MARINE POWER SYSTEMS | WAVESUB

Project Information Summary

August 2021



Purpose

This Project Information Summary gives a high-level view of the company, the device, and the proposed project. This document is being submitted in lieu of a Construction Method Statement. 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	13/08/21	For EMEC review	GS (MPS)	DL (EMEC)	
2	16/08/21	For submission	DL (EMEC)		

Disclaimer

The information provided is correct and relevant. As the project progresses information and images may be subject to change.

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1 Introduction

1.1 Company background

From its 2007 inception by Dr Gareth Stockman and Dr Graham Foster, Marine Power Systems (MPS) has followed a structured development pathway, delivered by its ever expanding strong team of engineers, scientists, managers and support staff to deliver clean energy ocean technology. MPS's technology portfolio can extract wave energy, wind energy and wind and wave combined; making best use of a marine area with minimal spatial impact whilst delivering maximum energy yield.

The company's habitual expertise lies in understanding the core constituents to succeed in marine energy; the governing physics and economical drivers and applying these in a forward thinking movement and translating this into a practical commercial design. Each technology readiness level stage gate has been approached with thousands of hours of in house numerical modelling and simulations, validated with scaled prototype tank testing at Plymouth COAST lab and endorsed in the latter stages with an 12 month medium scale prototype sea trial at the pre-consented Falmouth Bay marine energy test site (FaBTest). These in house skills are ever honed through the fast learning curves and valuable lessons learnt from experience by doing, followed by reviewing, backed up by third party verification exercises and commercial benchmarking.

Following the hard won success to date, the final research and development led testing is focused on deploying a megawatt capacity scale demonstrator, supported by a £12.8m EU grant at the Biscay Marine Energy Platform (BiMEP) in 2023.

The planned deployment at EMEC described within this document is a critical part of our journey to develop the technology further and prepare MPS's for full commercialisation and take advantage of the global market opportunity for wave energy.

1.2 Technology background

MPS's technology ethos uses a common platform system to host its proprietary ocean energy extraction technology and is able to accommodate the largest commercially available offshore wind turbine. This approach provides a set of shared advantages suitable to the demands of offshore energy production. These unique features of MPS's platform technology are: Manufacturable, Transportable, Deployable, Stable, Maintainable, Survivable.

To understand and finetune these principles MPS has been no stranger to applicable testing and demonstration to guide the development pathway. In 2009, the company conducted proof of concept trials with early stage prototype sea trials at Weymouth and power generation testing at the National Renewable Energy Centre (NaREC), demonstrating the ability to convert wave energy to electrical power.

2010-2012, the company completed further concept development and small scaled testing with a comprehensive cost of energy study.

2013-2015, MPS secured a mixture of innovation grants allowing the company to complete detailed design specifications for the delivery of the medium scale sea trial prototype, combined with tank testing optimisation and validation studies at the Plymouth COAST laboratory.

Securing significant private and public investment in 2015, MPS began the manufacture of the sea trial prototype, completing manufacture in 2017. 2018 saw the company tow the device on a 169NM sea voyage from Pembrokeshire to the FaBTest marine energy test site in Cornwall, where it underwent a successful testing programme in a range of sea conditions.

Following successful decommissioning of the medium scale sea trialled prototype in 2019, MPS was awarded with its most significant development grant to date. This £12.8m grant, will be used to advance the technology campaign through TRL 8 by deploying a megawatt scale demonstrator at the BiMEP marine energy test facility in the Cantabrian sea.

1.3 Project background

MPS is nearing the completion of its research and development pathway and moving towards commercial demonstration. This next phase will see the long term deployment of a small array of MPS energy systems. EMEC's Billia Croo grid connected site is the premium choice to host this next key milestone with the site being UKAS accredited, this verification will add a thorough level of credibility to the project and bridge the closing of R&D testing to commercial delivery.

The project aim is to deploy two grid connected multi-megawatt WaveSub wave energy converters for a long term deployment of 8-10 years. Installation target is 2025.

The company technology objectives of this deployment are to:

1) Move MPS technology through the final TRL gate, from protype to commercial scale, and test devices in grid array configuration.
2) Ensure technology features adequately meet market demands and anticipated needs.

