Falmouth Bay Short Term Test Site
for
Marine Energy Converters

A Description of the Proposed Facility submitted in support of FEPA / CPA Consent Applications

Falmouth Harbour Commissioners

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1. Introduction

This document outlines the requirement and specifications for a test site to facilitate the short term testing of Marine Energy Converters (MECs) in Falmouth Bay prior to full operational deployment at a generating site such as Wave Hub. The proposed test site, in Falmouth Bay, is referred to as FabTest within this document. The document is prepared for submission to the Marine Management Organisation (MMO) to accompany an application for FEPA and CPA consent.

2. Background

The construction of large-scale marine energy projects such as the 20MW Wave Hub site mark the emergence from the prototype and demonstration stage towards commercial deployment of marine energy converters (MECs). The viability and success of these renewable energy projects is strongly dependent on the reliability of the devices as this determines the amount of generated electricity and the cost for operation and maintenance.

Wave Hub is creating the world's largest commercial test site for wave energy technology by providing a grid-connected socket on the seabed off the coast of Cornwall in South West England, to which wave power devices can be connected and their performance evaluated. It is expected that in the near future, groups of marine energy devices will be connected to the Wave Hub at its site 16km off the north coast of Cornwall in 50 m water depth. Whilst the Wave Hub site would provide berthing places at a Technology Readiness Level (TRL) 9 (pre-commercial to commercial), some marine energy devices will require commissioning tests at TRL 7-8 (in water system testing, demonstration and operation). Figure 1 shows the TRL levels 1-9.

The viability of commercial marine energy projects will be driven by plant-performance indicators such as reliability, availability and maintainability, as these will heavily influence project cost and revenue. To obtain concise performance and reliability assessments, commissioning tests at TRL level 7-8 in moderate sea conditions will be vital. The determination of performance indicators will lead to economically viable, durable and reliable long term installations.

Importantly, the FabTest site will provide the opportunity for device developers to undertake tests at a TRL 7-8 level to confirm structural integrity, response behaviour, mooring/umbilical behaviour and subsea component performance, whilst the installation is subjected to a less

energetic sea state than will be encountered at Wave Hub. Further, the short term deployment will be used to develop suitable monitoring systems and deployment procedures. In summary, a commissioning test at the Fabtest site will provide key evidence of capability that will be necessary for deployments at the Wave Hub site.

