AWS Ocean Energy Ltd | Partial Scale Waveswing Demonstrator

Decommissioning Programme

EMEC Scapa Flow Scale Site

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Document History

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Executive Summary

AWS Ocean Energy Ltd (the Company) is a technology development company aiming to provide marine energy solutions to customers and partners worldwide. Established in 2004, the Company has developed a range of technologies and services to meet customer needs from isolated off-grid power supplies to utility scale offshore power production.

The Company aims to deploy and test the Partial Scale Waveswing Demonstrator (the device) with a power capacity up to 16kW at the European Marine Energy Centre (EMEC) Scapa Flow scale test site, Orkney Islands, Scotland.

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 submerged 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 AWS Ocean Energy Ltd

AWS Ocean Energy Ltd is a technology development company aiming to provide marine energy solutions to customers and partners worldwide. Established in 2004, AWS has developed a range of technologies and services to meet customer needs from isolated off-grid power supplies to utility scale offshore power production.

The company's main focus is wave power generation technology, but they are also working on intelligent active mooring systems and sub-sea self-drilled piling equipment.

The company's team has significant experience in marine engineering, technology development, business growth and fund-raising.

This project is being undertaken through the WES NWEC3 programme, providing a significant opportunity to advance the Waveswing technology and to achieve TRL7.

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 1.

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 1 to deploy the device.

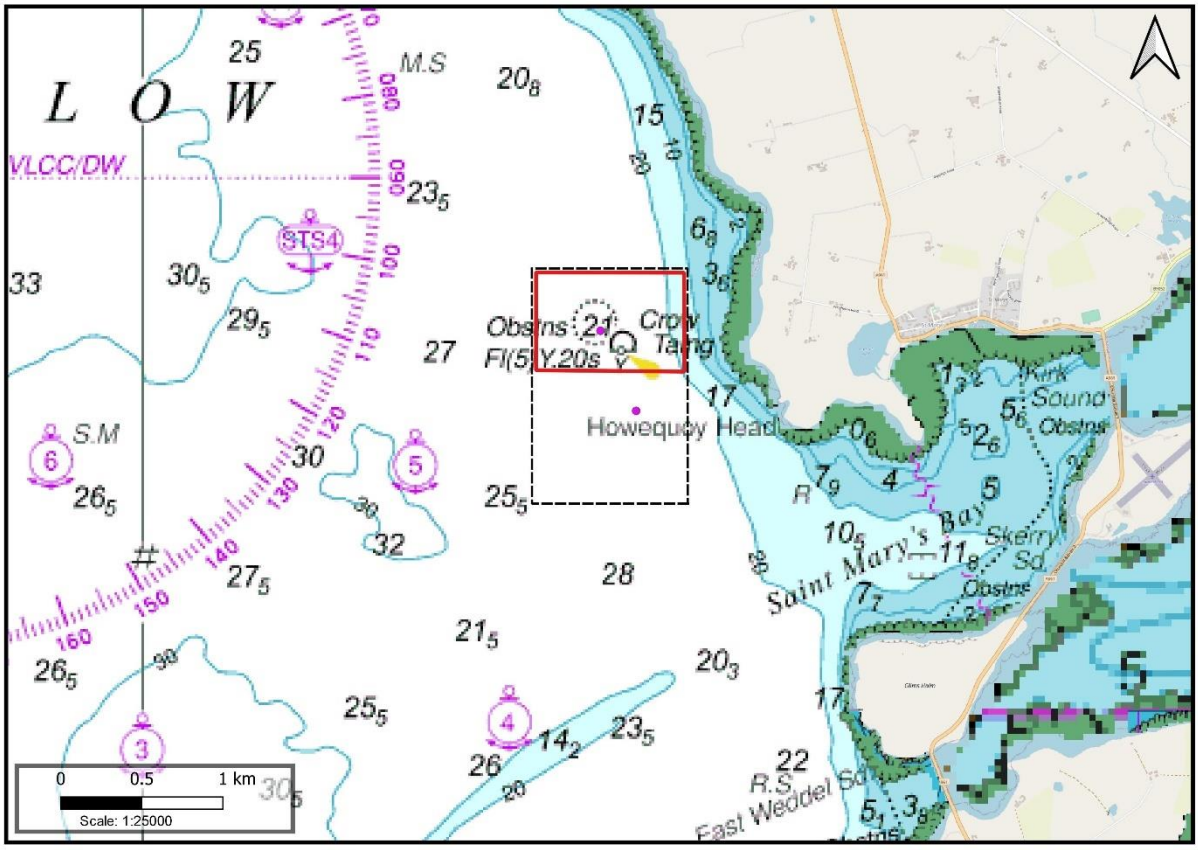

Figure 1. Marine licence boundary (red line), site boundary (black dashed line), and berths (purple dots)

The deployment will be in the vicinity of the berth location and within the boundary coordinates provided in Table 1.

