MOCEAN ENERGY | M100P

Project Information Summary

February 2020

Purpose

This Project Information Summary gives a high-level view of the company, the device, and the proposed project. This document is the foreword to the project's Marine Licence application, and will feed into the rest of the application supporting documentation, including but not limited to the following documents:

- Project Environmental Monitoring Plan
- Navigational Risk Assessment Addendum
- Decommissioning Program
- Third Party Verification

Document History

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

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1 Introduction

1.1 Company background

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.

1.2 Technology background

Blue Horizon is our utility-scale machine – designed to deliver reliable green energy to transmission networks around the world. Development of Blue Horizon has been funded through Wave Energy Scotland's Novel Wave Energy Converter Programme, where competing technologies were required to pass through a 'stage gate' selection process where technologies were assessed by industry experts and the most promising concepts were selected to proceed to the next funding stage.

Blue Horizon is one of only two technologies to reach the scale prototype stage, and the £3.3 million support from Wave Energy Scotland will fund the design, manufacture and deployment of a half-scale machine to be deployed in Orkney in 2020.

1.3 Project background

Mocean Energy is undertaking a project funded by Wave Energy Scotland (WES) through its Novel WEC Programme to build and test at sea a 1/2-scale prototype of its M100 (i.e. 100 kW) WEC. The 1/2-scale prototype, which is to be tested is referred to as the M100P.

Testing is planned to be undertaken at EMEC's Billia Croo test site, Orkney in June 2021. The primary purpose of testing is to gather performance data and learnings from deployment of the device in order to inform further development of Mocean's Wave Energy Converter designs.

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2 Technology

2.1 Device Description

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.

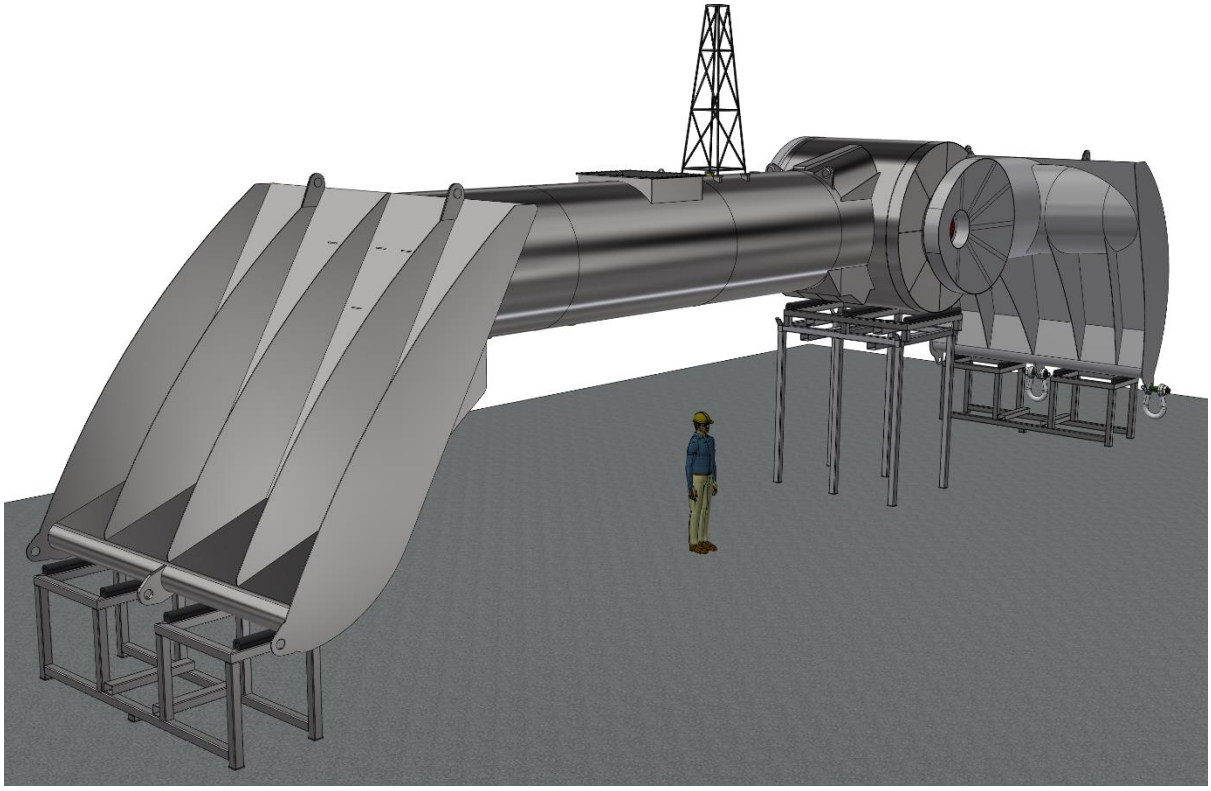

Figure 1. M100P visualisation on pier.