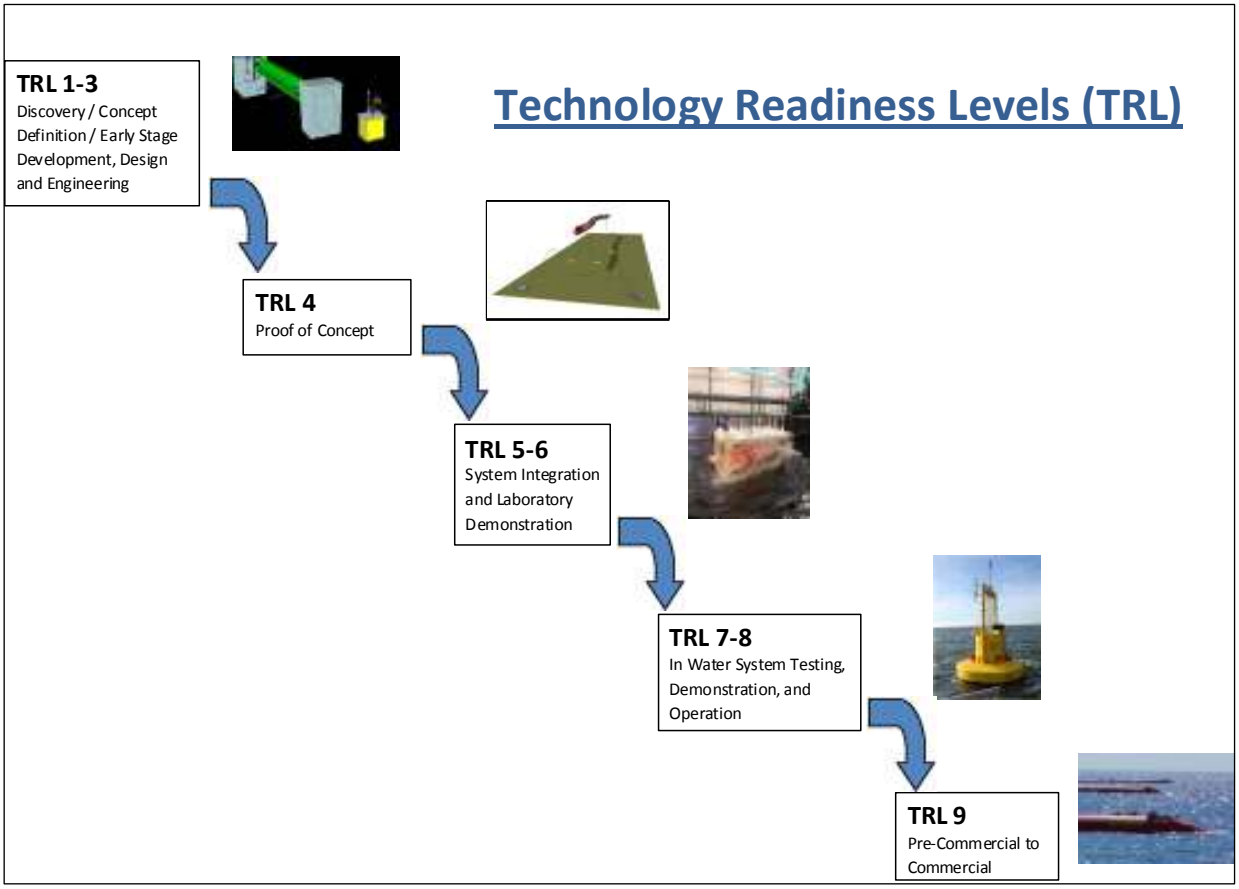

Fig 1: Technology Readiness Levels

3. The Test Facility

3.1 Mode of Operation

The test site will be located within the Port of Falmouth limits and will be controlled by Falmouth Harbour Commissioners supported by an advisory / management group. Allocation of temporary berthing within the test site area will be for periods of between one day and a maximum of three months. No more than three devices will be deployed at any one time.

3.2 Management of Test Deployments

The advisory / management group will comprise the following bodies:

- Falmouth Harbour Commissioners
- University of Exeter (Peninsula Research Institute for Marine Renewable Energy)
- The Marine Management Organisation
- The Wave Hub operating organisation
- Mojo Maritime Ltd (offshore marine renewable energy consultancy)
- A & P Falmouth Ltd (dockyard, ship re-fitters, marine engineers, fabricators)
- Cornwall Marine Network (local marine sector support body)

The management group will defer to the independent decisions of Falmouth Harbour Commissioners in all matters relating to their statutory obligations regarding navigational safety, environmental management and operations within the port. The management group will actively administer and control the allocation of test berths within the bounds of the consents held and the port operations mentioned above. Further, the management group will rigorously apply the considerable engineering, marine engineering, hydrodynamics, naval architecture and moorings design expertise held within the group, to validate the readiness and suitability of a device / mooring system for deployment at the site.

3.3 Test Site Selection

The test site area has been selected with reference to the following factors:

1. Encompass water depths (LW) between 20 m and 50 m to suit differing MECs.
2. Avoid wrecks and other fish attracting / fish holding bottom features.
3. Be wholly outside and away from the Fal and Helford SAC.
4. Avoid the main fairway into and out of Falmouth Harbour.
5. Avoid the areas frequently used for ship anchorages.
6. Remain wholly within the Falmouth port limits.
7. Be of minimum inconvenience to the local fishing community and other stakeholders.

