes | |
|---|---|
| Project Title | Orbital Marine Power |
| Project Number | AC22-NASH-0309 |
| Meeting subject / purpose | Fall of Warness NRAs |
| Revision | R01-00 |
| Date of meeting | 27-Mar-2023 |
| Start time | 11:00 |
| Finish time | 12:00 |
| Client | Orbital Marine Power |
| Location | Teams Meeting |

## DOCUMENT CONTROL

| Revision | Date of Issue | Description | Approved |
|---|---|---|---|
| R01-00 | 31-Mar-2023 | Issued to attendees for comment | ADR |
| | | | |

## ATTENDEES

| Organisation | Attendee | Role | Initial |
|---|---|---|---|
| **NASH Maritime** | Redacted | Principal Consultant<br>Senior Consultant | AR<br>AF |
| **Orbital Marine Power** | Redacted | Program Manager | JM |
| **NLB** | Redacted | Coastal Inspector<br>Navigation Officer | AL<br>GB |
| **MCA** | Redacted | Offshore Renewables Lead<br>Navigation Policy Advisor | NS<br>VJ |
| **Orkney Ferries** | Redacted | Service Manager<br>Marine Superintendent<br>Master – Earl Sigurd | EB<br>JT<br>LG |
| **RYA Scotland** | Redacted | Planning and Environment Officer | GR |
| **RNLI** | Redacted | Lifeboat Operations Manager | MC |
| **Orkney Marinas** | Redacted | Chairman | BK |
| **Orkney Fisheries** | Redacted | Head of Orkney Fisheries Association | HF |
| **Orkney Harbours** | Redacted | Harbour Master | AC |

## AGENDA

1. Introductions.
2. Overview of Orbital Marine Power.
3. Overview of Fall of Warness.
4. Fall of Warness: Site Specific Issues.
5. Overview of Westray.
6. AOB.

## NOTES OF MEETING

| 1 | Introductions | Action |
|---|---|---|
| 1.1 | Introductions between attendees. | |
| **2** | **Overview of Orbital Marine Power** | |
| 2.1 | AR provided an overview of Orbital Marine Power and the proposed tidal devices to be used. | |
| 2.2 | AR listed the risk controls currently in place for existing Orbital Marine Power devices. | |
| **3** | **Overview of the Fall of Warness** | |
| 3.1 | AR presented an overview of the Fall of Warness site. | |
| 3.2 | AR noted that Berth 3 and Berth 6 as per the current marine licenses will not be pursued and asked JM to comment.<br>JM said that Marine Licences have been secured for one device at Berth 6 and two devices at Berth 3. It is preferable to install three devices at the proposed Phase 1 location. This is due to anchoring options available (drilled anchor) to improve installation. | |
| 3.3 | AR said that an NRA is currently being prepared for the three devices at the Phase 1 (southern) location. | |
| 3.4 | AR noted that separately, an additional four devices are being considered to the northwest of the site which constitutes Phase 2 of the NRA. This would require an amendment to EMEC's current Section 36 consent for the site to increase the maximum allowed generating capacity which is limited at 10MW. These devices are not currently being considered in the NRA, however, Orbital Marine Power would like to discuss any potential issues with the devices.<br>JM stated that the area is in a favourable location and although not currently being assessed in the NRA, would be keen to receive comments. | |
| 3.5 | AC asked what are the three devices planned to be located at the Phase 1 location.<br>JM said that they will be similar to the current devices with an increased rotor diameter from the current 20m to 24m. | |
| 3.6 | AL asked about the distance between the devices for Phase 1.<br>JM said that there is approximately 250m lateral spacing.<br>There is 760m between Muckle Green Holm and the most western device. There is 900m between Eday and the most eastern device. | |

| | | |
|---|---|---|
| 3.7 | AL asked whether the extension of the S36 consent would enable other developers to install devices or just Orbital Marine Power.<br>AR said that it is an EMEC site so can't be definitive, but it is likely that they would apply for additional capacity to allow further turbines from multiple developers.<br>JM noted that there is a low number of tidal developers operating at commercial scale but unable to comment on the commercial aspirations for EMEC. | |
| 3.8 | AL asked if the Phase 2 layout is indicative or confirmed.<br>JM said it may change slightly but the staggered layout will likely remain due to the effect of wake on other turbines. | |
| 3.9 | AR presented AIS data for the area by vessel type and by vessel size.<br>AR noted that there are larger vessels navigating in the area, predominantly cruise ships but relatively few through the Fall of Warness site.<br>AR said that the most common vessels are the Orkney Ferries and small craft. | |
| 3.10 | AR presented the NRA process to be applied and noted that there is already a sitewide NRA in place for EMEC and this NRA will fall within the sitewide NRA. | |
| **4** | **Fall of Warness: Site Specific Issues** | |
| 4.1 | AR noted the main potential issues relate to Orkney Ferries and passages through the Fall of Warness. | |
| 4.2 | AC asked if there will be any safety zones or buoyage installed in the area.<br>AR said that buoyage would likely be difficult to install given the prevailing conditions and that they would reduce the searoom further acting as additional obstacles to be avoided. Previous devices have not applied for mandatory safety zones and this was not the intention.<br>AC agree with the comments regarding the buoys and that they would represent further obstructions in the area. | |
| 4.3 | LG said that there are no problems with current devices due to AIS, Radar reflectors and the available searoom. Following installation of Phase 1 devices the ferries will have to assume a safe route based on their risk assessments. This would likely affect ferry timetables. Would need to identify a safe channel through the area, and this may require deviation to the north of the existing devices.<br>LG said that Phase 2 devices will affect the adverse weather/tidal routeing through the area.<br>AR suggested that a further meeting should be held with Orkney Ferries regarding the routeing through the area. | A01 |
| 4.4 | AC noted that he considers the site is currently at the limit to navigate safely through the area with available searoom, particularly in the event of an emergency situation. | |
| 4.5 | VJ asked whether the sitewide NRA will also be updated.<br>AR said that the sitewide NRA is managed by EMEC and is updated every two years as per MGN654. The last update was early/mid last year.<br>VJ said the Phase 2 devices should be considered in the cumulative section of the NRA.<br>NS stated that the MCA was consulted on the sitewide NRA but haven't seen a finalised version. AR has previously asked EMEC to release the updated site wide NRA but this may have been delayed following the application to extend the S36 consent to 2026. | |
| 4.6 | AL said that for lighting and marking. NLB would like to meet with Orkney Ferries to discuss which options would be best for marking the area e.g. should lighting be synchronised. | |

