



Mocean Energy Orkney M100P Test 2022

Decommissioning Programme

Report to Mocean Energy

Issued by Aquatera Ltd/Mocean Energy

P874 – July 2022



www.aquatera.co.uk

This study was completed for:

Mocean Energy Ltd
Floor 2 Murchison House
10 Max Born Crescent
Edinburgh EH9 3BF

Contact: Cameron McNatt
Tel: 07852 328117
Email: cameron.mcnatt@moceanenergy.com

This study was completed by:

Aquatera Ltd
Old Academy Business Centre
Stromness
Orkney
KW16 3AW

Contact: Shane Quill
Tel: 01856 850 088
Email: shane.quill@aquatera.co.uk

Issue record

Version	Date	Details
V1	05 th Mar 19	Draft provided to Mocean
V2	29 th Oct 19	Draft issued to MS-LOT
V3	08 th Nov 19	Revised with WGS84 coordinates for MS-LOT
V4	17 th Jun 20	Revised and issued to MS-LOT
V5	14 th Dec 21	Revised with system and issued to MS-LOT (Mocean update)
V6	04 th Jan 22	Revised and issued to MS-LOT (Mocean update)
V7	28 th Feb 22	Revised after MS-LOT feedback (Mocean update)
V8	11 th Apr 22	Consultation feedback (Mocean update)
V9	07 th Jul 22	Schedule update (Mocean update)

Members of:



Contents

CONTENTS	II
LIST OF FIGURES	IV
LIST OF TABLES	IV
1 EXECUTIVE SUMMARY	1
RODUCTIONINTRODUCTION	1
1.1 BACKGROUND	1
1.2 ENERGY ACT 2004	1
2 INTRODUCTION	2
2.1 MOCEAN ENERGY	2
3 BACKGROUND INFORMATION	3
3.1 PROJECT LOCATION	3
3.2 TYPE AND STATUS OF ANY OTHER ADJACENT FACILITIES	4
3.3 LAYOUT OF THE FACILITIES TO BE DECOMMISSIONED	4
3.4 SITE CONDITIONS	4
3.4.1 Prevailing weather	4
3.4.2 Sea water temperatures	4
3.4.3 Seascape	4
3.4.4 Wave conditions.....	5
3.4.5 Seabed conditions	5
3.5 NAVIGATIONAL ACTIVITY	5
3.6 CONSERVATION AREAS	5
4 DESCRIPTION OF ITEMS TO BE DECOMMISSIONED	6
4.1 THE DEVICE	6
4.2 MOORINGS SYSTEM OVERVIEW	7
4.3 HALO	9
4.4 HAUV	9
4.5 UMBILICAL	10
4.6 ANCILLARY SCIENTIFIC EQUIPMENT	11
5 DESCRIPTION OF PROPOSED DECOMMISSIONING MEASURES	12
5.1 INTRODUCTION	12
5.2 PROPOSED METHOD OF REMOVAL	12
5.2.1 Device decommissioning	12
5.2.2 HALO and HAUV decommissioning.....	12
5.2.3 Mooring legs decommissioning.....	13
5.2.4 Ancillary Scientific Equipment.....	13

5.3	HEALTH AND SAFETY CONSIDERATIONS	13
5.3.1	Health, Safety and Environment (HSE)	13
5.3.2	Quality Control (QC).....	13
5.3.3	Worksite changes to approved procedure.....	14
5.4	PROPOSED WASTE MANAGEMENT SOLUTIONS	14
5.5	DETAILS OF ANY ITEMS WHICH MAY BE LEFT IN SITU	14
6	ENVIRONMENTAL IMPACT ASSESSMENT	14
7	CONSULTATIONS WITH INTERESTED PARTIES.....	14
8	COSTS.....	18
9	FINANCIAL SECURITY	18
10	SCHEDULE	18
11	SEABED CLEARANCE	18
12	RESTORATION OF THE SITE.....	19
13	POST-DECOMMISSIONING MONITORING, MAINTENANCE AND MANAGEMENT OF THE SITE	19
14	OPERATIONAL PLANS AND METHODOLOGIES.....	20
14.1	CONSTRUCTION AND INSTALLATION	20
14.2	DEVICE AND SUBSURFACE SYSTEM TESTING	22
14.3	MAINTENANCE	23
14.4	MONITORING	23
15	APPENDIC.....	24

List of Figures

Figure 1 Proposed licence and deployment area at Test Site	3
Figure 2 M100P visualisation.....	6
Figure 3 M100P General Arrangement.....	7
Figure 4 Mooring leg structure	8
Figure 5 The WEC with Mooring Spread.....	8
Figure 6 Mooring footprint (left), with allowance (right)	9
Figure 7 HALO Unit	9
Figure 8 HAUV Unit	10
Figure 9 Illustration of entire system	10
Figure 10 Example vessel of Multi Cat.....	20
Figure 11 Example vessel of RHIB	20
Figure 12 WEC installation.....	21
Figure 13 HALO installation	22

List of Tables

Table 1	Coordinates of licence boundary	3
Table 2	Key dimensions of the M100P.....	6
Table 3	Vessels utilised for installation.....	20

1 EXECUTIVE SUMMARY

1.1 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 is undertaking a project part funded by Net Zero Technology Centre (NZTC) and Wave Energy Scotland (WES) to test at sea a 1/2-scale prototype of its M100 (10 kW) WEC. The 1/2-scale prototype is referred to as the M100P and will be tested along with a HALO subsea energy storage system and a residential AUV.

Testing is planned to be undertaken in an area to the East and offshore of Deerness, Orkney in 2022. 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.

1.2 ENERGY ACT 2004

Section 62 of the Scotland Act 2016 transfers to Scottish Ministers powers under the Energy Act Part II Chapter 3, to require developers of offshore renewable energy projects in Scottish Waters and the Scottish part of a Renewable Energy Zone, to prepare a decommissioning programme. These powers constitute the regulatory functions of decommissioning including: powers for Scottish Ministers to approve such a programme; to require financial security for a programme to be put in place by responsible persons; and, should that responsible party default, to ensure that the decommissioning programme is carried out.

Under the statutory scheme, the appropriate Minister may require those persons with an interest in such installations to produce a fully costed Decommissioning Programme detailing how they intend to remove the installation when it comes to the end of its useful life and how the costs of doing so will be funded.

This Decommissioning Programme describes the works required to decommission the M100P device, its umbilical, the HALO unit, the HAUV and associated infrastructure at the deployment site along with the costs of doing so. It further sets out the mechanism for the return of the site to its pre-existing condition.



2 INTRODUCTION

This document will outline a decommissioning programme for a wave energy converter (WEC), which will harness the energy of waves and convert into electrical energy. The WEC will be tested along with a HALO subsea energy storage system and a residential AUV

The device is intended to be deployed in an area to the East and offshore of Deerness, Orkney in 2022.

This document is submitted for approval in accordance with the requirements of the Energy Act 2004 and has been prepared in line with the Decommissioning of offshore renewable energy installations under the Energy Act 2004. This decommissioning programme is a live document which will be revisited over the life of the project to ensure the planned methodologies for removal and disposal remain safe and current.