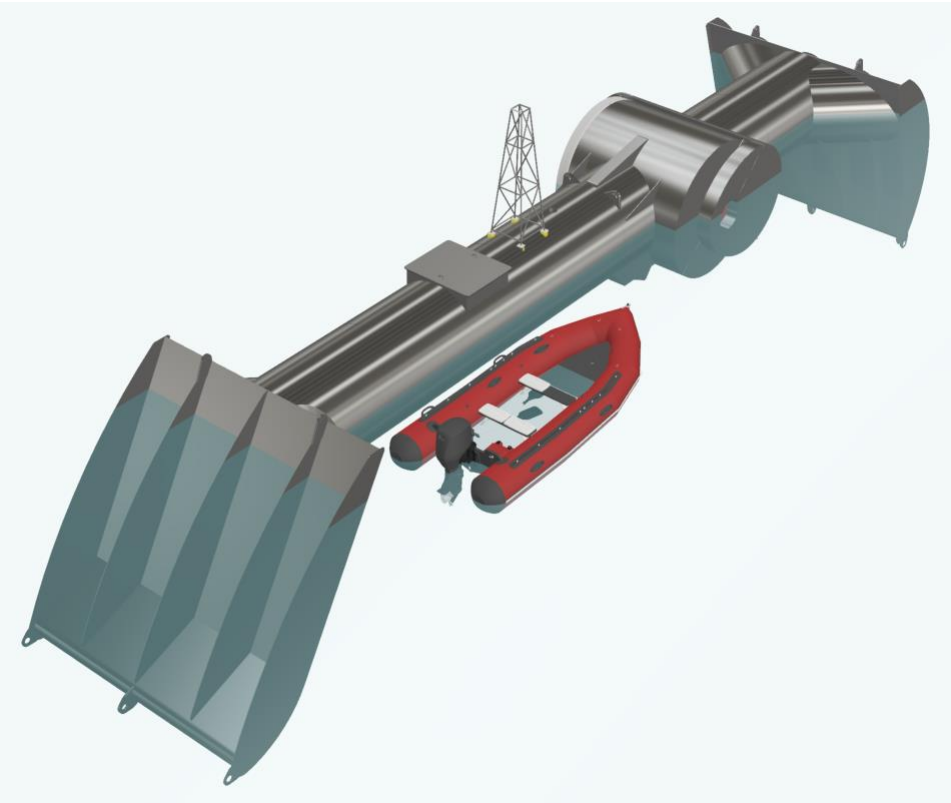

Figure 2. M100P visualisation as deployed at sea.