3.4 Test Site Location

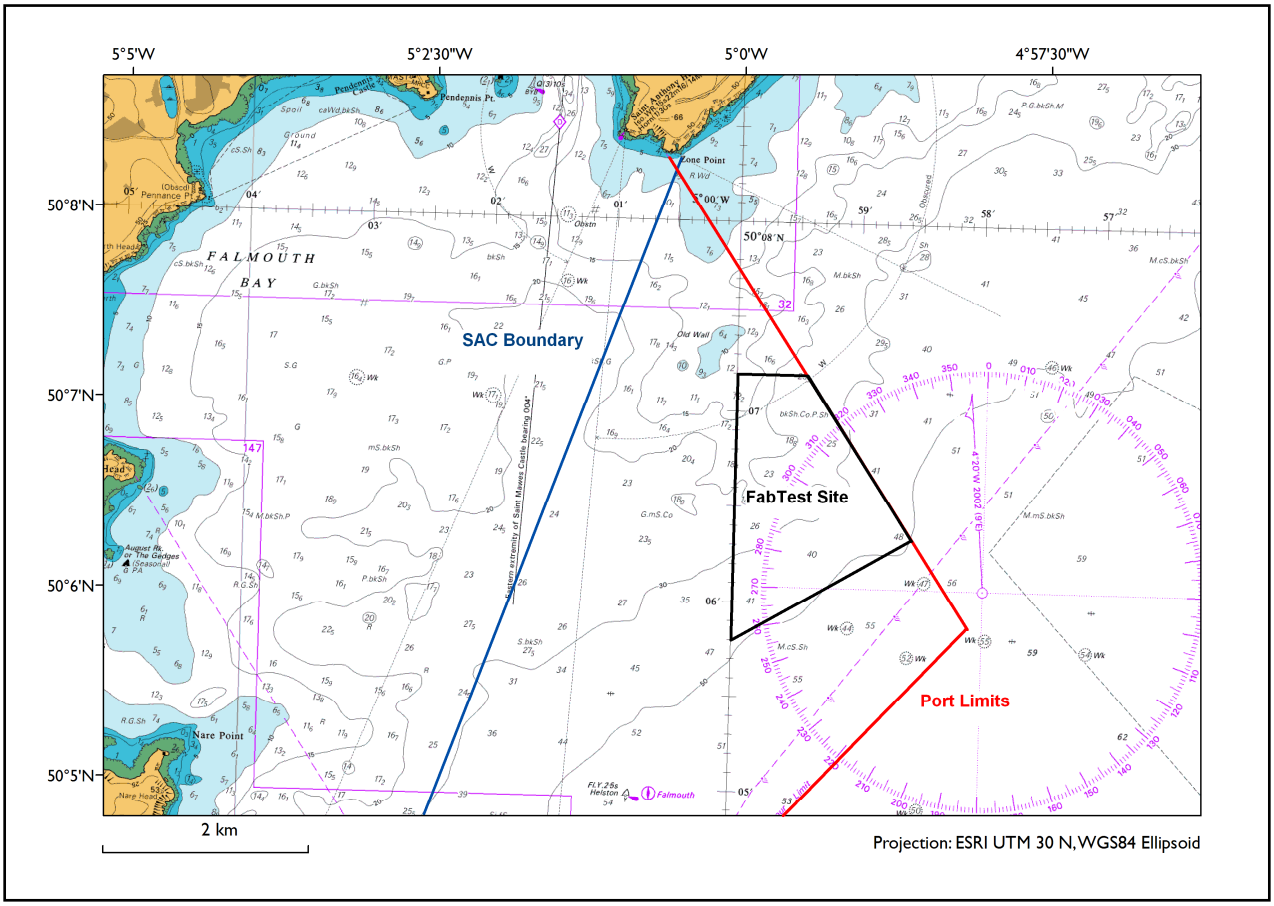

Figure 2: Chart extract showing the boundaries of the proposed test site.

Source: UK Hydrographic Office.

The location and the boundaries of the test site are shown in relation to the Port limits and the SAC boundary in Figure 2.

4. Device Deployments at the Test Site

4.1 Overview

It is stressed that the MEC devices to be deployed for testing at the Falmouth Bay site will not have a cable connection to shore. Some tests will not include electrical generation at all and in those cases where electrical generation forms part of the test, the electrical energy will be consumed immediately on site via an onboard or adjacent dump load.

A Rochdale Envelope approach is employed to describe the range extent of both MEC devices and mooring systems that this consent application includes.

Marine Energy Converters will be buoyant or semi buoyant structures attached to the seabed via a mooring system and seabed anchoring. Seabed anchoring will be by means of drag embedment or gravity anchors. Seabed anchors will be deployed for the duration of a single test and retrieved on completion of the test.

Mooring piles, rock bolts and suction anchors are not included within this application. Additionally, a device utilising an unguarded open water turbine (with respect to marine mammals) is also excluded from this application.

4.2 MECs and Mooring systems to be Deployed at the Test Site

Two particular WEC devices are known to require a test berth during the summer of 2011, these are:

- Bolt 2 - Developed by Fred Olsen Renewables Ltd
- Searaser - Developed by Dartmouth Wave Energy Ltd

These two devices are described together with their mooring systems below.