Table 1. Coordinates of site and device location

Location Description	Latitude and longitude (WGS 84)				UTM (Eastings and Northings)			
Berth 1	58°53.07'N, 002°57.02'W				502820E, 6528441N			
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**	**652882 6E**	**652737 8E**	**652737 7E**	**652882 6E**
	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° 53.94'N	**58° 53.61' N**	**58° 53.61'N**	**58° 53.94'N**	**652880 6E**	**652819 4E**	**652819 5E**	**652880 7E**

	002° 57.47’ W	002° 57.4’W	002° 56.52’ W	002° 56.52’ W	502430 N	502497 N	503343 N	503342 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 Waveswing is a submerged point absorber that changes volume in response to pressure variations caused by ocean waves. Nominal rating for a full-scale device is 195kW although this is capable of being scaled up as the technology becomes further developed.

In simple form the device is a submerged telescopic structure with a lower part tethered to the seabed and the upper part free to move vertically. The device comprises two large concentric cylinders. The moving upper cylinder or Floater has a closed upper end which provides the wave absorbing surface whilst the lower, fixed part or Silo contains the PTO and other equipment. The Silo is held on station by means of a tension tether connected to a suitable anchor, the design of which is dependent upon sea-bed conditions. The relative motion between the two parts drives a power take-off unit (PTO).

The device proposed for Stage 3 open-water testing is a half-scale machine which will contain all the major subsystems, including a fully functioning PTO and control system and representative versions of other sub-systems. The device drawings are presented in 18-002-1047

Overall, the partial-scale WEC will measure 4.5m diameter and have an approximate height of 7.5m. The PTO will have a continuous rating of 16kW. The device will be designed for full onshore commissioning and extended dry testing ahead of deployment direct from sea-transport at the test site.

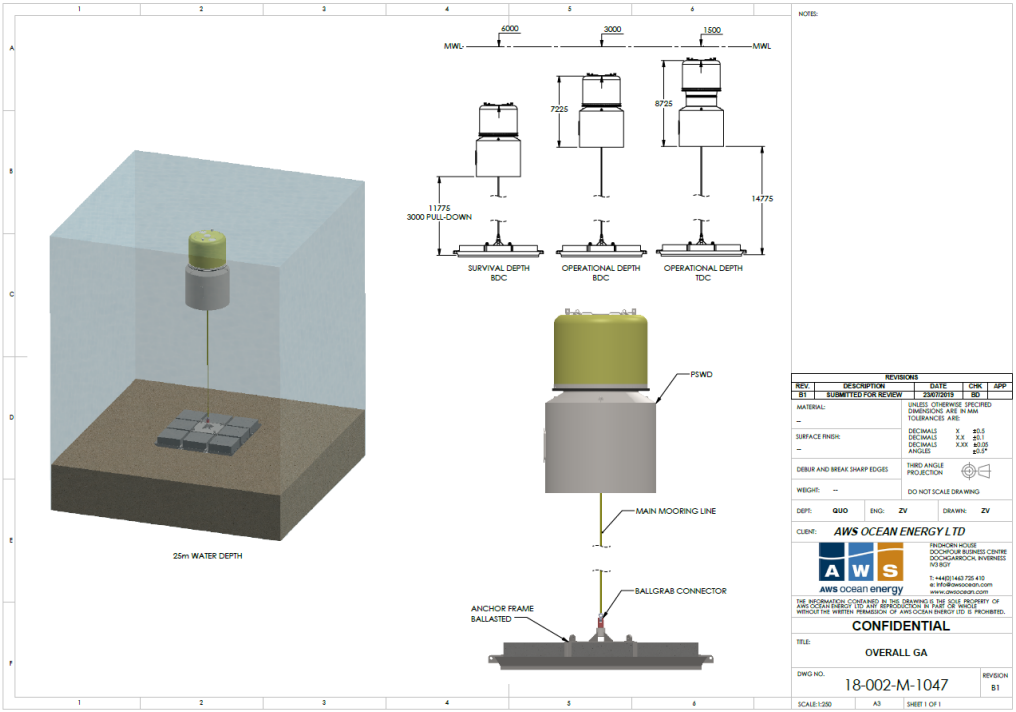

Figure 2. General Arrangement of Device (drawing 18-002-1047)

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 presence is 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 Orkney Inshore Waters pSPA and Scapa Flow pSPA.

