

Orbital Marine Power Limited Orbital O2.2 Tidal Turbine

EMEC Berth 6, Fall of Warness, Eday, Orkney

Draft Decommissioning Programme

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Document prepared for:

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Glossary

AC	Alternating Current
GSM	Global System for Mobile communications
HMI	Human Machine Interface
kV	Kilovolt (1000 volts)
LAN	Local Area Network
LED	Light Emitting Diode
MVA	Mega Volt Ampere
MW	Megawatt (1,000,000 watts)
PLC	Programmable Logic Controller
РТО	Power Take-Off
RIB	Rigid Inflatable Boat
RPM	Revolutions per minute
SCADA	Supervisory Control and Data Acquisition
UPS	Uninterrupted Power Supply
UTM	Universal Transverse Mercator

V Volt

1 Executive Summary

Orbital Marine Power Limited plan to install a 2 MW tidal turbine, the Orbital O2.2, at the European Marine Energy Centre's (EMEC) tidal test site, Berth 6, at the Fall of Warness, Eday, Orkney in 2023. Orbital are required to prepare a Decommissioning Programme under Section 105 - 114 of the Energy Act 2004 for submission to Marine Scotland. Consultation is required with a number of stakeholders specified by Marine Scotland. A final report will then be produced taking into account the response to this consultation process.

The decommissioning process will include the removal of the O2.2 turbine from the site and the removal of all associated mooring, anchoring infrastructure and electrical cabling deployed as part of the project with the exception of rockbolts, which if employed, would remain in situ. A post decommissioning ROV survey of the site will then inform the requirement for any seabed restoration. The subsea electrical cable and onsite infrastructure used as part of the project that are part of the EMEC test site infrastructure are not covered by this decommissioning programme.

It is anticipated that decommissioning will take place at the end of the planned 14 year operational project, i.e. c. summer 2038. All decommissioning works are likely to be undertaken using multicat workboat vessels or similar over a period of 6 months depending on weather and tidal conditions. The O2.2 device will be towed to a sheltered water location and from there will be removed to a suitable facility for recycling.

2 Introduction

Orbital Marine Power Limited plan to install a 2MW commercial demonstrator turbine, the Orbital O2.2 at Berth 6 at the EMEC Fall of Warness tidal test site in Eday, Orkney, see Figure 1.

Orbital have submitted a new marine licence application to Marine Scotland under Section 20(1) of the Marine (Scotland) Act 2010 to cover the activities associated with the project namely "the deposit of a substance or object in the sea or under the seabed".

Under Sections 105 – 114 of the Energy Act 2004 Orbital are required to submit a Decommissioning Programme for approval by Marine Scotland. Consultation is required on the proposed decommissioning programme following which a final version of the document will be produced incorporating comments from stakeholders, where appropriate. This document forms Orbital's draft Decommissioning Programme for consultation and has been produced in compliance with Scotlish Government draft guidance notes for industry¹.

3 Background Information

3.1 Location of project to be decommissioned

The O2.2 turbine will be installed at EMEC Fall of Warness test site at Berth 6, see Figure 1. The locations of the mooring spreads are given in Table 1 below. These locations would be subject to micrositing of up to 400m as requested in the marine licence application but likely to be much less in reality. Further detailed project information is contained within the Project Information Document.

Anchor	Co-ordinates Universal Trans (UTM)	verse Mercator	Latitu (WGS	de 84)	Longitude (WGS84)	Water depth CD (m)
NW	509893	6556378	59°	8.790' N	2° 49.624' W	35
NE	510042	6556486	59°	8.848' N	2°49.468'W	34
SE	510259	6556187	59°	8.687′ N	2° 49.241' W	44
SW	510110	6556079	59°	8.629′ N	2° 49.397′ W	35

 Table 1. Proposed Orbital O2.2 anchor positions

¹ Decommissioning of Offshore Renewable Energy Installations in Scottish Waters or in the Scottish Part of the Renewable Energy Zone under the Energy Act 2004 Guidance notes for industry (in Scotland).

3.2 Relative location of adjacent facilities

The EMEC Fall of Warness test site consists of a number of testing facilities including berths which are occupied by various other technology developers, though typically not all berths are occupied. Figure 1 illustrates the position of the O2.2 project and anchor locations within the EMEC site.

There are no other facilities such as pipelines or platforms adjacent to the test site.



Figure 1. Site layout

3.3 Weather and sea conditions

The EMEC tidal test site is located in the Fall of Warness to the west side of the island of Eday in the Orkney Islands. The centre of the Orbital berth is 59° 8.742' N, 2° 49.429' W (WGS84) at a water depth of approx. 35m. The site experiences strong tidal flows of over 6 knots (3.08 m/s) as a result of the interaction of two independent tidal systems in the North Sea and the North Atlantic. The northward Atlantic wave peak arrives roughly 2-3 hours earlier than the southward travelling North Sea wave, producing a net flow of water from east to west and complex interactions among the island sounds.

The Fall of Warness test site is exposed to the northwest and southwest due to the orientation of the channel. Modelled wave data is available for Berth 6 for the 20 year period 1986 to 2005, analysis of this data shows that the average significant wave height was 0.5-1m, with only 0.4% exceedance of 3m. Average wave height maximum was between 1-1.5m with approximately 1.4% exceeding 5m. The

average peak wave period was between 4-6 seconds and the predominant wave directions are northwest and south. The peak wave direction was northwest².

Orbital has extensive experience of working in the harsh offshore conditions at the test site.

3.4 Local marine activity

As part of the marine licence application, a device-specific Navigational Risk Assessment (NRA) was undertaken for the deployment of the O2.2 at EMEC. This document specifically considers the installation, operation and decommissioning of the O2.2 at Berth 6 and builds on EMEC's site-wide NRA for the Fall of Warness test site³.