The company objectives of this deployment are:

1) Position to accept commercial orders
2) Demonstrate supply chain capability
3) Validate execution in accordance with business model
4) Verify profitable financial model for MPS

MPS is in a financially strong position having received significant ERDF funding from WEFO and has recently completed a private investment campaign (August 2021) where over £4m was invested. MPS is engaged with a corporate financial advisor to arrange a follow on investment round that will accommodate the project at EMEC.

2 Technology

2.1 Device Description

WaveSub consists of a floating platform moored using a tension leg system. The platform accommodates a number of WEC floats. Once the device is deployed as shown in figure 1, the absorber floats are undocked and are excited by the subsurface orbital energy carried by the ocean waves. This excitation actuates the floats which capture and transfer this from mechanical energy to electrical energy using the onboard power take off system (PTO). This generated electrical energy is delivered to the grid network via a subsea cable.

The subsea cable is to be connected between the MPS WEC and EMEC's subsea connector. Its purpose is to transport the generated electrical energy from the WEC to the onshore substation (via the existing EMEC offshore cable infrastructure). The section of the cable closest to the WEC will be ‘dynamic’ in that it will have a degree of freedom to move with the moored WEC system. The cable will also act as a communications link between the WEC and shoreside communication, control & monitoring system, allowing system monitoring and transmission of commands between the WEC and operator.

In its deployed position WaveSub is always visible for marine navigation and is accessible for offshore maintenance and repair.

Shown in figure 1, is a commercial scale WaveSub. Two commercial scale WaveSub wave energy converters (WEC) are to be deployed, each device will have 3MW name plate capacity. The system component breakdown is shown in figure 4.

