Decommissioning Programme

Oceanus 2 Wave Hub Sea Trial

Seatricity Ltd

20 January 2015

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Revision table				
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Executive Summary

This document presents the decommissioning programme for the Oceanus 2 project, to be installed at Wave Hub.

This decommissioning programme is supported by the WHL Environmental statement which provides the baseline information for the site and may be downloaded for their website: http://www.wavehub.co.uk/wp-content/uploads/2011/06/Environmental-Statement-June-2006.pdf

As detailed in this document it is proposed to remove all surface and subsea items to shore for further decommissioning, recycling or disposal. Seatricity assumes responsibility for decommissioning the Oceanus 2 WEC.

It is intended that this decommissioning plan is a live document, and as such will be reviewed as the project progresses and further information and/or technological practices come to light.

Contents

Abbreviations

API	American Petroleum Institute	MWS	Marine Warranty Surveyor
CofG	Centre of Gravity	SL	Seatricity Limited
DPR	Daily Progress Report	WHL	Wave Hub Limited
IACS	Int'l Ass'n of Classification Societies	SWL	Safe Working Load
LARS	Launch and Recovery System	TBC	to be confirmed
LR	Lloyd's Register	TBD	to be defined
MOB	Man Over Board	WEC	Wave Energy Converter
MSL	mean sea level		

1. Introduction

Seatricity Limited is planning to deploy the Oceanus 2 WEC at the Wave Hub test site (see Figure 1) in Q2 of 2014. The site is located 17km off the north coast of Cornwall near Hayle, and is fully consented and permitted for the deployment of WECs. The device is not to be grid connected, and further information regarding the development pathway and device specific details can be found in the Seatricity documents *Seatricity_MMO_MarineLicenceApplication_DSS_140205* and *Seatricity_MMO_Oceanus2Details_DSS_140213,* submitted to the MMO as part of the marine licence application for the deployment.

The sea trial of the Oceanus 2 WEC consists of the deployment of a surface float and pump connected to a reaction tether. The float is held in position with 4 point mooring system. This will be deployed in the Wave Hub area known as "Berth 1" which is on the southern part of the site nearest to the Hub itself.

Seatricity Limited is responsible for the development, financing, operation and decommissioning of the Oceanus 2 project.

This decommissioning plan is being submitted to Wave Hub Limited in order to satisfy their obligation to section 105(2) of the Energy Act 2004, as required by WHL's consent under Section 36 of the Electricity act 1989.

It is expected that the decommissioning programme will be reviewed throughout the life of the project and where necessary revised to take account of changes in environmental conditions, regulatory requirements as well as advances in technology and working practises.

