Mocean Energy | M100P

Decommissioning Programme

EMEC Scapa Flow Scale Site

June 2020




Document History

Revision	Date	Description	Originated by	Reviewed by	Approved by
1	09/06/20	Submitted	DL (EMEC)	JC (ME)	
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Executive Summary

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 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 Scapa Flow scale test site, Orkney from October 2020. 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.

This document outlines a decommissioning programme for the device and is submitted for approval in accordance with the requirements of the Energy Act 2004.

1 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 device is intended to be deployed at the EMEC Scapa Flow test site, Orkney.

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.

1.1 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 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.

2 Background Information

2.1 Device Location

The device is intended to be deployed at the EMEC Scapa Flow scale test site, Orkney, at Berth 2.

Figure 1 illustrates the area of EMEC test site at Scapa Flow, together with the positions of the berths. It has been proposed to use berth 2 to deploy the device.

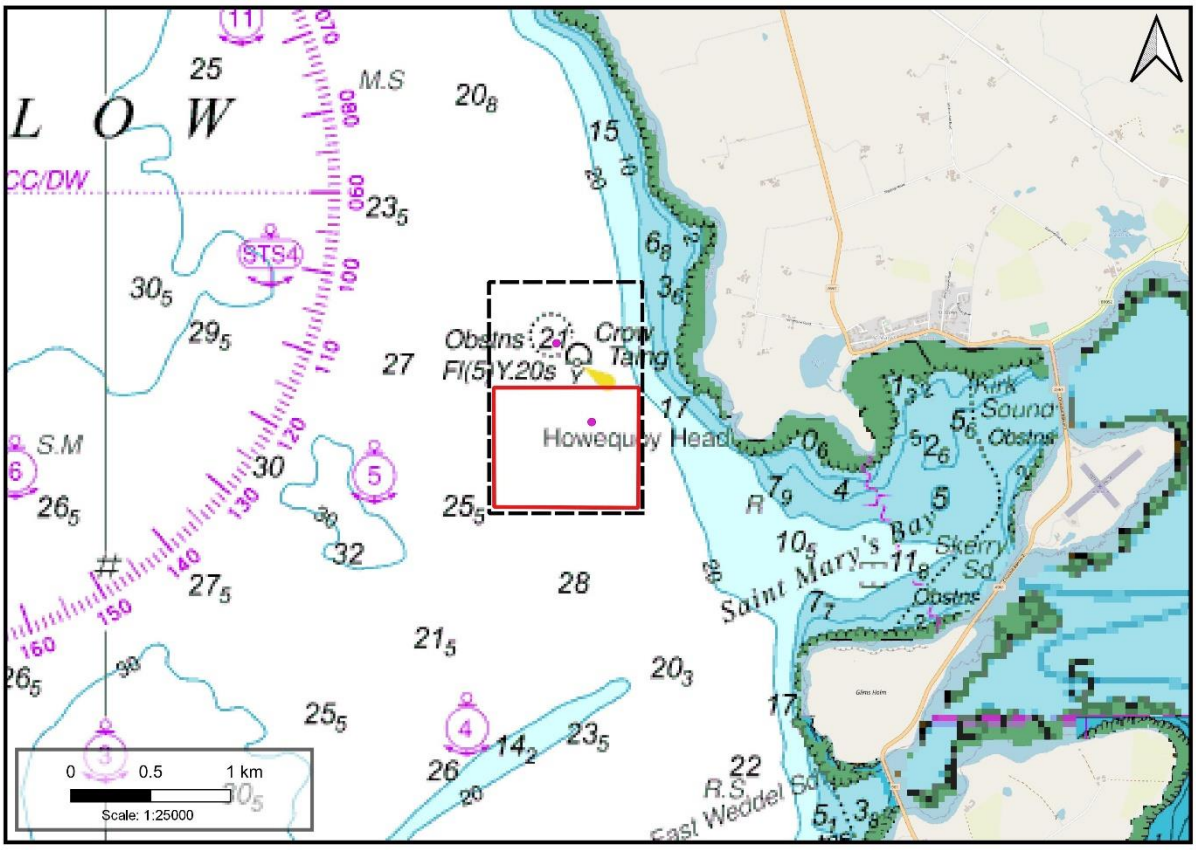

Figure 1. Marine licence boundary (red line), site boundary (black dashed line), and berths (purple dots)

The deployment will be in the vicinity of the berth location and within the boundary coordinates provided in Table 1. The licence boundary area is roughly 0.9km West to East, and 0.8km North to South. The area of the licence boundary is roughly 0.7km^2.