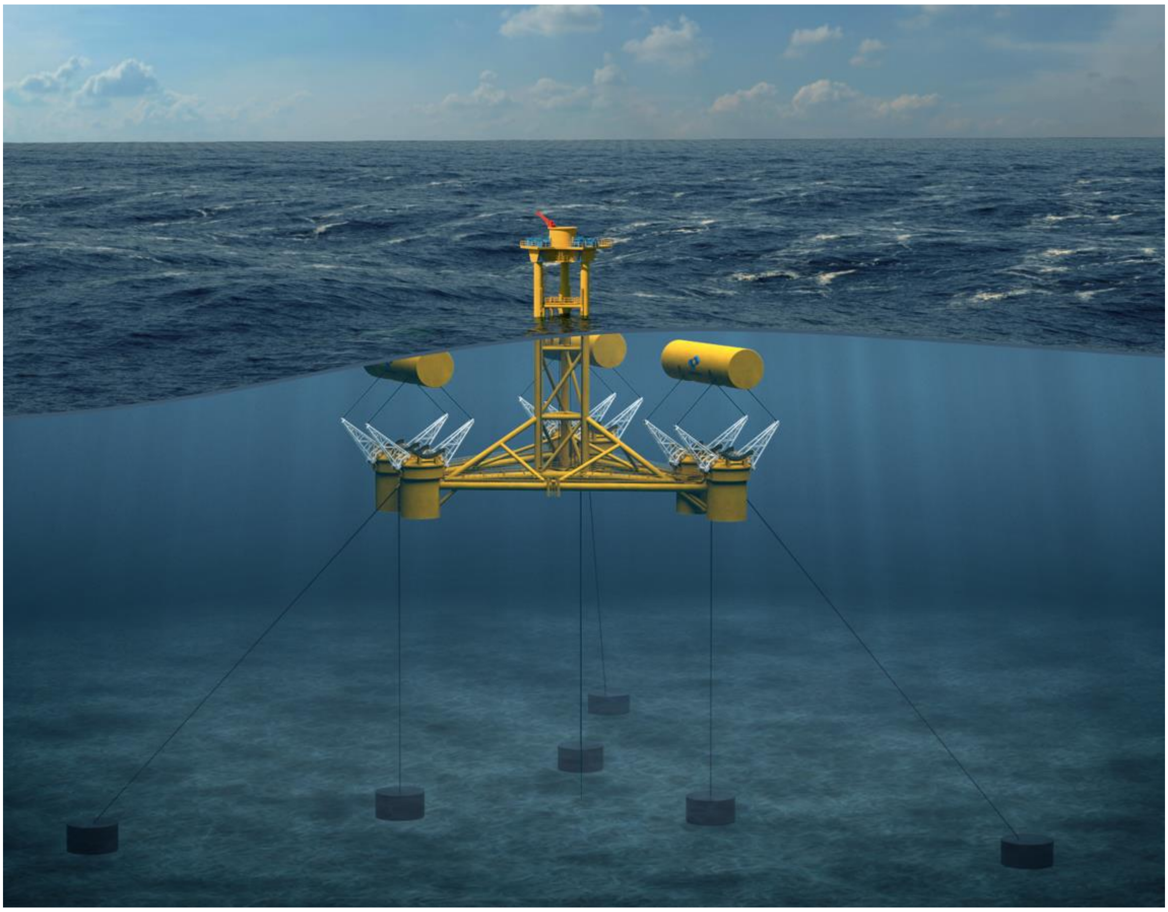


Figure 1: Commercial Scale WaveSub (Concept Image subject to change)

2.2 Mooring system

MPS’s system uses a tension leg mooring platform (TLP) to provide station keeping. Each device installed at EMEC will have 6 mooring lines. The platform will be semi-submerged in the top layer of the water column with the central platform proud of the sea surface in all sea conditions & tidal ranges. Anchors will be confirmed post geophysical and geotechnical investigations and will be suited to TLP style systems. An example of the mooring system layout is shown in figures 2 & 3.

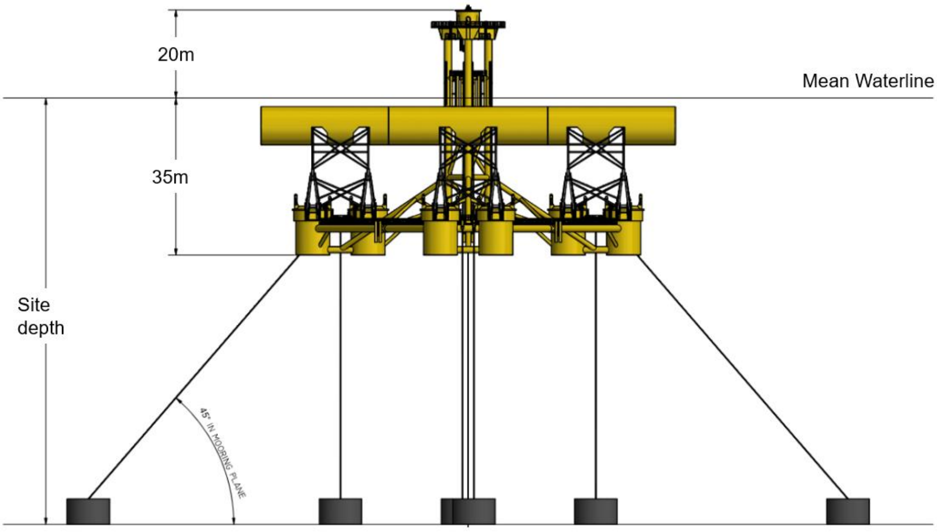


Figure 2 WaveSub concept mooring layout.