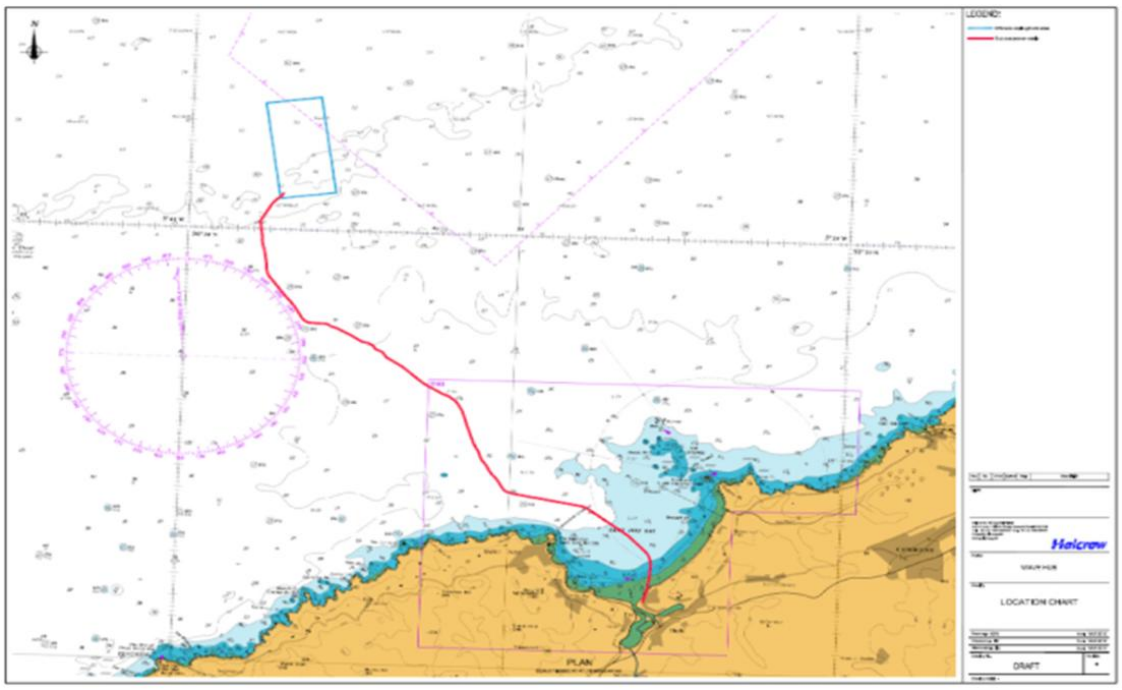

Figure 1

2. Background Information

2.1. General description

The Oceanus 2 system consists of a surface float and associated subsea mooring equipment. This will be deployed in the Wave Hub Berth 1, details of which are shown in Figure 2 & Figure 3.

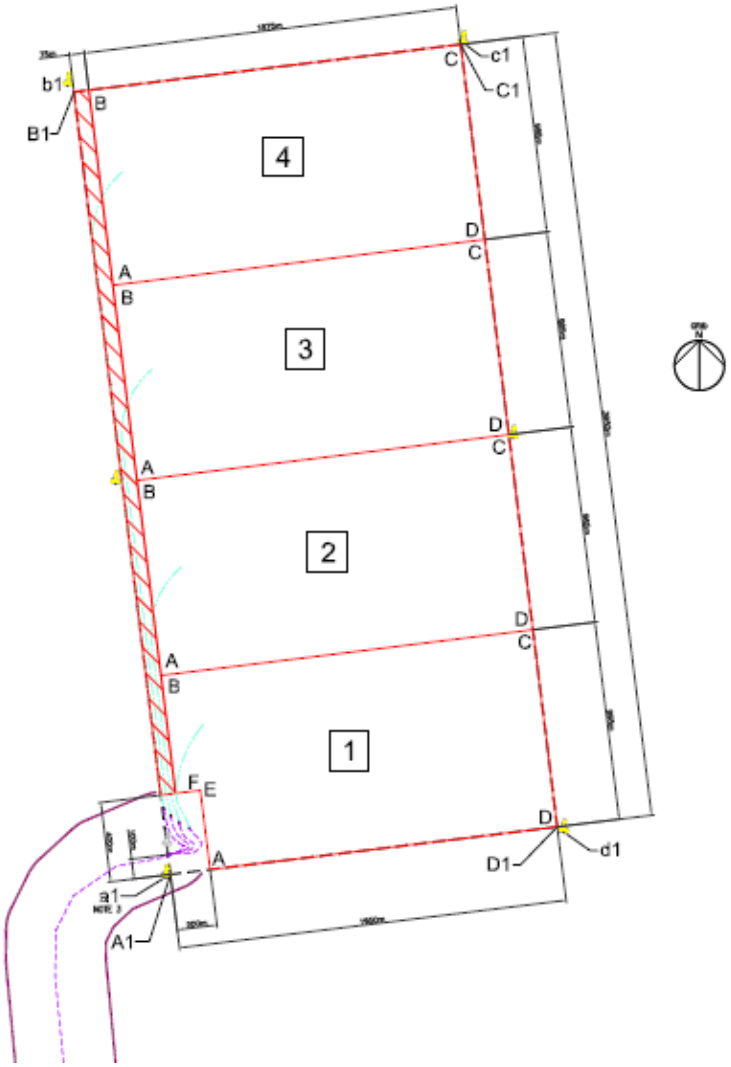

Figure 2

	BERTH 1	
1A	313 777.89 E	5580 311.58 N
1B	313 532.19 E	5581 283.84 N
1C	315 393.13 E	5581 513.05 N
1D	315 514.77 E	5580 525.51 N
1E	313 728.99 E	5580 708.58 N
1F	313 604.93 E	5580 693.30 N

Figure 3

2.2. Location & Layout

The location of Wave Hub is 17km north of St Ives on the north coast of Cornwall. Table 1 lists the coordinates of the Wave Hub itself, along with the marker buoys and the proposed position of Oceanus 2. The position of Oceanus 2 will be updated with as built coordinates once the device has been installed.