Table 1. Coordinates of berth and test site boundary

Location Description	Latitude and longitude (WGS 84)				UTM (Eastings and Northings)			
Berth 2	58° 53.28'N, 002° 56.50'W				503039N, 6527948E			
Test site boundary points	Corner A	Corner B	Corner C	Corner D	Corner A	Corner B	Corner C	Corner D
	58° 53.950' N	58° 53.170' N	58° 53.170' N	58° 53.950' N	6528826 E	6527378 E	6527377 E	6528826 E
	002° 56.500' W	002° 56.500' W	002° 57.500' W	002° 56.500' W	503361 N	503362 N	502402 N	503361 N
Marine Licence Boundary	Corner A	Corner B	Corner C	Corner D	Corner A	Corner B	Corner C	Corner D
	58° 53.59'N	58° 53.19'N	58° 53.19'N	58° 53.59'N	6528157 E	6527415 E	6527415 E	6528158 E

	002° 57.47' W	**002° 57.47' W**	**002° 56.53' W**	**002° 56.53' W**	**502430 N**	**502431 N**	**503334 N**	**503333 N**

2.2 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 EMEC test site is available for use by other developers, other installations on the site and EMEC-owned infrastructure, must be considered during decommissioning activities. All operations at EMEC's test site must comply with EMEC's Standard Operating Procedures, Emergency Operating Procedures and Health, Safety and Environment requirements. Before activities begin, there should be a review of other planned work due to be carried out at the site with potential to coincide with the decommissioning works. 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 berths at the site will be considered when updating the decommissioning methodology closer to the time of decommissioning.

2.3 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 on the pier. Figure 3 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 4 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.