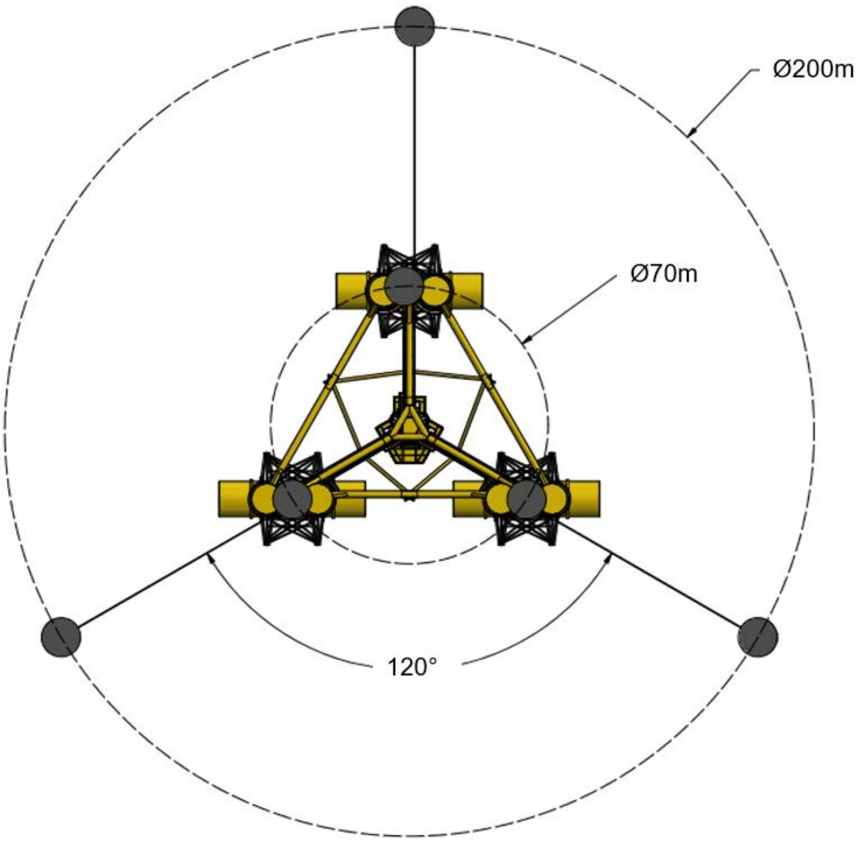


Figure 3 WaveSub concept mooring layout. Plan view

2.3 Materials used

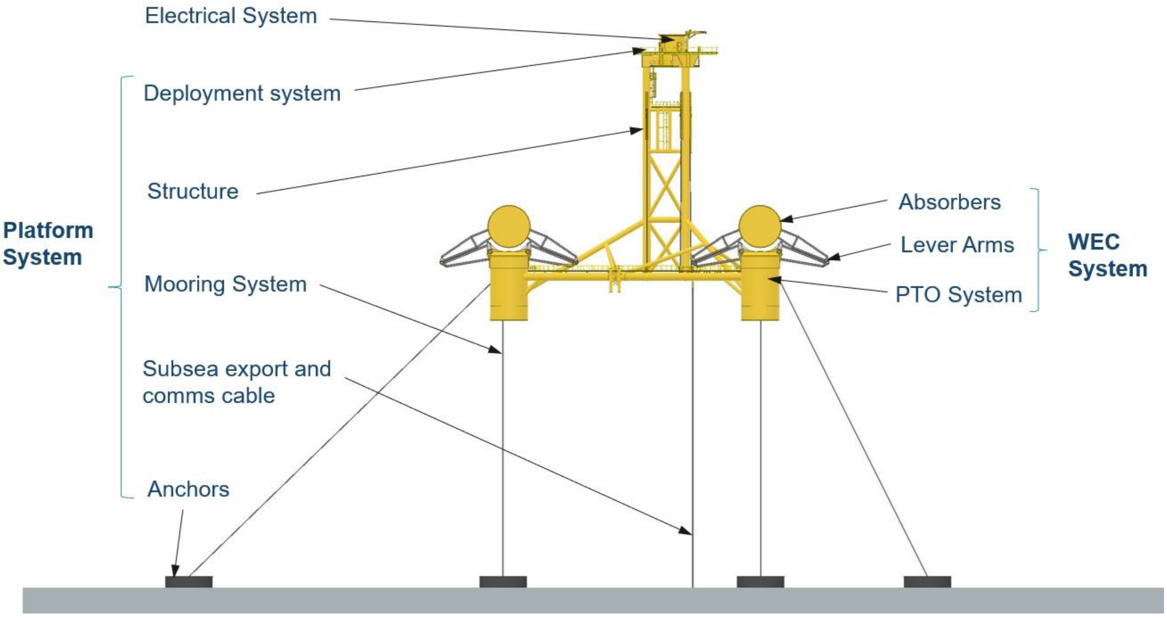


Figure 4 WaveSub system breakdown

Table 1. Proposed list of materials to be used

Components	Type of Deposit*	Nature of Deposit (P = Permanent, T = Temporary)	Deposit Quantity (tonnes, m^3, etc.)		Contingency Allowance (included in Deposit Quantity)
Platform System					
Structure	Steel	P	960t		160t
Deployment System	Steel	T	36t		6t
Mooring system	Steel chain, synthetic line.	P	54t steel chain 6t synthetic		9t 1t
Anchors (two scenarios)	Steel, concrete	P	3-6 x 700 – 1000mm diameter, 12-14m embedded length	3-6 x 200-400mm diameter, 6-20m embedded length	N/A
Subsea export & comms cable	Cable	P	2000m		1000m
WEC System					
PTO System	Steel	P	324t		54t
Lever arms	Steel	P	576t		96t
Absorbers	Steel Composite	P	36t steel 108t composite		6t 18t
Electrical system	Steel Cable	P	25t		5t

*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)

TPV is intended to be carried out by an accredited certification body with appropriate track record in the assurance of wave energy and floating platform systems. E.g. DNV, Lloyds' Register.

3 Project Description

3.1 Onshore Assets

MPS will require the use of EMEC's Billia Croo berths 1 & 2 grid connection and shoreside balance of plant infrastructure. If required, installation of local vhf / 4G link.

3.2 Offshore Location

MPS are currently undertaking a geophysical campaign to aid its micro sighting exercise at the Billia Croo test site. The final deployment locations will be confirmed at the end of this activity. The devices will connect to berths 1&2.