2.1 MOCEAN ENERGY

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.

Mocean Energy is undertaking a project part funded by Net Zero Technology Centre (NZTC) and Wave Energy Scotland (WES) to test at sea a 1/2-scale prototype of its M100 (10 kW) WEC. The 1/2-scale prototype is referred to as the M100P and will be tested along with a HALO subsea energy storage system and a residential AUV.



3 BACKGROUND INFORMATION

3.1 PROJECT LOCATION

The M100P will be installed at a location to the east of Deerness, Orkney (see Figure 1). The licence boundary required for installation of the device is specified in Table 1. The precise location of the device and anchors (within the licence boundary provided) will be determined prior to anchor installation and will be confirmed (post-installation) with Marine Scotland Licensing Operations Team (MS-LOT) upon submission of the formal Table of Deposits (Form FEP5). This flexibility in the installation location is required to ensure that no obstructions exist in proximity of the anchoring locations on the seabed.

Table 1 Coordinates of licence boundary

Latitude		Longitude	
Degrees	Decimal Min	Degrees	Decimal Min
58	52.266'N	2	45.085'W
58	51.716'N	2	45.089'W
58	51.714'N	2	44.028'W
58	52.264'N	2	44.024'W

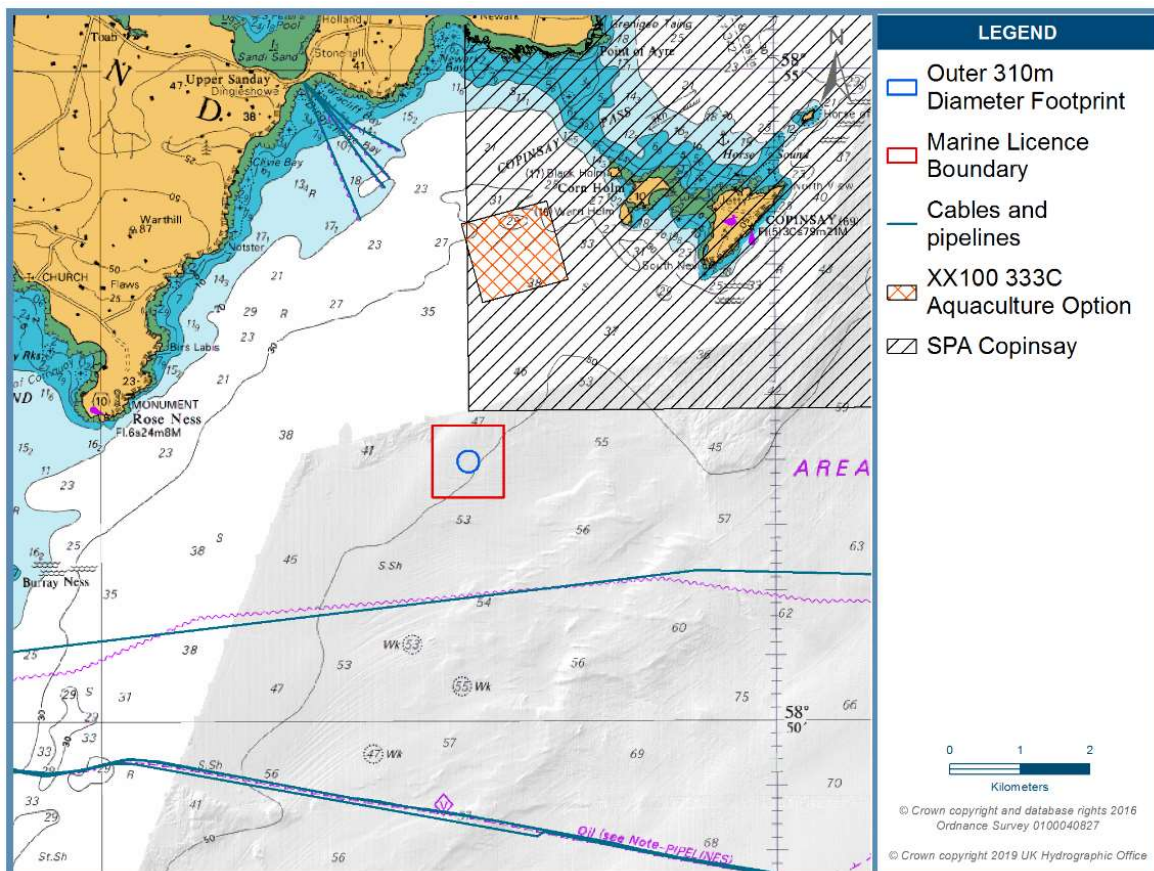


Figure 1 Proposed licence and deployment area at Test Site



3.2 TYPE AND STATUS OF ANY OTHER ADJACENT FACILITIES

During decommissioning, any facilities adjacent to the berth will need to be taken into consideration. As the test site will be leased by Mocean Energy and will not be available for use by other developers, no other installations on the site are expected. All operations at the test site must comply Mocean Energy's Standard Operating Procedures, Emergency Operating Procedures and Health, Safety and Environment requirements. Site access permits will only be issued if the site is safe for the intended work or may be issued subject to a set of conditions. The relative proximity of the development to other devices and sites will be revisited when updating the decommissioning methodology closer to the time of decommissioning.

3.3 LAYOUT OF THE FACILITIES TO BE DECOMMISSIONED

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 2. Figure 2 shows a visualisation of the machine. Figure 3 gives the general arrangement of the machine.

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.

The M100P will be connected to a mooring system which will be made of 2 mooring lines, the mooring attachment points on the 2 legs will be attached to a 4.2m bridle at the forward mooring point on the WEC. The WEC will be tested along with a HALO subsea energy storage system and a residential AUV. The umbilical is connected from the WEC to the Halo unit. An illustration of how all of the above components work together is in Figure 9 . More details are presented in [Description of items to be decommissioned](#).

3.4 SITE CONDITIONS

3.4.1 Prevailing weather

Strong winds and gales are very common in Orkney, predominately from the west and the southeast. In the spring and early summer there is a marked increase in the frequency of easterly winds, and in May south-easterly winds are more frequent than winds from any other direction.

3.4.2 Sea water temperatures

Pursuant to sea surface temperatures collected by EMEC from various sources around Orkney and other sources of sea temperature data available from Marine Scotland, satellite, modelled data and The Crown Estate, among others, it can be concluded that temperature ranges from 6.5 °C to 13.5 °C in an annual cycle, with maximum temperatures recorded around August and September and minimum temperatures around February.

3.4.3 Seascape

Most of the Orkney Islands are composed of sedimentary rocks of Devonian age (410 - 360 million before present) and are predominantly Middle and Upper Old Red Sandstone. There are older metamorphic rocks and younger dykes in some places. The nature of the rock and the glacial features help to determine the present-day landscape of the coast.