Table 1

Hub Position						
	Latitude	Longitude	Light	Radar Reflector	Topmark	AIS
	50°20'49"N	05°37'08"W	-	-	-	-
Special Marks						
1	50º 22'.833N	05º 37'.767W	Fl Y 5s	✓	✓	
2	50º 22'.983N	05º 36'.100W	Fl Y 5s	✓	✓	
3	50º 20'.866N	05º 35'.567W	Fl Y 5s	✓	✓	
4	50º 20'.700N	05º 37'.233W	Fl Y 5s	✓	✓	
5	50º 21'.765N	05º 37'.495W	Fl Y 5s	✓	✓	
6	50º 21'.920N	05º 35'.830W	Fl Y 5s	✓	✓	
Cardinal Marks:						
North	50º 23'.057N	05º 38'.251W	VQ Fl	✓	✓	✓
South	50º 20'.644N	05º 35'.082W	VQ(6) + L Fl 10s	✓	✓	
Oceanus 2:						
	50º 20'.834N	05º 36'.651W	Fl (4) Y 20s	✓	✓	✓

Figure 4 shows a schematic layout of the Wave Hub site. This includes the Wave Hub marine infrastructure comprising of a subsea cable, the hub itself, and cable tails for the four berths. Oceanus 2 will not be connected to this infrastructure.

Figure 5 is an extract from the general arrangement drawing of the Oceanus 2 WEC device showing the layout of the surface float and subsea moorings. The full GA will be included as an appendix to this document.