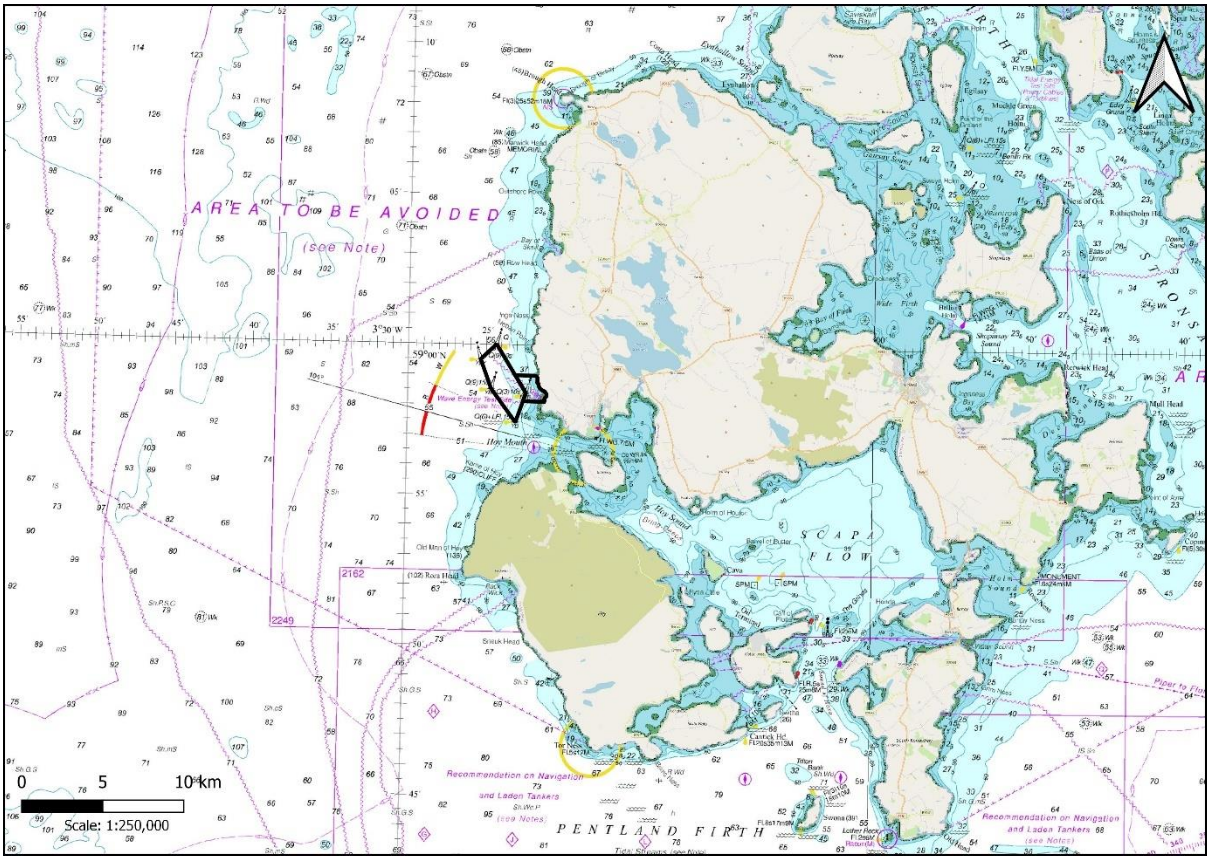


Figure 5. Location of Billia Croo test site in relation to Orkney mainland

Table 2. Coordinates of Billia Croo test site boundary

Site	Co-ordinates (WGS 84)