Whilst the west coast of Orkney is particularly renowned for cliffs, arches, stacks and geos, the lower lying coastal features likely to be found in the vicinity of Scapa Flow (such as tilted flags, sand dunes and sandy bays) are considered important for recreation and accessibility. The coastlines also contain sites of built and natural heritage interest; prehistoric remains are characteristic features and the cliffs and adjacent heaths are key seabird nesting sites.

3.4.4 Wave conditions

The annual mean significant wave height at the test site is 0.9m, while typical winter peaks are 6.1m.

3.4.5 Seabed conditions

A Remotely-Operated Underwater Vehicle (ROV) and Vessel Mounted Acoustic Doppler Current Profile (VMADCP) survey was conducted on behalf of Mocean Energy by Aquatera in an area east of Burray in September 2019. Water depths at the deployment site were approximately between 50 and 53 m. Sediment characteristics within this area generally alternated between pronounced fine sandy ripples with sparse echinoderm epifauna, and coarser-grained heterogeneous sands with increased amounts of shell fragments.

3.5 NAVIGATIONAL ACTIVITY

The proposed deployment location is not in a high-density traffic area or in a frequent traffic lane, there is potential for the following infrequent traffic:

- Vessel servicing the West of Shetland Oil Fields transiting from the mainland Scotland
- Vessels infrequently transit through the area, such as, tankers, recreational vessels, cargo vessels, commercial work boats (referenced as special craft in AIS data).
- Cruise Liners/passenger vessels
- High-speed craft
- Tugs

Total traffic passing in summer months (information taken from one-year AIS data) is 95 vessels and 41 vessels in the winter months. The majority of the traffic that has passed the area within this period has passed the exact deployment location by at least 0.5NM with the exception of sailing vessels. The device will be appropriately marked by lights and shapes, Notice to Mariners will be issued to make any vessels transiting the area aware of the device location so they can pass clear of the device.

3.6 CONSERVATION AREAS

Several Local Nature Conservation Sites (LCNS) have been designated around Orkney as part of the Orkney Islands Council Local Development Plan (2017). LNCS are regarded as being worthy of protection due to their ornithological, botanical or geological/geomorphological interest.

It is also important to acknowledge that the test site is located just outside a wider area of Orkney coastline and inshore habitats which represent, in some cases, nationally and internationally important regions of conservation interest which have been identified as Special Areas of Conservation (SACs), Special Protection Areas (SPAs), proposed Special Protection Areas (pSPAs) and National Scenic Areas (NSAs) amongst others.



4 DESCRIPTION OF ITEMS TO BE DECOMMISSIONED

The items which are subject to decommissioning are listed below:

- The device
- The two mooring lines, that are attached to the device and two drag-embedded anchors or gravity-based anchors
- Two drag-embedded anchors or gravity-based anchors, to which the mooring lines are attached
- HALO unit
- Hybrid AUV
- Umbilical
- Ancillary Scientific Equipment.

4.1 THE DEVICE

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 2. Figure 2 shows a visualisation of the machine. Figure 3 gives the general arrangement of the machine.

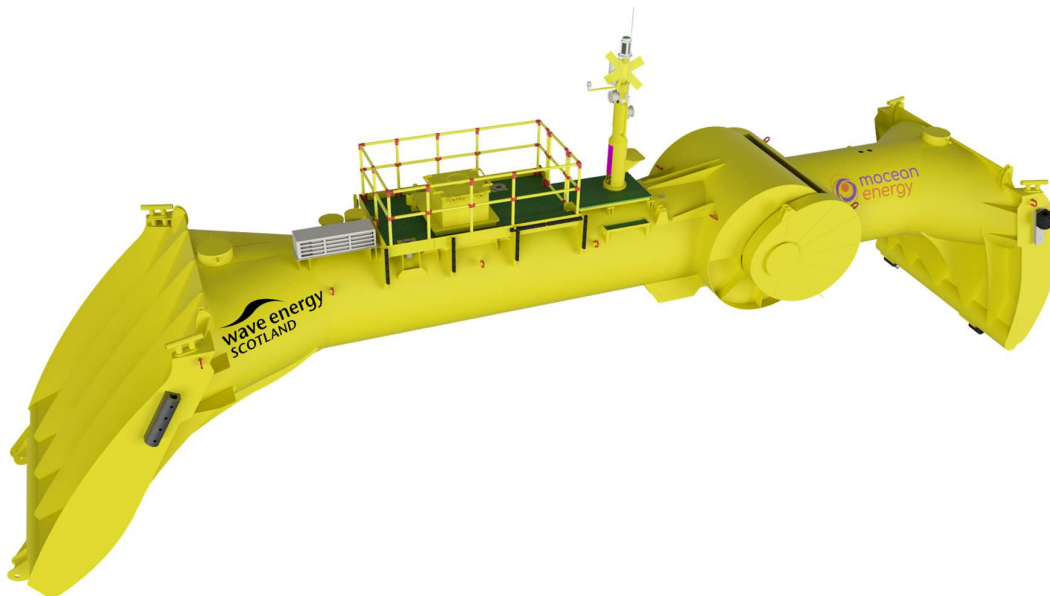
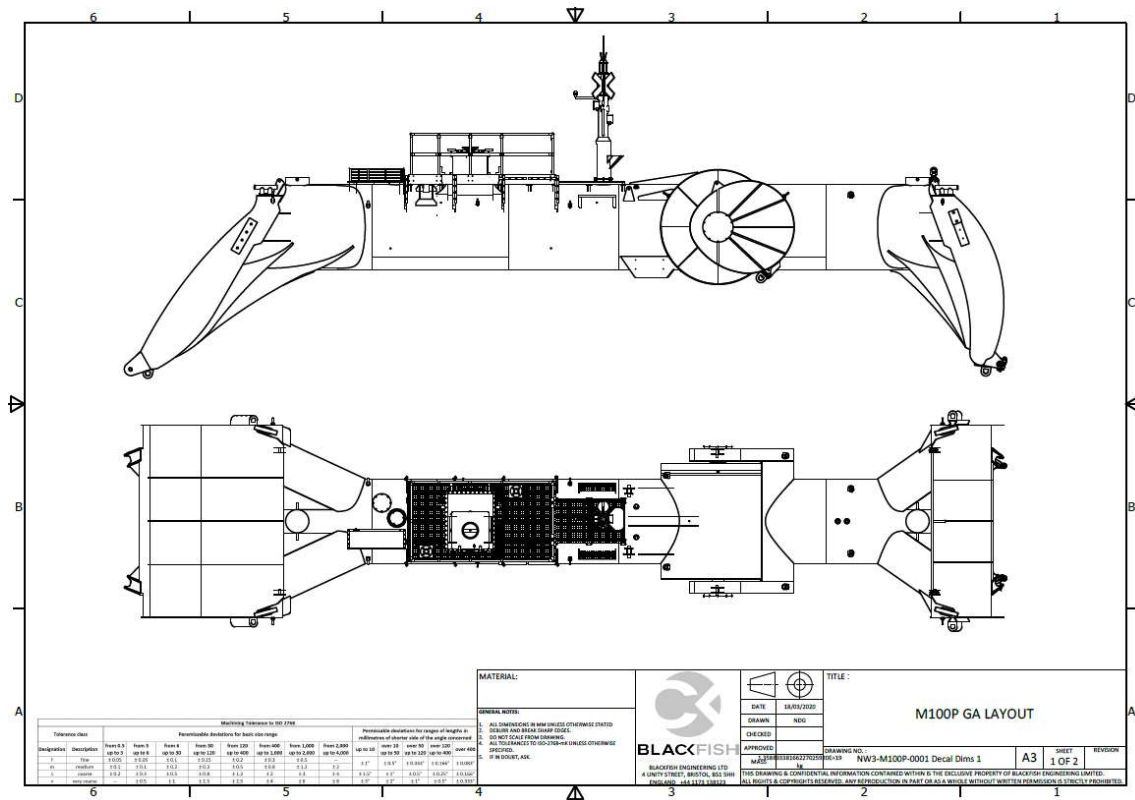