4.2.1 Bolt 2

Bolt 2 is a floating annular device of steel hull construction measuring 16 metres in diameter with the open centre of the device measuring approximately 10 metres in diameter. Energy conversion is primarily via heave and surge in relation to a seabed fixing. Each of five independent power take off units (PTOs) mounted on the deck of the hull, is moored to the seabed via a sub surface float. The PTOs convert the heave and surge motions of the hull to rotary motion which is mechanically transmitted to the generator. Auxiliary moorings provide full security to the device in the event of any critical failure within the PTO system. The hull of Bolt 2 will have a draught of approximately 0.3 metre and will have a freeboard of approximately 0.8 metre. A structure will be provided above deck level to accommodate the necessary navigational safety equipment. Seabed anchoring will be achieved by gravity anchors.

4.2.2 Searaser

Searaser will take the form of a buoy of approximately 5 metres diameter having a deck height of approximately 0.8 metre, a draught of approximately 15 metres and an upper structure accommodating navigational safety equipment. The energy conversion is achieved by reacting the wave lift forces of the surface float against a seabed fixing with a subsurface float element contributing to the stability of the device. Searaser does not itself generate electricity, rather it pumps water ashore or to a floating generating station. In this case (in Falmouth Bay) Searaser will simply pump water from the sea and return it directly to the sea.

Searaser is expected to employ a three limbed catenary mooring system with a drag embedment anchor on each of the three limbs.

4.2.3 Other MECs and Mooring Systems Forming the Rochdale Envelope

Other marine energy converters that will potentially require short term testing at the Falmouth Bay site will take one of the following physical forms:

- A substantially buoy shape device e.g. the OPT PB40 and the PB150 WECs (Figure 3).
- A substantially box shape device e.g. the Oceanlinx WEC device (Figure 4).
- A substantially tubular shaped device e.g. Pelamis (Figure 5).

Figure 3: OPT PB40 WEC

Figure 4: Oceanlinx WEC

Figure 5: Pelamis

Other variants might include non rectangular box type forms e.g. the OWEL Grampus WEC (Figure 6) and floating platform constructions such as the Blue H floating wind platform (Figure 7).

The dimensions of the devices will vary but indicative maximum sizes are given as:

- 30 m diameter for a buoy form
- 30 m x 30 m (or equivalent area in plan) for a box form
- 35 m x 35 m (or equivalent area in plan) for a platform
- 180 m long for a tubular form.

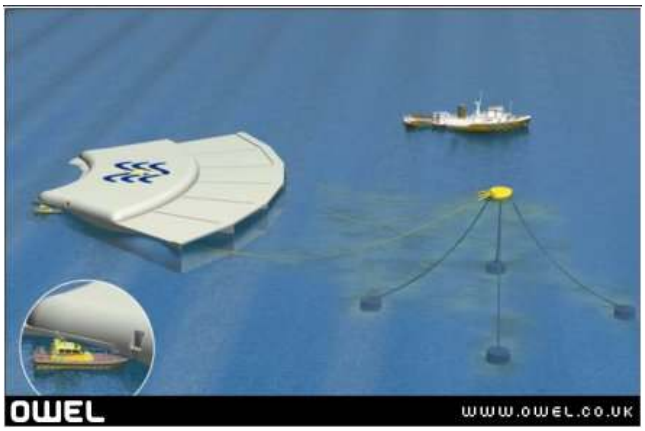

Figure 6: OWEL Grampus WEC

Figure 7: Blue H floating wind platform

Power take off mechanisms will include hydro turbines (guarded for mammals), air turbines, hydraulic systems and mechanically driven linear / rotary generators.

As previously stated, seabed anchors will be drag embedment or gravity anchors. Gravity anchors will be of steel, iron or concrete construction. Any loose ballast included within a gravity anchor (e.g. sand gravel etc) will be sealed so that no exchange with seawater is possible.

Mooring systems will comprise wire rope, fibre rope, steel chain, sub-surface floats and coupling components (e.g. shackles, swivels etc). It is expected that the maximum number of mooring limbs will be 12 in the case of a box shape device.