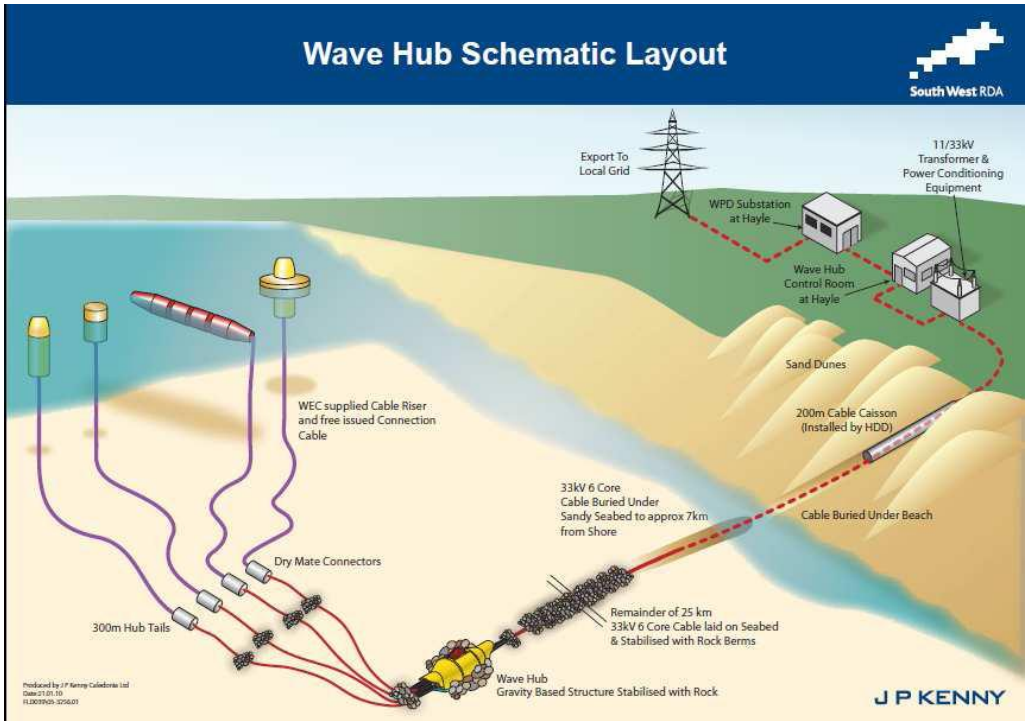

Figure 4

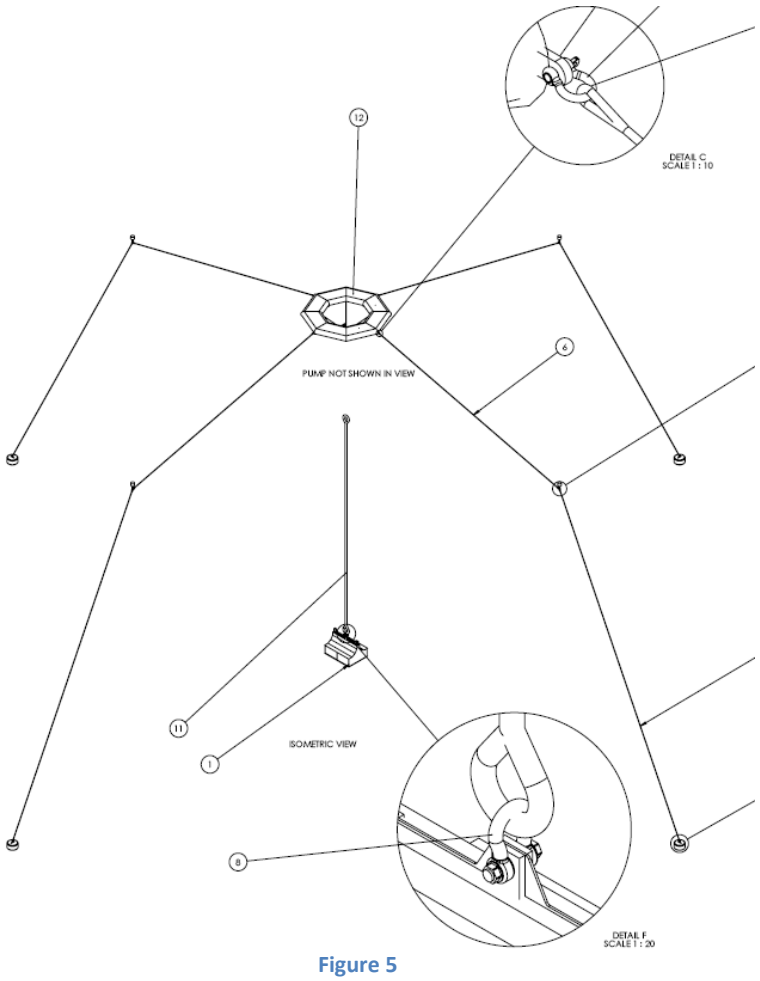

Figure 5

2.3. Site Characteristics

A site specific metocean report is available from Wave Hub. This shows the site to have the following characteristics.

Table 2 – Extreme conditions

100 Year Hs	13.7m (Tz 13.4s)
100 Year Max Wave Height	25.1m (Tz 14.1s)
100 Year maximum current (1m above seabed)	1.05 m/s
Max surface current	1.5 m/s

Table 3 – Extreme water levels at Hub position

	m LAT	m msl
100 year total	24.8	20.7
50 year total	24.0	19.9
100 year +ve swl	8.3	4.2
50 year +ve swl	8.2	4.1
10 year +ve swl	8.1	4.0
1 year +ve swl	7.9	3.8
HAT	7.3	3.2
MHWS	6.8	2.7
MHWN	5.5	1.4
MSL	4.1	0.0
MLWN	2.7	-1.4
MLWS	1.0	-3.1
LAT	0.0	-4.1
1 year –ve swl	0.5	-3.6
10 year –ve swl	0.3	-3.8
50 year –ve swl	0.2	-3.9
100 year –ve swl	0.1	-4.0

2.4. Fishing Activities

Fisheries surveillance data was obtained for 29E4 – Sub-Square 1 [Ref 14] for the period 2000-2005 (although 2004 is the last complete year for which data is available). From this data, the following key observations were made:

- Fishing activity is highest in February and March during the sole fishery and lowest in November and December;
- U.K. vessels (47%) and French vessels (43%) account for the majority of sightings of active vessels;
- The great majority of French vessels are otter trawlers. Almost all of these fish outside the 12 mile limit;
- All the Belgian vessels are beam trawlers. Most sightings of these are outside the 12 mile limit;
- U.K. vessels use a number of different fishing methods in the area, including beam and otter trawling, potting and gill netting. Activity is spread across the whole of ICES rectangle 29E4, Sub-Square 1;
- Beam trawling activity is highest in February and March;
- Otter trawling activity is highest in January and February;
- Potting activity is highest in August and September;
- Gill netting activity is highest from June to October;
- Most of the otter trawling takes place outside of the 12 mile limit;
- Much of the beam trawling takes place outside of the 12 mile limit However, some vessels are allowed to work inside the 12 mile limit;
- Much of the potting takes place close to the deployment area;