Figure 2 M100P visualisation

Table 2 Key dimensions of the M100P

Dimension	Units	Value
Length overall	m	19.2
Beam	m	4.2
Draft	m	3.4
Mass	tonnes	37.9





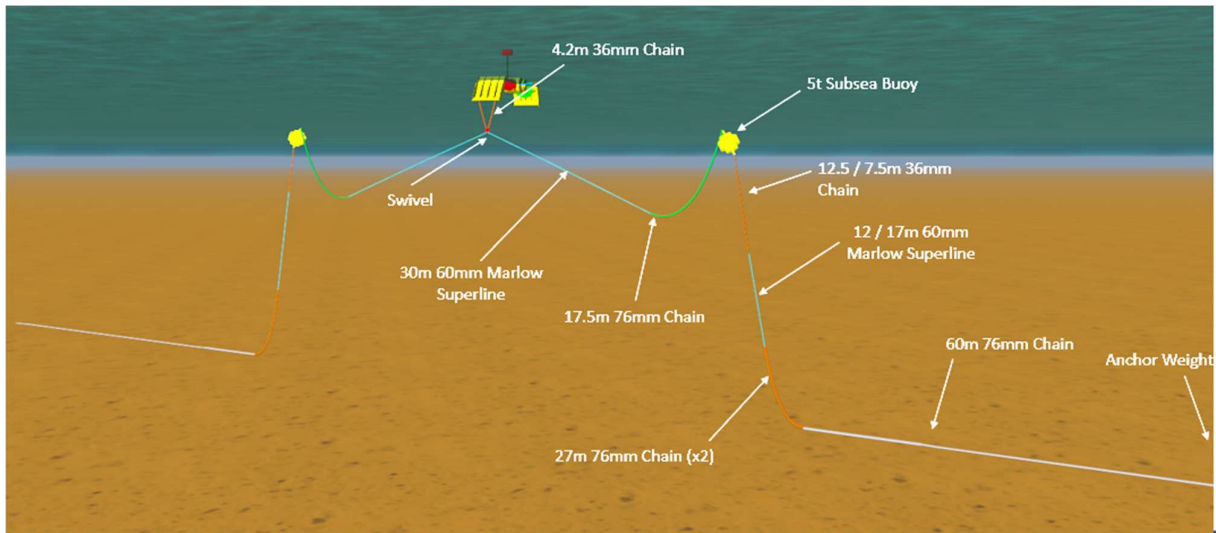


Figure 4 Mooring leg structure

The distance between the end points of the mooring legs is shown in Figure 5.

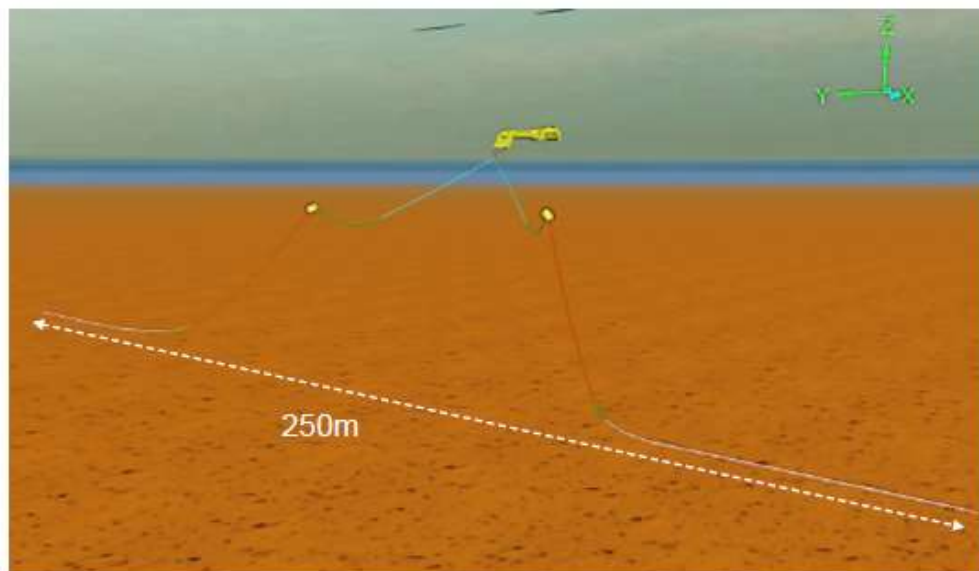


Figure 5 The WEC with Mooring Spread

The mooring footprint is represented in the schematic in Figure 6.

- The radius of the current mooring design, without contingency for design optimisation is 125m.
- The static position of the moorings is shown by the dashed blue line.
- The static point of the forward mooring point on the WEC is marked by the red cross.
- The dynamic excursion as a result of 6m Hs conditions is measured to be 75m from the static position of the device.
- The maximum 75m excursion is likely to be from East to West, with less excursion from West to East.
- The marker buoys are 45m along the mooring line from the forward mooring attachment point on the WEC.



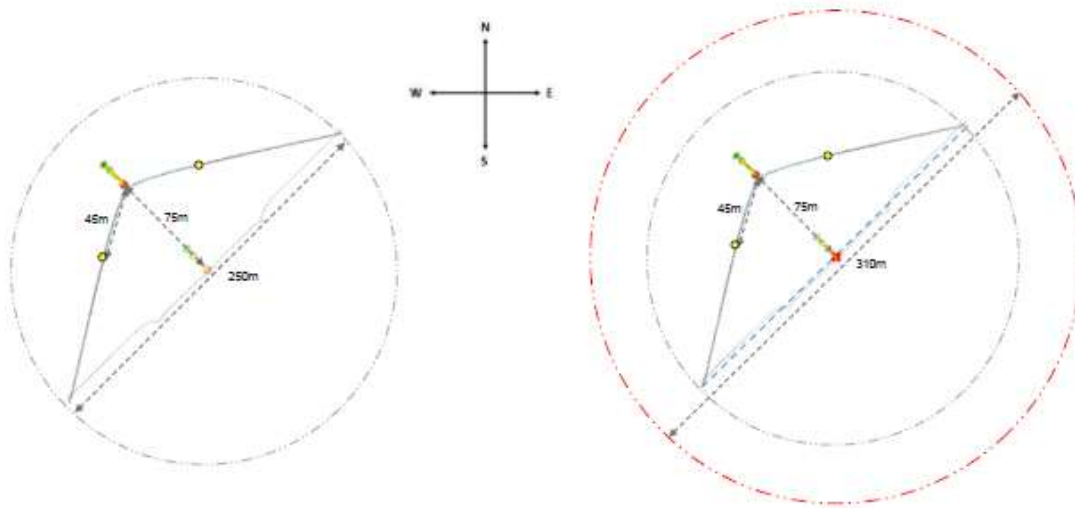


Figure 6 Mooring footprint (left), with allowance (right)