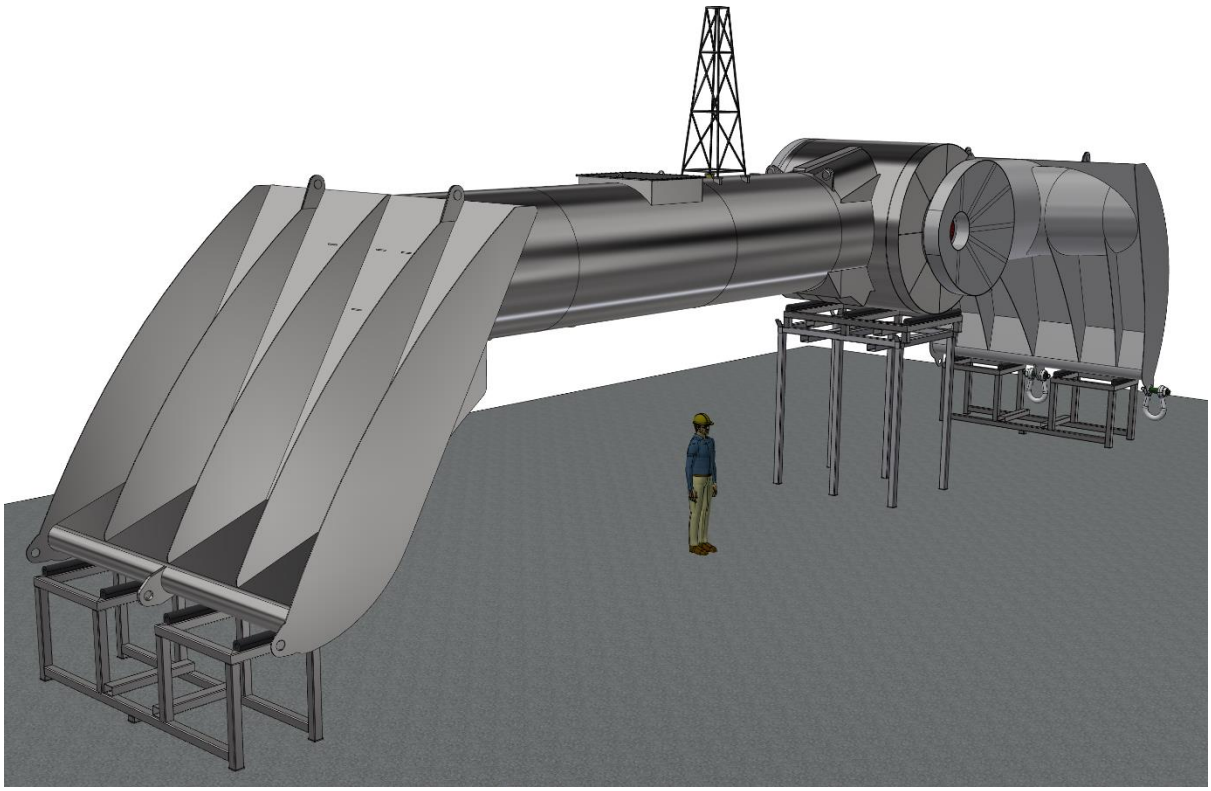

Figure 2. M100P visualisations on pier.

2.4 Site conditions

2.4.1 Prevailing weather

Strong winds and gales are very common in Orkney, predominately from the west to 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.

2.4.2 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 ºC to 13.5 ºC in an annual cycle, with maximum temperatures recorded around August and September and minimum temperatures around February.

2.4.3 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.

2.4.4 Currents

The maximum recorded current speed at the Scapa Flow test site is 1.2m/s, however the typical current speed is closer to < 0.2 m/s.

2.4.5 Seabed conditions

The seabed sediments and communities of the Scapa Flow area have been the subject to several site surveys. These surveys have been used to establish an understanding of the baseline physical and biological environment at the Scapa Flow test site.

Reports indicate a moderately low energy site that is characterised by stable sands of quite fine consistency. Some mud and appreciable amounts of uniform sized shell fragments are present also, in addition to small stones and patches of red macroalgae that are found at intervals across the site. The habitat may be broadly classified as “Sheltered Muddy Gravels” and subcategorised as “Subtidal Mixed Sediments”.

2.4.6 Water depths

Water depths across the area ranged from approximately 15 to 30 m, approximately 1 m deeper than charted depths. A sand wave lying WSW-ENE across the south section of the area was found to rise up to a depth of 14.8 m.

2.5 Navigational activity

It is worth mentioning that Scapa Flow test site has been established since 2010 and its selection was made based on the local traffic features. In addition, its boundaries are defined on navigational charts; this allows vessels to plan their passage taking into account the test site. In fact, local vessels in the area, such as inter-island ferries, have good awareness of test site location.

2.5.1 Shipping activity

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.

2.5.2 Fishing vessel activity

Very few fishing vessels 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.

2.5.3 Recreational activity

The area is not routinely used for organised events such as races. The AIS data shows that no recreational vessels pass through the test site, with only one track occurring to the south into Saint Mary’s.

2.6 Conservation areas

The Scapa Flow test site is located within the Pentland Firth proposed special protection area. The nearest sites are Keelylang Hill and Swartabeck Burn SSSI and the Orkney Mainland Moors SPA, both of which are situated 7.6 km from the test site.

It is also important to acknowledge that the Scapa Flow test site is located within 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).

3 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.

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.

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Table 2. 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

