EMEC
THE EUROPEAN MARINE ENERGY CENTRE LTD

Scapa Flow Scale Wave Site Navigational Risk Assessment (NRA)

September 2019




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Disclaimer

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Prepared for:	The European Marine Energy Centre (EMEC) Ltd Old Academy Business Centre Stromness Orkney KW16 3AW
Author(s):	William Heaps
Checked By:	Rebecca Worbey

Marine and Risk Consultants Ltd
Marico Marine
Bramshaw
Lyndhurst
Hampshire
SO43 7JB
United Kingdom

Tel. + 44 (0) 2380 811133

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Abbreviations

Abbreviation	Detail
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
ATBA	Area to be Avoided
AtoN	Aid to Navigation
CCTV	Closed Circuit Television
CGOC	Coastguard Operations Centre
DECC	(Former) Department of Energy and Climate Change
EMEC	European Marine Energy Centre
ERCoP	Emergency Response and Cooperation Plan
GPS	Global Positioning System
GT	Gross Tonnage
HAT	Highest Astronomical Tide
HMCG	Her Majesty's Coast Guard
HSE	Health and Safety Executive
HW	High Water
IALA	International Association of Lighthouse Authorities
IMO	International Maritime Organisation
km	Kilometre
kt	Knot (unit of speed equal to nautical mile per hour, approximately 1.15 mph)
kV	kilovolt
LAT	Lowest Astronomical Tide
LOA	Length Over-All
LW	Low Water
m	Metre
MAIB	Marine Accident Investigation Branch
Marico Marine	Marine and Risk Consultants Ltd
MCA	Maritime and Coastguard Agency
MGN	Marine Guidance Note
MHWN	Mean High Water Neaps
MHWS	Mean High Water Springs
ML	Most Likely
MLWN	Mean Low Water Neaps
MLWS	Mean Low Water Springs
MW	Megawatt
NLB	Northern Lighthouse Board
nm	Nautical Mile
NRA	Navigation Risk Assessment

Abbreviation	Detail
NtM	Notice to Mariners
O&M	Operations and Maintenance
OREI	Offshore Renewable Energy Installation
PIANC	Permanent International Association of Navigation Congresses
PPE	Personal Protective Equipment
RNLI	Royal National Lifeboat Institution
RORO	Roll-On Roll-Off (Vehicle Carriers)
RYA	Royal Yachting Association
SAR	Search and Rescue
SCADA	Supervisory Control and Data Acquisition
SHA	Statutory Harbour Authority
SMS	Safety Management System
SOP	Standard Operating Procedure
STCW	Standards of Training Certification and Watchkeeping
TEC	Tidal Energy Converter
UKC	Under Keel Clearance
UKHO	UK Hydrographic Office
VHF	Very High Frequency (radio communication)
VMS	Vessel Monitoring System
VTS	Vessel Traffic Service
WC	Worst Credible
WGS	World Geodetic System

Executive Summary

Since 2003, the European Marine Energy Centre Ltd (EMEC) has provided purpose-built, accredited open-sea testing facilities for wave and tidal energy convertors across four test sites in the Orkney Islands. Scapa Flow test site, offshore from Howequoy Head near St Mary's, to the south of Kirkwall was established in 2011. The Scapa Flow test site is a small-scale, non-grid connected wave energy test site situated in relatively sheltered waters.

EMEC has identified a requirement for a Navigational Risk Assessment compliant to the Maritime and Coastguard Agency MGN 543 in order to update the previous Navigation Risk Assessment including impact on navigational safety, identifying any revised recommendations as required.

The Scapa Flow test site is within a Statutory Harbour Authority Area. Orkney Islands Council Marine Services is the Statutory Harbour Authority and provides Vessel Traffic Services with full radar coverage of the Scapa Flow test site and it actively monitors and directs traffic within the harbour limits.

This Navigation Risk Assessment is device neutral, not assessing any particular device or type of device, but instead assumes a range of possible devices located within the test site. Vessel traffic analysis was undertaken using data from the Automatic Identification System, visual observations from a shore-based survey conducted over a number of years and a variety of secondary sources.

The greatest density of traffic is to the west of the test site and is chiefly associated with anchorages for the North Sea hydrocarbon industry. In particular there are a number of well used nominated large vessel anchorages, some of which are used for ship to ship hydrocarbon transfers. These activities are well managed by the Harbour Authority. The density of traffic close inshore is not significant, although these areas are used by fishing vessels for potting. The principal traffic close to the site, apart from device related vessels, is from vessels servicing the aquaculture site immediately to the north of the EMEC test site.

As part of this assessment, consultation was undertaken with local stakeholders and statutory regulators to better understand the baseline conditions and possible impacts to their activities. No consultees raised any significant concerns regarding the test site. A review of incident data from the Marine Accident Investigation Branch identified no incidents in close proximity to the test site.

Impacts to navigation were identified and individually assessed. The assessment considered the following baseline assumptions:

- There are no underwater cables associated with the Scapa Flow test site;
- No impact on Search and Rescue capability was anticipated;
- There are no other renewable developments currently in close proximity to Scapa Flow. Future exploitation of existing lease areas are unlikely to result in cumulative and in-combination effects; and
- No impact on communications, radar or positioning systems is anticipated.

A navigational risk assessment was conducted that identified 11 hazards relevant to this site. The likelihood and consequence of each were scored based on the results of this assessment and all hazards were deemed to be low risk. From the assessment the following conclusions were drawn:

- The impact on vessel traffic routeing is low, with no existing routes through the Scapa Flow test site being identified;
- Devices positioned in the site posed a low risk of contact from passing vessels;
- The impact on collision risk and visual navigation is assessed to be low given the small physical size of the devices anticipated to be deployed;
- The impact as a result of device breakout was assessed and deemed to be low due to the low traffic density surrounding the site;
- The impact on vessel grounding is assessed to be low; and
- No significant impacts on recreational or fishing activity were identified due to the low density of these vessel types in proximity to the site.

A number of embedded site wide risk controls were identified. In addition to this, a list of possible additional risk controls which could be considered for future devices were identified.

Guidance is provided for developers conducting device-specific NRA addendums and the considerations which should be made in each case. This assessment has provided a device neutral baseline. Any deviations resulting from the specific characteristics of a device should be considered within device specific assessments.

The NRA has not identified any significant hazards that relate to the current Scapa Flow test site. This document should be reviewed and updated at regular intervals to provide developers with an up-to-date and relevant site-wide assessment of the risks associated with the continued operation of the Scapa Flow test site.

1 Introduction

Since 2003, the European Marine Energy Centre Ltd (EMEC) has provided purpose-built, accredited open-sea testing facilities for wave and tidal energy convertors across four test sites in the Orkney Islands. Scapa Flow, situated in relatively sheltered waters in Scapa Flow, offshore from Howequoy Head near St Mary's, to the south of Kirkwall, was established in 2011 and is a small-scale non-grid connected wave energy test site.

EMEC has identified a requirement for a Navigational Risk Assessment (NRA) compliant to the Maritime and Coastguard Agency (MCA) Marine Guidance Note (MGN) 543 in order to update the existing NRA. This should include the assessment of impacts to navigational safety and identification of additional recommendations as required.

This NRA is device neutral assuming a range of possible devices within the test site. Hazards relating to specific characteristics of a device should be considered within device specific assessments.

This assessment was conducted to the MCA's MGN 543 standard for assessing Offshore Renewable Energy Installations (OREIs) as well as other guidance described in Section 0.

1.1 Guidance to developers

This document serves as a baseline NRA for the Scapa Flow test site. Developers should utilise this information to develop an NRA addendum which addresses the specific navigational implications of their respective project and associated device. Recommendations for developing such addendums are provided in Section 10.2.

1.2 Study area

The study area under assessment is depicted in Figure 1.

1.3 Previous studies

This assessment builds on the following work conducted for EMEC:

> Scapa Flow Navigation Risk Assessment (Anatec Ltd, November 2010) (REP299-01-01)

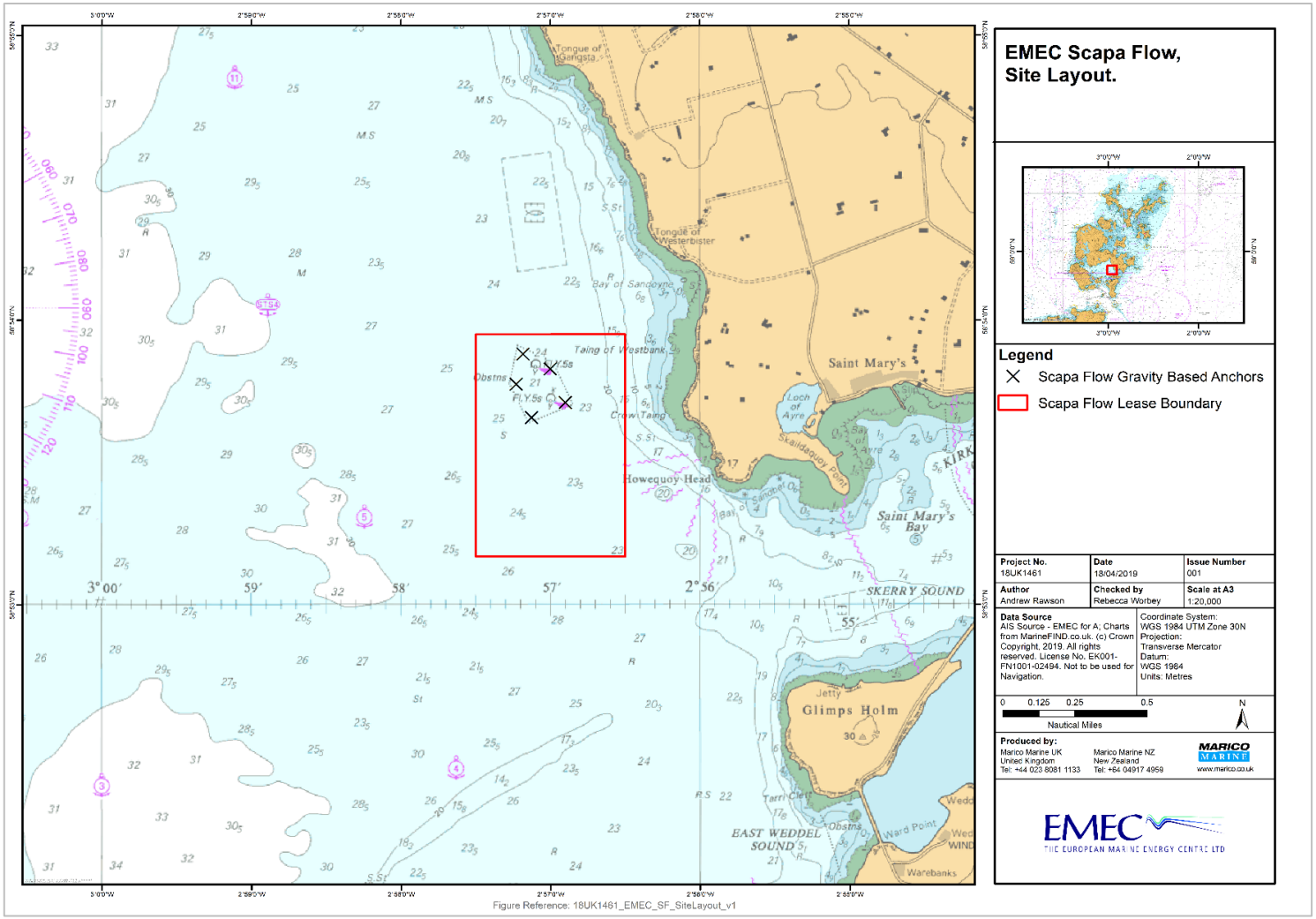

Figure Reference: 18UK1461_EMEC_SF_SiteLayout_v1

Figure 1: Test site layout at Scapa Flow

1.4 Scope and methodology

The scope of this assessment is to:

1) Describe the Scapa Flow test site;
2) Provide a description of the existing environment and activities in the study area; including:
    a. Local ports and harbours;
    b. MetOcean conditions;
    c. Existing vessel management plans;
    d. Other uses of the area such as; aquaculture, anchorages, military and renewable energy installations;
    e. Existing vessel traffic patterns, including frequency and types; and
    f. Existing risk profile for navigational incidents.
3) Determine likely future traffic profile;
4) Identify and assess impacts associated with the development to shipping and navigation, including:
    a. Traffic routeing;
    b. Collision risk;
    c. Contact risk;
    d. Communications, radar and positioning systems;
    e. Search and rescue; and
    f. Cumulative and in-combination effects.
5) Undertake an NRA that identifies navigational hazards during the general construction, operation and maintenance of the test site.
6) Make recommendations as to the safety of the test site and identify any additional measures that should be implemented to further improve safety at the site and reduce the risk to As Low as Reasonably Practicable (ALARP).

1.5 Guidance

Guidance on the assessment requirement was primarily sought from the MCA's MGN 543 (M+F) which replaces MGN 371 and advises the correct methodology to evaluate navigational safety around OREIs. This report adheres to this standard accordingly. Guidance was also sought from a variety of other publications (outlined in Table 1)

Table 1: Guidance Document Table.

Policy / legislation	Key provisions
MGN 543 Guidance on UK Navigational Practice, Safety and Emergency Response Issues	This MGN highlights issues to be considered when assessing the impact on navigational safety and emergency response, caused by OREI developments. Including traffic surveys, stakeholder consultation, structure layout, collision avoidance, impacts on communications/ radar/ positioning systems and hydrography.
Department of Energy and Climate Change (DECC) Methodology for Assessing Marine Navigational Safety Risks of Offshore Wind Farms	The DECC guidance document provides a template for preparing NRA's for offshore wind farms. This template has been used throughout to define the methodology of assessment and is read in conjunction with MGN 543.
MGN 372 Guidance to Mariners Operating in the Vicinity of UK OREIs	Issues to be considered when planning and undertaking voyages near OREI developments off the UK coast.
International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures	Guidance to national authorities on the marking of offshore structures.
International Maritime Organisation (IMO) Formal Safety Assessment	Process for undertaking marine navigation risk assessments.
Royal Yachting Association (RYA) Position on Offshore Energy Developments	Outlines recreational boating concerns for offshore renewable energy developments.
Regulatory expectations on moorings for floating wind and marine devices – HSE and MCA 2017	Guidance document on mooring arrangements for OREIs.
MCA 2014. Under Keel Clearance – Policy Paper	Guidance on assessment methodology for under keel clearance of OREI devices.

1.5.1 MGN 543 compliance table

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

Table 2: MGN 543 Compliance Table.

Annex 1		Report Section
1	An up to date traffic survey of the area	Section 0 – Consultation Section 5 – Vessel Traffic Analysis Section 8 – Impact on Navigation
2	OREI structures	Section 8 – Impact on Navigation

3	Assessment of access to and navigation within, or close to, an OREI	Section 8 – Impact on Navigation Section 9.3 – Risk Controls

Annex 2		Report Section
1	Effects of tides and tidal streams	Section 4.1 – MetOcean Details Section 0 – Impact of Tides
2	Weather	Section 4.1 – MetOcean Details Section 0 – Impact of Weather
3	Visual navigation and collision avoidance	Section 0 – Impact on Collision Avoidance and Visual Navigation Section 0 – Impact on SAR
4	Communications, radar and positioning systems	Section 0 – Impact on Equipment
5	Marine navigational marking	Section 0 – Existing Marking Section 9.3 – Marking and Lighting Guidance

Annex 3		Report Section
1	MCA Shipping Route Template	Section 8.1 – Vessel Routeing

Annex 4		Report Section
1	Safety and mitigation measures	Section 9.3 – Site wide Risk Controls Section 9.5 – Device Specific Risk Controls

Annex 5		Report Section
1	Emergency response	Section 0 – Impact on SAR Section 9.3 – Site wide Risk Controls Section 9.5 – Device Specific Risk Controls

2 Scapa Flow test site

2.1 Test berths

The Scapa Flow test site is within Harbour Limits, with Orkney Islands Council Marine Services being the Statutory and Competent Harbour Authority. It should be noted that the total area of the site in use at any given time will be reduced in comparison to the full extents shown on **Figure** 1**.** The area within which moorings will be deployed will typically occupy between one-third and one-half of the box shown. However, the full lease allows flexibility in the final deployment of the moorings or devices.

Unlike the full-scale sites, the scale test sites do not have predefined device berths and devices can be deployed anywhere within the test area. The sites are located within relatively sheltered water providing a more flexible sea space in comparison to tank testing and act as stepping-stones towards larger scale projects. The scale test sites can enable marine energy developers and suppliers to learn lessons in a sheltered environment, reducing the need for big vessels or large plant.

Currently five anchor positions are provided in the northern part of the defined site (Figure 1). EMEC offer developers the use of a bespoke test support buoy. If required, the device under test will be connected to the test support buoy via two umbilical cables: one for power transmission and the other for control and communications. These buoys can relay data by wireless technology allowing developers to monitor performance remotely, as well as dissipating electricity generated by the device. The buoys are also equipped to supply the devices with power and act as navigational aids.

2.2 Devices

Waves have the potential to provide a completely sustainable source of energy, which can be captured and converted into electricity by Wave Energy Converter (WEC) machines. There are a variety of WEC concepts that have been developed to date to extract energy from the shoreline out to the deeper waters offshore.

This assessment is considered device neutral, considering the navigational safety implications of a variety of possible devices and operations within the defined envelope for EMEC's scale test sites. Further information on device characteristics and structures is detailed within the document: Scapa Flow Scale Site: Environmental Description (EMEC 2011) (REP416).

Generic devices which could be deployed can be found on EMEC's website.[1]

2.3 Moorings

There are a variety of possible methods for fixing WECs to the seabed. MGN 372 lists these five main types:

1. Seabed mounted / gravity base devices: Physically sit on the seabed by virtue of the weight of the combined device/foundation. In some cases, there may be additional fixing to the seabed;

[1] http://www.emec.org.uk/marine-energy/wave-devices/

2. Pile mounted: This principle is analogous to that used to mount most large wind turbines, whereby the device is attached to a pile penetrating the ocean floor. This may be mono, twin or tri-piled;
3. Floating flexible mooring: The device is tethered via a cable/chain to the seabed, allowing considerable freedom of movement. This allows a device to swing as the tidal current directions changes with the tide;
4. Floating rigid mooring: The device is secured into position using a fixed mooring system, allowing minimal movement; and
5. Hydrofoil inducing down force: The device uses a number of hydrofoils mounted on a frame to induce a positioning down force from the tidal current flow.

2.4 Existing marking and lighting

The site does not have any boundary markings, such as floating Aids to Navigation (AtoN), although one lit and charted yellow buoy may be on station during active testing, and act as a navigational aid.

The site is marked on the largest scale chart of Scapa Flow (Admiralty Chart 35), however, there are no specific chart notes relating to the test site.

The marking of the devices themselves varies, but in general any surface piercing device is marked with one or more yellow lights and is coloured predominately yellow above the surface (see IALA requirements in Section 9.3.1 for detail)

An advisory 500m Area to be Avoided is in place around each device[2] (see Annex A).

[2] https://www.orkneyharbours.com/port-authority/info/notices/marine-excursions-within-the-emec-test-areas

3 Consultation

Consultation was conducted with key stakeholders to gain local knowledge and insight on navigation. A list of stakeholder consultations undertaken to support this update to the NRA is given in Table 3. Following each conversation or correspondence, summary notes were drafted and agreed – these are contained in Annex D.

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

Table 3: List of stakeholder consultation

Organisation	Details
Orkney Fisheries Association	29th August 2018 – Meeting at Kirkwall
Orkney Islands Council Marine Services – Statutory Harbour Authority	29th August 2018 – Meeting at Scapa
Orkney Ferries	30th August 2018 – Meeting at Kirkwall
Orkney Marinas	30th August 2018 – Meeting at Kirkwall
Royal Yachting Association	5th September 2018 – Meeting at Hamble
Maritime and Coastguard Agency	19th September 2018 – Meeting at Southampton
Northern Lighthouse Board (NLB)	21st September 2018 - Teleconference

4 Overview of the marine environment

The Orkney Islands, a group of more than 50 islands, lie NNE of the NE extremity of mainland Scotland, from which they are separated by the Pentland Firth. This section provides details of the test site and conditions as relate to navigation.