EMEC wave test site, Billia Croo, Orkney	59° 00.000'N 03° 24.330'W
	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

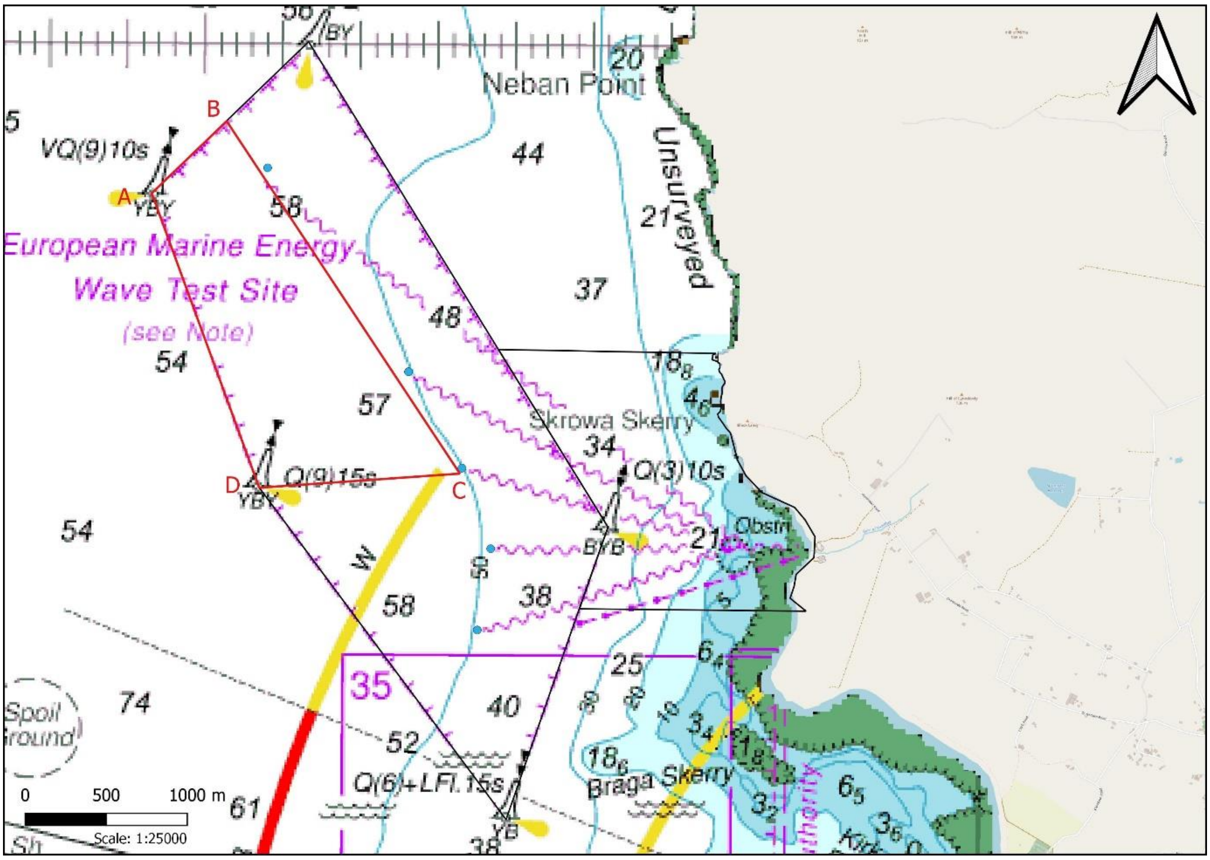


Figure 6. Marine licence boundary (red line), Billia Croo test site (black line)