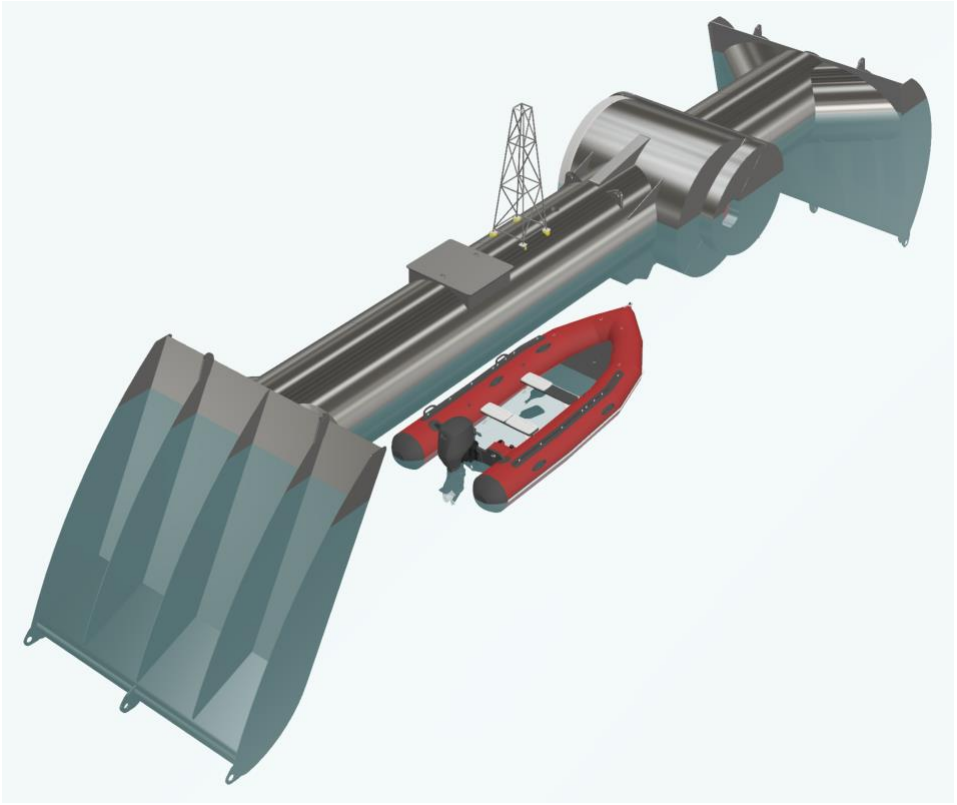

Figure 3. M100P visualisations as deployed at sea.