4.1 MetOcean conditions

4.1.1 Wind

The Admiralty Sailing Directions for the North Coast of Scotland state that there are on average 50 days with gales each year in Kirkwall. This ranges from between one and nine per month, with gales most frequently in the winter months. The prevailing wind is south /south-westerly. Figure 2 shows the wind directions and speeds for the Scapa Flow site.

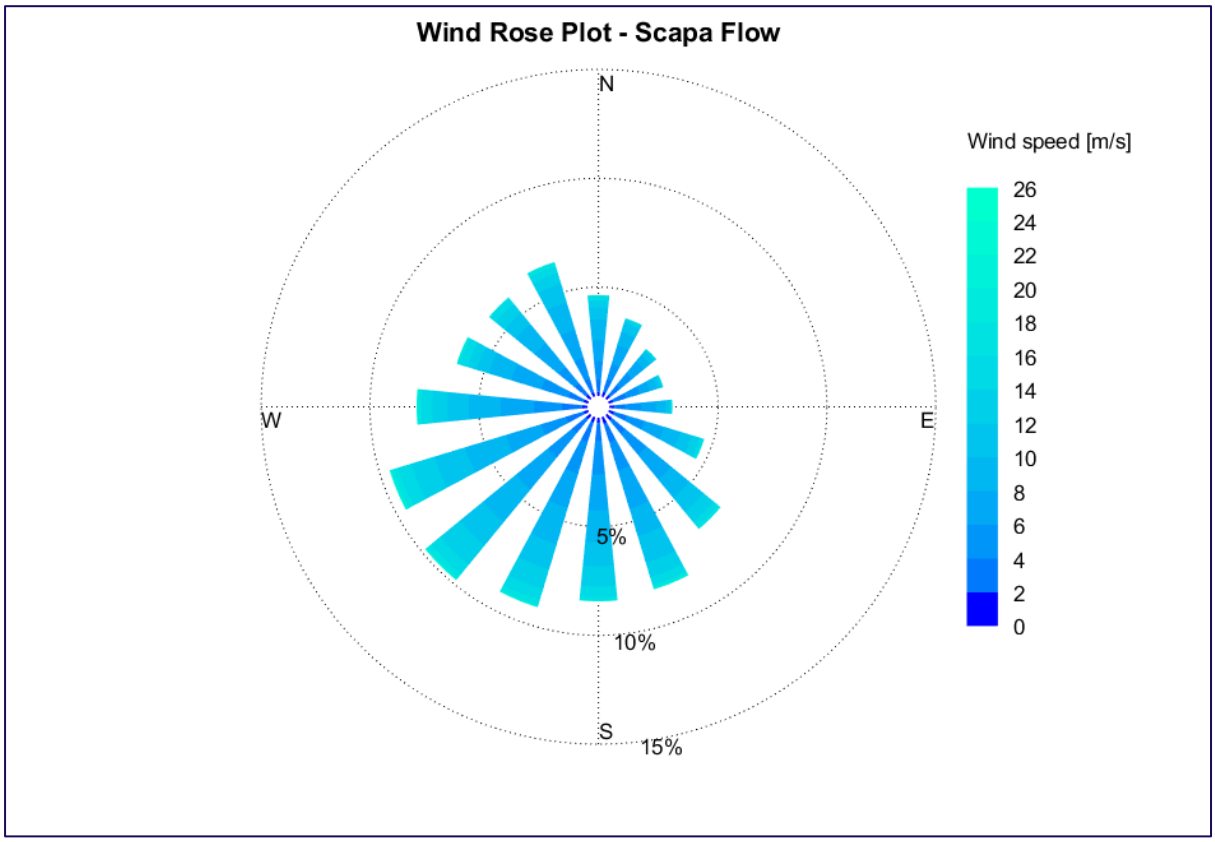

Figure 2: Percentage occurrence of wind directions (m/s) (source: EMEC)

4.1.2 Wave

Figure 3 shows the wave rose for the site, the predominant direction is south-westerly with significant wave heights generally below one metre.

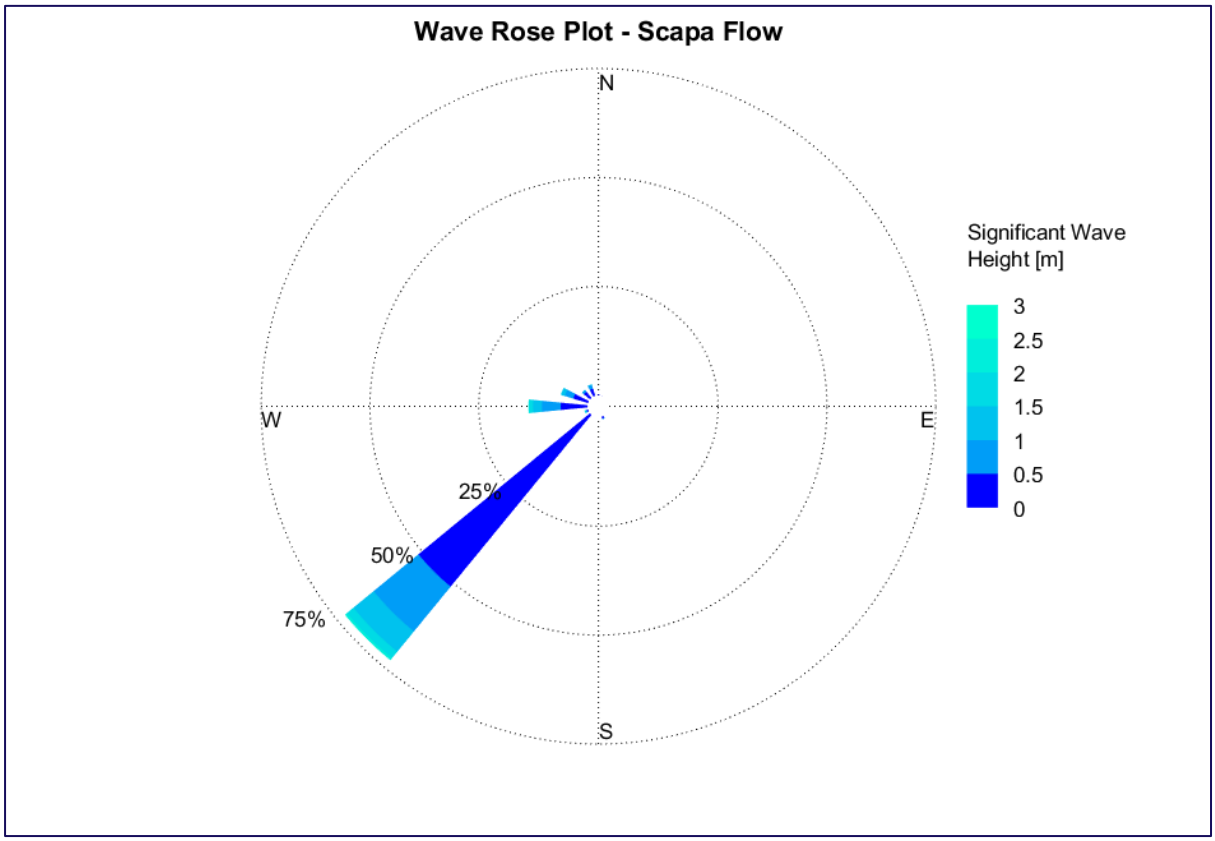

Figure 3: Wave rose plot for Scapa Flow (source: EMEC)

4.1.3 Tide

Table 4 and Table 5 give the tidal characteristics near to the test site.

Table 4: Tidal Heights (Source: Admiralty Chart)

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

Table 5: Admiralty Total Tide Predictions (Wick)

Wick (58° 43.57’N 003° 14.18’W)			
Tidal Hour	**Direction (deg)**	**Spring (kts)**	**Neaps (kts)**
-6	355	1.5	0.8
-5	076	1.7	0.9
-4	097	4.3	2.2
-3	080	4.4	2.2
-2	089	4.5	2.3
-1	099	2.6	1.3

Wick (58° 43.57'N 003° 14.18'W)			
HW	119	0.9	0.5
+1	258	1.9	1.0
+2	264	3.9	2.0
+3	264	5.0	2.5
+4	261	5.5	2.8
+5	311	2.0	1.0
+6	343	1.9	1.0

4.1.4 Visibility

The Admiralty Sailing Directions for the North Coast of Scotland gives the days with fog per year as 41 in Kirkwall. This ranges from between two and five per month, with fog most frequently in the summer months. Consultees identified that the Orkney Islands are frequently affected by thick fog.

4.2 Existing vessel traffic management

The Scapa Flow test site is within port limits. Orkney Islands Council Marine Services has Vessel Traffic Services (VTS) with full radar coverage of the Scapa Flow test site.

Scapa Flow is a significant anchorage destination for large hydrocarbon tankers, and the charted anchorages are managed by the Port Authority and VTS

4.3 Search and rescue

Royal National Lifeboat Institution (RNLI) lifeboats are stationed in the Orkney Islands at Longhope (Hoy), Stromness and Kirkwall (both Orkney Mainland). The Longhope lifeboat is a Tamar class all weather lifeboat. She is 16.3m Length Over-All (LOA), has a crew of seven, and is capable of 25 knots having a range of 250 nm.

Her Majesty's Coastguard (HMCG) helicopter assets are based at Sumburgh, Stornoway and Inverness.

Shetland Coastguard Operations Centre (CGOC) is the local coastguard base for the Orkney Islands. The 2015 implementation of the Future Coastguard Programme saw a restructuring of the CGOCs and implementation of a new IT system that enabled areas to be monitored and incidents responded to from any CGOC or from the National Maritime Operations Centre (NMOC), near Southampton. Therefore, whilst Shetland CGOC would likely manage an incident in the Orkney Islands, it could be managed from elsewhere.

4.4 Other offshore activities

4.4.1 Aquaculture

Marine farms of various types are numerous throughout the waters of the Orkney Islands with farms being added and removed on a continuous basis. Farms in proximity to shipping routes are marked by buoys. Other farms are marked by beacons (X topmark) and some are fitted

with radar reflectors. Lights, when fitted, show flashing yellow as described in IALA guidance O-139 (IALA, 2013)[3].

Orkney Islands Council prohibits anchoring and diving close to aquaculture sites within the Orkney Statutory Harbour Area. Mariners are required to give as wide a berth as possible when passing the farms and to proceed with caution, consideration and at slow speed in their vicinity.

An aquaculture site is charted immediately to the north of the EMEC test site, and another in Skerry Sound to the South East. Together, these sites generate additional vessel traffic, some transiting from one farm to the other and passing the test site (see section 5).

4.4.2 Renewables

There are no existing renewable energy sites near to the Scapa Flow test site. Proposals exist for future developments in the area, these are discussed in Section 0 and Section 0.

4.4.3 Subsea Cables

There are no cables in the study area.

4.4.4 Anchorages

There are a number of anchorages within Scapa Flow, a well-known deep-water safe haven. The anchorages are regularly used by commercial vessels, including for Ship To Ship (STS) fuel transfer operations. The anchorages are actively managed and monitored by VTS and are well regulated and clearly charted. Anchorage Number 5 lies approximately 1500m south-west of the active area of the test site, while STS anchorage 4 lies approximately 2000m to the North-West

4.4.5 Military exercise areas

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

4.4.6 Spoil grounds

There are no spoil grounds near to the test site.

[3] IALA (2013) Marking of Man-Made Structures 0 -139

5 Existing vessel traffic at the Scapa Flow test site

5.1 Data sources

MCA's MGN 543 requires that *"An up to date, traffic survey of the area concerned should be undertaken within 24 months prior to submission of the Environmental Statement. This should include all the vessel types found in the area and total at least 28 days duration but also take account of seasonal variations in traffic patterns and fishing operations. (Note: AIS data alone will not constitute an appropriate traffic survey)."*

The NRA should, therefore, be based on the best available data and account for all marine users, not just those equipped with AIS. Typically, this is achieved through a radar and visual traffic survey from shore or from afloat. Given the availability of alternative data sources, this approach is not considered proportional to the scale of the development, given that:

- The devices are small scale in nature;
- The sites have been long established;
- The activities at EMEC test sites are familiar to all local users and any modifications widely promulgated through Notice to Mariners (NtM);
- Previous applications for developments at the EMEC test sites have not been considered to have a significant impact upon navigational safety by national and local stakeholders[4]; and
- Previous NRAs submitted by EMEC or its developers have satisfactorily demonstrated the impact on navigational safety without the use of radar traffic surveys.

To ensure that the NRA includes a full assessment of all vessel types in the study area, particularly those which would not normally carry AIS, use of the following datasets is proposed:

- AIS data between 1st January 2017 and 30th June 2018 (18 months);
- Visual observations between 2010 and 2013 (see Section 5.8);
- Consultation with local stakeholders, particularly to establish behaviour of small fishing vessels and recreational craft;
- Fishing VMS Data;
- RYA recreational cruising datasets; and
- Additional secondary sources and previous NRAs, where appropriate.

5.2 Vessel traffic routes in Orkney

Figure 4 shows the main routes used by vessel traffic passing the Scapa Flow test site. The greatest density of traffic is to the west of the site, which includes large commercial vessels using the deep-water anchorages and their associated support vessels (tugs, pilot vessels. and other harbour service craft). Vessels can be seen transiting through the Scapa Flow test site especially in the north west and towards Kirk Sound to the south east. The majority of

[4] However, it is noted that a recent application has had an objection submitted by OIC Marine Services.

these transits were made by project maintenance vessels and traffic associated with the aquaculture site immediately to the north. The density of traffic close inshore is not significant.

The tracks of all vessels have been categorised by their LOA, as shown in Figure 5. The largest vessels (>300m LOA) are commercial ships (often tankers) utilising the anchorages to the west, well clear of the test site. Within the test site the majority of vessels are <50m LOA.

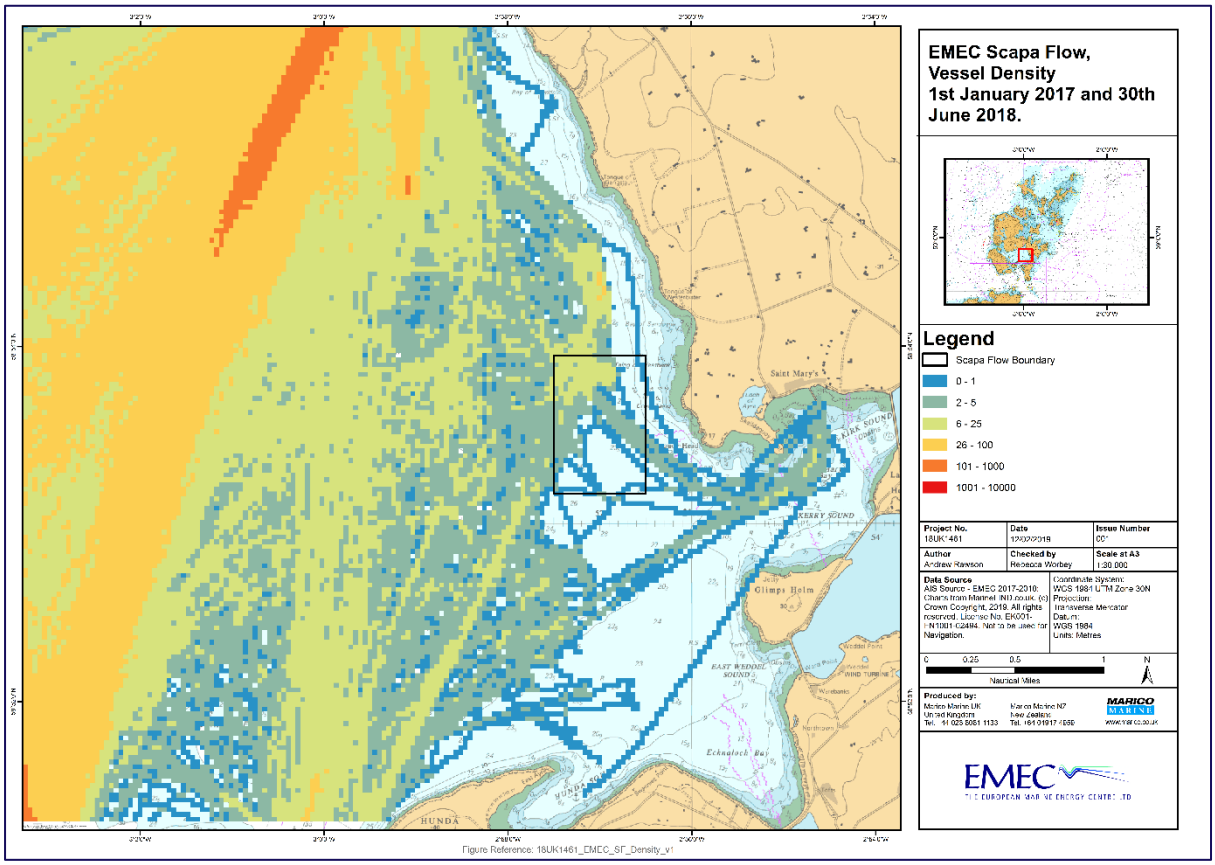

Figure 4: Vessel transit density at the Scapa Flow test site

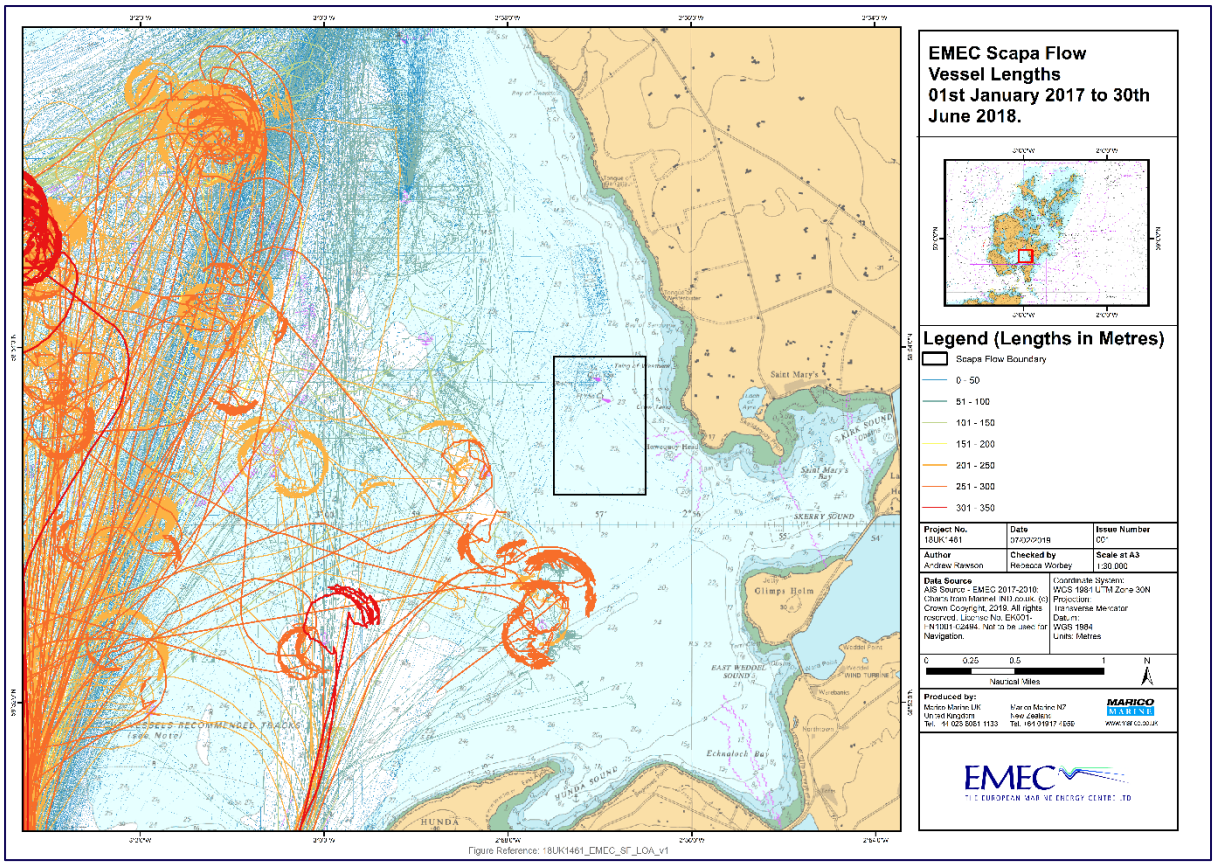

Figure 5: Vessel tracks by Length Over-All (LOA)

5.3 Commercial shipping

Commercial shipping (mostly tankers) is recorded to the west of the test site. The majority of commercial traffic is associated with the anchorages. The closest anchorage to the test site is approximately 0.7nm to the south-west. Commercial vessels on transit are at least 1 nm west of the site.