The following U.K. national fishery regulations apply between 6 miles and 12 miles from land in the study area:

- No beam trawlers allowed to fish with engine capacity of >221 kw;
- No foreign vessels without clear historical fishing rights and quota (in this area this includes mainly Belgian beam trawlers and French otter trawlers).

Cornwall Sea Fisheries District (CSFD) regulations apply to waters from the coast out as far as the 6 mile limit; the following byelaws are relevant:

Shellfish fishing:
No vessels greater than 16.46 m overall length may fish for shellfish, except that between 3 and 6 miles from land any shellfish vessel who had fished in this area prior to 6th August 1997 may (under registration with CSFD) continue to do so.

Trawling:
No vessels of greater than 18.28 m overall length or with an engine power of > 221 kw can trawl inside 6 miles, except that between 3 and 6 miles from land, any trawler under this category who had fished in this area prior to 6th August 1997 may (under registration with
CSFC) continue to do so.

2.5. Shipping

Shipping traffic studies have been performed and are available from the wave Hub website:
2011 Anatec Navigational Risk Review

In addition to this a further shipping review was completed in March 2013, which is available directly from Wave Hub [document: *201303_shipping review_Anatec*].

Seatricity has completed a device specific Navigational Risk Assessment which was submitted when applying for the marine license for the Oceanus 2 deployment from the Marine Management Organisation, *Seatricity_Oceanus2_NRA_DSS_140314*, is included as an appendix to this document.

3. Description of Items to be Decommissioned

3.1. Surface device

The Oceanus 2 surface device comprises of a surface floating buoy, details Table 4, and a connected tubular pump. The pump and float are assembled ashore and are installed as a single item. The device only has 5 mooring connections (as shown in Figure 5), 4 of which are shackled connections above the waterline not requiring any specialist equipment to disconnect. The 5 connection is remotely operated from the deck of the buoy by the use of a single valve, and connects the pump to the main reaction tether. This connection is charged with Nitrogen so the opening of the valve releases the pressure which opens the mooring connection. The failure mode for this system is to fail open, so that in the event of the connection system being damaged and gas pressure being lost the connection will disconnect. In the event that the disconnection valve is damaged or has excessively corroded, the rubber pipe can be cut to release gas pressure.

Figure 6 shows the general arrangement of the Oceanus 2 float and subframe. The pump in this figure is stowed horizontally for lifting and transport. Figure 7 shows the Oceanus 2 installed at Wave Hub.

Table 4

Item	Notes
Diameter of hull	12m
Draft of hull	1m
Draft of device including pump	12m
Draft of device towed	6m
Total mass of device	12 Te
Materials of hull	Marine grade aluminium
Materials of sub frame	Mild steel with anti corrosion coating
Materials of pump	Marine grade stainless steel & chrome/nickel plated mild steel