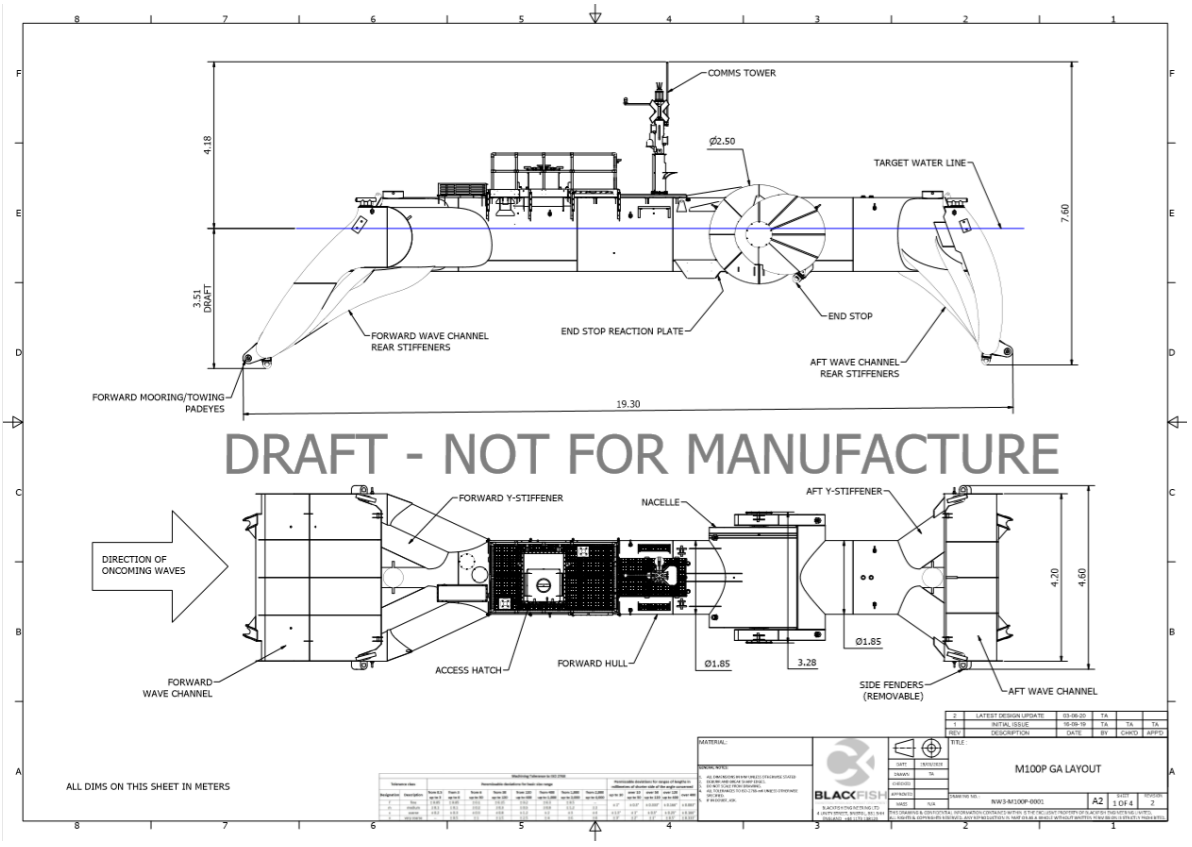

Figure 4. M100P drawing with dimensions.

Figure 5 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.