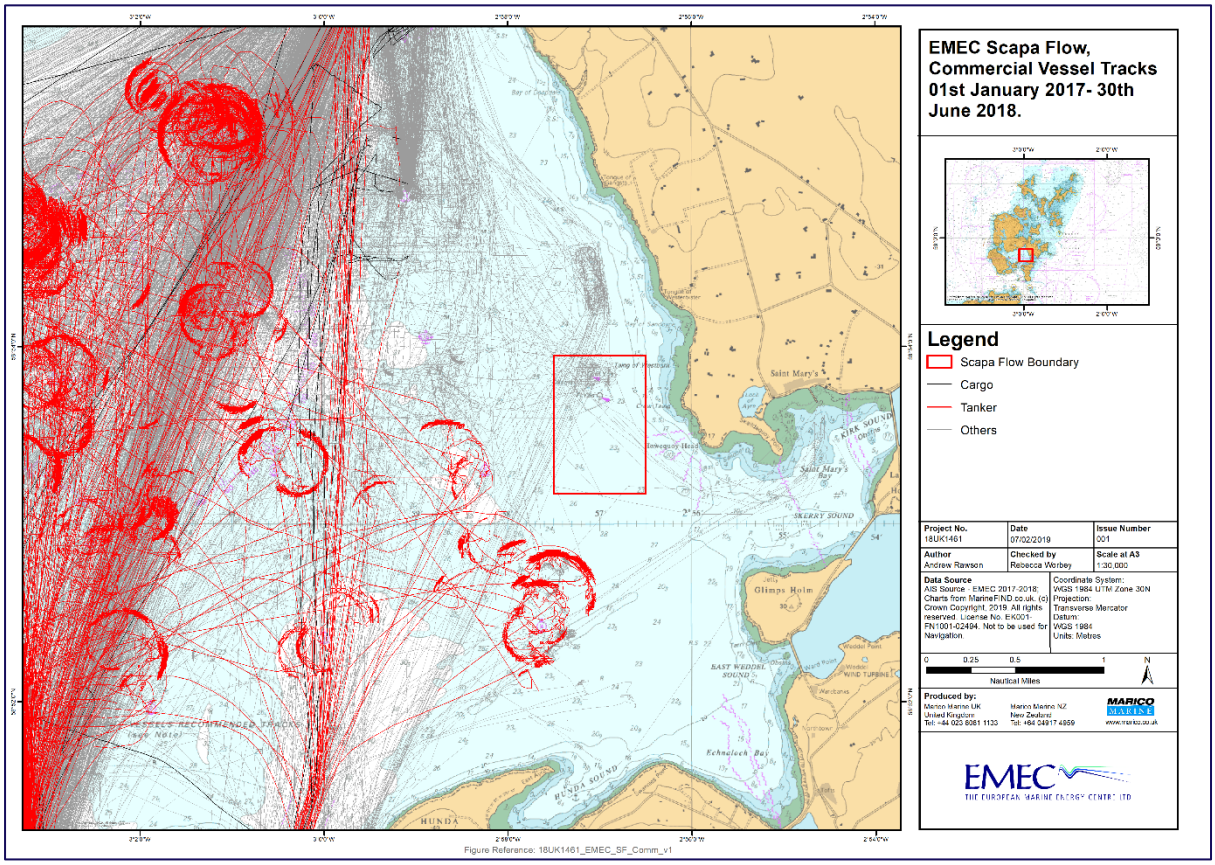

Figure 6: Commercial vessel transits at the Scapa Flow test site

5.4 Passenger vessels

No passenger vessels have been recorded passing through or near to the test site. This was confirmed during consultation. The closest ferry transit past the site was at a distance of 1nm.

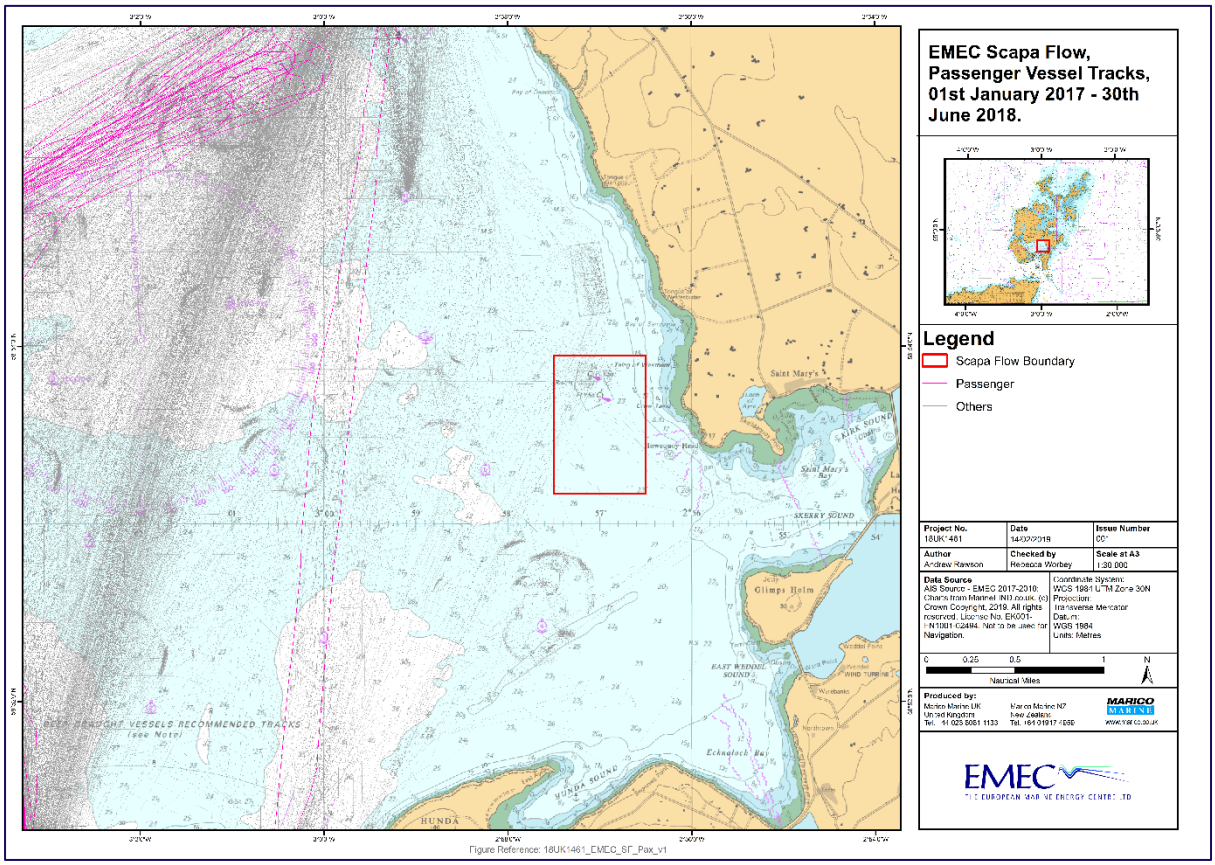

Figure 7: Passenger vessel transits at the Scapa Flow test site

5.5 Fishing vessels

The transits of fishing vessels are shown in Figure 8. Very few are recorded in the AIS data set, and those that are, are associated with the aquaculture site to the north and do not pass through the test area. No inshore transits were noted from AIS data, although it is known from consultation that smaller vessels may engage in potting very close inshore.

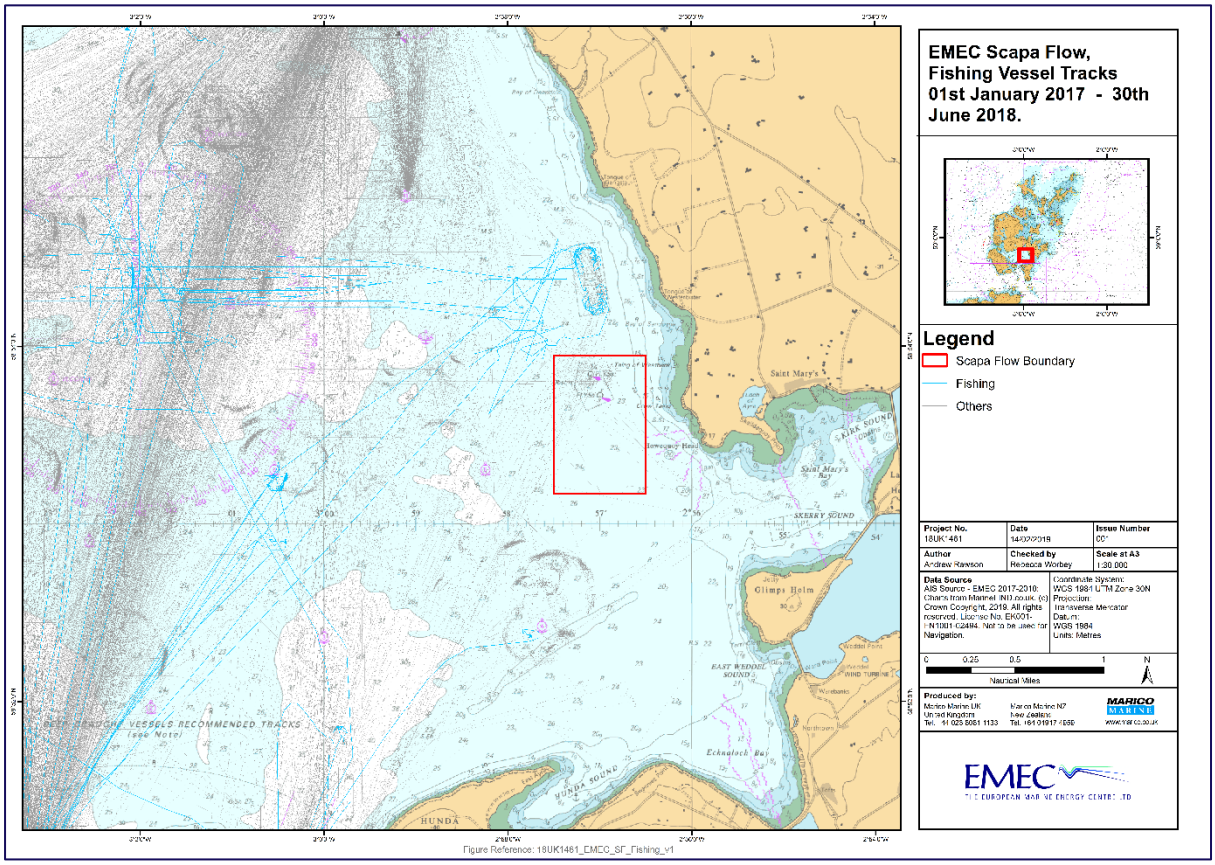

Figure 8: Fishing vessel transits at the Scapa Flow site

5.6 Recreational craft

Figure 9 shows the routes of recreational vessels recorded during the data period. None pass through the test site, with only one track occurring to the south into Saint Mary's.

The area is not routinely used for organised events such as races.

AIS is not mandatory on recreational craft and, therefore, the analysis identifies only a proportion of the total number. A RYA survey in 2014 stated that 37% of vessels transmit AIS, although this is likely to be an overestimate and bias towards larger vessels[5].

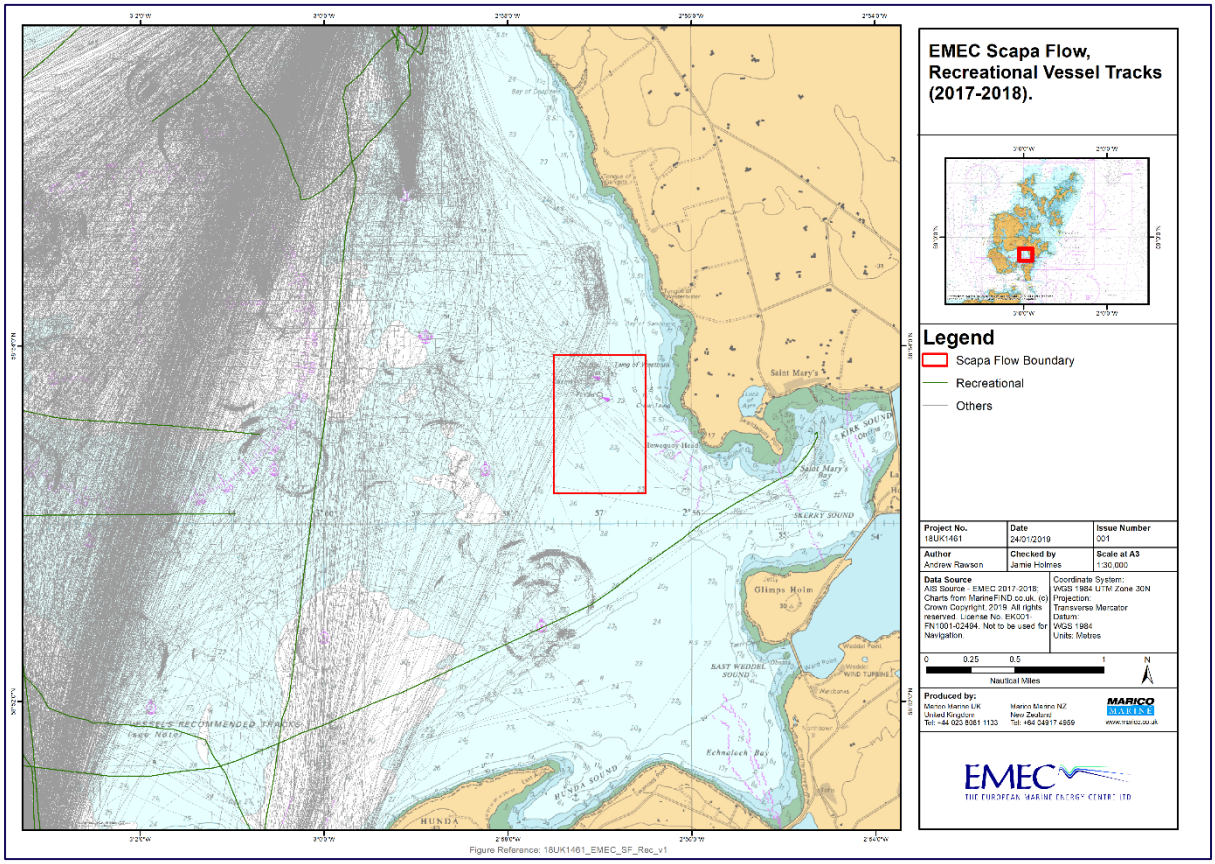

Figure 9: Recreational vessel transits at Scapa Flow

5.7 Tugs and other service vessels

Finally, tugs and service craft, which include; pilot boats, tugs, maintenance vessels and other workboats are shown in Figure 10. The key activity within the test site is that of construction, maintenance and decommissioning vessels working at devices positioned within Scapa Flow, and the vessels associated with the nearby aquaculture sites. The far greater intensity of harbour support craft can be seen well to the west of the test site.

[5] https://www.rya.org.uk/newsevents/news/Pages/RYAAISsurveyresults.aspx

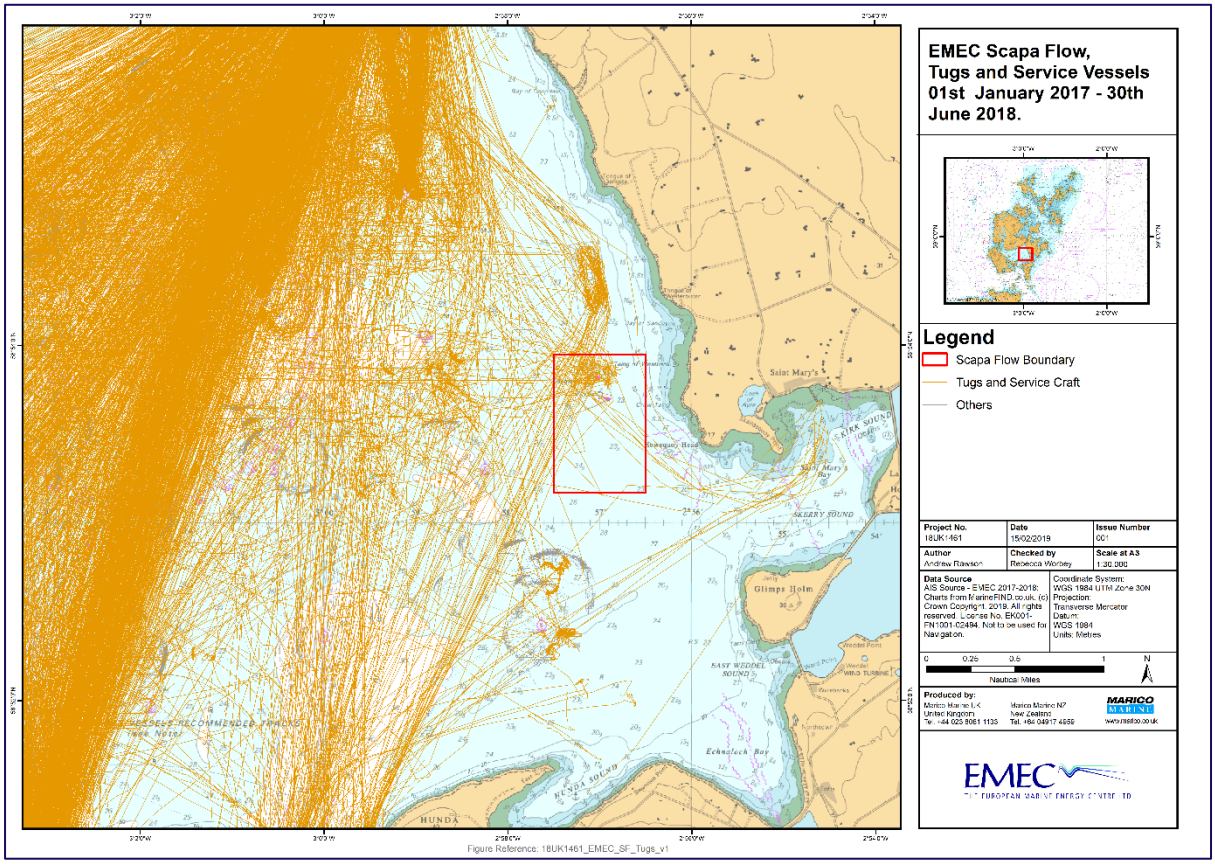

Figure 10: Tug and Service vessel transits at Scapa Flow

5.8 Visual observations

Visual observations obtained between 2010 and 2013 were analysed to supplement AIS data. Figure 11 shows density grids for both leisure and fishing vessels observed in the vicinity of the test site, confirming the stakeholder opinion that traffic density for both classes of vessel is low, with the exception of fish farm support vessels in the immediate vicinity of the aquaculture sites.