The design may be subject to further optimisation in advance of deployment. Therefore, an allowance of 30 m on each mooring leg is presented as this allows for minor changes that may occur during detailed design. This results in an increased radius of the mooring spread to 155 m (310 m diameter).

Depending on the seabed conditions, the anchors will be either drag embedment anchors or gravity-based foundations. No drilling will be required for their installation.

When the M100P is not connected to the mooring system (i.e. prior to installation or during maintenance), the mooring system will be held in place by a surface buoy.

4.3 HALO

The Halo unit is an energy storage and management system comprising of Lithium-ion batteries and electronics housed in a painted structural carbon steel gravity-based skid. A *representative* skid is shown below.

HALO	
Energy Capacity	150 kWh (scalable to 1 MWh+)
Output A (SPCS)	250 VAC 1PH 50 Hz (configurable)
Output B (HAUV)	350 VDC, 3 kW
Dimensions	4m(L) x 2.9m(H) x 2.5m(D)
Total Mass	10 Te



Figure 7 HALO Unit

4.4 HAUV

The HAUV is an autonomous underwater water vehicle that will be stored in a painted structural carbon steel gravity-based skid. A *representative* skid is shown below. Its approx. 4.6t



Hybrid AUV

Battery Capacity	30 kWh
Endurance	~14 hrs
Survey Range	~40 km survey / charge
HAUV Dimensions	4.1m(L) x 1.35m(H) x 0.5m(D)
Dock Dimensions	5.04m(L) x 3.94m(H) x 3.2m(D)



Figure 8 HAUV Unit

4.5 UMBILICAL

The umbilical is connected from the WEC to the Halo unit described above. The umbilical is 32mm in diameter and will be approximately 220m long. Voltage 400V AC, Single Phase and Power 3KW.

An illustration of how all of the above components work together is provided below.

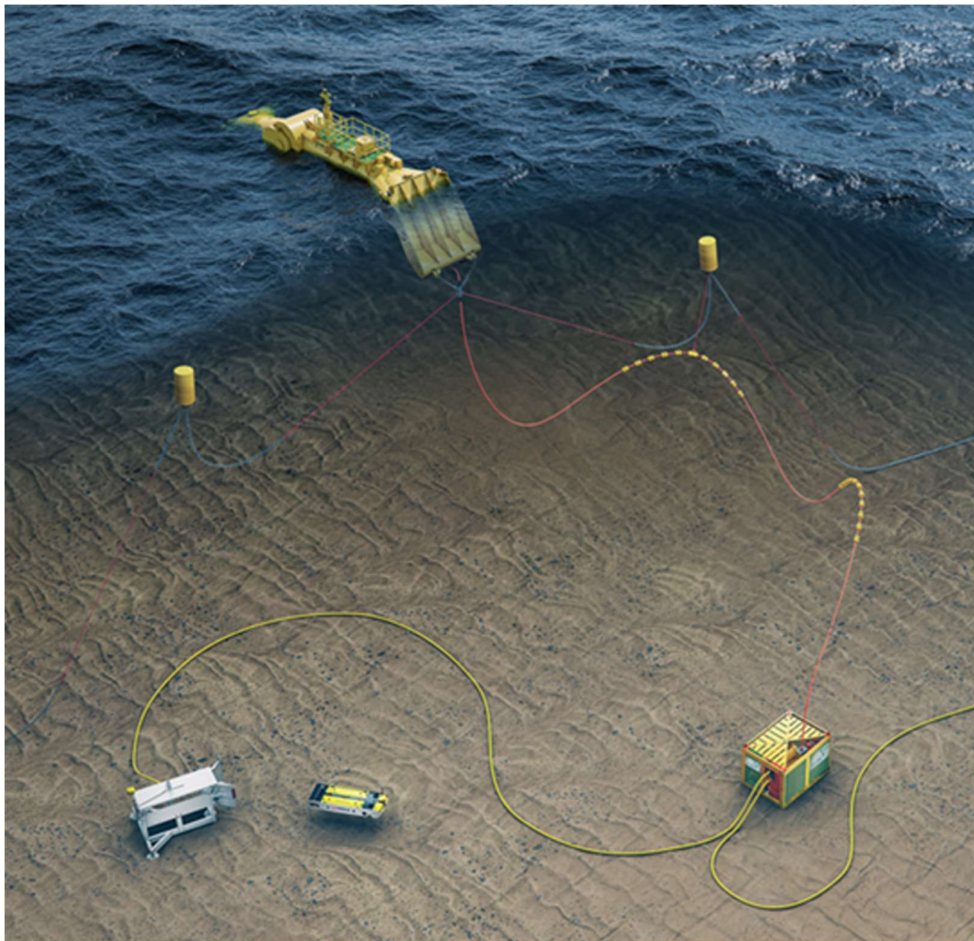


Figure 9 Illustration of entire system



The subsurface system will be connected to the WEC in order to demonstrate the potential to power a temporary piece of equipment placed on the seabed (e.g. a remotely operated vehicle docking station and/or a battery) as proof of concept. This will not provide power to shore and hence will not be grid connected. The umbilical will be integrated with the mooring and will not involve excursion of any equipment outside of the consented area.

4.6 ANCILLARY SCIENTIFIC EQUIPMENT

In addition to the WEC, a Wave Rider (or similar) measurement buoy, including its own mooring and anchor, will be anchored in the vicinity of the WEC within the licence boundary to measure metocean conditions.



5 DESCRIPTION OF PROPOSED DECOMMISSIONING MEASURES

5.1 INTRODUCTION

This section aims at describing the proposed measures to be taken for decommissioning the installation. It has to be considered that the level of detail provided may be improved upon over time, although it is understood that the programme is detailed enough to demonstrate that the decommissioning has been fully considered and factored into design decisions.

5.2 PROPOSED METHOD OF REMOVAL

Decommissioning will involve the removal of the M100P, HALO unit, Umbilical, HAUV and all associated equipment. This will be a reverse of the installation procedures outlined in Section 14.1. The device is planned to be removed from site by a Multi Cat and a workboat vessel in 1 day, and its mooring lines and anchors, and the Waverider like buoy are planned to be removed from site by a Multi Cat vessel in a further 1 day. Prior commencement of works Mocean Energy will liaise with local stakeholders and issue a local Notice to Mariners. A proposed method of removal is described below and will be further reviewed closer to the decommissioning period after incorporating lessons learnt from the installation described in [Operational plans and methodologies](#).