| | | |
|---|---|---|
| 4.7 | MC said that his biggest concern is Phase 2 devices. The route is regularly used by recreational vessels on an ebb tide, passing Westray Firth close into Sule Skerry on Eday. Recreational vessels have less power than commercial vessels so pass through where the devices will be to avoid the strongest currents. This is the only route through that area in those tidal conditions. | |
| 4.8 | AR presented the paths of larger vessels transiting through the area.<br>AC said that larger vessels would want to keep as much distance as possible from Muckle Green Holm and would want to transit more centrally where Phase 1 devices will be located.<br>AR asked whether with Phase 1 in place, is it feasible for larger vessels to pass to the east of Muckle Green Holm, noting an alternative route is available to the west and has been used by large cruise ships.<br>AC said that vessels could choose to pass to the east instead but need options given the conditions in the area.<br>EB said that it is important to maintain options given weather and tidal conditions to maintain sailing of lifeline ferry services. AR noted that there is significant guidance/legislation in place recognizing the importance of lifeline ferries.<br>GR agreed with the points being made and that they apply equally to recreational vessels. There are two types of recreational vessels: local and visiting. There needs to be better advice available for visiting boats navigating in the area. GR also noted that the Clyde Cruising guide does not have sufficient detail for visiting yachtsman on how to navigate through the EMEC site. | |
| 4.9 | AL noted that the western turbine of Phase 1 appears to be the issue. He asked if it is possible to move the turbines further east to allow for further space.<br>AR responded that moving them further east could have further impact on Orkney Ferries transiting close to Eday.<br>JM said that the spacing of the turbines is to allow three turbines to be installed, to minimize the effects of wake and due to tidal resource modelling.<br>MC said that recreational vessels don't tend to transit between Muckle Green Holm and Eday meaning that if the turbines could move east, it would be beneficial. | |
| **5** | **Overview of Westray** | |
| 5.1 | JM described that Orbital were looking at the potential Westray site for a commercial operation with a lease obtained for up to 30MW. Some limited consultation through the leasing process run by Crown Estate Scotland. Would like to discuss the site with stakeholders before development of indicative layouts. If consented, would be installed either late 2020s or early 2030s. | |
| **6** | **AOB** | |
| 6.1 | Look to arrange further meeting with Orkney Ferries to discuss routeing. If other stakeholders wish to have a meeting to discuss further, happy to organise. | |

## MEETING ACTIONS

| Number | Owner | Action |
|---|---|---|
| A01 | AR | Arrange meeting with Orkney Ferries to discuss routeing |
| | | |

| Meeting Minutes | |
|---|---|
| Project Title | Orbital Marine Power |
| Project Number | AC22-NASH-0309 |
| Meeting subject / purpose | Fall of Warness NRAs |
| Revision | R02-00 |
| Date of meeting | 25-Apr-2023 |
| Start time | 14:00 |
| Finish time | 15:30 |
| Client | Orbital Marine Power |
| Location | Teams Meeting |

## DOCUMENT CONTROL

| Revision | Date of Issue | Description | Approved |
|---|---|---|---|
| R01-00 | 28-Apr-2023 | Issued to attendees for comment | ADR |
| R02-00 | 15-May-2023 | Updated following Orkney Ferries response | ADR |

## ATTENDEES

| Organisation | Attendee | Role | Initial |
|---|---|---|---|
| **NASH Maritime** | Redacted | Principal Consultant | AR |
| **Orbital Marine Power** | Redacted | Program Manager | JM |
| | Redacted | Commercial Director | OW |
| **Orkney Ferries** | Redacted | Service Manager | EB |
| | Redacted | Vessel Master | LG |
| | Redacted | Relief Vessel Master | SP |
| | Redacted | Mate | MD |
| | Redacted | Marine Superintendent | AC |

## AGENDA

1. Introductions.
2. Review of existing Operations:
3. Review Phase 1 NRA (southern 3 devices).
4. Review Phase 2 NRA (northwestern devices).
5. Early discussion of impacts and potential mitigations for Westray.
6. AOB