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, comprising of the upper cylinder (Floater), and lower cylinder (Silo).
- The mooring line, that fixes the lower cylinder in position and is attached to the anchor
- The anchor, to which the mooring line is attached and ensures that the position of the device is maintained.
- The umbilical cable that connects to the Test Support Buoy (TSB)

Table 2. Items to be decommissioned

Components	Type of Deposit*	Nature of Deposit (P = Permanent, T = Temporary)	Deposit Quantity (tonnes, m^3, etc.)	Contingency Allowance
WEC	Steel	T	60t	10t (included)
Anchor	Steel	T	30t	10t (included)
Anchor	Concrete	T	250t	50t (included)
Umbilical Cable	Umbilical Cable	T	170m	20m (included)

The device comprises (i) an upper cylinder, also called the Floater; (ii) a lower cylinder, also called the Silo which connects with the anchor; and (iii) a mooring line that connects the Silo to the anchor. Overall, the device weighs around 60t (10t contingency) and is comprised of mostly steel.

The mooring line connects to the anchor via a Rocksteady connector that attaches to a steel frame around the anchors concrete blocks.

The anchor is made up of eight concrete blocks which a frame to connect them into one anchor. Each concrete block is approximately 2.4m in width and 1m in height, and all together weighs around 250t (50t contingency). The steel frame that connects the concrete blocks is around 8m x 8m and weighs around 30t (10t contingency).

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

The mooring line is split into two sections; one part connected to the Silo and the other connected to the anchor frame. Both sections of the mooring line will be decommissioned along with the part they're connected to.

4.2.3 Anchoring system decommissioning

First, the concrete blocks will be lifted individually from the frame onto the deck of a vessel. Then, the steel frame around the concrete blocks will be decommissioned along with the connected mooring line. The frame and blocks will be returned to harbour and dry stored in an appropriate location.

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.

Closer to the time of decommissioning, the marine contractors will be required to produce a detailed method statement of the decommissioning operations and this will be passed onto Marine Scotland once available. Currently, the expected length of the decommissioning operations will be around 4-5 days and is expected to occur in March 2022.

4.3.1 Health, Safety and Environment (HSE)

- Risk Assessments will be performed for all tasks to be carried out
- Risk Assessment Report / Task Risk Assessments should be read and properl communicated 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).

4.4.1 Device

It will be removed from the site and checked in detail in order to know its general condition and in order to analyse how the initial design can be enhanced. Afterwards, AWS hope to deploy the device for further testing through future projects.

4.4.2 Mooring lines

Will be removed from the site. Afterwards, AWS would hope to reuse them where possible or sell them for reuse in other projects.

4.4.3 Anchor

Concrete blocks and frame will be removed from the site. Afterwards, AWS hope to make use of the frame and blocks for future deployments.

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.

6 Costs

The costs for the decommissioning are considered commercially sensitive data to the company. As a result, the overall cost estimate of the proposed decommissioning measures is to be provided separately, which will be made available to Marine Scotland.

7 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.

8 Schedule

The high level chart below 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.

Table 3. Project proposed schedule

Activity	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7
Anchor deployment							
WEC deployment							
WEC mid-test recovery							
WEC re-deployment							
WEC recovery to storage							

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.

9 Seabed clearance

During decommissioning operations, debris is not expected, since the device together with its mooring line and anchor will be removed completely.

Upon the completion of decommissioning, it will be confirmed that the site has been cleared.

10 Restoration of the site

As it is only forecasted the deployment of a single device and that such device is a floating WEC attached to the seabed only by means of one anchor point, it is not expected that there

will be significant disturbance to the site during the decommissioning of the device. 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 would only have influence in a quite limited zone (of several tens of square meters) and would not impact on areas to be conserved due to micro-sitting during installation.

11 Post-decommissioning monitoring, maintenance and management of the site

Due to the small potential area of impact on the seabed, the lack of generation of debris forecasted and the complete 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 it will be confirmed that the dismantling and removal has been done correctly.

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