MOCEAN ENERGY | M100P

EMEC Billia Croo Test Site

Navigational Risk Assessment Addendum

February 2020

Purpose

This document is provided as an addendum to and should be read in conjunction with the document 'Billia Croo Navigation Risk Assessment (NRA) – REP522'. It describes the key project-specific navigational risks to be addressed in relation to proposed activities at the European Marine Energy Centre test site at Billia Croo, Orkney Islands, together with proposed mitigation for reduction/elimination of these risks. Site location navigational risks are covered in the site-wide Billia Croo NRA produced by EMEC.

This document has been prepared to support a marine licence application for the Mocean Energy M100P. For further information regarding the project, please refer to the Project Information Summary.

Document History

Revision	Date	Description	Originated by	Reviewed by	Approved by
1	25/02/21	Submitted	DL (EMEC)	JC (ME)	

Contents

List of Figures

List of Tables

1 Introduction

Mocean Energy, based in Edinburgh, is developing wave energy converters (WECs) for various applications from small-scale off-grid use to large, utility-scale projects. Its core technology is its hinged raft WEC, which consists of two hulls with novel shapes connected by a single hinge. Wave forcing, and the hulls' dynamics cause a rotation about the hinge, which is converted to electricity via a power take-off system.

Mocean Energy have built an expert team combining scientific principles and real-world experience to develop new technologies which can harness the power of waves – and accelerate the transition to a zero-carbon world.

Mocean's approach utilises numerical modelling and optimisation, rapid prototyping and tank testing – allied to hard-won ocean experience – to deliver wave energy machines that produce high levels of power for their size and work in some of the world's harshest environments.

This assessment has been produced as an addendum to the site-wide Navigational Risk Assessment for the Billia Croo test site. This document identifies and assesses any project-specific navigational risks and discusses the proposed risk control measures to be implemented in order to reduce the risk associated with the project.

2 Project overview

Further information regarding the project is available in the Project Information Summary.

2.1 Asset information

The M100P consists of two yellow painted steel hulls connected at a hinge through a pair of steel hinge pins. The key dimensions of the machine are given in Table 1. Figure 1 shows a visualisation of the machine on the pier. Figure 2 shows a visualisation of the machine deployed at sea; however, the mooring lines are not shown here. Note that in both figures, the machine will be painted yellow. Figure 3 gives the general arrangement of the machine.