## NOTES OF MEETING

| 1 | Introductions | Action |
|---|---|---|
| 1.1 | Introductions between attendees. | |
| **2** | **Overview of Orbital Marine Power** | |
| 2.1 | OW provided an overview of Orbital Marine Power and its history of operations in the Fall of Warness. | |
| 2.2 | OW/JM described the future proposed developments of Orbital:<br>1) Phase 1 – installation of three O2 devices to the south of the EMEC lease area, circa 2025-2027.<br>2) Phase 2 – installation of between four and eight O2 devices to the northwest of the EMEC lease area, circa 2027-2029.<br>3) Westray – new lease area to the northwest of the Fall of Warness, circa late 2020s. | |
| 2.3 | AR recognized that each of these phases has potential impacts on Orkney Ferries and therefore this early engagement would help Orbital with site selection to minimize impacts.<br>The Phase 2 extension of the Fall of Warness would require EMEC to increase the site capacity and for Orbital to obtain the licenses and therefore there would be more opportunities for dialogue with Orkney Ferries. | |
| 2.4 | AR presented vessel traffic plots of Orkney Ferries movements between 2021 and 2022. | |
| **3** | **Phase 1 (South)** | |
| 3.1 | OW explained that the specific locations for Phase 1 were based on seabed conditions for testing new anchoring system as well as wake minimization. | |
| 3.2 | During a flood tide with wind over tide, vessels pass to the north of Muckle Green Holm and through the location of the proposed Phase 1 device locations.<br>*[Post meeting note – during the 2021-2022 data this occurred on 103 movements of 2,558 total c.4%].*<br>There was a consensus amongst Orkney Ferries that there was insufficient searoom to manoeuvre between the existing devices and the Phase 1 device locations.<br>Masters would instead choose to pass to the north of the existing devices. | |
| 3.3 | Concerns were raised on the location of the most easterly device position. It was felt that this reduced the available searoom with the War Ness headland and reduced contingency in an emergency.<br>*[Post meeting note – 700m searoom between 10m contour and this device].* | |
| 3.4 | A more frequent deviation into the Fall of Warness for vessels passing south of Muckle Green Holm occurred and would come close to the Phase 1 locations – these may require rerouteing further north. | |
| 3.5 | Passing to the north of the existing devices would necessitate an increase in journey times which could have timetable/schedule impacts for lifeline ferry services.<br>It is possible that hours of rest requirements would be encountered if there were excessive delays as the ferries are single crewed. | |
| 3.6 | On extreme occasions, vessels may pass north of Eday entirely. | |

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| | It was agreed that were it not possible to manoeuvre between Muckle Green Holm and War Ness, it would not be safe to cross between Kirkwall and Eday and the sailing would be cancelled or the vessel would pass north of Eday. | |
| 3.7 | AR reviewed AIS data and suggested a minimum passing distance of two cables (370m) from the existing devices was apparent. It was recognised that the passing distances were dependent on the specific conditions at the time. | |
| 3.8 | Other traffic may be encountered within the EMEC test site, but not regularly during adverse weather conditions. | |
| 3.9 | It was suggested that the most easterly device could be moved further north or northwest to maximise the searoom with the War Ness headland.<br>Furthermore, moving the most westerly device further north could improve the passage for vessels to pass north of Muckle Green Holm and south of the devices.<br>OW agreed to liaise with engineering team on the feasibility of this. | OW/JM |
| 3.10 | Based on the consensus that ferries would not transit between the existing and proposed devices, a discussion was held regarding inserting additional devices between the existing device and proposed new devices, given that it would not be used for navigation. It was concluded that this posed no significant navigationally safety or routeing impacts and could potentially be used for future device deployment after the installation of the three turbines to the southeast of the site. | |
| **4** | **Phase 2 (North)** | |
| 4.1 | Ferries would route close inshore at the Sule Skerry using the OpenHydro device and Muckle Green Holm to align themselves. There can be significant set to the west, up to 45 degrees at times. | |
| 4.2 | Concerns were raised that there was insufficient searoom between Sule Skerry and the indicative northerly devices, particularly as the tide would be setting them towards them. It was recommended that the devices were moved further west, albeit noting the limits of the EMEC lease area. | |
| 4.3 | It was stated that the removal of the OpenHydro device would not materially alter the routeing constraints for this route. | |
| 4.4 | OW suggested that it may be possible to alter the geometry of the EMEC Fall of Warness site, removing parts of the most southerly lease area and increase the northwesterly area. This would enable Orbital to offset the Phase 2 devices further west and clear of the Orkney Ferries route (see annotations below).<br>It was noted that the Crown Estate are likely to be accepting of changes to the lease area, provided the area doesn't increase and that the purpose was to safeguard a ferry route. AR noted that EMEC's Billia Croo lease area has been increased recently so there is precedent.<br>OW noted that the lease area was not Orbital's to change but would open discussions with EMEC around the viability of this option.<br>OW/JM to investigate this option. | OW/JM |

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| **5** | **Westray** | |
| 5.1 | Vessels navigating the centre of Westray do so in generally calm conditions, which occurs infrequently. More typically vessels would navigate to the west or east of Westray Firth, close to shore, depending on whether it was an ebb or flood tide. | |
| 5.2 | It was suggested that the most westerly limits of the lease area would partially impede routeing of Orkney Ferries to the west of Westray Firth so should be removed (see above). OW considered whether this area could then be added further east, avoiding the eastern ferry route but maintaining the same lease area. | OW/JM |
| 5.3 | The most eastern portion of the lease area was generally clear of the Orkney Ferries route, noting the concerns raised with the Phase 2 device locations (see above). | |
| 5.4 | Therefore, no significant concerns were raised on placing the devices in the centre of Westray Firth for impacts on Orkney Ferries. | |
| 5.5 | Some cruise ships passing out of Kirkwall, through Shapinsay Sound and then up through Westray Firth onto Iceland/Faroe Islands take this route, but very infrequently.<br>AR described discussions with Northern Lighthouse Board and Chamber of Shipping on the routes to the east/west of Muckle Green Holm and potential additional navigational aid requirements. | |
| **6** | **AOB** | |
| 6.1 | Marking and lighting arrangements for the site were discussed. Typically devices are required to be lit (with two flashing yellow lights) with AIS and Racons, at the Northern Lighthouse Board's discretion. | |