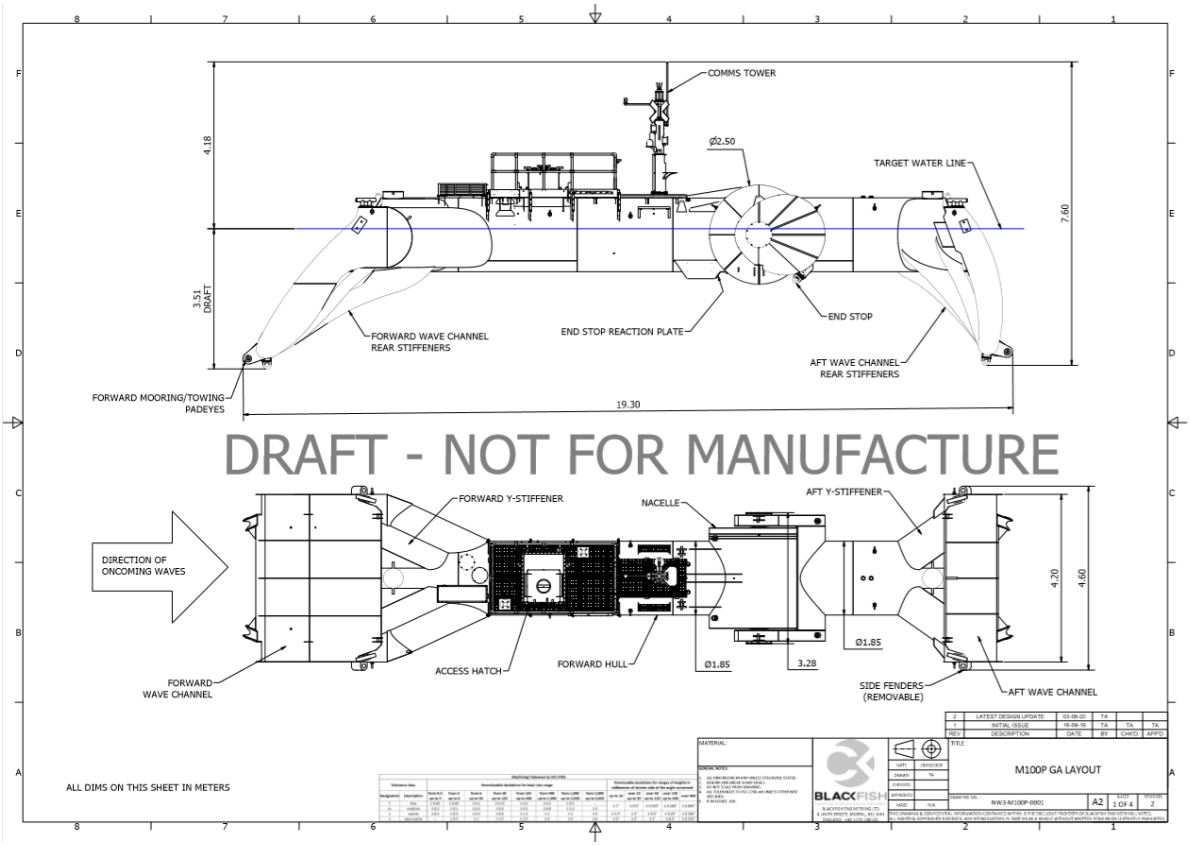

Figure 3. M100P drawing with dimensions.

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.

2.2 Mooring system

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 Billia Croo is shown in Figure 4.