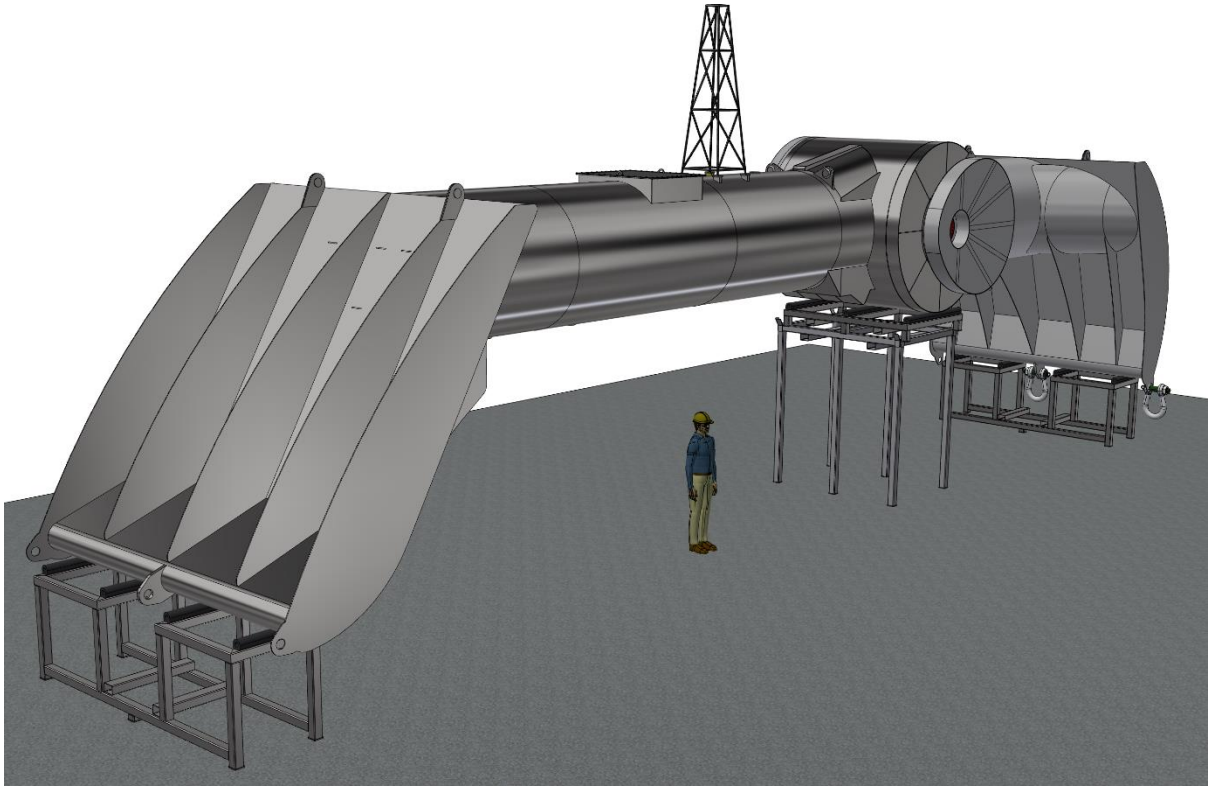

Figure 1. M100P visualisation on pier.

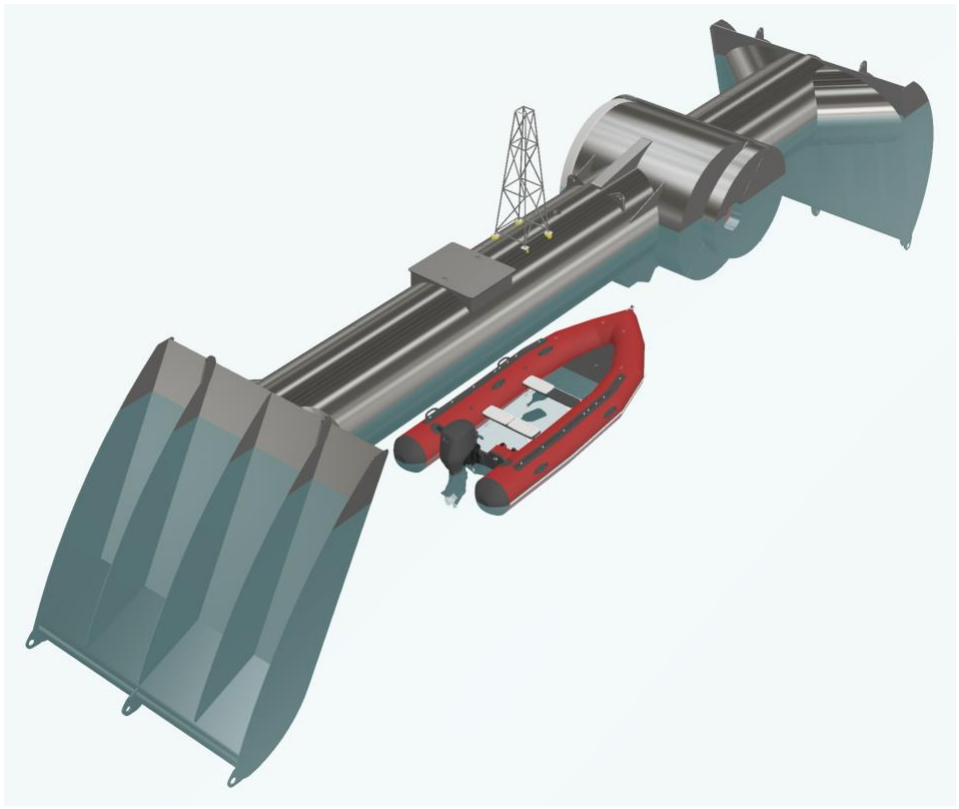

Figure 2. M100P visualisation as deployed at sea.