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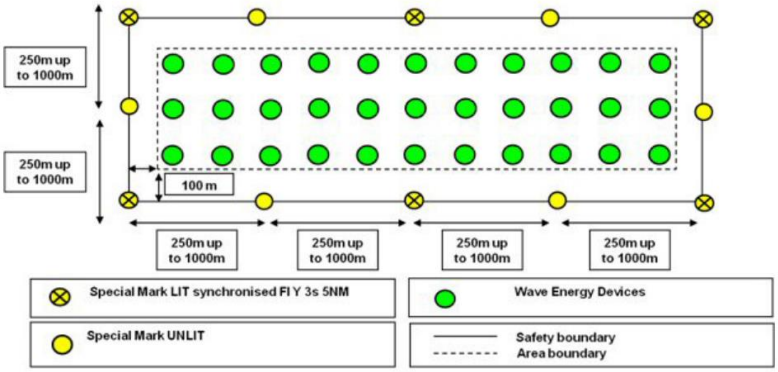
|---|---|---|
| | There was consensus amongst the masters that the existing marking and lighting arrangements were fit for purpose for the ATIR/O2 device currently installed.<br>It was agreed that where arrays of tidal devices existed, marking the corners prominently may be more suitable to avoid cluttering with multiple lights/AIS/Racons which would mask other vessels and be confusing to navigators.<br>AR recommended review of IALA G1162 on marking significant peripheral structures.<br>*[Post meeting note: see relevant guidance from IALA G1162].*<br>  <br> | |
| 6.2 | Questions were raised on the charted obstructions in the Fall of Warness.<br>AR to check status of UKHO surveys of Fall of Warness site. | AR |

## MEETING ACTIONS

| Number | Owner | Action |
|---|---|---|
| A01 | OW/JM | To investigate ground conditions around Phase 1 devices with the view of moving further north to open up searoom to east and west for improved ferry routeing opportunities. |
| A02 | OW/JM | To liaise with EMEC on possible amendments to Fall of Warness lease area to enable Phase 2 devices to be offset further west to safeguard ferry routeing off Sule Skerry. |
| A03 | OW/JM | To review possible amendments to Westray lease area, removing western portion and extension elsewhere, to reduce impact on Orkney Ferries routeing to west of Westray Firth. |
| A04 | AR | To review status of UKHO chart status for obstructions in Fall of Warness. |
| | | |

| Meeting Minutes | |
|---|---|
| Project Title | Orbital Marine Power |
| Project Number | AC22-NASH-0309 |
| Meeting subject / purpose | Fall of Warness NRAs |
| Revision | R01-00 |
| Date of meeting | 20-Oct-2023 |
| Start time | 14:00 |
| Finish time | 15:00 |
| Client | Orbital Marine Power |
| Location | Teams Meeting |

## ATTENDEES

| Organisation | Attendee | Role | Initial |
|---|---|---|---|
| **NASH Maritime** | Redacted | Principal Consultant | AR |
| **Orbital Marine Power** | Redacted<br>Redacted | Program Manager<br>Commercial Director | JM<br>OW |
| **MCA** | Redacted<br>Redacted | Offshore Renewables Project Lead<br>Navigation Policy Advisor | V.Ja<br>V.Jo |
| **Northern Lighthouse Board** | Redacted | Navigation Manager | PD |
| **Chamber of Shipping** | Redacted | Policy Manager | RM |

## AGENDA

1. Introductions.
2. Recap of Fall of Warness Site
3. Review Phase 1 NRA Results and Actions
4. Review Phase 2 NRA Locations – Impacts and Hazards
5. Review of Risk Control Options
6. Recap of Westray Proposal
7. AOB

## NOTES OF MEETING

| 1 | Introductions | Action |
|---|---|---|
| 1.1 | Introductions between attendees. | |
| 1.2 | OW provided an overview of Orbital Marine Power and its history of operations in the Fall of Warness. OW noted that they would move up to 25m around their moorings but this would be with each tide.<br>OW noted that their first devices have operated successfully with no navigational problems. | |
| 1.3 | AR described the risk controls agreed and implemented on Orbital devices such as aids to navigation and integration with EMEC risk controls. | |
| 1.4 | AR gave an overview of the status of the Fall of Warness site and noted the approach taken for two phases of NRAs. | |
| **2** | **Phase 1 NRA** | |
| 2.1 | AR recapped progress on Phase 1 NRA for southern 3 devices earlier in 2023. Orbital positioned the most westerly device to maintain a passage with Muckle Green Holm and the most easterly device was relocated to minimise impact on Orkney Ferries, following consultation. | |
| **3** | **Phase 2 NRA** | |
| 3.1 | AR described the changes made to the phase 2 device locations following Phase 1 consultation, In particular, offsetting devices from Seal Skerry to maintain ferry passage, and given the limits of the EMEC test site, this required placing a device in the center of the Fall of Warness. | |
| 3.2 | AR also noted that the devices were all east of the exiting 100m vessel route used through the Fall of Warness, with approximately one large vessel movement per month. | |
| 3.3 | RM questioned what the impact of relocating the devices had on tidal resource.<br>OW described how areas of tidal streams very discrete and even moving a few hundred metres might make the resource unviable.<br>At RM request, OW agreed to share some information on tidal resource across the study area which RM would be grateful for.<br>OW noted that the most resource effective positioned would have been to the west of Magallanes/Orbital existing devices but this would impact the navigational route. RM agreed and would raise concerns on such a device position.<br>OW noted that the best tidal resource tends to overlap with navigational channels.<br>JM added that it was also ground conditions and depth which are important in device siting. In particular, suitable ground for drilled anchors, with quite a bit of variation across the EMEC site. | OW/JM |
| 3.4 | AR questioned aids to navigation across the site with up to 8 devices with individual lighting. PD noted they any changes to site layout would impact their effectiveness so NLB had no plans to change the requirements at present. | |
| 3.5 | It was questioned whether there was an equivalent comparison site, such as Morlais, but it was noted the site was bigger and had a phased approach. VJo noted that there were no devices at this site at present only acoustic profilers. | |
| 3.6 | VJo confirmed he had been in direct contact with EMEC on the charting arrangements at the site and ensuring they are up to date, noting that ENCs are more up to date than raster charts. In particular, Berth 8 is shown as an obstruction. JM confirmed this was an old berth location used by prior Orbital devices. | |