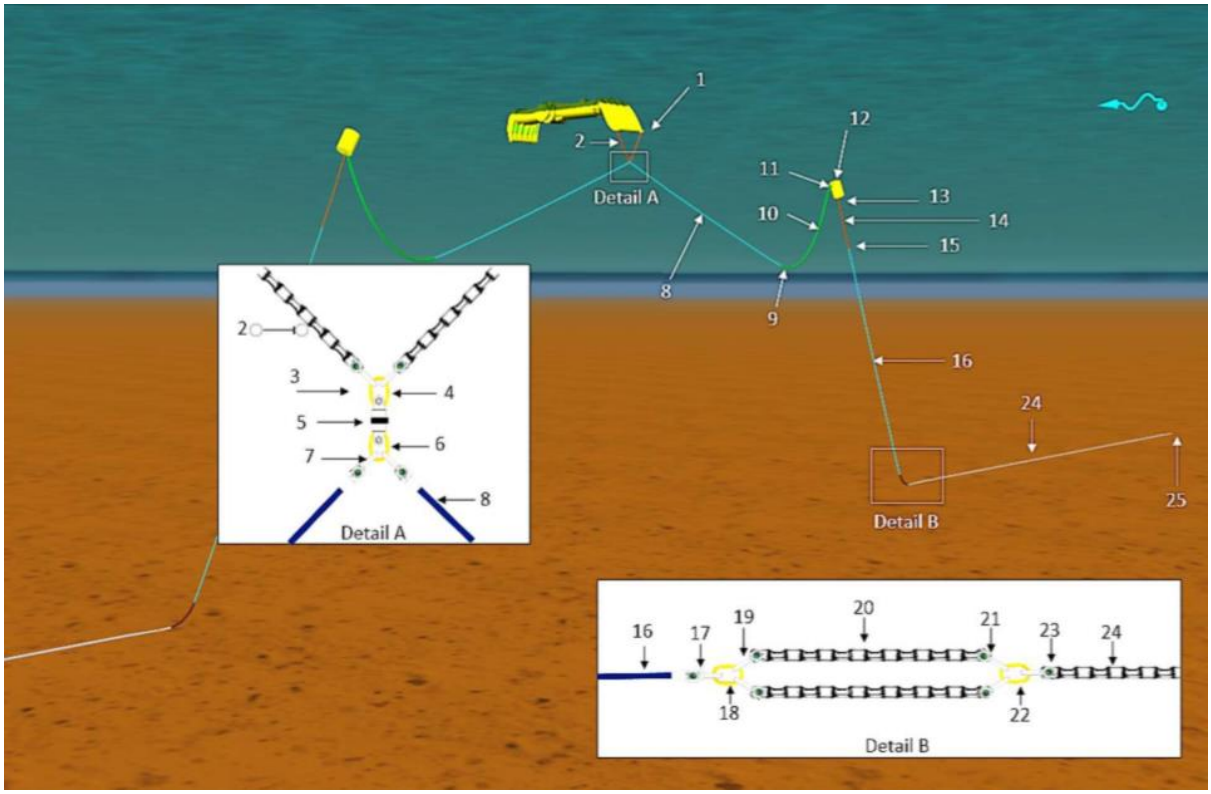

Figure 5. Mooring leg structure

Previous designs have been completed for the Dearness deployment, however due to the change of testing location and shallower water depths the moorings must be redesigned. The general design will remain the same, however due to shallower water depths, lengths and mooring spread will change. The exact specifications and measurements of mooring design have not been finalised yet by Leask Marine, and will be supplied to Marine Scotland once completed.

The mooring design will not differ significantly from what has been previously designed, therefore no change to the decommissioning programme methodology is expected. Some lengths and sizes may slightly change due to deployment at the Scapa Flow site as the water depth is shallower, however the actual design will not change significantly. Any small change to design as a result of deploying in shallower water will not change the decommissioning and removal methodology.

4 Description of proposed decommissioning measures

4.1 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.

4.2 Proposed method of removal

4.2.1 Device decommissioning

The device will be disconnected from the mooring line with the help of a multicat workboat and towed from Scapa Flow to an appropriate harbour, where it will be temporarily dry stored.

4.2.2 Mooring lines decommissioning

Both mooring lines will be decommissioned using a multicat workboat. Decommissioning will involve the complete removal of mooring lines from the site.

4.2.3 Anchoring system 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.

4.3 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.

4.3.1 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.

4.3.2 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 task plans and the related Task Completion Certificates (where identified for permanent works).
- Task Completion Certificates form will be filled and gathered offshore by the Project Engineer to be part of the As-Built dossier / Mechanical Completion Certificate.

4.3.3 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.

4.4 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.

4.5 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 upmost importance.

5 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.

6 Consultations with interested parties

Requirements to be confirmed by Marine Scotland

7 Costs

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

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9 Schedule

The high level chart in Appendix A details key activities and dates (in months) 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.

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 in order to finalise the decommissioning measures proposed.

10 Seabed clearance

During decommissioning operations, it is not expected there will be generation of debris, since the device together with 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. 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. Survey will be undertaken in accordance with EMEC procedures and independent, third party will be involved when providing evidence that the site has been cleared.

11 Restoration of the site

As it is only forecasted to deploy a single floating WEC attached to the seabed by means of two anchor points, 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, as referred to in previous sections, would only have influence in a quite limited zone and would not impact on areas to be conserved.

12 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 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 seabed survey will be undertaken so as to confirm that the dismantling has been done correctly. The survey will be carried out as per EMEC procedures and third party will be involved when providing evidence that the site has been cleared.

Appendix A: Project Programme

Table 3. Project Programme.

Month	October - 2020				November - 2020							December - 2020					January - 2021				February - 2021				March - 2021				April - 2021			
Week Commencing	05 Oct	12 Oct	19 Oct	26 Oct	02 Nov	09 Nov	16 Nov	23 Nov	30 Nov	07 Dec	14 Dec	21 Dec	28 Dec	04 Jan	11 Jan	18 Jan	25 Jan	01 Feb	08 Feb	15 Feb	22 Feb	01 Mar	08 Mar	15 Mar	22 Mar	29 Mar	05 Apr	12 Apr	19 Apr	26 Apr
Scenarios																														
Scenario 1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Contingency													
Scenario 2					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Contingency									
Scenario 3									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Contingency					
Scenario 4													1	2	3	4	5	6	7	8	9	10	11	12	Contingency					
Consent Period																														

The scenario is dependent on the final impact Covid-19 will have on the project timeline. If everything goes to plan from the point of this application then Scenario 1 will be the most likely, however, to accommodate Scenario 4 the marine licence should extend until 30th April 2021. EMEC will update Marine Scotland on the situation as it becomes clearer which scenario is most likely, as this may change throughout or after the determination process. Given current circumstances, the most 'common-sense' approach should be to consent for the worst-case scenario (Scenario 4) while providing updates to Marine Scotland on which scenario is more likely as future circumstances become clearer.