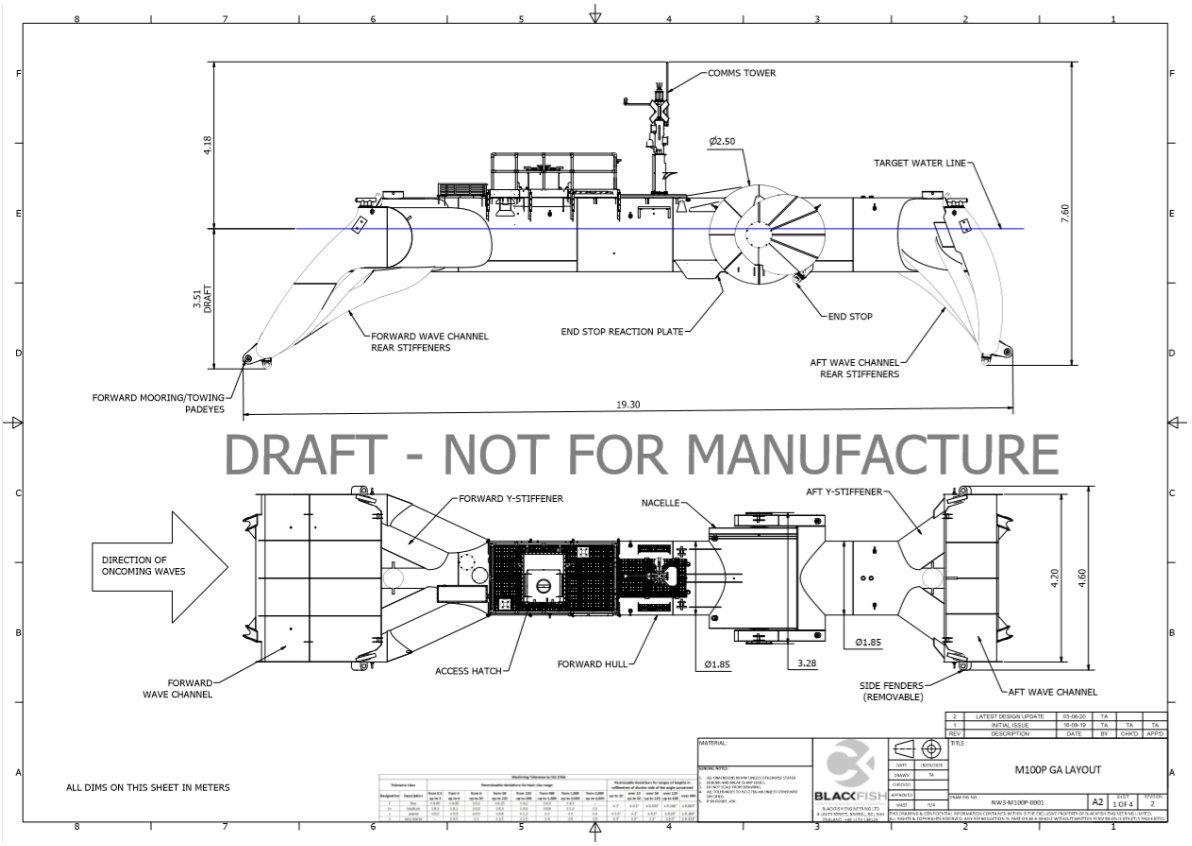

Figure 3. M100P drawing with dimensions.

Table 1. Key dimensions of the M100P.

Dimensions	Units	Value
Length Overall	m	19.2
Beam	m	4.2
Draft	m	3.4
Mass	tonnes	31.5

The rotation of the aft hull with respect to the forward hull drives a gearbox and then a generator. Power from the generator is then conditioned and used onboard the WEC to power local system. Power beyond that needed to power on-board systems is stored in 30 kWh of batteries. Once the batteries are fully charged, excess power is dissipated through an onboard dump resistor. Key onboard systems that use power include: the control, communications, cooling, instrumentation, and navigation lighting.