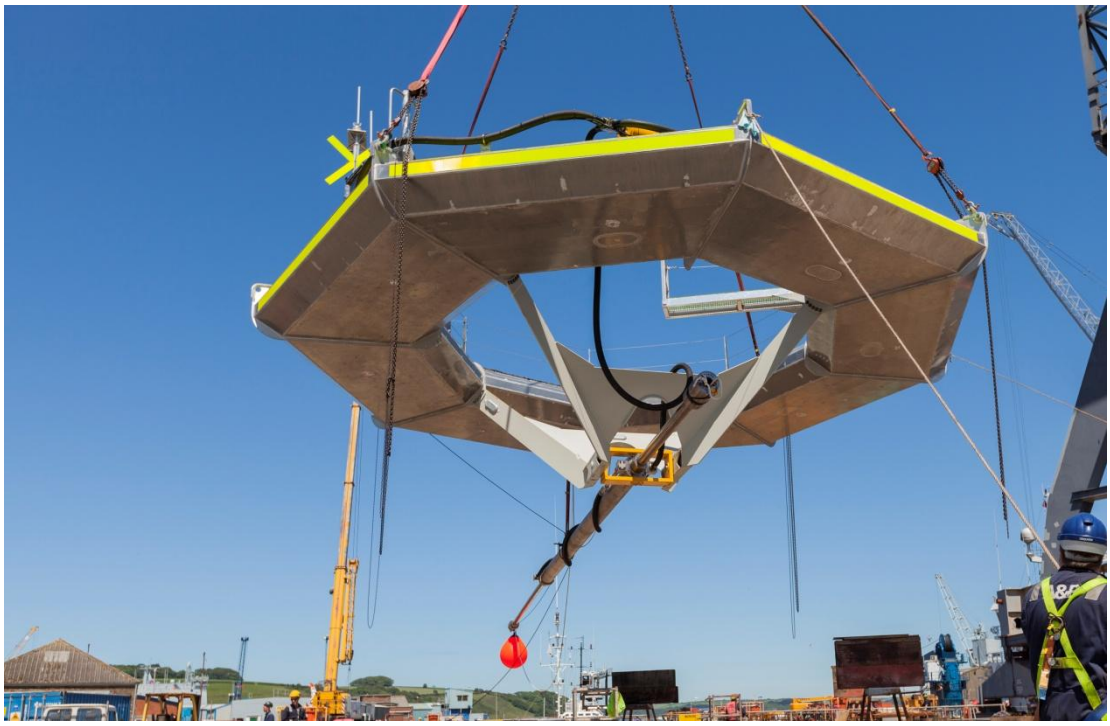

Figure 6

Figure 7

3.2. Subsea moorings

The subsea moorings are made up of 5 mooring legs and associated clump weights as shown in Figure 9. These are to be installed, and removed, as complete legs with the lines and components pre assembled up to the float/pump interface. There are two types of clump, 4 square ancillary clumps of 23Te (dry), and two circular main clumps of total 80Te (dry), as shown in Figure 10 with dimensions. The clump weights are manufactured from mild steel and filled with concrete without any reinforcing bars.

Figure 8

The installed coordinates of the mooring blocks are given in Table 5 below.

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WGS84	Latitude	Longitude
Clump 1	50 20.813	5 36.616
Clump 2	50 20.856	5 36.620
Clump 3	50 20.812	5 36.690
Clump 4	50 20.856	5 36.689
Clump A	50 20.834	5 36.651