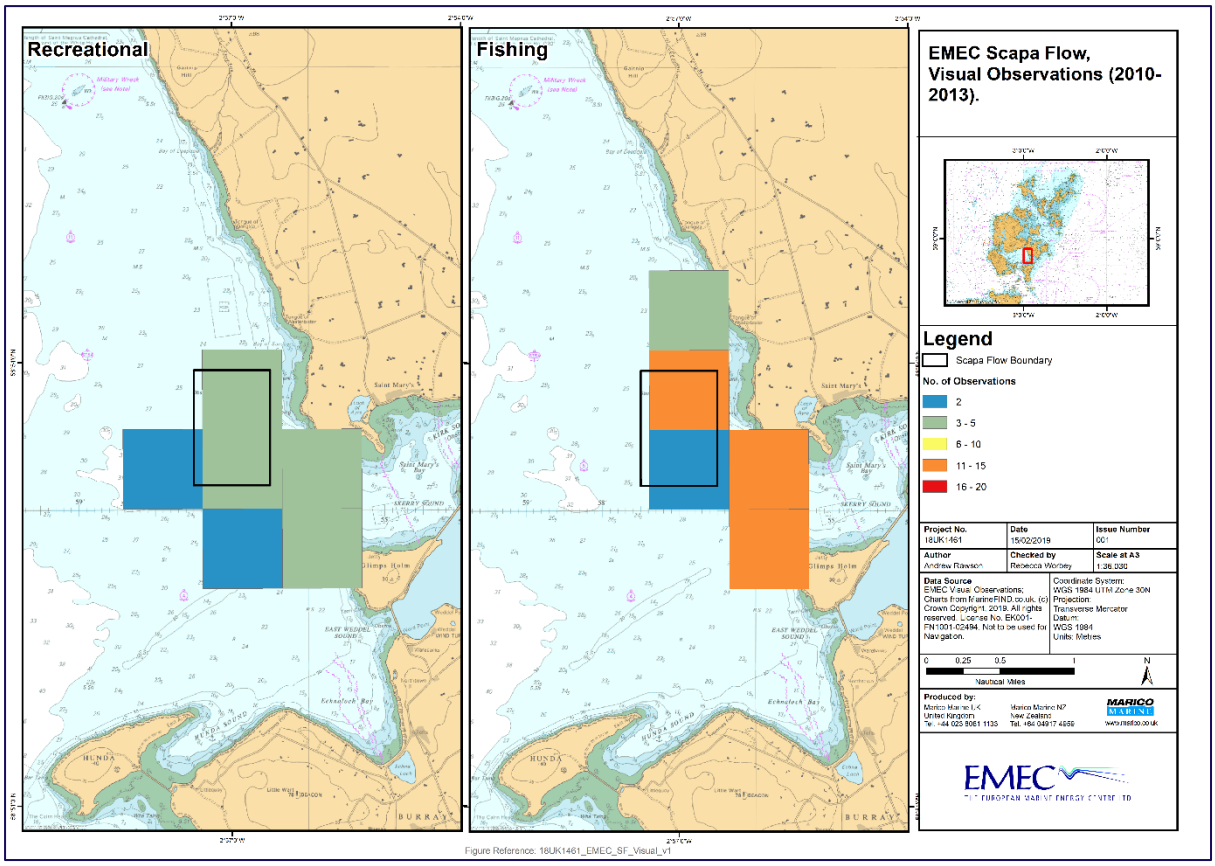

Figure 11: Visual Observations 2010 - 2013

6 Historical incidents

Analysis of MAIB incidents between 1997 and 2015 was conducted. No incidents were recorded near to the Scapa Flow test site.

Stakeholder consultation, including with the Statutory Harbour Authority, confirmed that commercial vessel incident rates are low. Leisure diving incidents are a concern in the wider region, but these are related to the well-known Scapa Flow historic wreck site[6] and not in the vicinity of the test site.

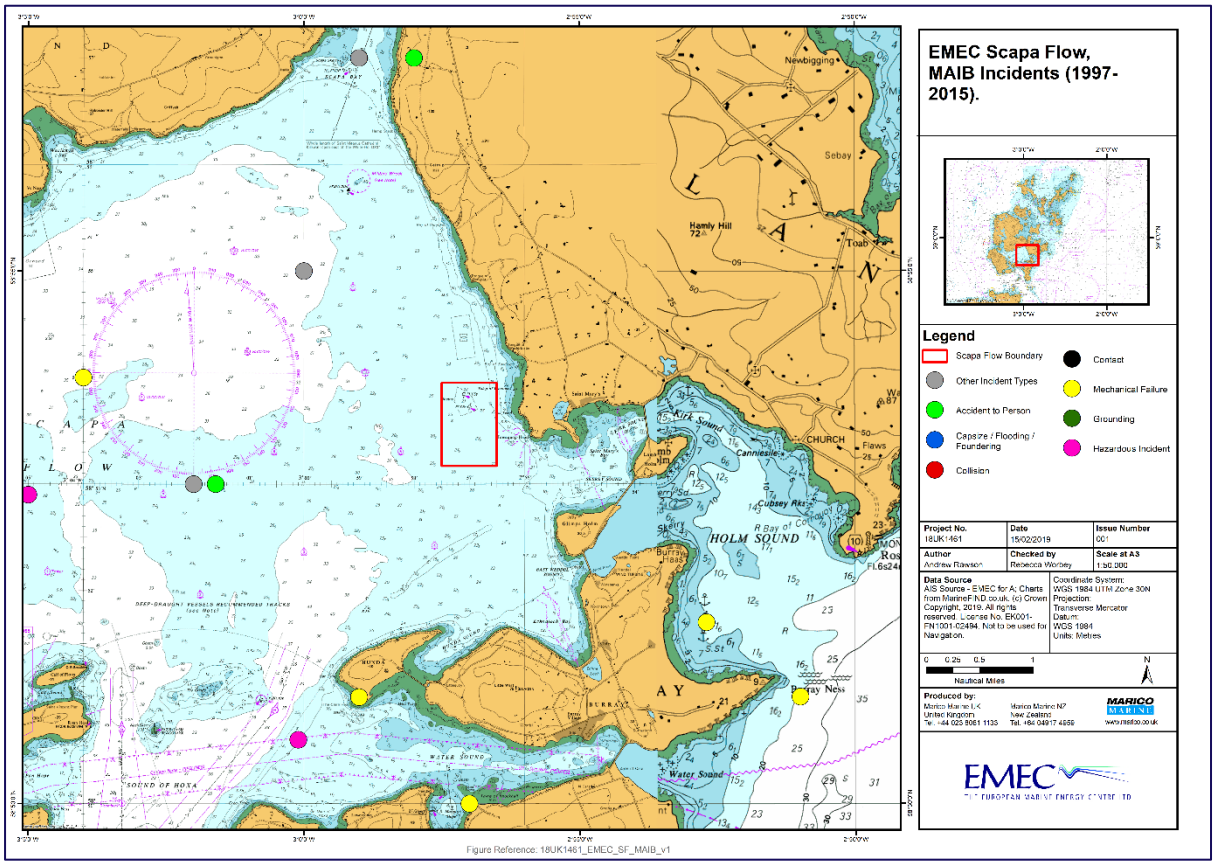

Figure 12: MAIB Incidents between 1997-2015 near Scapa Flow

[6] http://www.scapaflowwrecks.com/

7 Future traffic profile

7.1 Orkney commercial traffic

The following information was captured from the Orkney Islands Council Harbour Authority Annual report 2017-2018[7]:

- Pilotage movements to all facilities have increased from 526 in 2015-2016, to 606 in 2016-2017 and 708 in 2017-18. An increase over 3 years of 34%.
- Demand for Orkney Ferries Ltd. routes has increased from 97,335 passengers to 101,339 passengers between 2015 and 2018 for the outer islands, and from 217,697 to 229,675 during the same period for the inner islands, though both categories saw a slight decrease between the most recent two years of records.
- Cruise ships calls increased significantly from 79 in 2014/2015 to 126 in 2016/2017 and 137 in 2017/2018. 127 are already booked for 2019.

There are no known plans to increase the number of services in the area.

7.2 Fishing and recreational traffic

A review of the Scottish Sea Fisheries Statistics was undertaken from 2008 to 2016[8]. The number of voyages by Scottish vessels has fluctuated from 3,613 in 2008 down to 2,570 in 2012 and then back up to 3,667 in 2016. Although, the catch quantity increased year on year from 2,952 tonnes in 2008 through to 4,993 tonnes in 2016, the number of registered fishing vessels has declined from 142 in 2012 to 131 in 2016.

In 2012, there were 354 employed fishermen in the Orkneys (235 regularly and 119 irregularly employed), which declined to 292 (199 regularly and 93 irregularly) in 2016.

7.3 Renewable energy related traffic

The EMEC test site and the associated test devices are periodically maintained by vessels approaching from both the north and south as shown in Figure 10. The degree to which this traffic varies is dependent upon the number of devices under test within the site, with maintenance operations primarily carried out during neap tides.

Any significant changes in renewable vessel traffic, not associated with EMEC, would be the result of further tidal, wave or wind leases. There are no new proposed sites in the Scapa Flow area.

Figure 13 shows the offshore renewables sites identified in the Scottish National Marine Plan (2015)[9].

A number of Crown Estate lease sites have been identified and are at various stages of consideration:

[7] https://www.orkneyharbours.com/about/news/orkney-islands-council-harbour-authority-annual-report-2017-2018

[8] http://www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/PubFisheries

[9] Scottish National Marine Plan (2015) Scotland's National Marine Plan: A Single Framework for Managing Our Seas.

- Lashy Sound – scoping not yet undertaken, application will be made for an initial 10MW
- Costa Head – scoping report issued in 2011 for initial 10MW's, lease capacity is for 200MW
- Marwick Head – scoping report issued in 2012 for initial 10MW's, lease capacity is for 50MW
- Brough Head - scoping report issued in 2011 for initial 9MW's, lease capacity is for 200MW
- West Orkney Middle South – scoping report issued in 2012 for initial 10MWs, lease capacity for 50MW.

None of these sites have been advanced and no further details have been provided by Marine Scotland.

The plan also identified options for wind, wave and tidal sites. WN2 and OWN1 are recognised areas for wave and wind energy respectively.

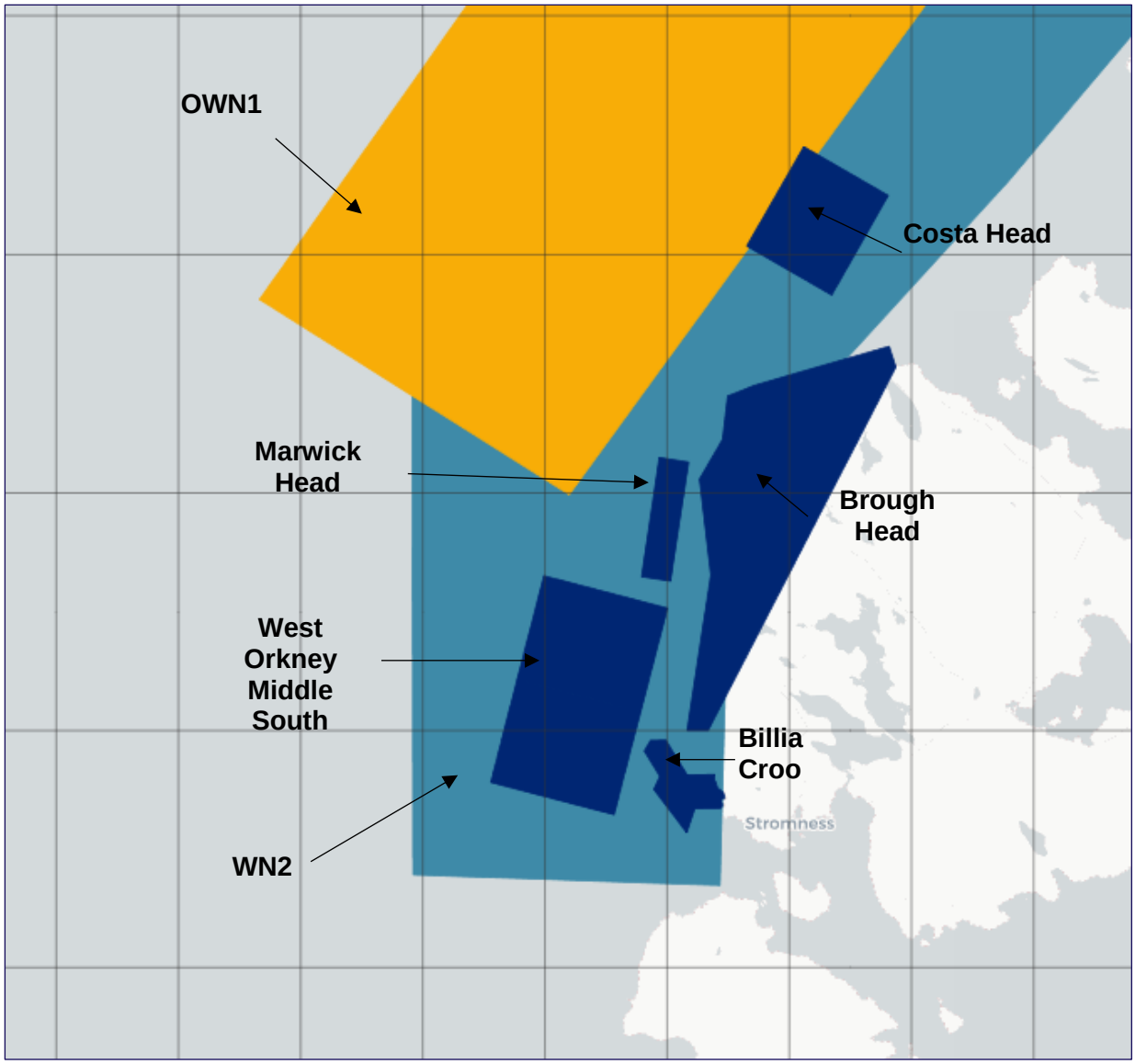

Figure 13: Scottish National Marine Plan Options (Source: Marine Scotland 2015)

In 2018, Marine Scotland published a scoping study for new offshore wind energy sites in Scottish waters. Figure 14 shows the locations of possible areas of future wind leasing sites, several of which are located near to Orkney and are subsequent revisions of those shown in Figure 13.

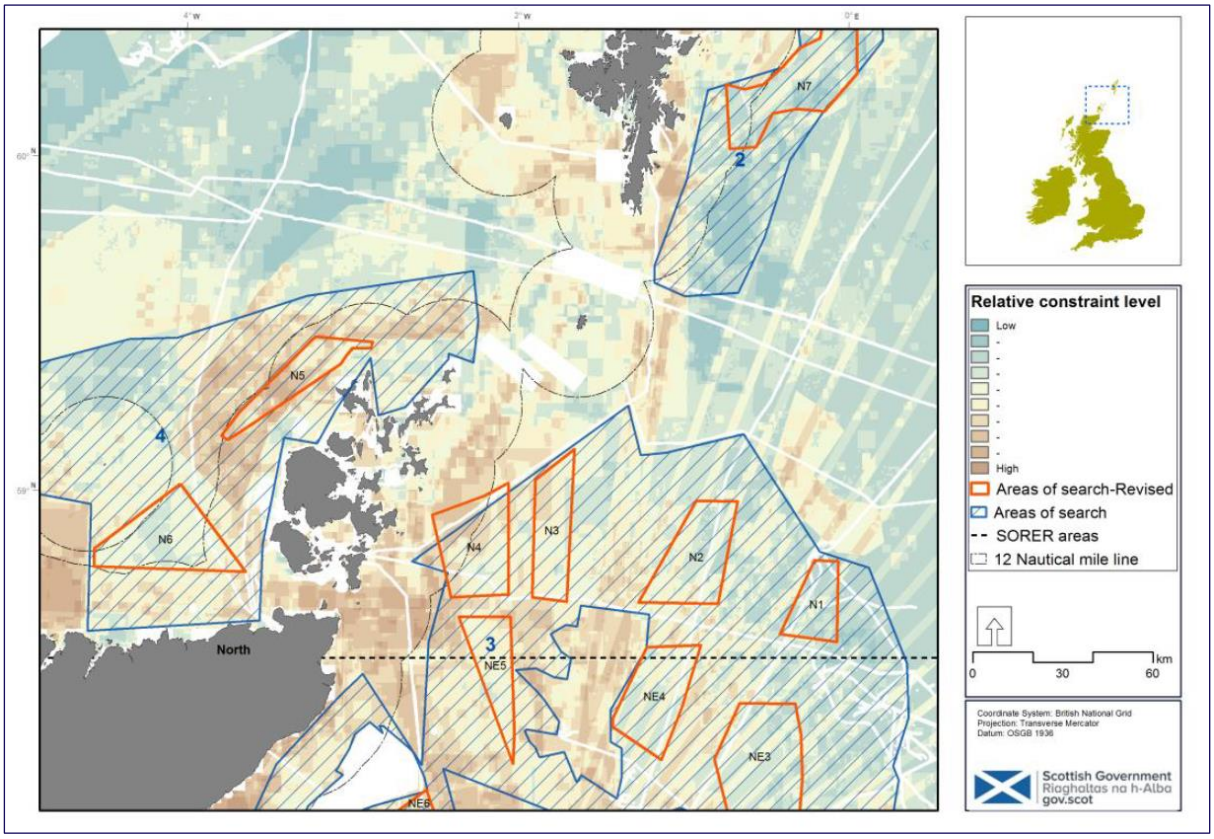

Figure 14: Location of possible wind energy areas (Marine Scotland, 2018)

8 Impacts to navigation

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

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

8.1 Impact on vessel traffic routeing

8.1.1 Access to the Scapa Flow test site

MGN 372 provides advice for mariners operating in close proximity to OREIs. There are three options described:

1. Avoid the OREI area completely;
2. Navigate around the edge of the OREI development area; or
3. In the case of a wind farm, navigate, with caution, through the array (although this is not applicable to other marine renewable energy sites).

There are no specific chart notes on the largest scale chart covering Scapa Flow (35) specifically relating to the Scapa Flow test site, but normal location of the test support buoy and mooring spread is delineated by pecked lines and the yellow test support buoy and associated lights are charted. As shown in Section 5, most vessels pass around the well promulgated active test area. In addition, advisory 500m Areas To Be Avoided (ATBA) exist around each device, as advised by the relevant NtM (see Annex A).

Upon reviewing the AIS data contained in Section 5, it is apparent that very little traffic transits through the test area. Those vessels that do transit close to the test site are either directly serving the test devices, or nearby aquaculture sites. All of these vessel masters have very good local knowledge of device locations and deployment methods. It was clear from consultation that device deployment is well promulgated and understood by local and visiting mariners, and this is reflected in observed vessel tracks.

8.2 Impact on contact/allision risk

8.2.1 Powered contact

A detailed discussion regarding the methodology for the analysis of contact risk can be found in the NRA documents for the full scale EMEC test sites (Billia Croo and Fall of Warness). These should be referred to if traffic patterns around the Scapa flow test site should significantly alter in the future.

Currently, however, the traffic density in the vicinity of the test site is low, with no regular vessel routes passing close. This has been considered in the NRA.

8.2.2 Drift contact

The environmental conditions at Scapa Flow are less challenging than those experienced at the full-scale test sites, with Scapa Flow being relatively sheltered resulting in lower wave heights, and moderate tidal flows. However, Orkney can experience significant wind speeds and vessels may be driven on to an obstruction in the event of machinery failure, for example. This is considered to be an unlikely event given the low density of traffic.

8.2.3 Contact by maintenance vessel

Due to the nature of the operations, a contact between an installation/maintenance vessel and a device is much more likely to occur than with another passing vessel. The vessel operators active at EMEC's test site are well trained and used to operating in close proximity to devices which mitigates the likelihood.

8.3 The effects of tides, tidal streams and weather

Navigation around OREIs can be influenced by the; tide, tidal streams and weather conditions and this should be considered as part of an NRA.

Section 0 provides data on the met-ocean conditions around Scapa Flow. The tidal stream conditions are relatively benign in the test site.

The prevailing south-westerly wind has the potential to impact on vessels transiting past devices. Given the low density of traffic and proximity to the lee-shore (for which prudent mariners would leave a wide berth), this is not considered to be a significant hazard.

Poor visibility is relatively common in the Orkney Islands; however, the site is well charted and has existed for several years, and therefore, local vessel operators are well-aware of the site. These factors combined result in a low likelihood of a vessel contacting a device during periods of poor visibility.

8.4 Impact on under keel clearance

A detailed discussion regarding analysis of under keel clearance can be found in the NRA documents for the full scale EMEC test sites (Billia Croo and Fall of Warness). Given the small scale of the Scapa Flow test site, and the very low density of traffic, and experience of the crews operating in close proximity to the site, detailed under keel clearance analysis is not considered appropriate for the Scapa Flow test site, but should be considered on a case by case basis for device specific assessments with reference to the MCA (2014) Under Keel Clearance – Policy Paper[10].

Risk of contact with a device that may be sub-surface is considered in the appropriate hazard analysis within the NRA.

[10] MCA (2014) Under Keel Clearance – Policy Paper. Guidance to Developers in Assessing Minimum Water Depth over Tidal Devices.

8.5 Impact on collision risk, visual navigation and collision avoidance

OREIs have the potential to disrupt traffic flows and obscure other navigating vessels which has the potential to result in a collision. Given the low traffic density at Scapa Flow, this is not considered to be significant (see section 5).

8.6 Impact on communications, radar and positioning systems

The profile of the devices and the relative size compared to other OREIs does not suggest that there would be any significant impacts upon communications, radar or positioning systems. There are no export cables which might create an electromagnetic impact.

8.7 Impact of failure of moorings

The test site may contain a number of devices which will be moored to the seabed, the failure of these moorings is a possible hazard. Mooring failure could occur for a variety of reasons, including; incorrect moorings, equipment fatigue and extreme met-ocean conditions.