Table 3. Coordinates of marine licence boundary

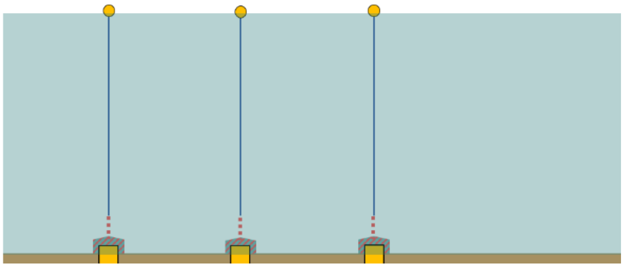
Location Description	Latitude and longitude (WGS 84)				UTM (Eastings and Northings)			
	Corner A	Corner B	Corner C	Corner D	Corner A	Corner B	Corner C	Corner D
Marine Licence Boundary	58° 59.49' N	58° 59.73' N	58° 58.57' N	58° 58.52' N	318365E	318829E	320235E	318998E
	003° 25.34' W	003° 24.86' W	003° 23.35' W	003° 24.64' W	1012457 N	1012906 N	1010712 N	1010646 N

The large marine licence boundary is not indicative of the space that will be occupied by the two devices. A much smaller and accurate boundary will be submitted to Marine Scotland once plans are finalised ahead of the 2025 deployment date which will be largely informed by the geophysical surveys being carried out at Billia Croo. Details of the variation process will be discussed with Marine Scotland closer to the deployment date.

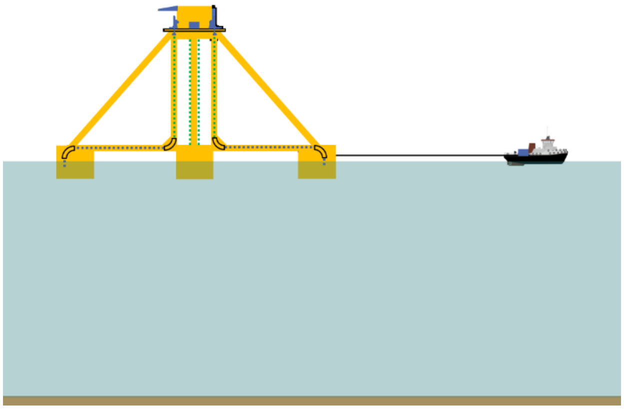
3.3 Installation method

The installation sequence is as follows:

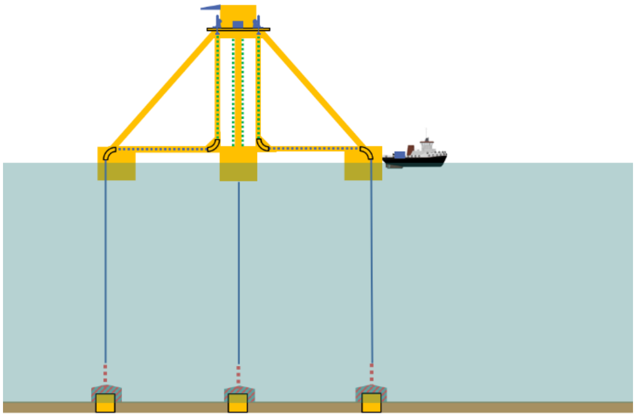
1) Install anchors and mooring lines: Pre-installation works ahead of towing the device to location.



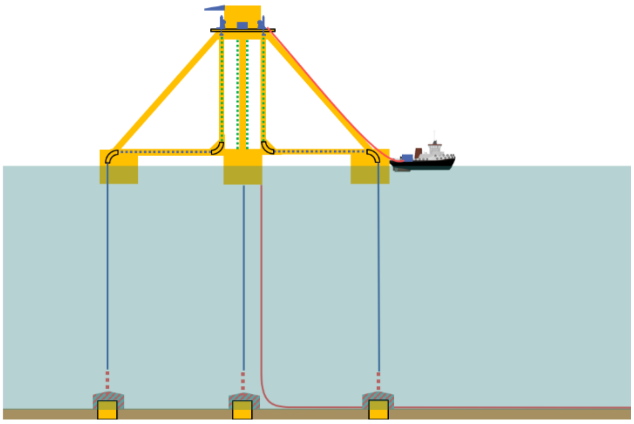
2) Mobilise from Stromness with device in tow. (Device wet parked in Scapa Flow)