5.2.1 Device decommissioning

The device will be disconnected from the mooring line with the help of a multicat workboat and a workboat vessel in 1 day, towed from the test site to an appropriate harbour, where it will be temporarily dry stored.

The procedure to disconnect from the mooring lines is as follows:

- The towing vessel approaches the pick-up buoy very slowly into wind or into tide whichever has most effect.
- The towing vessel will come to a stop where the pickup buoy can be reached.
- A grapnel line or boat hook will be used to capture the pickup buoy and line and bring it on board.
- Using towing vessel winches the pickup line and mooring lines will be brought on board over the stern to bring Umbilical Connection to deck.
- Disconnect Device Umbilical from Connection Point. Umbilical Cable lashed onto Steel Wire on board.
- The mooring lines will be disconnected and eased back into the water with a pick up buoy for recovery later.
- The towing line will be connected to the towing vessels towing line and the WEC brought to port.

5.2.2 HALO and HAUV decommissioning

Both the HALO unit and the HAUV will be decommissioned using a multicat workboat and a workboat. The HALO and AUV garage units might be combined into one unit, thus the recovery of the HAUV garage might be integrated in the HALO recovery, which should further simplify the recovery procedure and minimise the units in the seabed.

Proposed steps for retrieving the HALO unit and cable:

- Recover Buoy to Vessel Deck via Marker Buoy.
- Pay-in on Mooring Line to bring Umbilical Connection Point to deck.
- Disconnect HALO Cable from Connection Point and retrieve
- Vessel to position at HALO installation waypoint.
- Simultaneously, hydraulic shackle to be utilised to retrieve HALO with Winchline
- HALO and cable/umbilical retrieved



The AUV garage recovery has the following task:

1. Deploy multicat mooring spread on site
2. Transit to site, hook onto Multicat mooring and use ROV to retrieve AUV umbilical cable
3. Disconnect umbilical and AUV garage
4. Retrieve AUV skid from seabed
5. Recover mooring spread and Remote Operated Vehicle

5.2.3 Mooring legs decommissioning

Both anchors, one at the end of each mooring line, will be decommissioned along with the mooring lines using a multicat workboat. Decommissioning will involve the complete removal of anchors from the site.

- A grapnel line or boat hook will be used to capture the pickup buoy and line and bring it on board
- Disconnect buoy and retrieve
- Using towing vessel winches the mooring line will be brought on board over the stern and retrieved
- Ground chain winched on board and Anchor suspended under bow roller for tow to port for dry storage
- Repeat for other mooring leg

5.2.4 Ancillary Scientific Equipment

The Waverider like buoy is planned to be removed from site by either a Multi Cat vessel or a RHIB depending on the type of device that will be utilised.

5.3 HEALTH AND SAFETY CONSIDERATIONS

The marine contractor is at all levels responsible for ensuring that the offshore and dive operations to achieve the decommissioning scope, are conducted in accordance with the relevant policy and that, as a minimum, the contractors management system is applied on all vessels, sites, and operations where the contractor takes responsibility for employees and subcontractors.

This section will be updated through method statements when the decommissioning operations have been organised.

5.3.1 Health, Safety and Environment (HSE)

- Risk Assessments will be performed for all tasks detailed in this procedure.
- Risk Assessment Report / Task Risk Assessments should be read prior to carrying out the tasks in order to make sure that hazards, risks and mitigating actions have been identified and understood. As a minimum, Toolbox Talk are to be carried out to convey this.

5.3.2 Quality Control (QC)

- Activities will be monitored in accordance with a Quality Plan and applicable sections of an Inspection & Test Plan.
- The Project Engineer and work site Supervisors are responsible for monitoring the progress of the work and recording pertinent information as dictated in a task plan. Each task should be signed off as the work progresses.
- Where required, the Project Engineer and Worksite Supervisors shall provide the company with sufficient notification of the activities taking place.
- On completion of the works, the Project Engineer must collate the completed forms and plans.
- Permit and Toolbox forms will be filled and gathered offshore by the Project Engineer to be part of the As-Built dossier / Mechanical Completion Certificate.



5.3.3 Worksite changes to approved procedure

In the event of any unplanned operation or required change to the procedure offshore which has not been subject to an onshore HIRA, reference should be made to MOC procedures.

The Shift Supervisor responsibility to ensure that Management of Change is clearly communicated to all on shift personnel. During shift handover, minutes should be taken and documented to identify that all parties have understood and agreed to continue operations after handover of responsibility is completed.

5.4 PROPOSED WASTE MANAGEMENT SOLUTIONS

Waste management will be carried out in accordance with all relevant legislation at the time of decommissioning. Furthermore, regard shall be had to the waste hierarchy (reuse, recycle, incinerate, disposal).

All components will be re-used where feasible with those materials that cannot be re-cycled. Any waste will be disposed of in accordance with good practice and statutory guidance.

5.5 DETAILS OF ANY ITEMS WHICH MAY BE LEFT IN SITU

Components which constitute the device, mooring system, and anchor at the berth will be removed. There will be no components left *in situ* relating to the device or anchoring systems. Returning the site to pre-testing conditions is of utmost importance.

6 ENVIRONMENTAL IMPACT ASSESSMENT

A project-specific Environmental Monitoring Plan has been developed which encompasses the decommissioning phase of the project. Appropriate mitigation measures have been identified as part of the plan and will be reported to the regulator when required. During installation and decommissioning of the platform, there is the possibility of disturbance to marine species due to vessel traffic. For that reason, special effort will be made so that those operational activities will be accomplished in the shortest time possible. In addition, all vessel activities onsite and to and from site will be conducted as far as possible in line with the Scottish Marine Wildlife Watching Code (SMWWC).

The materials used for construction of the device, anchor and mooring have been chosen for their suitability for use at sea, both in terms of durability and their impact on the environment. The materials are all non-toxic. Environmental acceptable lubricants will be used, and all hydraulic fluids used within the device will be certified as suitable for marine environment.