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|---|---|---|
| 3.7 | RM confirmed that there would be a need to validate impacts and safety buffers with ferries. AR confirmed that liaison was ongoing. | |
| **4** | **Westray** | |
| 4.1 | AR provided an introduction to the Westray site and OW provided further details:<br>• Progression of 2010 SSE AfL for 200MW.<br>• Orbital have good local presence with head office and maintenance base to progress this project.<br>• Secured a 30MW AfL at present but looking to increase substantially.<br>• Devices likely to be placed in rows with clear navigation channels.<br>• 6 months of bird surveys have been completed.<br>• 2 week summer vessel traffic survey completed.<br>• Scoping to be submitted in approximately 4 weeks. | |
| 4.2 | OW outlined a provisional programme:<br>• S36 application November 2024<br>• Mar-2026 Contracts for Difference application<br>• 2031 construction | |
| 4.3 | OW noted that a larger scoping boundary was defined to provide opportunity to microsite and address any constraints, such as navigation. | |
| 4.4 | VJo questioned the type of devices and OW confirmed they would be the same floating O2 devices. | |
| 4.5 | RM questioned the required density of devices. JM noted that the devices required some separation to minimize wake effects but that this wasn't fully determined and additional research was ongoing. | |
| 4.6 | RM and VJo both noted concerns for navigational access and safety based on scoping boundary. AR/OW emphasized that Orbital were aware of these concerns and would engage in the future to find solutions to address them. | |
| 4.7 | RM questioned why they couldn't be subsurface to reduce impacts. OW explained that their evidence and research suggested that subsurface were not cost-effective as they required more maintenance and they were harder to access, noting that wind turbines require annual maintenance. Floating turbines can be accessed and maintained much more effectively reducing OpEx costs. | |
| **5** | **AOB** | |
| 5.1 | RM requested the slides for his records. | AR |

## MEETING ACTIONS

| Number | Owner | Action |
|---|---|---|
| 1 | OW/JM | To identify suitable site selection information to share.<br>POST MEETING NOTE: Issued by JM with turbine positions superimposed. |
| 2 | AR | To share slide deck with minutes.<br>POST MEETING NOTE: Shared with minutes. |
| | | |
| | | |
| | | |

**From:** [redacted]
**Sent:** 20 October 2023 15:18
**To:** [redacted]
**Cc:** [redacted]

**Subject:** RE: Orbital Fall of Warness NRA Update

Classification: OFFICIAL

Hi Andrew

Apologies for the delay in coming back to you, our initial feedback is as follows,

We can't complain about the phase 1 revision, the most eastern device has been moved as we suggested and will open the navigable room between device and shore. The placement of the phase 2 additional device in the centre is a concern however, this is now in the path of the bad weather route we would use commonly to avoid the Phase 1 devices, so we'll need further consultation on this.

We are in the process of consulting our other Masters , I have also copied in our colleagues at Orkney Marine Services so that they are aware of the initial response, obviously as we have outlined before we must consider the impact that the placing of the devices will have on our ability to complete the delivery of lifeline services to the islands in different prevailing weather conditions, and it would seem that the location of phase 2 could have an impact on this. That said we appreciate you efforts on the phase 1 revision to make it navigable.

I am on leave next week so I have asked our Marine Superintendents to coordinate any further comments that may be returned from the vessels.

Thanks / Best Regards

[redacted]

[redacted]
Service Manager (Ferry Operations)
Orkney Ferries Ltd
Shore Street
Kirkwall
Orkney
KW15 1LG
[redacted]

Orkney Ferries

Join us on social media for news and updates

**Consultation**

**From:** [redacted]
**Sent:** 23 October 2023 11:17
**To:** Consultation
**Subject:** RE: Orbital Fall of Warness NRA Updates

Dear Dr Rawson,

Thank you for your email. RYA Scotland welcomes these changes to the plan, which will reduce the risk to recreational boaters.

Kind Regards

[redacted]

**Senior Administrator**

[redacted]

**Royal Yachting Association Scotland**

[redacted]

**From:** [redacted]
**Sent:** 02 November 2023 10:33
**To:** Consultation
**Subject:** RE: Orbital Fall of Warness NRA Updates

Classification: OFFICIAL

Hi Andrew

Good morning!

Further to your email below requesting feedback on Orbital's proposals within the Fall of Warness, we have no comment that we wish to make.