Figure 4 shows the construction of the mooring system. The system is made of 2 mooring lines, the mooring attachment points on the 2 legs are attached to a bridle at the forward mooring point on the WEC.

The mooring design for the Billia Croo deployment is shown in Figure 5.

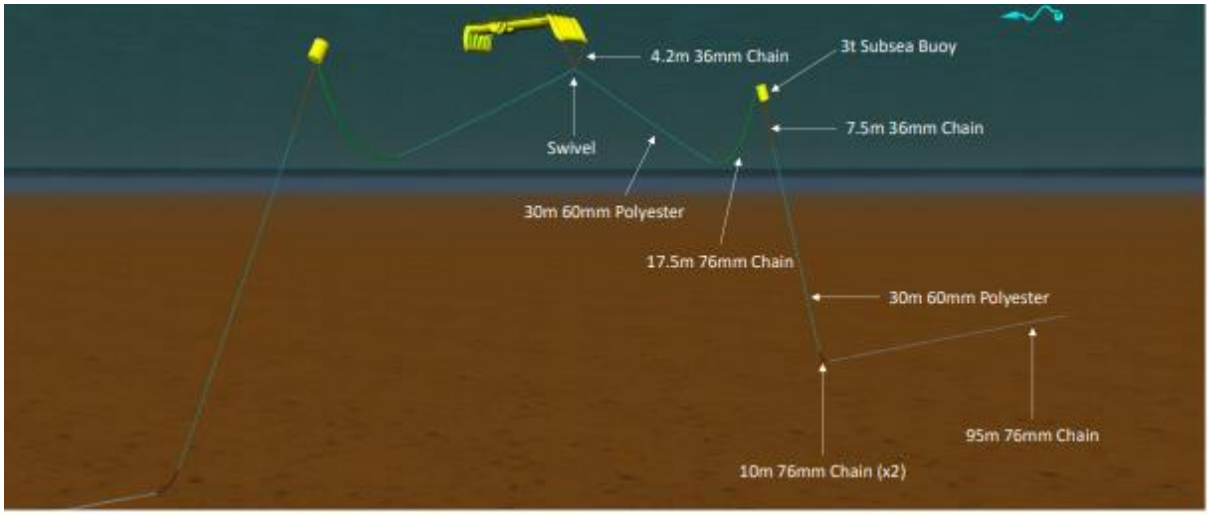

Figure 4. Mooring design for Billia Croo

2.2 Schedule and test plan

The proposed schedule (indicative) for the Project is shown in Appendix A. The anticipated date of installation of the M100P and its associated mooring system is May 2021. The operational period of the test is anticipated to last up to 14 weeks. To allow some contingency in the programme, the marine licence application will cover the period until 28 February 2022. Thereafter, all equipment will be completely removed from site.

2.3 Deployment location

The device will be deployed within the EMEC Billia Croo test site.