7 CONSULTATIONS WITH INTERESTED PARTIES

Consultation on this document was carried out with reference to the notice issued by Mocean Energy. Emails were sent to consultees specified by Marine Scotland and the document was placed on the Mocean website inviting members of the public to comment. Consultees that were emailed include:

- Historic Environment Scotland (HES)
- NatureScot
- Maritime and Coastguard Agency (MCA)
- Northern Lighthouse Board (NLB)
- UK Chamber of Shipping (UKCoS)
- Scottish Fishermen's Federation (SFF)
- Orkney Fisheries Association (OFA)
- Orkney Islands Council Marine Services (Harbour Authority)
- Orkney Islands Council Planning Authority (OIC)
- Royal Yacht Association Scotland (RYA)





Consultee	Email	Receipt	Response	Objection	Comments	Action required
HES	Oliver.Lewis@hes.scot	Yes	Yes	No	Foresee no issues	None
NatureScot	Chris.Eastham@nature.scot	Yes	Yes	No	Foresee no issues	None
MCA	nick.salter@mcga.gov.uk	Yes	Yes	No	Expect all infrastructure to be removed and post-decommissioning surveys should be in accordance with our hydrography guidelines in MGN654.	Sections 11 and 13 has been updated to address requirement for compliance with MCA's hydrography guidelines. Requirements for full removal of infrastructure are in line with the Decommissioning Programme (DP).
NLB	adam.lewis@nlb.org.uk	Yes	Yes	No	Northern Lighthouse Board have no objection to the content of the Decommissioning Programme, and advise the following; Mocean Energy liaise with local stakeholders with regard to the operations, and issue a local Notice to Mariners informing of the scope and timeframe of the decommissioning works, in line with Appendix C of the Project-specific Environmental Management Plan.	Section 5.2 updated to clearly state that Mocean will liaise with local stakeholders and issue a local NtM.
UKCoS	RMerrylees@ukchamberofshipping.com	Yes	Yes	No	Support the full removal of all components from the seabed with nothing left in situ.	Requirements for full removal of all components are in line with the Decommissioning Programme (DP).
OICP, OICH	devplan@orkney.gov.uk	Yes	Yes	No	No issue on offshore works. Early Pre-consultation requested for onshore works.	Mocean Energy will liaise with Orkney Harbours to arrange a recurring meeting that will keep them appraised on any works

SFF, OFA	m.morrison@sff.co.uk	Yes	Yes	No	<p>On behalf of the Orkney Fisheries Association, and the other seven associations which make up the Scottish Fishermen's Federation (SFF) I am happy to reply to this consultation.</p> <p>Our position remains, as with all EMEC installations, that the SFF expects that at end of life the seabed must be returned to its condition prior to the trials.</p>	Section 13 has been update to state clearly that the seabed must be returned to its condition prior to the trials.
RYA		Yes	Yes	No	No issue	No None

8 COSTS

Project cost details are considered commercially sensitive data. As a result, those details are provided separately, which will be made available to Marine Scotland. Refer to APPENDIX A.

9 FINANCIAL SECURITY

Financial security details are considered commercially sensitive data. As a result, those details are provided separately, which will be made available to Marine Scotland.

10 SCHEDULE

The high level chart in APPENDIX B details key activities and dates (in weeks) associated with this testing programme. It is to be expected that any schedules are subject to change due to environmental and tidal conditions, and unforeseeable future barriers.

The anticipated date of installation of the M100P, the subsurface system and its associated mooring system is October 2022. The operational period of the test is anticipated to last up to the middle of February 2023. To allow some contingency in the programme, the marine licence application will cover the period until the end of June 2023. Thereafter, all equipment will be completely removed from site by March 2023 as requested on the licence conditions.

At all times, onsite works will be subject to Mocean Energy's HSE Plan and Mocean Energy's Operations Plan, which are managed by Mocean Energy to minimise any potential conflicts and maximise any opportunities that may arise.

Final details of timing will be given towards the end of the life of the installation, when a review of the decommissioning programme will be undertaken to finalise the decommissioning measures proposed.

11 SEABED CLEARANCE

During decommissioning operations, it is not expected there will be generation of debris since the device together with the subsea system and its mooring line and anchor will be removed completely.

Upon the completion of decommissioning, by means of the appropriate survey, it will be confirmed that the site has been cleared out, including anchor locations. At the end of the project an ROV survey will be undertaken to ensure that all anchoring, mooring and subsea system materials have been removed from the site. The post decommissioning survey will also record any potential impacts to the seabed where the subsea equipment, anchors and mooring lines have been contact with the seabed. Such survey will enable identification and subsequent recovery of any debris (if any) located on the seabed which may have arisen from the company's activities and which may pose a risk to navigation, other users of the sea or the marine environment. The post-decommissioning survey will be in accordance with MCA hydrography guidelines in MGN654 and will provide evidence that the site has been left clear and to its condition prior the testing.

Survey will be undertaken in attendance of an independent, third party when providing evidence that the site has been cleared. Currently all evidence indicates that given the nature of the seabed and proposed non-invasive works, no restoration works will be required.



12 RESTORATION OF THE SITE

It is not expected that there will be significant disturbance to the site during the decommissioning and removal of the device and associated infrastructure. Thus, it is not anticipated it will be necessary to implement a specific site restoration programme.

The removal of the components constituting the device mooring system, the HALO and HAUV unit, as referred to in previous sections, would only have influence in a quite limited zone and would not impact on areas to be conserved.

13 POST-DECOMMISSIONING MONITORING, MAINTENANCE AND MANAGEMENT OF THE SITE

Assuming the small potential area of impact on the seabed, the lack of generation of debris forecasted and the completely removal of the device, the subsea system together with its mooring lines and anchor, no post-decommissioning monitoring, maintenance or management of the site is considered to be necessary.

Following the decommissioning of the facilities a ROV seabed survey, which provides more details, will be undertaken so as to confirm that the dismantling has been done correctly. The post-decommissioning survey will be in accordance with MCA hydrography guidelines in MGN654 and third party will be involved when providing evidence that the site has been left clear and to its condition prior the testing.



14 OPERATIONAL PLANS AND METHODOLOGIES

14.1 CONSTRUCTION AND INSTALLATION

The vessel spread required for installation is shown in Table 3.

Table 3 Vessels utilised for installation

Vessel Type	Task
Multi Cat (x1) Workboat (x1)	Anchor and Mooring installation/removal. Device installation and removal. HALO, Umbilical and HAUV installation and removal.
Rigid Hulled Inflatable Boat (RHIB) (x1)	At-sea visual inspection. At-sea battery charging and power demonstration. Waverider like buoy installation and removal.



Figure 10 Example vessel of Multi Cat



Figure 11 Example vessel of RHIB



Mooring installation

The proposed mooring installation phases are described below:

- preliminary phase: anchor and ground chain installation
- deployment phase: The device is towed to site and final mooring arrangements and hook-up are made.

It is good practice to decouple where possible the installation of anchors from loadout, and this normally helps de-risk the project in terms of weather exposure. Depending on the seabed conditions, the anchors will be either drag embedment anchors or gravity-based foundations. The preferred anchor solution is conventional drag embedment anchors, which have very high holding to weight ratio when deployed in suitable stable sediments.

A Pre-installation survey of the site will take place prior commencement of operations, to include anchor locations, mooring leg corridors, HALO and HAUV position. The Installation steps:

1. MOBILISE & TRANSIT TO SITE; Equipment to include: Anchors, mooring chains, subsurface buoys)
2. INSTALL STARBOARD ANCHOR; Install Anchor 1 into position, Pay-out (tick-tock) mooring chain to lay.
3. INSTALL STARBOARD SUBSURFACE BUOY; Continue along mooring line to Subsurface Buoy position, Install Synthetic into Mooring Leg as Vessel progresses, Install Buoy onto Line.
4. REPEAT FOR PORT; Return to Quayside to load PORT Mooring Line, Repeat install for PORT Mooring Line, Install Umbilical Connection Point as part of PORT Mooring Line.
5. MOORING BUOY CHECK; Connect buoys with 75m Rope, Deploy buoys and confirm floating depth to be approx. 6m to top of buoys.