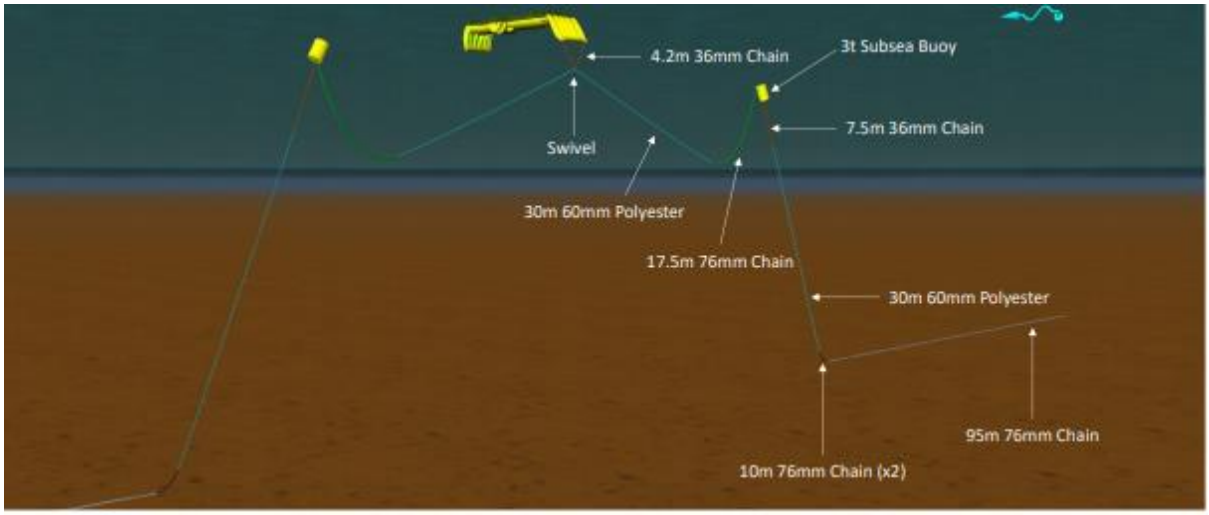

Figure 4. Mooring design for Billia Croo

2.3 Materials used

Table 2. Proposed list of materials to be used

Type of Deposit*	Nature of Deposit (P = Permanent, T = Temporary)	Deposit Quantity (tonnes, m^3, etc.)
Steel/Iron	P	275 tonnes
Plastic/Synthetic	P	12 tonnes
Cable	P	200 kg
Aluminium (stator segments, anodes)	P	120 kg
Copper (stator windings)	P	140 kg
Rubber (fenders and seals)	P	50 kg
Gearbox oil		5 kg
Bearing grease		5 kg

*Types of deposits to consider: Steel/Iron; Timber; Plastic/Synthetic; Composite; GRP; Concrete; Silt; Sand; Stone/Rock/Gravel; Concrete Bags/Mattresses; and, Cable.

2.4 Third Party Verification (TPV)

Third Party Verification (TPV) is currently underway and being undertaken by Orcades Marine Consultancy in Orkney. Once complete, the TPV documents will be submitted to the regulator.

Orcades uses 360 TPV which provides a holistic approach to readiness assurance covering engineering design, locational suitability, operability, regulatory and license compliance, as well as cost-effectiveness and invest-ability. 360 TPV brings confidence to project developers, insurers, investors, authorising bodies, customers, test facilities, and government.

360 TPV maximises opportunities for success, minimizes uncertainty, and manages risk by having an experienced, independent team evaluate your technology, project and/or organisation and provide feedback on the status that exists and consequences that could

arise. Orcades 360 TPV team takes a holistic approach; makes use of proven expertise and unparalleled global ocean energy experience.

3 Project Description

The M100P will be installed at EMECs Billia Croo test site as shown in Figure 5. The licence boundary required for installation of the device is specified in Table 3. There will be no onshore assets associated with this deployment. The device will not be associated with a specific berth as there will be no cable or grid connection.

Immediately before the Billia Croo deployment, the device will be deployed at the EMEC Scapa Flow test site. Current plans involve the device being kept at Hatston Harbour while inspections are carried out for one week after removal from Scapa Flow and then being re-deployed at Billia Croo test site.

3.1 Offshore Location

Figure 5 shows the location of deployment within the Billia Croo test site and Table 3 provides coordinates of the test site and marine licence boundary. The licence boundary area is roughly 0.5km West to East, and 0.5km North to South. The area of the licence boundary is roughly 4km^2.