Many thanks
[redacted]

Marine Services and Transportation
Orkney Islands Council
Harbour Authority Building
Scapa, Orkney
KW15 1SD
Tel: 01856 873636
Email: harbours@orkney.gov.uk
Web: www.orkneyharbours.com

ORKNEY ISLANDS COUNCIL
Marine Services & Transportation

**From:** [redacted]
**Sent:** 03 November 2023 16:05
**To:** [redacted]
**Cc:** [redacted]
**Subject:** SFF's Response on 'Orbital Fall of Warness NRA Updates'

Dear Andrew,

Thank you for sharing the consultation opportunity on 'Orbital Fall of Warness NRA Updates' with SFF.

SFF would be content with the NRA Updates as long as the following are met:

SFF would like to see the due diligence has been made with the users of the route and the correct procedures (i.e notice to mariners is issued in a timely manner alongside adhering to the appropriate COLREGS, correct VHF communication and kingfisher safety bulletins) are adhered to whilst works are ongoing and after installation to ensure vessels are aware of the current ongoings.

Best wishes

**Best wishes**

[redacted]
**Offshore Energy Policy Officer**

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**Scottish Fishermen's Federation (SFF)**
24 Rubislaw Terrace | Aberdeen | AB10 1XE
[redacted]
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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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | People | Property | Environment | Business | Frequency | | People | Property | Environment | Business | Frequency | | |
| 1 | 3 | Two project vessels collide during tow | Collision | Vessel Standards<br>PPE<br>Tow Risk Assessment and Passage Plan<br>Tow Weather Window<br>ERCOP | Insufficient Lookout<br>Human Error/Fatigue<br>Equipment or Mechanical Failure on Vessel<br>Poor Visibility in Area<br>Reduced Seakeeping due to Tidal or Weather Constraints | Minor injuries<br>Negligible damage<br>No pollution<br>No impact on schedule<br>Negligible adverse publicity | **2** | **1** | **1** | **1** | **4** | Multiple injuries<br>Moderate damage<br>Minor pollution<br>Installation aborted.<br>Moderate adverse publicity | **3** | **3** | **2** | **3** | **2** | 6.1 | Medium Risk – Tolerable (if ALARP) |
| 2 | 2 | Device collides with towing vessel | Collision | Vessel Standards<br>PPE<br>Tow Risk Assessment and Passage Plan<br>Tow Weather Window<br>Appropriate Tow Vessel<br>ERCOP | Equipment or Mechanical Failure on Vessel<br>Reduced Seakeeping due to Tidal or Weather Constraints | Minor injuries<br>Minor damage<br>No pollution<br>Minor impact on schedule<br>Local adverse publicity | **2** | **2** | **1** | **2** | **4** | Multiple injuries<br>Serious damage<br>Minor pollution<br>Loss of Device.<br>Major adverse publicity | **3** | **3** | **2** | **3** | **2** | 6.6 | Medium Risk – Tolerable (if ALARP) |
| 3 | 7 | Project vessels collide with other Large Vessels (Commercial/Passenger) | Collision | Vessel Standards<br>PPE<br>Tow Risk Assessment and Passage Plan<br>Notice to Mariners<br>Tow Weather Window<br>ERCOP | Insufficient Lookout<br>Human Error/Fatigue<br>Equipment or Mechanical Failure on Vessel<br>Poor Visibility in Area<br>Reduced Seakeeping due to Tidal or Weather Constraints | Minor injuries<br>Minor damage<br>No pollution<br>Minor impact on schedule<br>Local adverse publicity | **2** | **2** | **1** | **2** | **2** | Fatality/Multiple injuries<br>Moderate damage<br>Minor pollution<br>Loss of Device.<br>Major adverse publicity | **4** | **4** | **2** | **4** | **1** | 3.8 | Negligible Risk - Broadly Acceptable |
| 4 | 6 | Project vessels collide with other Small Vessels (Fishing/Recreational) | Collision | Vessel Standards<br>PPE<br>Tow Risk Assessment and Passage Plan<br>Notice to Mariners<br>Promulgation to Fishermen<br>Tow Weather Window<br>ERCOP | Insufficient Lookout<br>Human Error/Fatigue<br>Equipment or Mechanical Failure on Vessel<br>Poor Visibility in Area<br>Reduced Seakeeping due to Tidal or Weather Constraints | Minor injuries<br>Negligible damage<br>No pollution<br>No impact on schedule<br>Negligible adverse publicity | **2** | **1** | **1** | **1** | **2.5** | Multiple injuries<br>Moderate damage<br>Minor pollution<br>Installation aborted.<br>Moderate adverse publicity | **3** | **3** | **2** | **3** | **1.5** | 4.2 | Low Risk - Broadly Acceptable |
| 5 | 5 | Project tow contacts other infrastructure (Harbour/Other Devices) | Allision | Vessel Standards<br>PPE<br>Tow Risk Assessment and Passage Plan<br>Tow Weather Window<br>Appropriate Tow Vessel<br>ERCOP | Human Error/Fatigue<br>Equipment or Mechanical Failure on Vessel<br>Poor Visibility in Area<br>Reduced Seakeeping due to Tidal or Weather Constraints | Minor injuries<br>Negligible damage<br>No pollution<br>Minor impact on schedule<br>Negligible adverse publicity | **2** | **1** | **1** | **2** | **3** | Multiple injuries<br>Moderate damage<br>Minor pollution<br>Installation aborted.<br>Moderate adverse publicity | **3** | **3** | **2** | **3** | **1.5** | 4.8 | Low Risk - Broadly Acceptable |
| 6 | 4 | Project tow grounds | Grounding | Vessel Standards<br>PPE<br>Tow Risk Assessment and Passage Plan<br>Tow Weather Window<br>Appropriate Tow Vessel<br>ERCOP | Insufficient Lookout<br>Inadequate Passage Planning<br>Human Error/Fatigue<br>Equipment or Mechanical Failure on Vessel<br>Reduced Seakeeping due to Tidal or Weather Constraints<br>Poor Visibility | Minor injuries<br>Minor damage<br>No pollution<br>Minor impact on schedule<br>Negligible adverse publicity | **2** | **2** | **1** | **2** | **2.5** | Multiple injuries<br>Serious damage<br>Minor pollution<br>Installation aborted.<br>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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | People | Property | Environment | Business | Frequency | | People | Property | Environment | Business | Frequency | | |
| 7 | 1 | Tow breaks out | Breakout | Vessel Standards<br>PPE<br>Tow Risk Assessment and Passage Plan<br>Tow Weather Window<br>Appropriate Tow Vessel<br>ERCOP | Severe metocean conditions<br>Insufficient towage arrangements | No injuries<br>Negligible damage<br>No pollution<br>Minor impact on schedule<br>Negligible adverse publicity | 1 | 2 | 1 | 2 | 4 | Serious injury<br>Loss of Device<br>Minor pollution<br>Installation aborted.<br>Moderate adverse publicity | 3 | 4 | 2 | 4 | 2 | 7.1 | Medium Risk – Tolerable (if ALARP) |