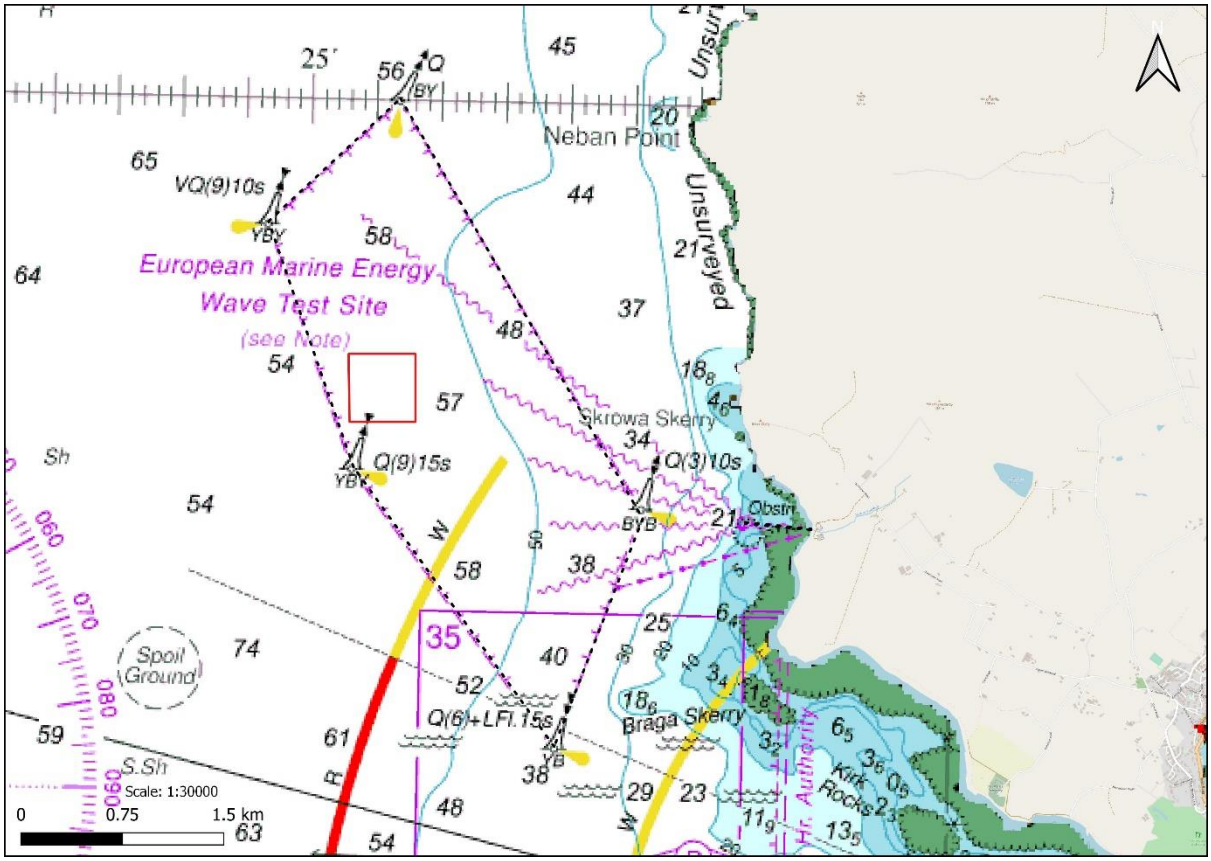

Figure 5. Marine licence boundary (red line)

Table 2. Coordinates of berth and test site boundary

Location Description	Latitude and longitude (WGS 84)				UTM (Eastings and Northings)			
	Corner A	Corner B	Corner C	Corner D	Corner A	Corner B	Corner C	Corner D
Marine Licence Boundary	58° 58.71' N	58° 58.71' N	58° 58.99' N	58° 58.97' N	318975E	319463E	319463E	318966E
	003° 24.67' W	003° 24.16' W	003° 24.20' W	003° 24.69' W	1011003 N	1011003 N	1011505 N	1011505 N

3 Key navigational themes

In order to complete this project-specific assessment, a comprehensive review of the site-wide NRA for EMEC's Billia Croo test site was conducted. The following navigational themes have been considered during the assessment.

3.1 Vessel routing

Any vessels that do transit the site or in waters adjacent to the site will be aware of the test site presence as it is marked on United Kingdom Hydrographic Charts. Also, a notice to mariners will be issued by Orkney Harbours Authority before any works relating to this project are undertaken.

3.2 Contact / allision risk

A notice to mariners and uses of appropriate marking and lighting to alert other mariners to the device should mitigate the risk of contact. The test site is charted on the United Kingdom Hydrographic Office Charts.

3.3 Effects of tide / tidal streams and weather

The location of the Billia Croo site was initially selected due to the strong wave conditions. A device-specific TPV has been conducted which includes assessment on the moorings and takes into account the conditions found at the Billia Croo test site.

3.4 Collision risk and visual navigation

The device is above the surface of the water and the scale of the assets to be installed during this project are not expected to hinder visual navigation. The exception may be small craft such as open top RIBs, workboats, or multicat vessels that will periodically perform maintenance tasks.

3.5 Communication, radar and positioning system

The scale of the assets to be installed during this project are not likely to impact on electronic communication or positioning systems. Given that no generating infrastructure exists above the surface, there is no anticipated impact upon communications, radar and positioning systems.