5. The Natural Environment

5.1 The Seabed Habitat

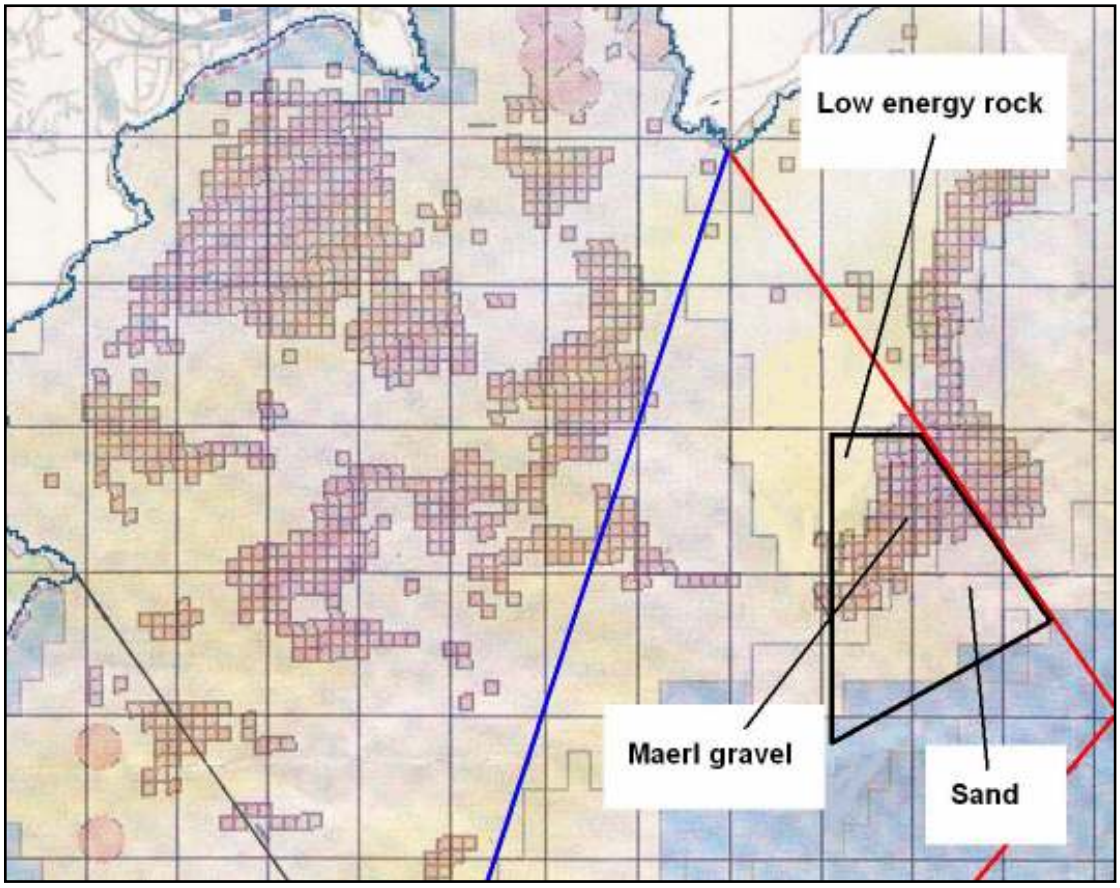

Figure 8: The seabed habitat

Source: Defra, Natural England & JNCC via website http://www.mczmapping.org/#

Figure 8 shows the three types of seabed habitat found within the proposed test site, these are:

- Low energy rock in the area with a depth of less than 20 m.
- Maerl gravel (dead maerl) in the area 20 m - 30 m deep.
- Sand in the area 30 m - 50 m deep.

5.2 Early Consultation with Natural England

Falmouth Harbour Commissioners have undertaken early stage consultation with Natural England's Truro office. The outcome of this contact was not unfavourable and did not seem to suggest that the site would be deemed inappropriate during any forthcoming consenting process.

5.3 Pollution Control

MEC device developers seeking a test berth at the Falmouth Bay site will be required to provide a detailed pollution prevention / control plan in advance of the allocation of a berth. Such a plan will need to demonstrate that the deployment will not breach existing Port regulations concerning pollution and that it will abide by any further constraints detailed in the Fabtest site consents.

5.3.1 Noise

Noise pollution by MECs can be considered in four categories, the product of the following:

- Sound transmitted through the water.
- Sound transmitted through the air.
- Sound generated during construction and decommissioning.
- Sound generated during operation.

The two noise components associated with construction / decommissioning are less relevant in the case of Fabtest due to the exclusion of piled / drilled / bolted seabed anchors.

The University of Exeter, supported by Falmouth Harbour Commissioners, will work together with each individual MEC device developer to monitor and quantify the sound outputs of the devices deployed for test.