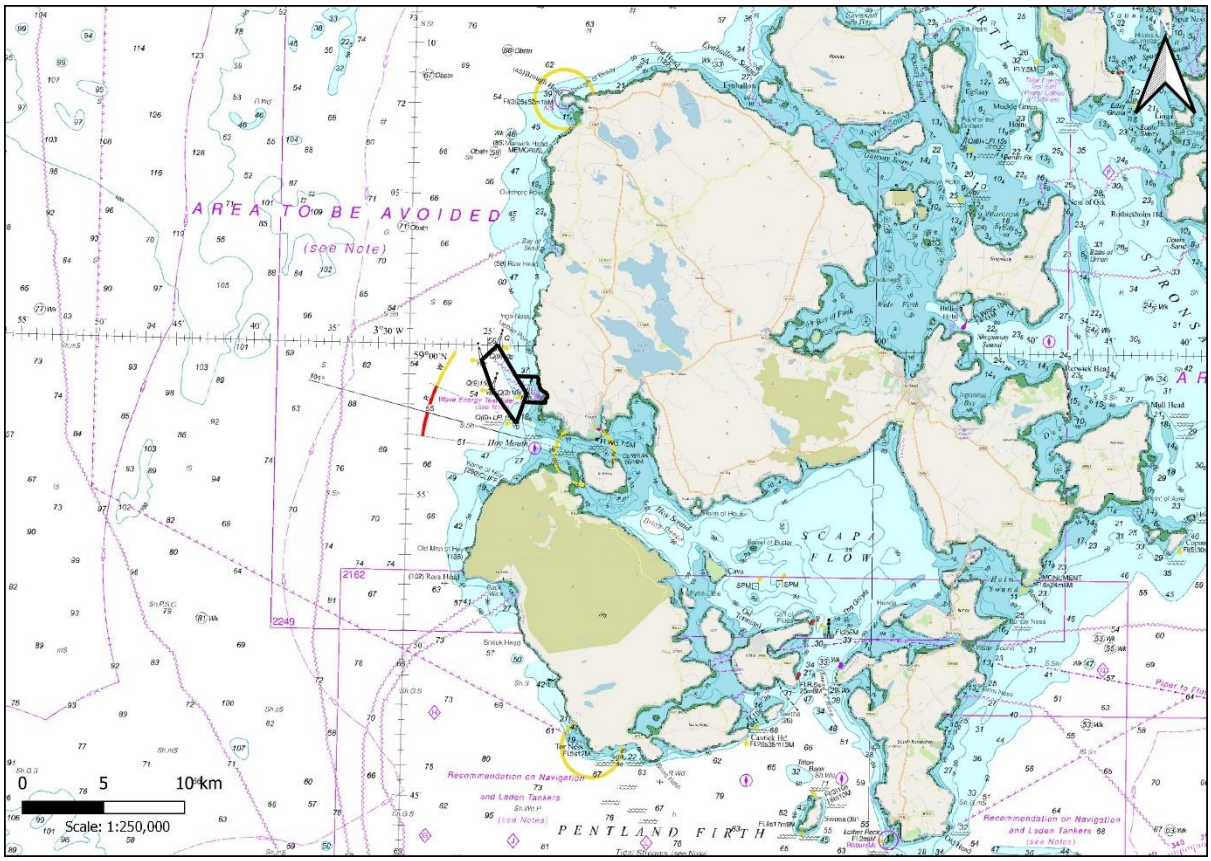

Figure 5. Location of Billia Croo test site in relation to Orkney mainland.

Site	Co-ordinates (WGS 84)
	59° 00.000'N 03° 24.330'W

EMEC wave test site, Billia Croo, Orkney	
	58° 57.434’N 03° 23.040’W
	58° 58.384’N 03° 22.393’W 58° 58.530’N 03° 24.634’W
	58° 59.500’N 03° 25.330’W