The adequacy of mooring arrangements will need to be assessed on a case by case basis, given the specifications of the equipment. Each developer has a requirement to provide third-party verification on the structural integrity of the device and mooring/foundation system.

If a device were to break free from its moorings, it could be detected through:

- A Supervisory Control And Data Acquisition (SCADA) system (If test device is connected to test support Buoy);
- Position Monitoring (AIS & GPS);
- Harbour Authority radar observations;
- Observations from nearby vessels; and
- Shore based observations from local residents.

A breakout could result from the actions of; wind, waves and tide. This could pose a navigational hazard to passing traffic, however, given the low density of traffic recorded during the vessel traffic analysis, the likelihood is relatively low. Emergency procedures would need to be in place for alerting HMCG and Orkney Harbours to implement navigational warnings and subsequently recover the device, which would be unlikely to travel far before grounding on a lee-shore.

8.8 Impact on fishing activity

Analysis of fishing activity near to Scapa Flow is given in Section 5.5. Through consultation with Orkney Fisheries it was established that fishing around the Orkney Islands is highly variable both in location and magnitude, however, fishermen; primarily potters, do work around the Scapa Flow test site close to shore. Whilst fishing can occur in the test site, generally fishermen choose to avoid the area due to the potential for surface and bottom hazards which could damage fishing gear through entanglement with devices such as creel lines or directly through trawling.

There have been no reported incidents of fishing gear being damaged on the test devices during active fishing. Once in location the devices are well marked and their location well promulgated reducing the chance of an incident. The deployment and maintenance of devices would necessitate the transit of vessels to and from the site which could pass through areas

of static gear deployment, potentially damaging them. This risk is mitigated by the marking of fishing gear.

8.9 Impact on recreational activity

Section 5.6 shows analysis of recreational activity from AIS data and RYA datasets. There are no marinas in the immediate vicinity of Scapa Flow, but the islands are an attractive cruising location, especially in the summer season. During consultation it was confirmed that few yachts make passage through this area and that no racing takes place around the devices. The nearest leisure harbour is Saint Mary's, but it is not heavily used by visiting yachts.

The Orkney Islands have a higher proficiency level of yachtsman as the area is isolated from the UK mainland and yachts must cross either the North Sea or Pentland Firth to reach the area.

8.10 Interaction with subsea cables

As described in Section 0, there are no known subsea cables within the test site which could pose risks to vessel anchors and fishing gear through snagging, as well as potentially damaging the cables.

8.11 Impact on search and rescue and emergency response

Given the small scale of the site, the continued operation of the test site is not anticipated to cause any significant impact on SAR operations.

A site-wide ERCoP is available which includes details of each device onsite. Each device should have a means of safe access in an emergency, if appropriate.

8.12 Cumulative and in-combination effects with other activities

Whilst Section 0 did not identify any existing conflicting marine activities in the test site, any new developments could result in a cumulative or in-combination effect on marine traffic.

No such new developments are anticipated close to the Scapa Flow test site.

9 Navigation risk assessment

9.1 Introduction and methodology

This NRA was commissioned to assess the impact on navigation potentially caused by continued operation of the test site and associated activities, including; installation, testing and decommissioning. The NRA is limited to identifying and quantifying any additional or increased navigational risk resulting from all stages of the project. It subsequently identifies possible mitigation measures where appropriate and makes recommendations.

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

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

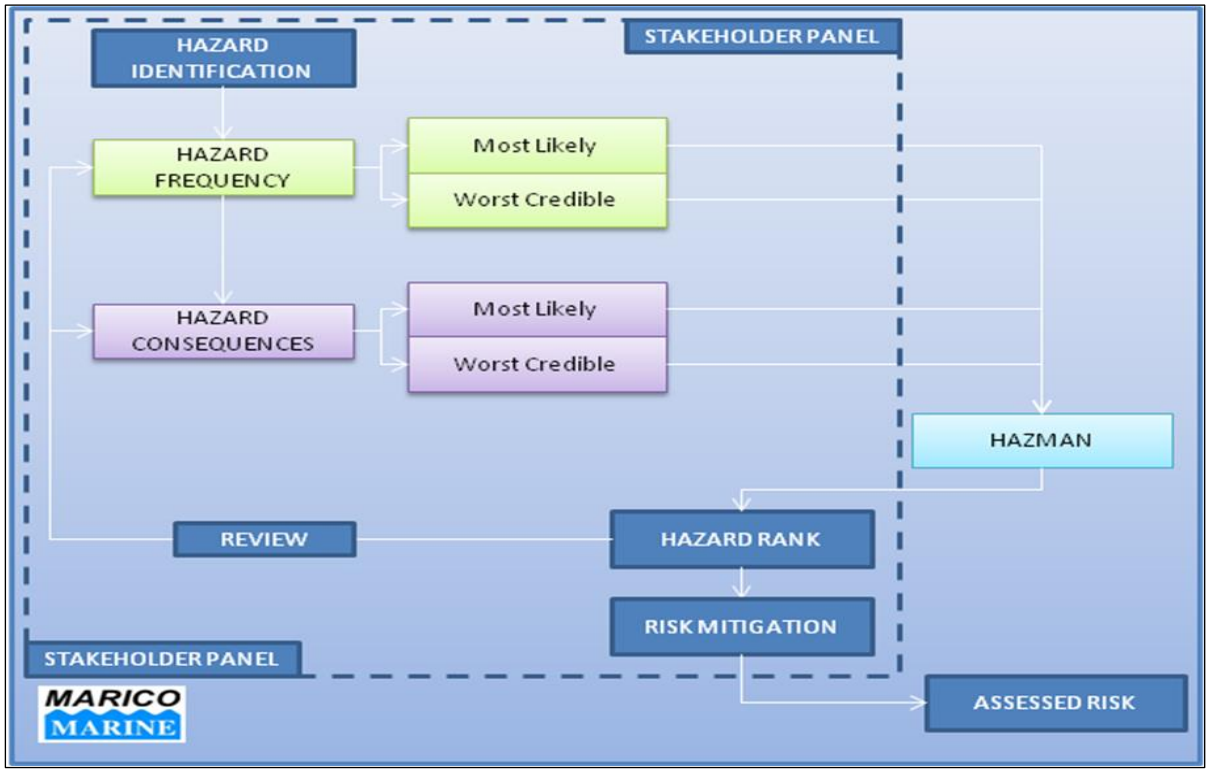

Figure 15: Marico Marine Risk Assessment Methodology

9.2 Hazard identification

The following hazard types were identified.

- **Collision** – two navigating vessels come into contact;

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

Vessel categories were defined as follows:

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

9.3 Risk control options

9.3.1 Marking and lighting requirements

Marking and lighting requirements for man-made offshore devices are described in IALA Recommendation O-139 (2013). Whilst the requirements for marking and lighting should be based on risk assessment, the document lays out the following recommendations:

- All surface piercing structures should be marked as:
    - Individual wave and tidal energy devices within a site that extend above the surface are painted yellow above the waterline;
    - If marked, the individual devices should have flashing yellow lights. The flash character of such lights must be sufficiently different from those displaying on the boundary lights with a nominal range of not less than 2 nautical miles; and
    - A single wave or tidal energy structure standing alone may be marked as either an isolated danger mark or a special mark.
- It is also recommended that:
    - Radar reflectors, retro-reflecting material, Racons and / or AIS transponders should be considered where the level of traffic and degree of risk requires it;
    - The lit Aid to Navigation (AtoN) must be visible to the mariner from all relevant directions in the horizontal plane, by day and night;
    - Any floating AtoNs should be located outside the moorings of the floating structures; and
    - AtoNs should comply with IALA Recommendations and have an appropriate availability, normally not less than 99% (IALA Category 2).

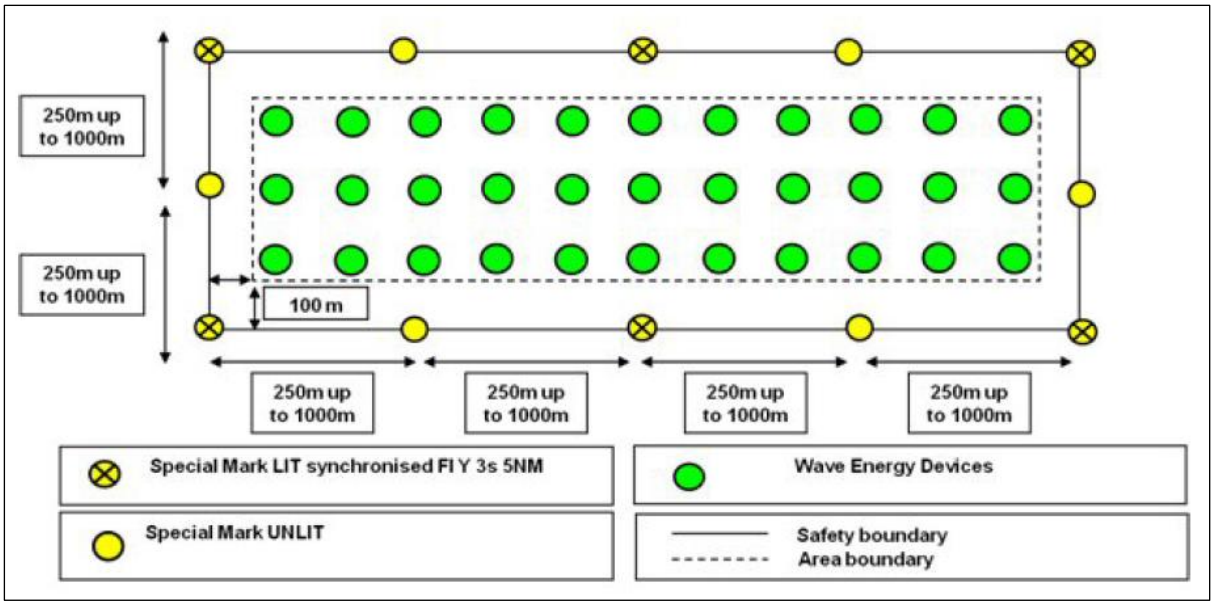

Figure 16: IALA recommendations on marking of wave and tidal devices

During consultation with the Northern Lighthouse Board, they stated that they would typically ask for the following on EMEC surface piercing devices:

- Yellow day marking/painting;
- Flashing yellow special mark light (Category 1);
- Day top mark (if deemed necessary);
- Radar reflector; and
- AIS AtoN.

Please note, AIS AtoN is mandatory on all floating devices located within EMEC's Scapa Flow test site.

Larger devices may require two lights at either end, with synchronised yellow lights. Light ranges are required to be at least three nautical miles. Lighting arrangements are considered on a case by case basis to properly account for the circumstances of each site and the proximity of other devices.

9.3.2 Site embedded risk controls

A number of risk controls are embedded at Scapa Flow as described within Table 6 and have been included in the risk assessment.

Table 6: Embedded Risk Controls

ID	Name	Description
1.	PPE Requirement	Maintenance teams to wear suitable PPE when working on the devices, including life jackets.
2.	Training of staff	Staff to be trained to the required standards for their work and have suitable local knowledge of regulations and operations in the Orkney Islands.

ID	Name	Description
3.	ERCoP	ERCoP for site to be developed and agreed with the MCA and SAR bodies to be consulted.
4.	NTM and Promulgation	In addition to NtM, EMEC's Maritime Safety Information Standard Operating Procedures (SOP) ensures that all key navigational consultees are informed prior to any works. Distribution could include HMCG, Orkney Harbours (available via Orkney Islands Council Marine Services website), Orkney Marina noticeboards (as necessary), Orkney Fisheries Association, Scottish Fisheries Federation and UKHO. Stakeholders are targeted with information about relevant devices based on their activities and location.
5.	Incident monitoring and reporting	EMEC to encourage incident/near miss reporting and monitor any safety issues at the test site. If necessary, risk control to be reviewed. Risk assessments to be reviewed following any incidents.
6.	EMEC Procedures	EMEC has a number of SOP and standards in place to reduce navigation risks, such as: • Task risk assessment; • Permit to work; • Permit to access site; • Hazard identification reporting; and • Maritime safety information.
7.	Hydrography	Contractual responsibility for developer to return the site to the original condition post-decommissioning.
8.	Charting	Site is marked on nautical charts.
9.	Site Monitoring	EMEC's SCADA system provides real-time status information, trends, alarms and remote-control access to facilitate a safe working environment, comprehensive assessment and safe operation of the sites. Note – only relevant if test support buoy is deployed
10.	Liaison with local stakeholders	EMEC regularly liaises with key local stakeholders to identify any potential issues as soon as possible. Regular updates include information regarding upcoming deployments and significant operations at the site.
11.	500m advisory ATBA	A 500m advisory ATBA exists around all test devices located at EMEC test sites.

9.4 Risk assessment

Full hazard logs are contained in Annex E.

Table 7 shows a summary risk assessment for Scapa Flow. All hazards were assessed to be low-risk with embedded mitigation in place.

Table 7: Scapa Flow summary risk assessment

ID	Hazard Title	Hazard Detail	Risk Score
5	Maintenance Vessel Contacts a Device	Project maintenance vessel contacts a device	2.74
10	Collision with Site Maintenance Vessel	A navigating vessel collides with a tug or maintenance vessel or construction/decommissioning vessel.	2.70
8	Third Party Collision Due to Avoidance of Site	Two navigating vessels (excluding project maintenance vessels) collide due to the presence of the site.	2.54
9	Third Party Grounding Due to Avoidance of Site	A navigating vessel (all types) grounds due to the presence of the site.	2.45
11	Grounding of Maintenance Vessel	A maintenance vessel grounds whilst on passage to/from the site	2.41
3	Fishing Vessel Contacts a Device	A fishing vessel (including workboats transiting to / from aquaculture site) contacts a device	2.30
4	Recreational Vessel Contacts a Device	A recreational vessel contacts with a device	2.28
12	Breakout of a Device from Moorings	A device's moorings fail, device becomes a hazard to navigation	1.91
7	Fishing Gear Interaction with a Device	A fishing vessel's gear interacts with a device or its moorings/cables.	1.91
1	Commercial Ship Contacts a Device	A commercial vessel such as a cargo vessel or tanker contacts with a device	1.90
2	Passenger Vessel Contacts a Device	A passenger vessel contacts with a device	1.82

9.5 Possible additional risk controls

Further additional risk controls identified during the assessment for device-specific implementation are listed within Table 8.

Table 8: Possible additional risk controls

ID	Name	Description
1.	Radar reflectors	Use of radar reflectors to improve marking during times of poor visibility.
2.	AIS	Use of AtoN AIS (or virtual AIS if permitted) fitted to all surface piercing devices to improve visibility to passing vessels. AIS should be Category 3 with at least 97% up time and use Message 21, or as directed by the NLB.
3.	Heightened monitoring in adverse met-ocean conditions	During gale force winds, periodic monitoring of the devices is recommended to ensure excessive forces are not acting on the moorings which might cause a breakout.
4.	Inspection and maintenance programme	Regular maintenance regime by developer to check the device, its fittings and any signs of wear and tear. This should identify any failings which might result in a mooring failure and breakout.
5.	GPS alert system for turbine moving	Remote monitoring of device to detect any major movements that might indicate a breakout for immediate response. Implement GPS excursion monitoring.

ID	Name	Description
6.	Marking and Lighting	Device to be lit to the requirements of NLB and marked in line with IALA guidance. Appropriate statutory sanctions must be in place to exhibit, alter or discontinue lighting.
7.	Tow risk assessment and passage plan	As required under Orkney Harbours Pilotage Directions 4(3)[11], prior to conducting a towing operation, a risk assessment and passage plan for the move should be conducted. The plan should account for the size of the tow, manoeuvrability restrictions, tow arrangements and met-ocean conditions.
8.	Guard vessels	During major construction or maintenance activities, a guard vessel may be considered to assist in protecting the devices from contacts with passing vessel traffic. Due to the low density of traffic, this is not considered necessary except for extraordinary circumstances. If guard vessels are to be used onsite, it is important that such vessels employed to guard the site follow appropriate guidelines, with clear instructions on when to intervene in a potential incident.
9.	Liaison with local stakeholders	Consultation should be undertaken with Orkney Islands Council Marine Services, the MCA and NLB prior to installation of device to confirm that adequate risk controls are in place. EMEC also conducts regular stakeholder consultation events to ensure that local marine users are aware of the pipeline of activity.
10.	Installation, maintenance and removal	All vessels undertaking activities on site should comply with EMEC standard operating procedures (Section 9.3.2). Vessels should be mindful of other navigating vessels and avoid disrupting the activities of others.
11.	ERCoP	Device-specific annex to be incorporated into site-wide ERCoP.

9.6 Summary

In summary, all hazards assessed in this NRA have been scored as low risk.

[11] Orkney Islands Council Competent Harbour Authority (2016) The Orkney Pilotage Direction 1988 (as amended 2007, 2010 and 2016).

10 Conclusions and recommendations

10.1 Conclusions

This site-wide NRA for EMEC's Scapa Flow test site has investigated the baseline conditions, possible future changes at the site and conducted a risk assessment for the continued operation of the test site. The following conclusions have been reached:

1. The Scapa Flow test site was established in 2011 as a wave energy test site and EMEC has successfully operated the site with a variety of devices tested since that date.
2. Met-ocean conditions in the area are relatively benign compared with the full-scale sites, with a prevailing south-westerly swell and south-westerly wind. Significant wave heights are generally < 1m. Poor visibility can occur regularly in the area. Tidal streams are not significant.
3. The area is within the limits of the Orkney Islands Council Marine Services and the VTS has full radar coverage of the site and adjacent commercial anchorages. A RNLI lifeboat is based in Longhope, Hoy.
4. No significant developments with the potential to impact the site have been identified.
5. Future exploitation of existing and planned lease areas to the west of the Orkney islands are unlikely to result in cumulative and in-combination effects.
6. Vessel traffic analysis was conducted using AIS, visual observations and secondary sources.
    a. There is very little commercial shipping activity through or near to the Scapa Flow test site, with the largest vessels excluded through the IMO adopted ATBA. There is no ferry traffic. However, very significant vessels anchor at nominated anchorage locations to the west of the site and may be engaged in STS hydrocarbon transfer operations. These activities are well regulated by the Statutory Harbour Authority.
    b. Some fishing vessels transit through the Scapa Flow test site, whereas static gear fishing is occasionally conducted close inshore at the site. Vessels supporting the adjacent fish farm are the most common passing traffic.
    c. Few recreational craft pass through or close to the Scapa Flow test site.
    d. The predominant vessel type in close proximity to devices in the test site are vessels associated with the renewables industry, transiting to and from the devices.
    e. Analysis of three years of visual observations also supported the AIS data analysis.
7. Analysis of MAIB incident data between 1997 and 2015 identified no incidents within or close to the test site.
8. The greatest changes in traffic patterns are related to maintenance vessels at the site, which varies depending on the level of site occupancy.
9. No established routes exist near the site. There is no anticipated future impact on vessel routeing.
10. Analysis of contact risk with the devices showed a very low likelihood of a passing or disabled vessel contacting a device. The most likely contact would involve a vessel operating on devices onsite such as installation, decommissioning and/or maintenance vessels.
11. The risks associated with the presence of the site were not considered to be increased due to the wind, wave and tides.
12. Given the low height profile of the devices which may be installed, the impact was not considered significant to SAR, visual navigation or communications, radar and positioning systems.

13. Mooring failure was identified as a possible hazard, particularly given the met-ocean conditions at the site, however, risk controls are already in place to prevent such an event.
14. An NRA was conducted which identified 11 hazards. By scoring the likelihood and consequence of each, it was determined that all hazards were low-risk.
15. A number of risk controls are already in place at Scapa Flow, and a number of additional risk controls were identified to enhance the safety of each additional device. The appropriateness of the implementation of additional risk controls should be considered on a case by case basis in consultation with the MCA and NLB.

10.2 Key navigational themes for device specific NRAs to consider

This NRA has identified the baseline conditions and key hazards at the Scapa Flow test site. Each developer should use this document to conduct a device-specific addendum NRA which references how these hazards may be impacted by the specific characteristics of their device. The following table is provided as a guide to developers.