## Fall of Warness Site

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | People | Property | Environment | Business | Frequency | | People | Property | Environment | Business | Frequency | | |
| 1 | 6 | Commercial Ship Contacts a Device | Contact / Allision | Charting<br>Marking and Lighting<br>Notice to Mariners<br>Radio Navigation Warnings<br>ERCOP | Insufficient Lookout<br>Inadequate Passage Planning<br>Human Error/Fatigue<br>Equipment or Mechanical Failure on Vessel<br>Poor Visibility in Area<br>Reduced Seakeeping due to Tidal or Weather Constraints<br>Failure of Navigational Aids on Device<br>Charts not up to date<br>Confusion on Site Layout | No injuries<br>Minor damage to vessel<br>No pollution<br>Moderate damage to device<br>Moderate adverse publicity | 2 | 2 | 2 | 3 | 3 | Multiple injuries<br>Moderate damage to vessel<br>Tier 2 Pollution Possible<br>Major damage to device<br>Widespread adverse publicity | 4 | 4 | 3 | 4 | 1 | 5.9 | Low Risk - Broadly Acceptable |
| 2 | 2 | Passenger Vessel Contacts a Device | Contact / Allision | Charting<br>Marking and Lighting<br>Notice to Mariners<br>Radio Navigation Warnings<br>ERCOP | Insufficient Lookout<br>Inadequate Passage Planning<br>Human Error/Fatigue<br>Equipment or Mechanical Failure on Vessel<br>Poor Visibility in Area<br>Reduced Seakeeping due to Tidal or Weather Constraints<br>Failure of Navigational Aids on Device<br>Charts not up to date<br>Confusion on Site Layout | Minor injuries<br>Minor damage to vessel<br>No pollution<br>Moderate damage to device<br>Moderate adverse publicity | 2 | 2 | 1 | 3 | 3 | Multiple fatalities possible<br>Serious damage to vessel<br>Minor pollution<br>Serious damage to device<br>Widespread adverse publicity | 5 | 5 | 3 | 4 | 2 | 8.4 | Medium Risk - Tolerable (if ALARP) |
| 3 | 3 | Fishing Vessel Contacts a Device | Contact / Allision | Charting<br>Marking and Lighting<br>Notice to Mariners<br>Radio Navigation Warnings<br>Promulgation to Fishermen<br>ERCOP | Insufficient Lookout<br>Inadequate Passage Planning<br>Human Error/Fatigue<br>Equipment or Mechanical Failure on Vessel<br>Poor Visibility in Area<br>Reduced Seakeeping due to Tidal or Weather Constraints<br>Failure of Navigational Aids on Device<br>Charts not up to date<br>Confusion on Site Layout | Minor injuries<br>Negligible damage to vessel<br>No pollution<br>Minor damage to device<br>Minor adverse publicity | 2 | 1 | 1 | 2 | 3 | Single fatality/Multiple injuries<br>Moderate damage to vessel<br>Minor pollution<br>Serious damage to device<br>Widespread adverse publicity | 4 | 4 | 2 | 4 | 2.5 | 7.3 | Medium Risk - Tolerable (if ALARP) |
| 4 | 3 | Recreational Vessel Contacts a Device | Contact / Allision | Charting<br>Marking and Lighting<br>Notice to Mariners<br>Radio Navigation Warnings<br>ERCOP | Insufficient Lookout<br>Inadequate Passage Planning<br>Human Error/Fatigue<br>Equipment or Mechanical Failure on Vessel<br>Poor Visibility in Area<br>Reduced Seakeeping due to Tidal or Weather Constraints<br>Failure of Navigational Aids on Device<br>Charts not up to date<br>Confusion on Site Layout | Minor injuries<br>Negligible damage to vessel<br>No pollution<br>Minor damage to device<br>Minor adverse publicity | 2 | 1 | 1 | 2 | 3 | Single fatality/Multiple injuries<br>Moderate damage to vessel<br>Minor pollution<br>Major damage to device<br>Widespread adverse publicity | 4 | 4 | 2 | 4 | 2.5 | 7.3 | Medium Risk - Tolerable (if ALARP) |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | People | Property | Environment | Business | Frequency | | People | Property | Environment | Business | Frequency | | |
| 5 | 1 | Maintenance Vessel Contacts a Device | Contact / Allision | Charting<br>Marking and Lighting<br>Construction Method Statement<br>Vessel Standards<br>Compliance with EMEC Procedures<br>PPE<br>ERCOP | Insufficient Lookout<br>Human Error/Fatigue<br>Equipment or Mechanical Failure on Vessel<br>Poor Visibility in Area<br>Reduced Seakeeping due to Tidal or Weather Constraints<br>Failure of Navigational Aids on Device | Minor injuries<br>Negligible damage to vessel<br>No pollution<br>Minor damage to device<br>Minor adverse publicity | 2 | 1 | 1 | 2 | 4 | Single fatality/Multiple injuries<br>Moderate damage to vessel<br>Minor pollution<br>Major damage to device<br>Widespread adverse publicity | 4 | 4 | 2 | 4 | 3 | 9.1 | Medium Risk - Tolerable (if ALARP) |