3.6 Moorings

The moorings will be marked by a site surface buoy when not in use.

3.7 Station keeping

The device has AIS capabilities, therefore if moorings failed and the device became loose the relevant personnel would be notified immediately.

3.8 Fishing activity

Fishermen would generally be expected to take precautions in order to avoid any underwater assets that may be present at the test site, especially if devices or vessels were onsite.

3.9 Recreational activity

There is minimal racing or small boat sailing at the test site, and few recreational vessels are recorded in the vicinity.

3.10 Subsea cables

There is no evidence of anchoring or gear snagging at Billia Croo historically.

3.11 Search and rescue

The device will not alter the capability of search and rescue operations in the area or interfere with neither RNLI nor helicopter operations.

3.12 Cumulative and in-combination

There are no other developments within the area, thus no anticipated cumulative or in-combination effects are expected.

4 Risk controls

4.1 Site-wide risk controls

A number of risk controls are embedded by the processes EMEC has implemented in order to operate the site and the layout of the Billia Croo test site. The embedded risk control measures are detailed in Table 3.

Table 3. EMEC embedded risk controls for Billia Croo test site

ID	Embedded risk control	Description
1.	PPE Requirement	Maintenance teams to wear suitable PPE when working on the assets, 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.
3.	Emergency Risk and Cooperation Plan (ERCoP)	ERCoP for site 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 assets 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; • Control of work (permit to access) • Hazard identification reporting; and • Maritime safety information.
7.	Hydrography	Contractual responsibility for developer to return the site to the original condition post-decommissioning.

ID	Embedded risk control	Description
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.

4.2 Project-specific risk controls

The following table provides a description of the risk controls that will be implemented during the project.

Table 4. Project-specific risk controls

ID	Project-specific risk control	Description
1.	Radar reflectors	Use of a radar reflector 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 Northern Lighthouse Board (NLB).
3.	Heightened monitoring in adverse metocean 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 asset, its fittings and any signs of wear and tear. This should identify any failings which might result in a mooring failure and breakout. Refer to the findings of your third party verification mitigation against device breakage.
5.	GPS alert system for asset moving	Remote monitoring of device to detect any major movements that might indicate a breakout for immediate response. Implement GPS excursion monitoring.
6.	Marking and Lighting	Assets to be lit to the requirements of NLB and marked in line with IALA guidance, IALA Recommendation O-139 (2013)[1]. The following is typically requested by the NLB:

[1] 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

ID	Project-specific risk control	Description
		• Yellow day marking/painting; • Flashing yellow special mark light (Category 1) (larger devices may require 2 lights at each end which are synchronised; light ranges should be at least 3 nautical miles); • Day top mark (if deemed necessary); • Radar reflector; and • AIS AtoN (mandatory for floating devices at EMEC). Appropriate statutory sanctions must be in place to exhibit, alter or discontinue lighting.
8.	Tow risk assessment and passage plan	As required under Orkney Harbours Pilotage Directions 4(3)[2], 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, maneuverability restrictions, tow arrangements and metocean conditions.
9.	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.
10.	Liaison with local stakeholders	Consultation should be undertaken with Orkney 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.
11.	Installation, maintenance and removal	All vessels undertaking activities on site should comply with EMEC standard operating procedures. Vessels should be mindful of other navigating vessels and avoid disrupting the activities of others.
12.	ERCoP	Project-specific annex to be incorporated into site-wide ERCoP.

- 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).

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

5 Summary and conclusion

This document has been prepared to support a marine licence application for the Mocean M100P and should be read in conjunction with the document 'Billia Croo Navigational Risk Assessment (NRA) – REP522'.

In summary, the NRA has concluded that the deployment of the device is low risk with suitable risk controls in place. This conclusion has been emphasised by the scale of this deployment and short testing period.

Appendix A: Proposed Schedule

Project Stage	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15
Vessel and Equipment Mobilisation															
Vessel Mooring Installation															
Device deployment															
Device testing															
Removal / Decommissioning															

Table 5. Project Programme