Table 9: Device Specific NRA Criteria

Item	Title	Description	NRA Comment
Project Description			
1.	Description	Developer to provide a detailed description of the device, its dimension and location.	N/A
2.	Mooring Arrangements	Developer to provide details of the mooring arrangements for the device and confirm that they have been independently verified as adequate to the expected met-ocean conditions and loadings.	N/A
3.	Construction Methodology	Developer to provide a description of the installation process and methodology.	N/A
4	Maintenance Plans	Developer to provide outline maintenance plans and schedule.	N/A
5	Decommissioning Plan	Developer to provide outline decommissioning methodology.	N/A
Key Navigational Themes			
1	Vessel Routeing	Does the device impact the routeing of vessels in the area?	Scapa Flow is clear of major shipping routes and vessels currently transiting the site appear to be well aware of device deployment.
2	Contact/Allision Risk	Does the device pose a risk of contact to navigating vessels?	Few vessels navigate within the site and the use of device and site charting mitigates the risk of contact.
3	Effects of Tide/Tidal Streams and Weather	Does the device influence met-ocean conditions or is at risk as a result of these conditions?	No impact was identified as relates to the effect of tides and weather.
4	Under Keel Clearance	Does the device compromise a vessel's UKC?	This would have to be assessed on a device specific basis
5	Collision Risk and Visual Navigation	Does the device hinder visual identification of other vessels or key landmarks/aids to navigation?	The scale of the devices does not hinder visual navigation.
6	Communications, Radar and Positioning Systems	Does the device impact the communications, radar and positioning systems on board vessels or on land?	The scale of the devices is not likely to impact on electronic systems.
7	Moorings	Are the moorings sufficient for the device and the conditions?	This should be independently verified for each device.
8	Fishing Activity	Does the device impact upon the activity of fishing vessels?	Relatively little fishing takes place in the study area and fishermen would generally be expected avoid the underwater infrastructure of the site.

Item	Title	Description	NRA Comment
9	Recreational Activity	Does the device impact upon the activity of recreational vessels?	There is no racing or small boat sailing at the site, and few recreational vessels are recorded in the vicinity.
10	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?	There is no evidence of anchoring or gear snagging at Scapa Flow historically. No subsea cables are provided, but if necessary this should be reviewed in device specific assessments.
11	SAR	Does the device impact SAR capability and has access been considered in the design of the device?	There is not anticipated to be any impact on SAR access to the site given the small scale of the devices.
12	Cumulative and In Combination	Are there nearby devices which might exacerbate the impacts discussed above?	Cumulative effects depend on layout. No potential effects identified.
Risk Controls			
1	Site Wide Risk Controls	Are the site-wide risk controls sufficient for this type of device?	A list of site-wide risk controls is given in Section 9.3.2
2	Device Specific Risk Controls	Which additional risk controls are proposed to be in place for this device?	A possible list of device specific risk controls is given in Section 9.5.
3	Marking and Lighting	Have the marking and lighting arrangements been agreed with the MCA and NLB?	Marking and lighting guidance is given in Section 9.3.1

10.3 Summary

In summary, this NRA has demonstrated that the navigational risks at the Scapa Flow test site are managed below ALARP. It is recommended that this site NRA is updated periodically to account for any changes in traffic profile or site use.

11 References

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Annex A - Area to be Avoided NTM

Orkney Islands Council Harbour Authority – Notice to Mariners

EMEC – 17 September 2010

MARINE EXCURSIONS WITHIN THE EMEC TEST AREAS

1. Purpose

This SOP describes the requirements for excursion trips into any of the EMEC test areas.

2. Scope

This SOP applies to all passenger carrying vessels, whether organised, accompanied or recommended by EMEC, intending to enter EMEC test areas for the purposes of viewing the sites or for photography. In the event that a third party independently charters a vessel in order to enter the EMEC test areas, it is expected that these guidelines are followed.

It does not permit; contact or any form of interaction with any marine energy devices or buoys, surveys, crew transfers, deliveries or collections to/from devices or to/from working vessels – all of these activities are covered by the EMEC Site Access or Work Permit systems.

3. Vessel Requirements

Prior to a site visit; copies of the vessel MCA code certificate, insurance certificate and Master's qualifications shall be sent to EMEC and shall be electronically filed within EMEC systems for reference. Vessel documentation shall be reviewed by EMEC annually.

Vessels accessing the sites are expected to carry at least a working Class B AIS Transponder to permit tracking of vessel movements by EMEC Operations and Orkney VTS.

4. Excursion Guidelines

Passenger boarding shall take place only at harbour steps or a boat slip. Any loading of equipment or baggage shall be loaded under supervision of the vessel crew and shall be lowered by rope or hoist where required. The vessel master is at all times responsible for the safety and welfare of his crew and passengers. Safe weather limits shall be established for the trip by the master, taking into account the vessel capabilities, number of passengers, experience of the passengers and trip purpose. The vessel master shall review current Notices to Mariners. Vessels are requested to remain at least 500m from devices, unless permitted otherwise by the EMEC Duty Manager or developer.

MARINE EXCURSIONS WITHIN THE EMEC TEST AREAS

Wildlife are sensitive to noise and disturbance, particularly marine mammals which use the test sites as a habitat – due care is to be taken.

5. Passenger Briefing

The vessel master shall ensure that all passengers receive a safety briefing which shall include emergency procedures, exits, personal safety equipment, life rafts and an introduction to the nominated first aider.

6. Notifications

The EMEC Operations team (24 hr Duty Manager on 07624 345411 if out of hours) shall be notified prior to all visits in order to establish activity levels on site and to safely co-ordinate traffic. The vessel shall always notify the EMEC Duty Manager, normally by text, on site entry & egress (including total POB).

Annex B - MGN 543 Checklist

MGN 543 (M+F) Safety of Navigation: Offshore Renewable Energy Installations – Guidance on UK Navigational Practice, Safety and Emergency Response

Issue: OREI Response	Yes/No	Comments
Annex 1: Considerations on Site Position, Structures and Safety Zones		
1. Site and Installation Co-ordinates: Developers are responsible for ensuring that formally agreed co-ordinates and subsequent variations of site perimeters and individual OREI structures are made available, on request, to interested parties at relevant project stages, including application for consent, development, array variation, operation and decommissioning. This should be supplied as authoritative Geographical Information System (GIS) data, preferably in Environmental Systems Research Institute (ESRI) format. Metadata should facilitate the identification of the data creator, its date and purpose, and the geodetic datum used. For mariners' use, appropriate data should also be provided with latitude and longitude coordinates in WGS84 (ETRS89) datum.		
Traffic Survey – includes:		
All vessel types	✓	Vessel traffic analysis is contained in Section 5. All vessel types were considered.
At least 28 days duration, within either 12 or 24 months prior to submission of the Environmental Statement	✓	Details of the vessel traffic data are contained in Section 5.1. 18 Months of AIS data was analysed (2017-2018) and in addition visual observations were used to identify non-AIS vessels.
Multiple data sources	✓	Details of the vessel traffic data are contained in Section 5.1 and include AIS, visual and secondary sources.
Seasonal variations	✓	Details of the vessel traffic data are contained in Section 5.1. Datasets of several years' duration were used. Datasets cover summer and winter periods.
MCA consultation	✓	The MCA were consulted and details are contained in Section 0 and Annex D.
General Lighthouse Authority consultation	✓	The NLB were consulted and details are contained in Section 0 and Annex D.
Chamber of Shipping consultation	**X**	Given the low level of commercial shipping, no consultation was conducted with the Chamber of Shipping.
Recreational and fishing vessel organisations consultation.	✓	The RYA, Orkney Marinas and Orkney Fisheries Association were consulted and details are contained in Section 0 and Annex D.
Port and navigation authorities consultation, as appropriate	✓	The Orkney Islands Council Marine Services Harbour Master was consulted and details are contained in Section 0 and Annex D.

Issue: OREI Response	Yes/No	Comments
Assessment of the cumulative and individual effects of (as appropriate):		
i. Proposed OREI site relative to areas used by any type of marine craft.	✓	Vessel traffic analysis of all vessel types is contained in Section 5.
ii. Numbers, types and sizes of vessels presently using such areas	✓	Vessel traffic analysis of all vessel types is contained in Section 5.
iii. Non-transit uses of the areas, e.g. fishing, day cruising of leisure craft, racing, aggregate dredging, etc.	✓	Vessel traffic analysis of all vessel types is contained in Section 5. Fishing and recreational vessels transit passed the site.
iv. Whether these areas contain transit routes used by coastal or deep-draught vessels on passage.	✓	Vessel traffic analysis of all vessel types is contained in Section 5. No deep draught vessels transit passed close to the site.
v. Alignment and proximity of the site relative to adjacent shipping lanes	✓	Section 8.1 considers the routeing of vessels adjacent to the site.
vi. Whether the nearby area contains prescribed routeing schemes or precautionary areas	✓	Section 0 describes the marine environment in the area. There are no routeing schemes or precautionary areas.
vii. Whether the site lies on or near a prescribed or conventionally accepted separation zone between two opposing routes	✓	Section 0 describes the marine environment in the area and there are no traffic schemes.
viii. Proximity of the site to areas used for anchorage, safe haven, port approaches and pilot boarding or landing areas.	✓	Vessel traffic analysis of all vessel types is contained in Section 5.
ix. Whether the site lies within the jurisdiction of a port and/or navigation authority.	✓	The site within the port limits of Orkney Islands Council Marine Services (Section 0).
x. Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds.	✓	Analysis of fishing vessel activity is contained in Section 5.5. Fishing vessels are not active in the area of the site, although aquaculture support vessels are present.
xi. Proximity of the site to offshore firing/bombing ranges and areas used for any marine military purposes.	✓	There are no PEXA areas near the site (Section 4.4.5).
xii. Proximity of the site to existing or proposed offshore oil / gas platform, marine aggregate dredging, marine archaeological sites or wrecks,	✓	Section 0 identifies other offshore activities near the site, of which there are none.

Issue: OREI Response	Yes/No	Comments
Marine Protected Area or other exploration/exploitation sites.		
xiii. Proximity of the site to existing or proposed OREI developments, in co-operation with other relevant developers, within each round of lease awards.	✓	Section 0 identifies other offshore activities near the site.
xiv. Proximity of the site relative to any designated areas for the disposal of dredging spoil or other dumping ground	✓	Section 0 identifies other offshore activities near the site, of which there are none.
xv. Proximity of the site to aids to navigation and/or Vessel Traffic Services (VTS) in or adjacent to the area and any impact thereon.	✓	The site is within the port limits of Orkney Islands Council Marine Services (Section 0). VTS has full radar coverage of the site.
xvi. 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 8.1 discusses the impact on vessel routeing.
xvii. With reference to xvi. above, the number and type of incidents to vessels which have taken place in or near to the proposed site of the OREI to assess the likelihood of such events in the future and the potential impact of such a situation.	✓	Section 6 analyses historical incidents near the site using MAIB data, of which there are none in or close to the site boundaries
3. OREI Structures – the following should be determined:		
a. Whether any feature of the OREI, including auxiliary platforms outside the main generator site, mooring and anchoring systems, inter-device and export cabling could pose any type of difficulty or danger to vessels underway, performing normal operations, including fishing, anchoring and emergency response.	✓	The impact of the site on vessel contacts is given in Section 4). Given the low density of traffic, this risk is not considered significant. The risk assessment also did not identify this as a significant hazard (see Section 9.4). Section 0 does not identify any significant impact on emergency response capability.
b. Clearances of wind turbine blades above the sea surface are *not less than 22 metres* above MHWS.		N/A

Issue: OREI Response	Yes/No	Comments
c. Underwater devices i. changes to charted depth ii. maximum height above seabed iii. Under Keel Clearance	✓	Section 8.4 provides brief discussion of the impact on UKC. This should be assessed on a case by case basis for each device.
d. The burial depth of cabling and changes to charted depths associated with any protection measures.	✓	Not applicable at this site
4. Assessment of Access to and Navigation Within, or Close to, an OREI to determine the extent to which navigation would be feasible within the OREI site itself by assessing whether:		
a. Navigation within or close to the site would be safe:		
i. by all vessels, or ii. by specified vessel types, operations and/or sizes. iii. in all directions or areas, or iv. in specified directions or areas. v. in specified tidal, weather or other conditions	✓	Section 8.1 considers the impact on vessel routeing and concludes that most vessels would transit around the devices. For vessels within the site, sections 0 and 8.4 consider the impact on contact risk and UKC requirements and do not identify a significant risk. The risk assessment also did not identify this as a significant hazard (see Section 9.4).
b. Navigation in and/or near the site should be:		
i. prohibited by specified vessels types, operations and/or sizes. ii. prohibited in respect of specific activities, iii. prohibited in all areas or directions, or iv. prohibited in specified areas or directions, or v. prohibited in specified tidal or weather conditions, or simply **vi.** recommended to be avoided.	✓ ✓ ✓ ✓ ✓	Section 8.1 considers the impact on vessel routeing and concludes that most vessels would transit around the devices.
c. Exclusion from the site could cause navigational, safety or routeing problems for vessels operating in the area e.g. by preventing vessels from responding to calls for assistance from persons in distress.	✓	Section 8.1 considers the impact on vessel routeing and concludes the impact is minimal. Section 0 considers that there would be no impact to SAR capability at the site.

Issue: OREI Response	Yes/No	Comments
Relevant information concerning a decision to seek a safety zone for a particular site during any point in its construction, extension, operation or decommissioning should be specified in the Environmental Statement accompanying the development application	✓	Section 9.3 discusses risk control options, voluntary safety zones (areas to be avoided) exist around devices.
Annex 2: Navigation, collision avoidance and communications		
1. The Effect of Tides and Tidal Streams : It should be determined whether:		
a. Current maritime traffic flows and operations in the general area are affected by the depth of water in which the proposed installation is situated at various states of the tide i.e. whether the installation could pose problems at high water which do not exist at low water conditions, and vice versa.	✓	Section 4.1 provides current met-ocean data for the area and the implications of these are considered in Section 0 and Section 8.4. The only impact would be for subsurface devices and should be assessed on a case by case impact on UKC.
b. The set and rate of the tidal stream, at any state of the tide, has a significant effect on vessels in the area of the OREI site.	✓	Section 4.1 provides current met-ocean data for the area and the implications of these are considered in Section 0 and Section 8.4. The only impact would be for subsurface devices and should be assessed on a case by case impact on UKC.
c. The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect.	✓	Section 4.1 provides current met-ocean data for the area and the implications of these are considered in Section 0, which shows the impact is not significant.
d. The set is across the major axis of the layout at any time, and, if so, at what rate.		Section 4.1 provides current met-ocean data for the area and the implications of these are considered in Section 0, which shows the impact is not significant.
e. In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream.	✓	Section 8.2.2 considers the risk of a disabled vessel contacting the device. This is not considered to be significant.
f. The structures themselves could cause changes in the set and rate of the tidal stream.	✓	Section 0 does not identify that the devices would impact tidal flows, this should be assessed on a case by case basis for each design of device.
g. The structures in the tidal stream could be such as to produce siltation, deposition of sediment or scouring, affecting navigable water	✓	Section 0 does not identify that the devices would impact tidal flows, this should be assessed on a case by case basis for each design of device.

Issue: OREI Response	Yes/No	Comments
depths in the OREI or adjacent to the area		
2. Weather: It should be determined whether:		
a. The site, in normal, bad weather, or restricted visibility conditions, could present difficulties or dangers to craft, including sailing vessels, which might pass in close proximity to it.	✓	Section 4.1 provides current met-ocean data for the area and the implications of these are considered in Section 0, which show no significant impact.
b. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	✓	Section 4.1 provides current met-ocean data for the area and the implications of these are considered in Section 0, which show no significant impact.
c. In general, taking into account the prevailing winds for the area, whether engine failure or other circumstances could cause vessels to drift into danger, particularly if in conjunction with a tidal set such as referred to above.	✓	Section 8.2.2 considers the risk of a disabled vessel contacting the device. This is not considered to be significant.
3. Collision Avoidance and Visual Navigation: It should be determined whether:		
a. The layout design will allow safe transit through the OREI by SAR helicopters and vessels.	✓	The impact on SAR is considered in Section 0. This is not considered to be significant.
b. The MCA's Navigation Safety Branch and Maritime Operations branch will be consulted on the layout design and agreement will be sought.	✓	This is an identified risk control in Section 9.3.
c. The layout design has been or will be determined with due regard to safety of navigation and Search and Rescue.	✓	This is an identified risk control in Section 9.3.
d.i. The structures could block or hinder the view of other vessels under way on any route.	✓	Section 8.5 does not identify any impacts in this regard given the scale of the devices.
d.ii. The structures could block or hinder the view of the coastline or of any other navigational feature such as aids to navigation, landmarks, promontories, etc.	✓	Section 8.5 does not identify any impacts in this regard given the scale of the devices.

Issue: OREI Response	Yes/No	Comments
4. Communications, Radar and Positioning Systems - To provide researched opinion of a generic and, where appropriate, site specific nature concerning whether:		
a. The structures could produce radio interference such as shadowing, reflections or phase changes, and emissions with respect to any frequencies used for marine positioning, navigation and timing (PNT) or communications, including GMDSS and AIS, whether ship borne, ashore or fitted to any of the proposed structures, to: i. Vessels operating at a safe navigational distance ii. Vessels by the nature of their work necessarily operating at less than the safe navigational distance to the OREI, e.g. support vessels, survey vessels, SAR assets. iii. Vessels by the nature of their work necessarily operating within the OREI.	✓ ✓ ✓ ✓	Section 0 reviews the possible impacts on ship communications, radar and position systems. Given the scale of the devices this is not considered to be significant.
b. The structures could produce radar reflections, blind spots, shadow areas or other adverse effects: i. Vessel to vessel; ii. Vessel to shore; iii. VTS radar to vessel; iv. Racon to/from vessel.	✓ ✓ ✓ ✓ ✓	Section 0 reviews the possible impacts on ship communications, radar and position systems. Given the scale of the devices this is not considered to be significant.
c. The structures and generators might produce sonar interference affecting fishing, industrial or military systems used in the area.	✓	Section 0 reviews the possible impacts on ship communications, radar and position systems. Given the scale of the devices this is not considered to be significant.
d. The site might produce acoustic noise which could mask prescribed sound signals.	✓	Section 0 reviews the possible impacts on ship communications, radar and position systems. Given the scale of the devices this is not considered to be significant.
e. Generators and the seabed cabling within the site and onshore might produce electro-magnetic	✓	Section 0 reviews the possible impacts on ship communications, radar and position systems.

Issue: OREI Response	Yes/No	Comments
fields affecting compasses and other navigation systems.		Given the scale of the devices this is not considered to be significant.
5. Marine Navigational Marking: It should be determined:		
a. How the overall site would be marked by day and by night throughout construction, operation and decommissioning phases, taking into account that there may be an ongoing requirement for marking on completion of decommissioning, depending on individual circumstances.	✓	Section 0 gives an overview of current lighting and marking arrangements and Section 9.3 discusses future requirements.
b. How individual structures on the perimeter of and within the site, both above and below the sea surface, would be marked by day and by night.	✓	Section 0 gives an overview of current lighting and marking arrangements and Section 9.3 discusses future requirements. These would need to be assessed on a case by case basis.
c. If the specific OREI structure would be inherently radar conspicuous from all seaward directions (and for SAR and maritime surveillance aviation purposes) or would require passive enhancers.	✓	Section 9.3 discusses the benefit of the use of radar reflectors on the devices. These would need to be assessed on a case by case basis.
d. If the site would be marked by additional electronic means e.g. Racons	✓	Section 9.3 discusses the benefit of additional marking on the devices. These would need to be assessed on a case by case basis.
e. If the site would be marked by an AIS transceiver, and if so, the data it would transmit.	✓	Section 9.3 discusses the benefit of additional marking on the devices. These would need to be assessed on a case by case basis.
f. If the site would be fitted with audible hazard warning in accordance with IALA recommendations	✓	Section 9.3 discusses the benefit of additional marking on the devices. These would need to be assessed on a case by case basis.
g. If the structure(s) would be fitted with aviation lighting, and if so, how these would be screened from mariners or guarded against potential confusion with other navigational marks and lights.	✓	Section 9.3 discusses the benefit of additional marking on the devices. These would need to be assessed on a case by case basis.
h. Whether the proposed site and/or its individual generators complies in general with markings for such structures, as required by the relevant GLA in consideration of	✓	Section 9.3 discusses the benefit of additional marking on the devices. These would need to be assessed on a case by case basis.