| 6 | 9 | Fishing Gear Interaction with Device | Obstruction | Charting<br>Marking and Lighting<br>Notice to Mariners<br>Radio Navigation Warnings<br>Promulgation to Fishermen<br>ERCOP | Insufficient Lookout<br>Unawareness of device layout<br>Human Error/Fatigue<br>Equipment or Mechanical Failure on Vessel<br>Poor Visibility in Area<br>Reduced Seakeeping due to Tidal or Weather Constraints<br>Failure of Navigational Aids on Device<br>Charts not up to date<br>Confusion on Site Layout | Minor injuries<br>Negligible damage to vessel<br>No pollution<br>Minor damage to device<br>Minor adverse publicity | 2 | 1 | 1 | 2 | 2 | Single fatality/Multiple injuries<br>Moderate damage to vessel<br>Minor pollution<br>Major damage to device<br>Widespread adverse publicity | 4 | 3 | 2 | 4 | 1 | 3.6 | Negligible Risk - Broadly Acceptable |
| 7 | 8 | Collision Due to Avoidance of Site | Collision | Charting<br>Marking and Lighting<br>Notice to Mariners | Reduced searoom with device<br>Increased maintenance traffic<br>Human Error/Fatigue<br>Equipment or Mechanical Failure on Vessel<br>Reduced Seakeeping due to Tidal or Weather Constraints<br>Poor Visibility | Minor injuries<br>Minor damage to vessel<br>No pollution<br>Minor adverse publicity | 2 | 1 | 1 | 2 | 2 | Single fatality/Multiple injuries<br>Moderate damage to vessel<br>Minor pollution<br>Moderate adverse publicity | 4 | 4 | 3 | 3 | 1.5 | 4.6 | Low Risk - Broadly Acceptable |
| 8 | 10 | Grounding Due to Avoidance of Site | Grounding | Charting<br>Marking and Lighting<br>Notice to Mariners | Reduced searoom with device<br>Human Error/Fatigue<br>Equipment or Mechanical Failure on Vessel<br>Reduced Seakeeping due to Tidal or Weather Constraints<br>Poor Visibility | Minor injuries<br>Minor damage to vessel<br>No pollution<br>Minor adverse publicity | 2 | 1 | 1 | 2 | 3 | Single fatality/Multiple injuries<br>Moderate damage to vessel<br>Minor pollution<br>Moderate adverse publicity | 4 | 4 | 3 | 3 | 1 | 4.5 | Low Risk - Broadly Acceptable |
| 9 | 5 | Collision with Site Maintenance Vessel | Collision | Construction Method Statement<br>Vessel Standards<br>Compliance with EMEC Procedures<br>PPE<br>ERCOP | Insufficient Lookout<br>Human Error/Fatigue<br>Equipment or Mechanical Failure on Vessel<br>Poor Visibility in Area<br>Reduced Seakeeping due to Tidal or Weather Constraints | Minor injuries<br>Negligible damage to vessel<br>No pollution<br>Minor adverse publicity | 2 | 1 | 1 | 2 | 2.5 | Single fatality/Multiple injuries<br>Moderate damage to vessel<br>Minor pollution<br>Moderate adverse publicity | 4 | 4 | 2 | 3 | 2 | 5.8 | Low Risk - Broadly Acceptable |
| 10 | 7 | Grounding of Maintenance Vessel | Grounding | Construction Method Statement<br>Vessel Standards<br>PPE<br>ERCOP | Insufficient Lookout<br>Inadequate Passage Planning<br>Human Error/Fatigue<br>Equipment or Mechanical | Minor injuries<br>Minor damage<br>No pollution<br>Minor adverse publicity | 2 | 1 | 1 | 2 | 2.5 | Multiple injuries<br>Moderate damage<br>Minor pollution<br>Moderate adverse publicity | 4 | 3 | 2 | 3 | 2 | 5.7 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | People | Property | Environment | Business | Frequency | | People | Property | Environment | Business | Frequency | | |
| | | | | | Failure on Vessel<br>Reduced Seakeeping due to Tidal or Weather Constraints<br>Poor Visibility | | | | | | | | | | | | | | |
| 11 | 11 | Breakout of a Device from Moorings | Breakout | Design, Inspection and Maintenance Programme<br>Remote Control and Monitoring of Site<br>Geofencing Using GPS<br>Emergency Shut Down<br>ERCOP | Severe metocean conditions<br>Insufficient mooring arrangements<br>Installation failure | Minor injuries<br>Negligible damage<br>No pollution<br>Moderate damage to device<br>Minor adverse publicity | 2 | 1 | 1 | 3 | 1 | Multiple injuries<br>Moderate damage to vessel<br>Minor pollution<br>Major damage to moorings.<br>Widespread adverse publicity | 3 | 3 | 2 | 4 | 1 | 2.9 | Negligible Risk - Broadly Acceptable |

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