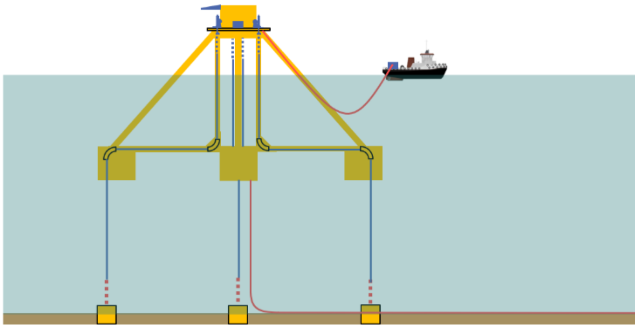
3) Install WaveSub onto pre-deployed mooring arrangement.



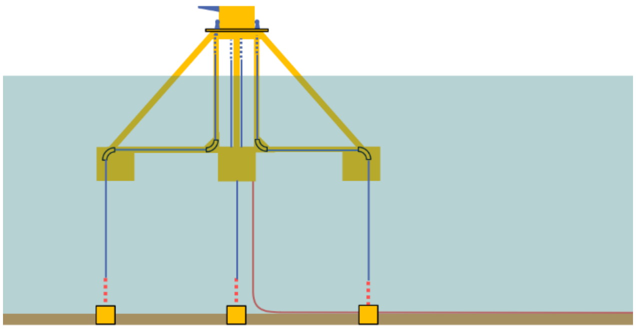
4) A subsea cable will be installed and connected between the offshore EMEC grid connection and MPS's WaveSub WEC location. Removal of the cable will be the reverse of the installation method. The cable will be recovered during the system decommissioning.



5) Submerge device to deployed position.



6) Vessels de-mobilise from site. Device installed.



3.4 Removal method

Decommissioning will be the reversal of the installation method, leaving the site to its pre-installed state.

3.5 Anticipated vessel traffic to site

Anticipated vessel traffic for the phases of the installation, inspection and maintenance is shown in table 3.

Table 4. Anticipated vessel traffic during operations.

Vessel Type	Vessels number required.	Duration (days)
Pre- installation works		
Light construction vessel (LCV) / Multi-purpose supply vessel (MPSV)	1-2	30-60
Device installation		
Anchor handling tug (AHT) / MPSV	1-2	2-5
Multicat	1-2	2-5
Support tugs	2-3	2-5
Wind farm support vessel (WFSV) / Crew transfer vessel (CTV)	1-2	2-5
CTV	1	2-5
Operations & Maintenance		
Inspection, maintenance and repair vessel (IMR) / MPSV	1-2	As per Inservice inspection plan.
WFSV / CTV	1-2	
Multicat	1-2	

A periodic in service inspection plan will cover the maintenance schedule. Regular inspections and preventative maintenance procedures will be used during the project life and interventions carried out where necessary. Reactive maintenance will also be planned for if, for example a device recovery is needed upon an inspection visit.

3.6 Device monitoring systems

To monitor the platform location, each device contains an independent commercial standard positional information system (e.g. AIS class A or B) linked to the Control Communication Monitoring System (CCM). The CCM will also feedback device key health status metrics. During operational hours the CCM is continuously monitored by experienced staff; out of operational hours, the system is linked to trigger an alarm internally and externally to the nominated ERCoP marine contractor notifying of a location perimeter breach. Depending on the alarm triggered, a pre-planned emergency response procedure will be enacted.

The device specific ERCoP will be approved by MCA before deployment.

4 Proposed Schedule

The project operational target is 2025. Ahead of this a geophysical survey has been conducted (July 2021).

STAGE	YEAR			
	2021	2025	2026	2035
SITE SURVEY				
PRE-CONSTRUCTION WORKS (ANCHORS)				
DEVICE INSTALLATION				
DEVICE COMMISSIONING				
OPERATIONAL				
DECOMISSIONNING				