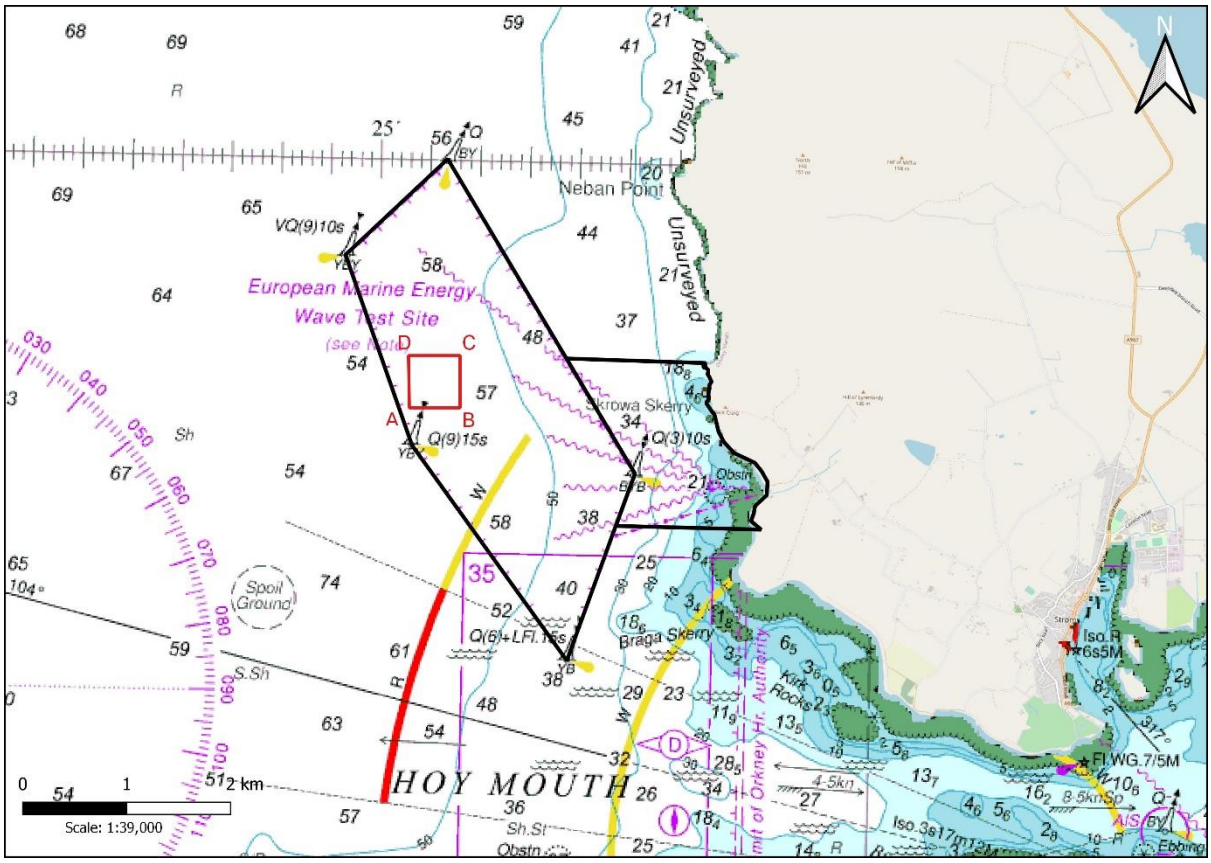

Figure 6. Marine licence boundary (red line), Billia Croo test site (black line)

Table 3. Coordinates of marine licence 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**

3.2 Installation method

The vessels required for installation are shown in Table 4. Further details of the vessels likely to be used for the deployment are provided in the Vessel Management Plan in Appendix B.

Table 4. Vessels utilised for installation

Vessel Type	Task
Multi Cat (x1)	Anchor and Mooring installation/removal. Device installation and removal. At-sea battery charging and power demonstration.
Rigid Hulled Inflatable Boat (RHIB) (x1)	At-sea visual inspection and access for maintenance. Wave Rider installation and removal.

Figure 7. Example vessel of Multicat.

Figure 8. Example vessel of RHIB

3.3 Removal method

Decommissioning will involve the removal of the M100P and all associated equipment. This will be a reverse of the installation procedures as outlined in the Decommissioning Programme. The device is planned to be removed from site by a Multi Cat vessel in 1 day, and its mooring lines and anchors are planned to be removed from site by a Multi Cat vessel in a further 1 day.

3.4 Anticipated vessel traffic to site

Although subject to change, initial plans will include planned maintenance every four weeks, which may occasionally involve towing back to Stromness harbour. Visits to the device using a RHIB for visual inspection are planned for at least once weekly, however this is weather dependant. Additionally, urgent maintenance may result in more than one trip to the device per week. Upon inspection, a decision will be made to repair the device on-site or organise a tow back to harbour. Once the detailed schedule for maintenance and inspection is available, Marine Scotland will be provided with the relevant information and informed of any deviation.

3.5 Device monitoring systems

During deployment, the device will be monitored 24/7 by the Mocean Team using the Graphic User Interface (“GUI”) and its related alarms. In addition to the GUI, the device will also include an AIS transponder which can be monitored in case of communications failure with the device. An emergency response plan will be in place which will identify contacts, contractors, process and procedures for responding to any unplanned excursion of the device.

4 Proposed Schedule

The proposed installation, operations, maintenance and decommissioning 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.

Appendix A: Project Programme

Table 5. Project 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															

Appendix B: Vessel Management Plan (VMP)

This VMP details the anticipated type and number of vessels that will be used during the construction and installation, maintenance and decommissioning of the M100P at the Test Site.

The selection and contracting of vessels are primarily driven by market conditions, vessel availability and ultimately, cost. Therefore, the actual vessels will be selected near to the time of works. The developer will confirm the project vessel spread at the earliest possible opportunity prior to works commencing as required (as per normal maintenance activities). The vessels presented in the following figures and Table 6 are indicative of the vessels likely to be used.

Figure 9. Example Multicat vessel.

Figure 10. Example RHIB vessel

Table 6. Primary vessel Information.

	MV C-FENNA	MV C-ODYSSEY	GREEN ISLE
Flag state	UK	UK	UK
Port	Kirkwall	Kirkwall	Stromness
Year of build	2013	2011	2015
Type	Neptune Eurocarrier 2611	Multiworker Twenty6	Damen
Length	26.5 m	26 m	27.7 m
Beam O.A.	11 m	10.5 m	12.5 m
Draught	2.6 m	2.5 m	2.9 m