Prior to device installation and while the device is at quayside for maintenance, the mooring system will remain deployed and buoyed off to a surface buoy.

Device installation

It is anticipated that the installation of the anchors will be completed in 1 day and connecting the M100P will be completed within 1 day. It is expected that the M100P device can be installed in conditions of $H_s < 1.5\text{m}$.

The following installation process is proposed. This will be confirmed with the nominated marine installation contractor.

1. The WEC is towed onsite with pennants¹ on
2. The mooring is retrieved from starboard surface buoys
3. The mooring is connected to preinstalled pennant¹ on WEC
4. This is repeated for the port surface buoy whilst the cable clamp is also recovered and the umbilical connection is made and tested and deployed.

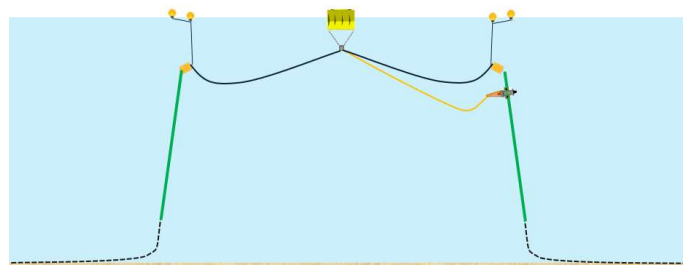


Figure 12 WEC installation

¹ The mooring pennant is a short length of line that forms part of the mooring system near the WEC.

HALO installation

The HALO deployment has the following tasks:

1. MOBILISATION & TRANSIT; Loadout HALO assembly onto Vessel, Loadout Cable Reel to Vessel with Spooler, Loadout Buoyancy and Cable Equipment, Transit to Site.
2. OVERBOARD HALO; Lift HALO assembly with crane over bow roller, Transfer to Winch Line and deploy to seabed.
3. HALO INSTALLATION; Vessel to position at HALO installation waypoint, HALO lowered into position on Winch Line, Umbilical paid out simultaneously as HALO lowered, HALO touchdown and position confirmed, HALO released from Winch Line via hydraulic shackle.
4. CABLE LAY; Lay Cable with buoyancy modules towards PORT Subsurface Buoy position, Vessel positions for Subsurface Buoy recovery.
5. CABLE LAY; Lay Cable with buoyancy modules towards PORT Subsurface Buoy position, Vessel positions for Subsurface Buoy recovery.
6. CONNECT HALO CABLE INTO UMBILICAL CONNECTOR ON MOORING LINE
7. HALO INSTALLATION COMPLETE; Lower Mooring Line back into Water, Deploy Subsurface Buoy, Moorings, Cable & Device installed.

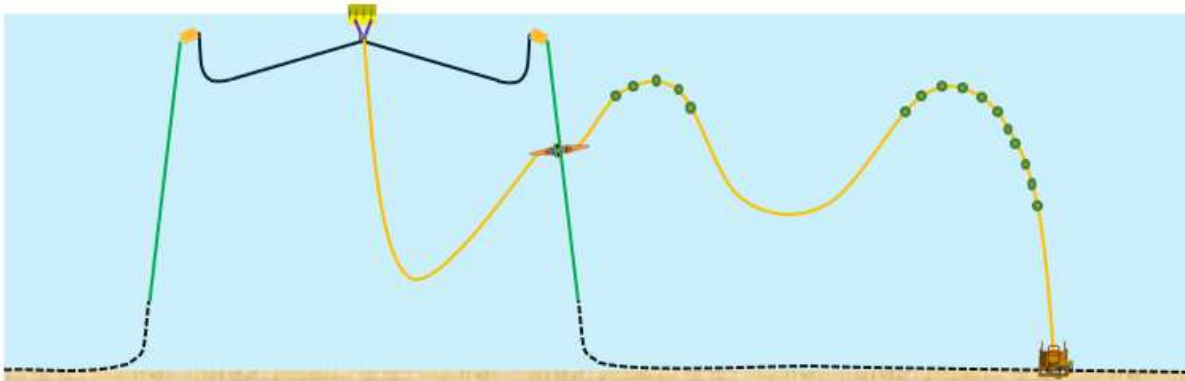


Figure 13 HALO installation

HAUV Installation

The AUV garage deployment has the following task:

1. DEPLOY MULTICAT MOORING SPREAD ON SITE
2. DEPLOY ROV; Transit to site, hook onto Multicat mooring and deploy ROV to retrieve AUV umbilical cable from seabed
3. MAKE CONNECTION BETWEEN UMBILICAL AND AUV GARAGE
4. DEPLOY AUV SKID TO SEABED
5. RECOVER MOORING SPREAD

The HALO and AUV garage units might be combined into one unit, thus this final step of HAUV installation might be integrated in the HALO installation, which should further simplify the installation and minimise the units in the seabed.

14.2 DEVICE AND SUBSURFACE SYSTEM TESTING

The device and subsurface system testing will consist of running the machine under normal operating conditions at the deployment site, collecting data with onboard instrumentation, logging that data, and sending some of it back to a control centre on shore via wireless signals. Onboard instrumentation will measure parameters needed to assess power absorption, engineering quantities like loads, and to monitor the health of the machine.



14.3 MAINTENANCE

The device has been designed so that regular maintenance is not required. However, because it is a prototype, it is anticipated that during performance testing, maintenance and inspection will be performed approximately every 2 weeks. Additional unplanned maintenance may also be necessary.

Maintenance activities will take place across three different locations, depending upon nature and duration of the activity:

- **On Station:** As much routine and responsive maintenance as possible will take place at the proposed mooring location.
- **Sheltered Mooring:** There is a designated sheltered mooring location nearby in Holm Sound where the device will be moored temporarily where a sheltered sea state is required for specific maintenance activities.
- **Hatston Quay:** For maintenance activity requiring the device to be lifted out of the water, Hatston Quay in Kirkwall will be used.

We estimate that maintenance activity or visual inspection will be required every two weeks.

14.4 MONITORING

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.



15 APPENDIC

APPENDIX A Decommissioning Budget

APPENDIX B Schedule

Activity	Project Week																											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
	26/09	03/10	10/10	17/10	24/10	31/10	07/11	14/11	21/11	28/11	05/12	12/12	19/12	26/12	02/01	09/01	16/01	23/01	30/01	06/02	13/02	20/02	27/02	06/03	13/03	20/03	27/03	
Mooring Installation	X																											
Device Installation		X																										
Testing		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X								
Maintenance – On Station						X					X					X												
Maintenance – Sheltered Mooring																												
Maintenance – Hatston Quay																												
Device & Mooring Removal																						X						
Contingency																						X	X	X	X	X	X	X