Table 5

Figure 9

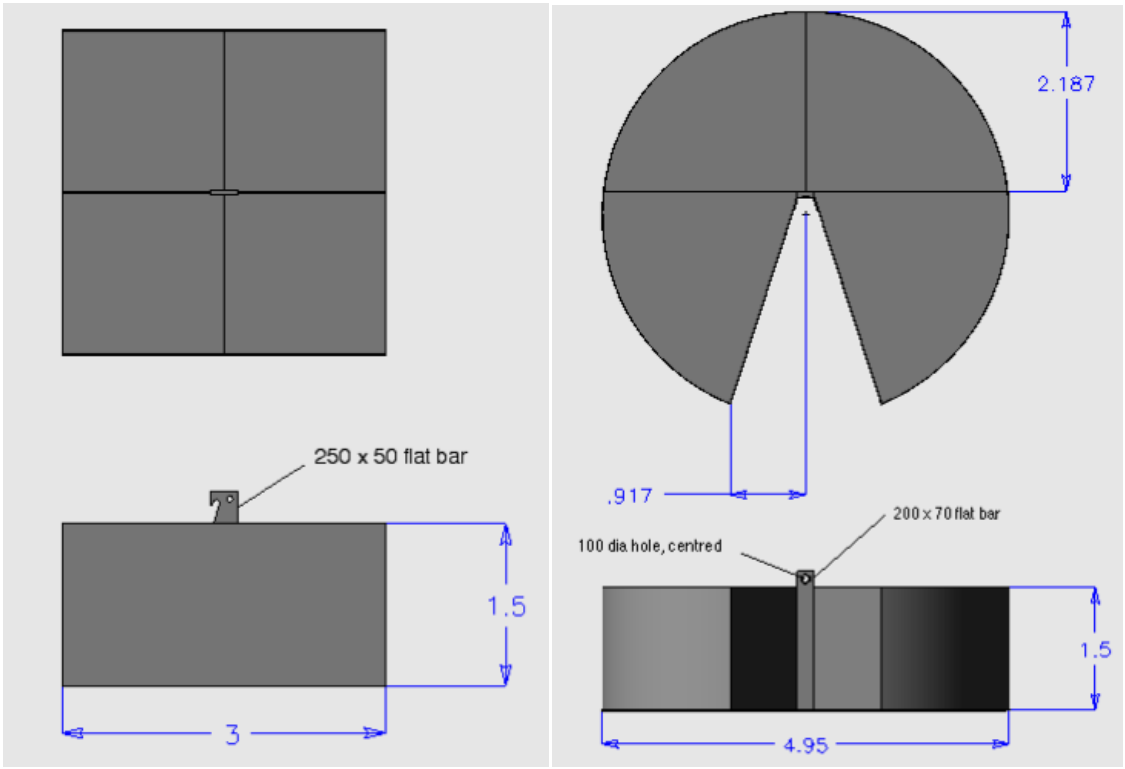

Figure 10 – 20t mooring block on left, 40t on right

4. Description of proposed Decommissioning Measures

4.1. General

Sections 104 to 114 of the Energy act 2004 introduce a decommissioning scheme for offshore marine energy installations. Offshore infrastructure is defined as that beyond Mean Low Water.

Guidance notes for the industry are in favour of the whole of all disused installations being removed and subsequently taken back to land for reuse, recycling, incineration with energy recovery or disposal at a licensed site. This is what is proposed for the Oceanus 2 project.

As decommissioning activities will inevitably lead to the production of controlled waste, under the Environmental Protection Act 1990, SL will have a duty of care to ensure that when waste is transferred, it is only transferred to an authorised person (e.g. a registered waste carrier or someone who holds a license to recover or dispose of waste) and that there is a written description of the waste on a waste transfer note.

All waste will be treated in accordance with waste disposal, pollution control, and environmental measures that are best practice in the industry.

4.2. Surface Device

4.2.1.Removal

The surface device float will be disconnected from its mooring system, and removed from the site either by towing or by being lifted onto a suitable vessel. Positional mooring connections are illustrated in Figure 9.

4.2.2.Reuse / recycling

The surface float, pump and instrumentation will be disassembled. The instrumentation system will be preserved by SL for possible future reuse. The materials of the pump and float are largely aluminium and steel, and will be recycled by a licensed metal recycler. No fluids are contained within the system, the reaction tether connection being nitrogen charged.

4.3. Subsea equipment

4.3.1.Removal

The subsea mooring clump weights, mooring lines and components will be removed by lifting. This will be performed either by a crane or winch from a suitable vessel. The clump weights have been designed to be easily slinged for decommissioning; only requiring an observation ROV to confirm secure slinging of the load. The items will then all be returned to shore by the decommissioning vessel.

4.3.2.Reuse / recycling

The clump weights, subject to inspection, may be reused on subsequent SL projects. It is likely that the mooring components; shackles, floats and synthetic rope will be recycled due to the risk of reuse. In the event that the mooring clump weights cannot be reused, they will be broken up disposed of on land according to construction industry best practice, being largely concrete and steel.

5. Environmental Impact

Decommissioning of the Oceanus 2 WEC poses no further risk environmental impact than the installation of the device. The device itself is manufactured from inert materials, and contains not lubricating oils or hydrocarbons of any sort. An EIA for the installation of the device is not required under the Marine Works (EIA) regulations 2007.

5.1. Restoration of Site

As previously raised, Seatricity Limited propose to remove all materials, from the site and seabed, that were installed by the company as part of the Oceanus 2 project. The site will, as far as reasonable practical, be returned to the condition that it was in prior to the Oceanus 2 project.

6. Costs

It is expected that offshore decommissioning works may take up to 4 days to perform (including mobilisation and unloading/demobilisation). With current market rates of £8,000 per day for an appropriate vessel, the cost is likely to be in the order of £45,000. This takes into account mobilisation, demobilisation costs and disposal charges along with any residual scrap value. The estimated potential liability will be approximately £45,000 including scrap value and a contingency fund. A breakdown of these costs is given in **Error! Reference source not found.**.