Issue: OREI Response	Yes/No	Comments
IALA guidelines and recommendations.		
i. The aids to navigation specified by the GLAs are being maintained such that the 'availability criteria', as laid down and applied by the GLAs, is met at all times.	✓	Section 9.3 discusses the marking requirements and these would need to be assessed on a case by case basis.
j. The procedures that need to be put in place to respond to casualties to the aids to navigation specified by the GLA, within the timescales laid down and specified by the GLA.	✓	Section 9.3 discusses the marking requirements and these would need to be assessed on a case by case basis.
k. The ID marking will conform to a spreadsheet layout, sequential, aligned with SAR lanes and avoid the letters O and I.	✓	Section 9.3 discusses the marking requirements and these would need to be assessed on a case by case basis.
l. Working lights will not interfere with AtoN or create confusion for the Mariner navigating in or near the OREI.	✓	Section 9.3 discusses the marking requirements and these would need to be assessed on a case by case basis.
6. Hydrography - In order to establish a baseline, confirm the safe navigable depth, monitor seabed mobility and to identify underwater hazards, detailed and accurate hydrographic surveys are included or acknowledged for the following stages and to MCA specifications:		
i. Pre-consent: The site and its immediate environs extending to 500m outside of the development area shall be undertaken as part of the licence and/or consent application. The survey shall include all proposed cable route(s).	✓	N/A as the site has already been established.
ii. Post-construction: Cable route(s)	✓	N/A as the site has already been established.
iii. Post-decommissioning of all or part of the development: Cable route(s) and the area extending to 500m from the installed generating assets area.	✓	Individual developers commit to a post-decommissioning survey as per their marine licence and berth agreement to demonstrate the seabed is in the condition prior to development.
Annex 3: MCA template for assessing distances between OREI boundaries and shipping routes		
"Shipping Route" template and Interactive Boundaries – where appropriate, the following should be determined:		

Issue: OREI Response	Yes/No	Comments
a. The safe distance between a shipping route and turbine boundaries.	✓	Section 8.1 considers the impact on vessel routeing, however the MCA shipping route template is not considered appropriate for a test site.
b. The width of a corridor between sites or OREIs to allow safe passage of shipping.	✓	Section 8.1 considers the impact on vessel routeing and that there is considerable sea room around the site. Few vessels transit within the site but the proximity of devices should be considered on a case by case basis.
Annex 4: Safety and mitigation measures recommended for OREI during construction, operation and decommissioning.		
Mitigation and safety measures will be applied to the OREI development appropriate to the level and type of risk determined during the EIA. The specific measures to be employed will be selected in consultation with the Maritime and Coastguard Agency and will be listed in the developer's Environmental Statement (ES). These will be consistent with international standards contained in, for example, the SOLAS Convention - Chapter V, IMO Resolution A.572 (14)3 and Resolution A.671(16)4 and **could include any or all** of the following:	✓	Section 9.3 provides an overview of all existing and possible future risk controls for the devices at the site.
i. Promulgation of information and warnings through notices to mariners and other appropriate maritime safety information (MSI) dissemination methods.	✓	Section 9.3 provides an overview of all existing and possible future risk controls for the devices at the site.
ii. Continuous watch by multi-channel VHF, including Digital Selective Calling (DSC).		
iii. Safety zones of appropriate configuration, extent and application to specified vessels[12]		
iv. Designation of the site as an area to be avoided (ATBA).	✓	See Section 0.

Issue: OREI Response	Yes/No	Comments
v. Provision of AtoN as determined by the GLA	✓	Marking and lighting arrangements are given in Section 9.3 but should be agreed on a case by case basis for each individual device.
vi. Implementation of routeing measures within or near to the development.	✓	Section 9.3 provides an overview of all existing and possible future risk controls for the devices at the site. Traffic routeing is not considered necessary.
vii. Monitoring by radar, AIS, CCTV or other agreed means	✓	Section 9.3 provides an overview of all existing and possible future risk controls for the devices at the site.
viii. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of safety zones.	✓	Section 9.3 provides an overview of all existing and possible future risk controls for the devices at the site.
ix. Creation of an Emergency Response Cooperation Plan with the MCA's Search and Rescue Branch for the construction phase onwards.	✓	Section 9.3 provides an overview of all existing and possible future risk controls for the devices at the site.
x. Use of guard vessels, where appropriate	✓	Section 9.3 provides an overview of all existing and possible future risk controls for the devices at the site.
xi. Any other measures and procedures considered appropriate in consultation with other stakeholders.	✓	Section 9.3 provides an overview of all existing and possible future risk controls for the devices at the site.
Annex 5: Standards, procedures and operational requirements in the event of search and rescue, maritime assistance service counter pollution or salvage incident in or around an OREI, including generator/installation control and shutdown.		
The MCA, through HM Coastguard, is required to provide SAR and emergency response within the sea area occupied by all offshore renewable energy installations in UK waters. To ensure that such operations can be safely and effectively conducted, certain requirements must be met by developers and operators.		
a. An ERCoP will be developed for the construction, operation and decommissioning phases of the OREI.	✓	Section 9.3 provides an overview of all existing and possible future risk controls for the devices at the site.
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.	✓	Checklist has been completed.

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

General Comments:

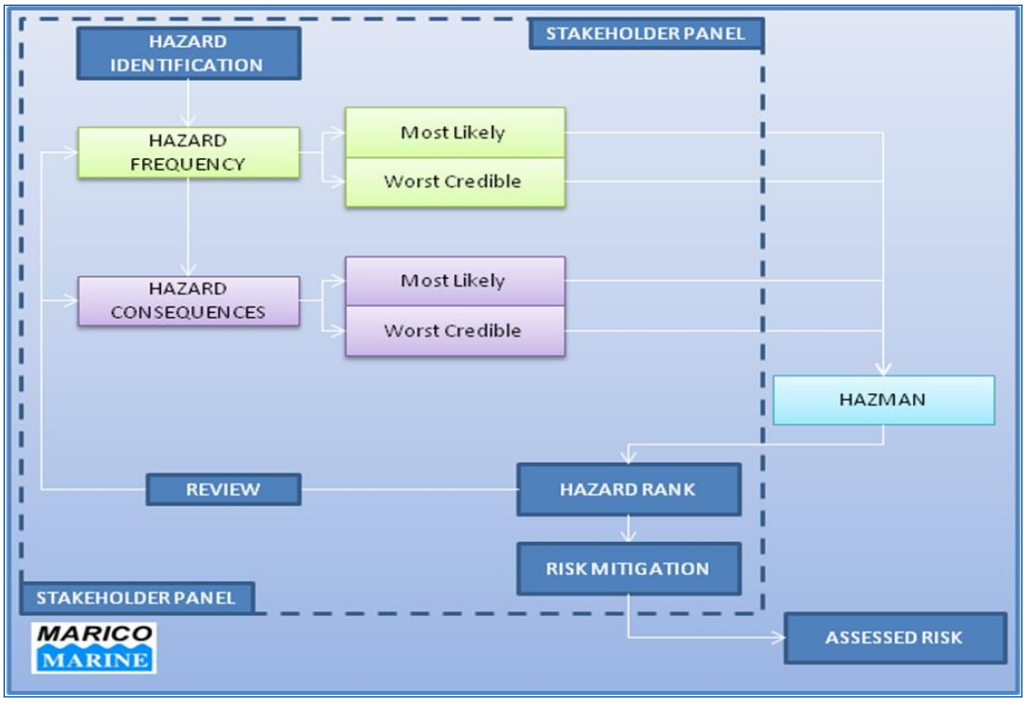
Section	Compliant Yes/No	Comments
A1: Reference Sources - Lessons learned.	✓	A list of guidance documents followed in this assessment is given in Section 0.
B1: Base case traffic densities and types.	✓	Baseline traffic analysis is given in Section 5.
B2: Future traffic densities and types.	✓	A discussion of possible future traffic profiles is given in Section 7.
B3: The marine environment:		
B3.1 Technical & operational analysis	✓	An overview of the site is given in Section 2.
B3.2 Generic TOA	✓	N/A
B3.3 Potential accidents	✓	All relevant hazards identified in Section 9.2
B3.4 Affected navigational activities	✓	All relevant hazards identified in Section 9.2
B3.5 Effects of OREI structures	✓	All relevant hazards identified in Section 9.2
B3.6 Development phases	✓	As this NRA is site wide, no phasing is considered.
B3.7 Other structures & features	✓	The NRA has included impacts on other marine users, described throughout Section 8
B3.8 Vessel types involved	✓	All relevant hazards identified in Section 9.2
B3.9 Conditions affecting navigation	✓	Met-ocean conditions effecting navigation have been identified in Section 4.1
B3.10 Human actions	✓	All relevant hazards identified in Section 9.2
C1: Hazard Identification	✓	All relevant hazards identified in Section 9.2
C2: Risk Assessment	✓	A risk assessment has been conducted in Section 9.4 using the methodology described in Annex C
C3: Influences on level of risk	✓	A risk assessment has been conducted in Section 9.4 using the methodology described in Annex C

Section	Compliant Yes/No	Comments
C4: Tolerability of risk	✓	A risk assessment has been conducted in Section 9.4 using the methodology described in Annex C
D1 : Appropriate risk assessment	✓	This NRA has been conducted in compliance with the guidance and is proportional to the level of risk at the site.
D2 : MCA acceptance for assessment techniques and tools	✓	The methodology has been discussed with the MCA.
D3: Demonstration of results	✓	The results are shown in Section 9.4 and Annex E
D4 : Area traffic assessment	✓	A baseline and future case assessment of vessel traffic is contained in Section 5 and Section 7.
D5 : Specific traffic assessment	✓	A review of impacts of traffic are throughout Section 8.
E1 : Risk control log	✓	Risk controls are described in Section 9.3.
E2 : Marine stakeholders	✓	Consultation with stakeholders has been conducted and is described in Section 0 and Annex D
F1 : Hazard identification checklist	✓	All relevant hazards identified in Section 9.2
F2 : Risk control checklist	✓	Risk controls are described in Section 9.3.

Annex C - NRA Methodology

Methodology

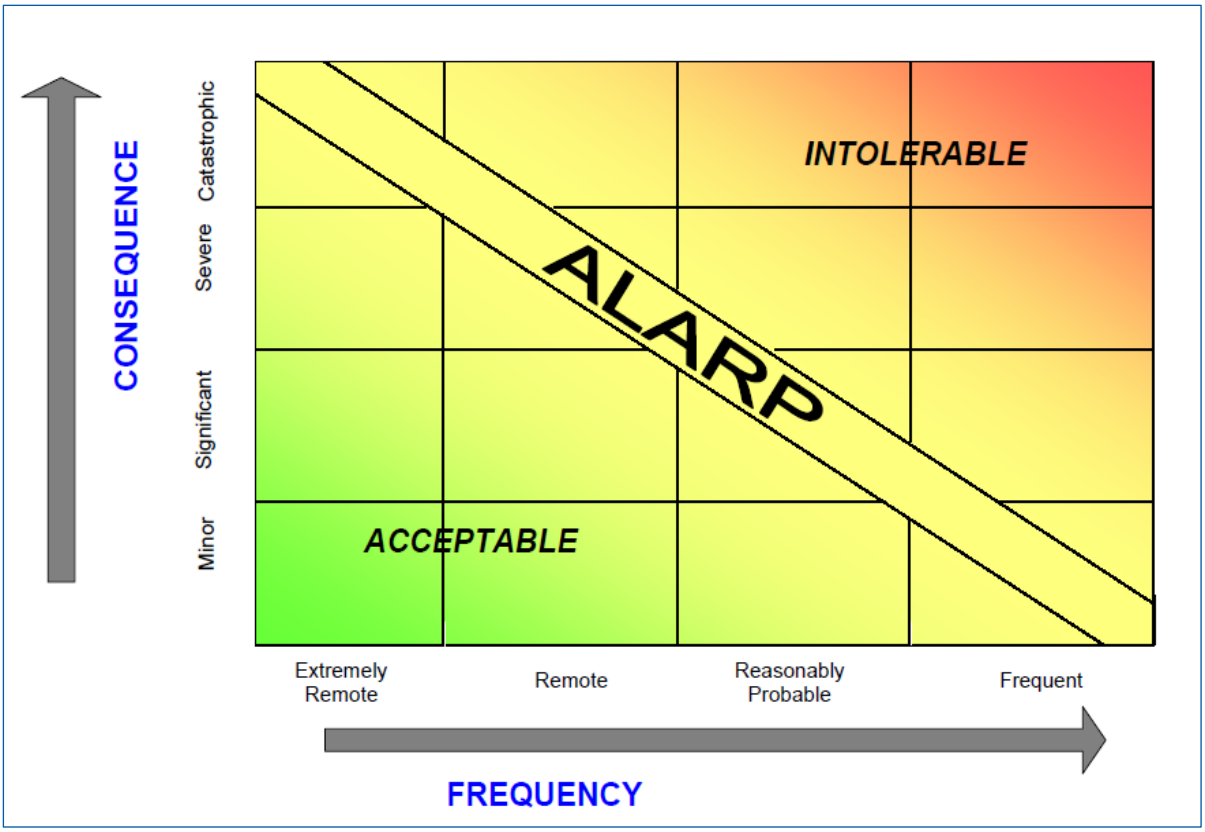
This Navigation Risk Assessment (NRA) was commissioned to assess the impact on navigation potentially caused by the continued operation of the test site and associated activities, including the installation, testing and decommissioning of devices. The NRA is limited to identifying and quantifying any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



Marico Marine Risk Assessment Methodology.

Criteria for Navigational Risk Assessment

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



General risk matrix.

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

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

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

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

Hazard Identification

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

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

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

- **Collision** – two navigating vessels come into contact;
- **Contact/Allision** – a navigating vessel comes into contact with a fixed or stationary object;
- **Grounding** – a navigating vessel makes contact with the seabed;
- **Obstruction** – A vessel or its equipment becomes entangled with subsurface infrastructure, including moorings or cables;
- **Breakout –** Device breaks its moorings and becomes a hazard to shipping or runs aground;
- **Personal Injury –** Maintenance activities result in a person injured or overboard.

The vessel types considered were:

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

Risk Matrix Criteria

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

Frequency criteria.

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

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

- People - Personal injury, fatality etc.;
- Property – Project and third party;
- Environment - Oil pollution etc.; and
- Business - Reputation, financial loss, public relations etc.

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

Consequence categories and criteria.

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

Hazard Data Review Process

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

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

Risk factor matrix used for hazard assessment.

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

Where:

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

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

Hazard Ranking

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

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

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

Mitigation

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

Annex D - Consultation Minutes

Minutes – EMEC NRAs – 18UK1461

Client:	EMEC	
Project:	18UK1461	
Attendees:	Helen Croxson (HC)	MCA
	Caitlin Long (CL)	EMEC
	Andrew Rawson (AR)	Marico Marine
	William Heaps (WH)	Marico Marine
Venue:	Spring Place, Southampton	
Date of Meeting:	13:30 to 14:30 19th September 2018	

Item	Action item / Notes for the record	Action
1	**Introduction**	
2	**Overview**	
2.1	AR gave an overview of the NRAs, consultation and work to date.	
3	**Licensing Requirements**	
3.1	HC described her involvement with the EMEC projects, in her previous role in MCA with licensing and more recently as OREI advisor.	
3.2	CL provided an overview of the licensing of the sites. EMEC have a Section 36 envelop for Fall of Warness and are applying for the same license for Billia Croo. For the main sites at Fall of Warness/Billia Croo – generally each developer applies for their own marine license. For the smaller scale test sites, either the developer can apply for their own marine license or if it falls within EMEC's envelope they can use the existing marine license.	
3.3	MCA had requested that EMEC update the NRAs due to the age of the documents. CL/HC were not aware of a specific reference in the licenses as to how regularly the NRAs should be updated, however HC said she believed the site wide NRAs should be updated every two years. It was agreed that it would be sensible to update at regular intervals, and this should be checked	
4	**NRA Requirements and Structure**	
4.1	AR questioned how the site wide NRAs and device specific NRAs should relate and the difference in their contents. It was agreed that the site wide NRAs should be full MGN 543 compliant NRAs, including traffic analysis, consultation and risk assessment covering all aspects of the sites. The device specific NRA addendums should cover the aspects which cannot be detailed at this stage: • Mooring arrangements • UKC impacts • Marking and Lighting • Account for any key changes in traffic profile beyond that in the full NRAs	

	• Proximity/presence of other devices within the site • How the devices will be installed/decommissioned These addendums should also consult with MCA and NLB.	
4.2	The requirements for vessel traffic surveys was discussed. AR explained the datasets gathered, including visual observations, and how this would fill the gaps in an AIS only assessment. CL stated that all assessments should be fully MGN 543 compliant and that any deviation from this is made clear, with the reasons why, and any deviations must be agreed by MCA. CL recommended that the NRAs make clear how this data gap has been addressed	
4.3	AR questioned whether the hydrographic data element of MGN 543 was required in an NRA update. HC and CL will both review their licensing documentation to establish whether there is a requirement or this is covered.	HC/CL
4.4	The process of NRA update submission was discussed. CL agreed that the reports will be issued to NLB/MCA with a Marine Scotland review. The submission of Billia Croo NRA, with the extension, will come through official channels.	
5	**Under Keel Clearance of Devices**	
5.1	For bottom/non-surface piercing devices, the UKC calculations were discussed, in relation to MCA guidance documents.	
5.2	It was confirmed that there was no specific guidance on how these calculations (e.g. significant wave height return periods) should be conducted but that they should account for local conditions and reflect the feedback from consultees. Information on UKC is available on MCA's website.	
5.3	WH described the feedback from consultees, many would assume doubling their operational draught or avoid the devices entirely, given the significant available sea room and low traffic density.	
6	**Navigational Issues of each site**	
6.1	A general discussion of each site and the feedback of consultees was discussed. AR reported that no issues had been reported by any of the consultees at each site and that specific comments would be fed into the NRAs.	
6.2	The extension to Billia Croo was not suggested to have a significant impact upon navigation given the alignment with traffic, marking arrangements and prior establishment.	

Minutes – EMEC NRAs – 18UK1461

Client:	EMEC	
Project:	18UK1461	
Attendees:	Peter Douglas (PD)	NLB
	Adam Lewis (AL)	NLB
	Caitlin Long (CL)	EMEC
	Andrew Rawson (AR)	Marico Marine
	William Heaps (WH)	Marico Marine
Venue:	Teleconference	
Date of Meeting:	10:00 to 11:00 21st September 2018	

Item	Action item / Notes for the record	Action
1	**Introduction**	
2	**Overview**	
2.1	AR gave an overview of the NRAs, consultation and work to date.	
3	**General Lighting and Marking Requirements**	
3.1	PD explained that NLB would typically ask for the following on surface-piercing EMEC devices: • Yellow Day Marking/Painting • Flashing yellow special mark light • Day top mark (if deemed necessary) • Radar Reflector AIS AtoN if practical	
3.2	PD described the lighting requirements for devices. Some of the longer devices may require two lights at either end, both of which are synchronised yellow lights. These allow redundancy in case of failure of one of the lights. Previously a 2nm range was required, this has since been increased to 3nm based on feedback from local stakeholders. There is no requirement for separate devices' lights to be synchronised within a site. E.g. at the Fall of Warness, one device has a 5 second period and one has a 3 second period. This could allow for navigators to differentiate between different devices. The NLB would include in the sanction letter the availability requirements, this is typically Category 1 with a 99.8% uptime for lights, and Category 3 (97%) for AIS AtoN.	
3.3	NLB would usually comment on lighting and marking during the due process of a marine license. Typically, developers would come to the NLB beforehand to discuss the requirements as this would need to be accounted for in the design of the device. If the device was covered by EMEC's Section 36 envelope, EMEC would discuss with NLB the requirements and feed this back to the developers.	
3.4	The test support buoys in the scale sites are marked with special yellow marks and this is considered appropriate.	
4	**Billia Croo and Extension**	

4.1	The current and passed marking at Billia Croo was discussed. The NLB maintain the five cardinal marks at Billia Croo, with annual inspections given the adverse conditions at the site to ensure the condition and moorings are not fatigued. There used to be an inshore mark due to the presence of a device in the inshore berths, however this has been removed due to the conditions which often caused this mark to be damaged/breakout.	
4.2	The routes passing the site and the use of the cardinals to divert traffic around the site were discussed. AIS analysis showed little evidence of vessels passing through the extension area given the orientation of traffic flows with the existing site.	
4.3	The requirements of the extension were discussed. Given the orientation of traffic, it may be possible to have a single west cardinal mark marking the western extent and a single northern cardinal marking the northern extent. This should be reviewed as part of the NRA as to how the positioning could achieve the removal of one of the western cardinals without allowing vessels to navigate over sub-surface devices.	
5	**Other Navigational Considerations**	
5.1	The promulgation of activities was discussed, and it was noted that it was difficult to work out exactly what was in place at each site at any particular time. AR explained that local consultees had raised the same issue.	