The decommissioning of the device is a three phase process:

1) **Removal of the device float and pump.** This is achieved without the use of a lift vessel. The device is disconnected from the mooring system, and then towed to port. The float and pump is towed to a quay and a mobile crane used to lift it from the water onto the wharf for dismantling and recycling. The float and pump will weigh 12t in total. Aluminium is sold for its scrap value and steel is recycled. This phase can be achieved with a small vessel, the only requirement is for a bollard pull of 6t as calculated in the Mojo mooring design report.

Item	Amount	Cost	Notes
Mobilisation	1 day	£1,500	From Falmouth if necessary
Operations	1 day	£1,500	Recover device and tow to port
Demobilisation	1 day	£1,500	
Wharf crane hire	1 day	£800	Lift device onto wharf
Total Cost		**£5,300**	

2) **Removal of the moorings.** This would require a vessel with a bow roller and a minimum 50t main winch. An eyeball RoV would also be required for connection of the lift line. The vessel would proceed to site, and connect to the mooring blocks by the lift hooks provided in the design. These would then be winched up to just below the vessel hanging off the bow roller. Each mooring would then be transported to port and deposited on the sea bed next to the quayside. Main moorings weigh 40t in water each. The smaller positional moorings can be lifted in the same manner and transferred to deck for transport. Positional moorings

Item	Amount	Cost	Notes
Mob/Demob	1 day	£8,000	£8000/day
Operations	2 days	£16,000	
Total Cost		**£24,000**	

3) **Recycling.** The buoy and pump would be cut up and recycled, with the scrap aluminium being sold as it has a residual value worth realising.

   There are two methods of recycling the mooring blocks:
   a) Reuse. Opportunities could be investigated for the reuse of the mooring blocks. Potential exists for use harbour moorings or reinforcing marine structures such as break waters and quays. Seatricity has experience of this on previous projects where clumps have been used to reinforce a quay wall.
   b) Dismantling and recycling. The blocks would be lifted onto the quay with a mobile crane. The heaviest mooring block is 64t in air, so a minimum of 150t mobile crane is

the minimum requirement, although this will be dependent on the required reach.the lift geometry should be checked and a lift plan prepared in order to specify the crane size.The mooring blocks would have the steel cut from the outside, and the concrete block broken up with a pneumatic drill on an excavator. The resulting rubble would be used as land fill in the construction industry. This phase could be competitively provided by a construction or demolition contractor.

Item	Amount	Cost	Notes
Wharf crane hire	1 day	£3,000	Lift items onto wharf
Disposal / Recycling cost	1 week	£7,000	Cut up steel and concrete
Contingency		£5,700	
Total Cost		**£15,700**	

Vessels for the decommissioning works could be provided by available local vessels. The lower requirement for decommissioning the float has been reflected in the £1500 cost. Clump decommissioning vessels could be found at costs below the £8000 per day quoted. This figure is conservative and includes fuel, lubes and crew. Examples of potential vessels are given in Figure 11.

Voe Earl	MultiCat	M	£5k	• Sufficient Deck area • Sufficient deck strength • Voe based in Shetland	
MTS Grey Bear	Dive boat	D	£1.5k	• Use local vessel	
MTS Xplorer	ROV boat	R	£1k	• Based in Penryn Cornwall • Mojo will be experienced in use • Suitable for operation	

Figure 11

A £5,700 contingency has been included which can be used for operational planning, or changes in vessel or dismantling and recycling costs.

It is expected that any pre-decommissioning survey requirements can be provided by the general inspection surveys performed during the device's life, and by the installation survey. A survey will be performed during decommissioning with an eyeball RoV to show the structure has been removed.

A detailed cost estimate will be prepared prior to decommissioning. Seatricity is aware of its obligation to fund any decommissioning works (see Section 1 for details).

7. Financial Security

Under the Energy Act decommissioning provisions it is left to the responsible person to determine what form of security they propose to provide.

Seatricity proposes that financial security will be agreed between SL and WHL. The agreed security will be provided to WHL by Seatricity.

8. Schedule

It is expected that decommissioning will commence 12 months form the installation of the Oceanus 2 WEC at Wave Hub (approx May 2015).It is expected that decommissioning will follow this outline schedule:

- Planning and contracting – 1 month
- Offshore works – 4 days
- Onshore disposal – 1 week

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