Minutes – EMEC NRAs – 18UK1461

Client:	EMEC	
Project:	18UK1461	
Attendees:	Andrew Blake (AB)	Orkney Ferries
	Glenn Porter (GP)	Orkney Ferries
	John Cowie (JC)	Orkney Ferries
	Caitlin Long (CL)	EMEC
	John Skuse (JS)	EMEC
	Andrew Rawson (AR)	Marico Marine
	William Heaps (WH)	Marico Marine
Venue:	Orkney Ferries, Kirkwall	
Date of Meeting:	09:30 to 10:30 30th August 2018	

Item	Action item / Notes for the record	Action
1	**Introduction**	
2	**Overview**	
2.1	AR gave an overview of the NRAs.	
3	**Fall of Warness**	
3.1	Ferries would enter the Fall of Warness site during strong south easterly winds and flood tides for safety and passenger comfort. Vessels would pass close to the monopile of OpenHydro and then passing inshore, close to the Scotrenewables device.	
3.2	Route would be used all year round, in all conditions and visibilities.	
3.3	In particular rough conditions, ferries would pass to the west and north of Eday. On occasions, crossings would be cancelled due to the weather.	
3.4	Ferries would not be concerned with new devices provided they were clearly marked and appropriate lit. Smaller devices may be hard to see in the rough conditions.	
3.5	Other vessels in the area include offshore supply vessels making passage through the sheltered waters and cruise ships and small passenger vessels. Routes include Iceland and the Faroe Islands. Recently the Dutch Royal Yacht passed through the Fall of Warness.	
3.6	It was noted that the Westray South tidal array, if developed, could squeeze ferry traffic towards the EMEC site or the shores. This combination effect should be included in the NRAs.	
3.7	It was agreed that the current EMEC devices and arrangements do not cause Orkney Ferries any concerns. At present an advisory safety zone of 500m exists around all the devices with the exception of 300m for Orkney Ferries.	
3.8	Notice to Mariners are well received and disseminated to all ferries.	
3.9	Exceptional local knowlwdge of crews, with very little turnover of staff meaning knowledge is retained.	
3.10	Radar returns of devices are generally good except in very poor weather however the bridge teams know where the devices are.	

3.11	Question over UKC, typical draft is 3.25m however UKC should be significant given the effect of the swell.	
3.12	AR to examine PEXA charts to determine if the Orkneys is an official military exercise area, however it is known that several naval vessels have transited through the islands.	AR
3.13	Future changes in traffic – no planned changes to vessel routes, however timetables may alter as part of general reviews. Possibility of increased activity associated with hydrogen industry but this is unlikely. Several new fish farm applications had been made.	
3.14	The advisory exclusion zone was recognized to be useful and does not impact the ferry routes.	
4	**Other sites**	
4.1	In general, no concerns about any other sites as ferries pass well clear of them.	

Minutes – EMEC NRAs – 18UK1461

Client:	EMEC	
Project:	18UK1461	
Attendees:	Fiona Matheson (FM)	Orkney Fisheries
	Caitlin Long (CL)	EMEC
	Jonathan Lindsay (JL)	EMEC
	Andrew Rawson (AR)	Marico Marine
	William Heaps (WH)	Marico Marine
Venue:	Orkney Fisheries Association, Kirkwall	
Date of Meeting:	11:00 to 12:30 29th August 2018	

Item	Action item / Notes for the record	Action
1	**Introduction**	
2	**Overview**	
2.1	AR gave an overview of the NRAs, FM gave an overview of Orkney Fisheries.	
2.2	Discussion of the importance of the Orkney Fishing Industry, impacts of wider trends in international trade. Annual fluctuations in the demand for certain catches changes the spatial locations and dynamic of fishing in the area.	
2.3	Fishing vessels are based throughout the Orkneys, fishing is conducted all year round, for a variety of catches and in a variety of places. Shellfish is a key catch in the Orkneys.	
2.4	Whilst there is some voluntary resting of sites, management of the fisheries is limited to minimum landing sizes.	
2.5	CL provided an overview of the planned devices likely to be on station at each of the test sites.	
3	**Fall of Warness**	
3.1	Layout of site to avoid 30m contour to avoid inshore Scallop Diving.	
3.2	Mostly Creel fishing in the area, some diving.	
4	**Shapinsay Sound**	
4.1	More pressure in winter due to reduced steaming time from Kirkwall and more sheltered site.	
4.2	Mostly Creel	
5	**Scapa Flow**	
5.1	No issues reported, little fishing in the area, occasional scallop dredging.	
6	**Billia Croo**	
6.1	Extension would increase steaming time around the site for navigating vessels. Increased transit time would exacerbate fatigue for returning fishermen which may increase the chance of an incident.	

6.2	Inshore route was a lee shore with significant wave reflection off the cliffs which made the passage hazardous during adverse weather. Vessels would therefore keep offshore in these conditions.	
6.3	The proposed extension was discussed, likely opposition from fishing community due to loss of fishing grounds.	
6.4	Fishermen avoid the site due to potential surface hazards and bottom hazards, such as debris left post decommissioning on the seabed.	
6.5	Fishing gear left inshore at Billia Croo for storage and would be moved offshore when strong winds forecast to avoid damage on the rocks.	
7	**General Discussion of Impacts**	
7.1	It was recognized that fishermen could fish in the EMEC test sites, although many avoided the sites due to potential interactions with devices or cables.	
7.2	Previous instances of loss of gear to contractor's vessels. However, recognized that most regular contractors were aware of the fishermen and their gear and so avoided them. CL asked that any specific instances of gear being cut by contractors is reported to her.	
7.3	No history of contacts between vessels and devices or snagging.	
7.4	Devices are well marked and charted, no issues of poorly visible devices reported by fishermen.	
7.5	Notice to Mariners – well distributed but information overload from multiple notices which makes it hard to understand which are relevant or current. The merits of a centralized store were discussed.	
7.6	Recognised that the sites had existed for many years and all local fishermen were aware of the sites, locations and types of devices installed.	
7.7	Impacts of surveys were highlighted, little notice had been giving for seismic surveys for cable routes that required moving a significant number of static gear.	
7.8	General concern on post-decommissioning debris littering the seabed and causing snagging hazard.	
7.9	Discussion on Electromagnetic Field impact on brown crab, but very localized (a few metres) from the cable and unlikely to be significant from the current used by EMEC.	

Minutes – EMEC NRAs – 18UK1461

Client:	EMEC	
Project:	18UK1461	
Attendees:	Brian Kynoch (BK)	Orkney Marinas
	Caitlin Long (CL)	EMEC
	John Skuse (JS)	EMEC
	Andrew Rawson (AR)	Marico Marine
	William Heaps (WH)	Marico Marine
Venue:	Jewsons, Kirkwall	
Date of Meeting:	11:00 to 12:00 30th August 2018	

Item	Action item / Notes for the record	Action
1	**Introduction**	
2	**Overview**	
2.1	AR gave an overview of the NRAs,	
2.2	BK gave an overview of Orkney Marinas, with three locations at Stromness, Kirkwall and Westray. Kirkwall marina opened in 2004 and there has been a notable increase in recreational traffic since then.	
2.3	BK would provide visitor numbers and statistics. 770 boats in 2017, 50% from the UK, rest is international (mostly European).	BK
3	**Shapinsay Sound**	
3.1	Little recreational activity, except on transit to Kirkwall.	
3.2	Annual round Shapinsay Race brought vessels through the Sound, however all other racing is done inside Kirkwall Bay.	
4	**Fall of Warness**	
4.1	Passage making recreational yachts use this route but no impacts reported by other users.	
4.2	Recognised importance of inshore traffic route to vessels, this route is often used for yachts on passage to Westray.	
4.3	BK questioned the exclusion area, was noted that 500m advisory area around each device and not from the test site as a whole.	
4.4	Whilst the site has significant tidal conditions, yachts would plan their passages to avoid the worst conditions.	
5	**Scapa Flow**	
5.1	Area is little used by yachts.	
5.2	A slipway, jetty and sailing club are located at St Marys but are not particularly active.	
5.3	Fish farms to the north are the key user close to the device.	
6	**Billia Croo**	
6.1	Yachts on passage would pass near the site.	

6.2	Both inshore and offshore routes are used, the inshore route can be treacherous when conditions are not right, forcing vessels to stay outside the EMEC site.	
6.3	The extension was discussed, no issues were identified as long as the inshore route remained open and the site is well marked.	
6.4	Most small boat activity is limited to inside Stromness Harbour.	
6.5	BK had noticed a trend for larger yachts at the marina, a minimum draft of 2m is maintained.	
7	**General Comments**	
7.1	Valued the increased awareness that leaflets and charts gave of what was happening at each EMEC test site so that these could be put on websites and disseminated to recreational users.	
7.2	Noticeboards at each marina which provide notice to mariners and info on EMEC. The sites are all marked on charts and are therefore well known to local and visiting yachtsman.	
7.3	Foreign visitors particularly research the Orkneys using the Orkney Marine Services website and the Clyde Cruising Club.	
7.4	A future planned expansion to Stromness marina is being planned.	
7.5	The recent data on recreational activity may be impacted by the works at Westray Pier which has limited recreational access to that marina.	

Minutes – EMEC NRAs – 18UK1461

Client:	EMEC	
Project:	18UK1461	
Attendees:	Brian Archibald (BA)	Orkney Marine Services
	Caitlin Long (CL)	EMEC
	Jonathan Lindsay (JL)	EMEC
	Andrew Rawson (AR)	Marico Marine
	William Heaps (WH)	Marico Marine
Venue:	Orkney Marine Services, Scapa	
Date of Meeting:	13:30 to 14:30 29th August 2018	

Item	Action item / Notes for the record	Action
1	**Introduction**	
2	**Overview**	
2.1	AR gave an overview of the NRAs.	
3	**Billia Croo**	
3.1	Site is not in harbour limits but is covered by CCTV and Radar and VTS operators informally monitor the site.	
3.2	The buoyage was discussed, BA preferred that the buoys are moved to the new extremities and the number is not reduced.	
3.3	The extension is the in line with the existing footprint and clear of the main traffic routes in/out of Stromness, most vessels keep clear.	
3.4	Most small boat traffic would take the inshore route, unless the weather was rough in which case they would stay further offshore or remain in the harbour.	
3.5	Possible that some visiting yachtsman would be unaware of the site however the site is well marked so this is mitigated.	
3.6	Pilotage required into Stromness for vessels greater than 80m, tows and passenger vessels greater than 65m. The ferries and NLB have PEC. Very few other large vessels would pass near to the site as they would typically approach from the south.	
3.7	VTS would broadcast key movements in and out of Stromness but unless the vessels were involved with Billia Croo site, they would not generally inform other traffic about EMEC activities.	
3.8	In general, the increase in the footprint would not impact navigation.	
4	**Scapa Flow**	
4.1	Within SHA limits and site is actively monitored by VTS.	
4.2	Fish farm located to the north was put in place several years after the test site and has increased traffic to and from the site. These vessels are based out of St Margarets to the south.	
4.3	2 Fish farm applications are being progressed in the eastern section of Scapa Flow. At Flimps Holm and Hunda.	

4.4	St Marys has a small slipway/jetty which is rarely used. Occasional tours used to operate from here but have since stopped/	
4.5	Most diving in Scapa is on the German wrecks to the west, diving in this area is typically off the beach.	
4.6	No significant fishing and recreational activity in and around the eastern part of Scapa Flow.	
4.7	Scapa Flow has significant anchorages, including for platforms and STS. The closest anchorages are STS4 and anchorage 5. These are located very close to the limits of the lease area.	
4.8	It was noted that charted limits of the test site and the lease area were not consistent. The chart showed the five gravity base anchors and not the full extent of the test site, future devices may be located further south. BA was concerned with devices further south impacting upon the adjacent anchorages, particularly in combination with future fish farm developments which limits the number of available anchorages.	
4.9	AR would examine the swept paths of the swing of anchored vessels.	AR
4.10	BA noted that there was no chart note on the Scapa Flow site, describing only the Fall of Warness and Bilia Croo sites.	
5	**Shapinsay Sound**	
5.1	BA noted that the charted limits and the lease area were also not consistent. The chart showed the three anchor blocks and not the full extent.	
5.2	The northern limits of the lease area were close to the main approach channel, when larger vessels were approaching other traffic generally transited further south and therefore much closer to the test site.	
5.3	Occasional anchorage to the south in the bay but vessels would be well clear of the test site. This is often used by the ETV.	
5.4	Yachts and fishing boats out of Kirkwall would transit passed the devices.	
6	**Fall of Warness**	
6.1	Orkney Marine Services now has radar coverage of the site from ERDF.	
6.2	BA noted that Orkney Ferries were a key user of the area, particularly in adverse weather. Any loss of navigation due to additional surface devices in this area would result in loss of sailings during adverse weather when this route is required.	
6.3	Larger vessels such as cruise ships and offshore support vessels use this route on transit to Shetlands or Iceland.	
7	**General Impacts**	
7.1	BA noted that EMEC test sites are well known by locals and being well managed to reduce the impact on navigation.	
7.2	No known contacts with devices in any of the sites.	
7.3	The EMEC test sites should not exclude vessels from navigating through them. Areas can be advised to be avoided but should not be prohibited.	

Minutes – EMEC NRAs – 18UK1461

Client:	EMEC	
Project:	18UK1461	
Attendees:	Stuart Carruthers (SC)	RYA
	Andrew Rawson (AR)	Marico Marine
Venue:	RYA House, Ensign Way, Hamble	
Date of Meeting:	14:00 to 15:00 05th September 2018	

Item	Action item / Notes for the record	Action
1	**Introduction**	
2	**Overview**	
2.1	AR gave an overview of the NRAs and the EMEC sites. To date the work has focused on vessel traffic analysis and consultation with local stakeholders, including the Orkney Marinas manager.	
2.2	It was agreed that the sites have not historically caused any incidents and have been well marked and promulgated. The Orkneys generally have a higher level of proficiency among yachtsman as they are isolated from the mainland by the Pentland Firth/North Sea and navigation to this area requires a high level of seamanship.	
2.3	AR/SC discussed the RYA Position Papers, contents and history.	
2.4	SC did not believe that there would be any significant impacts on recreation as a result of the extension to Billia Croo.	
3	**RYA Position Paper Impacts**	
3.1	The assumption on under keel clearance was discussed and a 3m model draft for a large yacht was discussed. This research was linked to the decision for 22m MHWS on wind turbine developments. Any deeper draught vessel would not be able to access most marinas.	
3.2	SC referred to the MCA's UKC policy paper.	
3.3	The charting of the sites were discussed, with the outlines shown on the EMEC website as a guide for visiting yachtsman. SC recommended that a navigational chart is used as a background.	
3.4	The impacts of the cable were discussed on navigation and communication equipment. This policy point refers principally to large offshore cables which pass through inter-tidal areas and where yachts may be in close proximity to them, impacting on cable accuracy. Given the size of the cables this was not thought to be significant.	
3.5	Whilst there were no sailing and racing areas adjacent to the test sites, SC recognised that there was a high degree of diving on wrecks in the area.	
3.6	No significant cumulative or in-combination effects were identified in the study area.	

Annex E – Scapa Flow Test Site Risk Assessment

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Risk Score
						People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
1	Commercial Ship Contacts a Device	A commercial vessel such as a cargo vessel or tanker contacts with a device	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel;	Moderate damage to device and its moorings; Negligible Damage to Vessel; No Injuries; No Pollution; Minor operational Downtime;	Multiple minor injuries or single major injury; Loss of Device; Moderate damage to Vessel; Moderate pollution; Moderate adverse publicity;	1	1	1	2	1	3	3	3	3	1	1.90
2	Passenger Vessel Contacts a Device	A passenger vessel contacts with a device	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel;	Negligible damage to vessel; Minor injuries; Negligible pollution; Bad local publicity or short-term loss of revenue.	Multiple minor or single major injury; Minor damage to vessel; Minor pollution; Moderate adverse publicity.	2	1	1	2	1	3	2	2	3	1	1.82
3	Fishing Vessel Contacts a Device	A fishing vessel (including workboats transiting to / from aquaculture site) contacts a device	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel;	Minor Damage to device and its moorings; Negligible Damage to Vessel; Minor Injuries; No Pollution; No operational Downtime;	Single fatality or multiple major injuries; Moderate damage to Device; Loss of Vessel; Minor pollution; Moderate adverse publicity;	2	1	1	1	2	4	3	2	3	1	2.30

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Risk Score
						People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
4	Recreational Vessel Contacts a Device	A recreational vessel contacts with a device	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel;	Minor Damage to device and its moorings; Negligible Damage to Vessel; Minor Injuries; No Pollution; Minor operational Downtime;	Single fatality or multiple major injuries; Moderate damage to Device; Loss of Vessel; Minor pollution; Moderate adverse publicity;	2	1	1	2	1	4	3	2	3	1	2.28
5	Maintenance Vessel Contacts a Device	Project maintenance vessel contacts a device	Insufficient Lookout; Human Error; Poor operating Procedures; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel;	Minor Damage to device and its moorings; Negligible Damage to Vessel; Minor Injuries; No Pollution; No operational Downtime;	Multiple minor or single major injury; Moderate damage to Device; Moderate damage to Vessel; Minor pollution; Moderate adverse publicity;	2	1	1	1	4	3	3	2	3	2	2.74
7	Fishing Gear Interaction with a Device	A fishing vessel's gear interacts with a device or its moorings/cables .	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions;	Minor Damage to moorings; Minor Damage to fishing gear; Minor Injuries; No Pollution; Minor operational downtime;	Single Major Injury; Loss of gear; No Pollution; Moderate Operational Downtime;	2	2	1	2	1	3	3	1	3	1	1.91

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Risk Score
						People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
8	Third Party Collision Due to Avoidance of Site	Two navigating vessels (excluding project maintenance vessels) collide due to the presence of the site.	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility;	Minor injuries; Minor damage to vessels; No Pollution; Minor Adverse Publicity;	Single fatality or multiple major injuries; Major damage to Vessels; Moderate pollution; Moderate adverse publicity;	2	2	1	2	1	4	4	3	3	1	2.54
9	Third Party Grounding Due to Avoidance of Site	A navigating vessel (all types) grounds due to the presence of the site.	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility;	Minor injuries; Minor damage to vessels; No Pollution; No operational Downtime;	Single fatality or multiple major injuries; Major damage to Vessel; Minor pollution; Major adverse publicity;	2	2	1	1	1	4	4	3	3	1	2.45
10	Collision with Site Maintenance Vessel	A navigating vessel collides with a tug or maintenance vessel or construction/decommissioning vessel.	Insufficient Lookout; Increased Vessel Activity; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility;	Minor Injuries; Minor Damage to Vessel; No Pollution; Minor Adverse publicity;	Single fatality or multiple major injuries; Loss of Vessel; Moderate pollution; Moderate adverse publicity;	2	2	1	2	2	4	4	3	3	1	2.70
11	Grounding of Maintenance Vessel	A maintenance vessel grounds whilst on passage to/from the site	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility;	Minor Damage to vessel; Minor Injuries; No Pollution; No operational Downtime;	Multiple minor or single major injury; Major damage; Minor pollution; Minor adverse publicity;	2	2	1	1	2	4	4	2	2	1	2.41

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence					Worst Credible Consequence					Risk Score
						People	Property	Environment	Stakeholders	Frequency	People	Property	Environment	Stakeholders	Frequency	
12	Breakout of a Device from Moorings	A device's moorings fail, device becomes a hazard to navigation	Equipment or Mechanical Failure; Adverse Environmental Conditions; Collision by object; Blade contacts seabed;	Minor damage to device and its moorings; Minor injuries; Negligible pollution; Minor Adverse Publicity; Minor damage to vessel.	Minor injuries; Moderate damage to device; Minor Pollution; Moderate Adverse Publicity.	2	2	1	2	1	2	3	2	3	1	1.91

European Marine Energy Centre (EMEC) Ltd
Old Academy Business Centre, Back Road, Stromness, ORKNEY, KW16 3AW
Tel: 01856 852060
Email: info@emec.org.uk **Web:** www.emec.org.uk
Registered in Scotland no.SC249331 VAT Registration Number: GB 828 8550 90