As part of the NRA process, shipping, fishing and other vessel activity was analysed predominantly via the use of Automatic Identification System (AIS) data. The following types of activity were noted in the area:

- Vessels engaged in installation and maintenance activities of adjacent TEC using the EMEC site;
- Vessels engaged in survey or other EMEC maintenance activities;
- Fishing vessels transiting the site to fishing grounds elsewhere;
- Fishing vessels working creels along the coast of Eday and the Holms;
- Yachts and other recreational vessels, and;
- Other vessels such as offshore support vessels transiting the area.

3.5 Protected Areas

There are no Natura 2000 or other protected areas within the boundaries of the Fall of Warness test site. The Orbital O2.2 Environmental Monitoring Programme (February 2021) provides detail on potential environmental impacts across all project phases and associated mitigation.

3.6 Other relevant information

The deployment of the O2.2 at the EMEC tidal test site will be covered by the following licences:

- Marine licence (being applied for in conjunction with submission of this programme)
- Licence to disturb European Protected Species (yet to be applied for); and
- Licence to disturb basking sharks (yet to be applied for).

4 Description of items to be decommissioned

4.1 General

Decommissioning of the O2.2 project at EMEC will consist of the removal of the following elements:

• O2.2 commercial demonstrator turbine, and;

² MARICO 2021. O2.2 Navigational Risk Assessment, Fall of Warness Berth 6, Marico Marine Limited, Feb 2021. ³ MARICO Marine. Fall of Warness Navigational Risk Assessment Aug 2019.

• Associated mooring, anchoring and project specific subsea cable infrastructure.

Other aspects of the project including the EMEC subsea cable are not included in the decommissioning programme as they form part of the EMEC infrastructure provided as part of the test facility.

4.2 O2.2 Commercial Demonstrator Turbine

The O2.2 turbine has been specifically designed with ease of connection/disconnection and transport to/from site as a major design parameter. The removal of the O2.2 from the site to a sheltered water location for periodic maintenance work will form part of the normal operational procedure for the device with the operation carried out in a single day. Decommissioning of the device from the EMEC site will employ a multicat vessel without the need for specialist contractors.

Once removed from the site the turbine will be towed to a sheltered bay location for temporary mooring. As with any operation involving moving the turbine, decommissioning the device from the site will be notified to local mariners via the Notice to Mariners system. On final removal from the berth Orbital will apply for a statutory Sanction to Discontinue lighting and marking from the Northern Lighthouse Board. UK Hydrographic Office would also be notified upon removal of the turbine and associated infrastructure.

Following on from removal from the site the most likely outcome for the O2.2 turbine will be dismantling and recycling owing to the long time period of the project and the likelihood that the technology will have advanced in the intervening period. If it is decided to decommission the turbine at this stage then the device will be removed to a suitable location for dismantling and recycling/disposal, as appropriate. Table 2 provides a summary of the main device components and Figure 2 provides the key dimensions for the device.



Figure 2. O2.2 Dimensions

Material	Approximate quantity	Waste management
Steel (buoyancy tube, nacelles, rotor legs, leg braces, mooring turret)	540 tonnes	Reuse or recycle
Glass reinforced plastic (rotor blades)	14 tonnes	Reuse or disposal
Copper (wiring)	4 tonnes	Recycle
Rubber (including seals)	3 tonnes	Recycle or disposal
Hydraulic fluid	<1500 litres	Recycle
Gearbox oil	<600 litres	Recycle
Grease (mooring turret)	<50 litres	Recycle
Diesel (backup generator)	<100 litres	Recycle
Batteries	0.6 tonnes	Recycle
Device coating	<2500 litres	Dispose

Table 2. Main materials to be decommissioned for the O2.2.

4.3 Mooring, anchor and cabling infrastructure

The Orbital O2.2 will be anchored with either 4 gravity anchors or 4 rockbolt anchors subject to site suitability. If gravity anchors are deployed, they would be entirely removed and decommissioned at the end of the project. If rockbolt anchors are deployed, it is proposed that as they are drilled into the seabed that they are left in situ, as it is considered that they pose minimal environmental impact or obstruction to any other seause. Further justification for leaving the rockbolts in situ is provided in Section 5. In either case, all other infrastructure owned by Orbital Marine Power Limited residing on the seabed would be removed.

If gravity anchors are deployed, they as described as follows:

The gravity anchors would be composed of a 'steel basket' which will be filled with ballast. The baskets will be approximately $11m \times 11m \times 2.5m$ and will have a weight of approximately 35T each. A schematic of the anchor basket with ballast is provided in Figure 3.

The ballast would consist of a scrap steel chain or steel modules.

- Scrap chain would be approximately 76mm diameter.
- Steel modules would be approximately 5.6m x 5.2m x 2m.

Figure 3. Anchor basket with ballast



If rockbolt anchors are deployed, they would be as follows:

The principle of rock bolt anchors is to use a drilling rig to insert a steel vertical bolt or bolts into the seabed to provide station keeping for the device. The bolts will provide stationkeeping by either being grouted in place or a groutless installation whereby a mechanical lock is used to prevent pull out. In this system, the 'cutting fingers' themselves of the drilling bit are expanded within the bolt hole to secure the anchor in place.

Subject to detailed design, each bolt would be around 6m in vertical length and up to 600mm in diameter. A schematic of a single rock bolt is provided in Figure 4. Each would be entirely drilled into the seabed with its head protruding from the seabed with a bespoke mooring connector.

It is envisaged that there would be a single rock bolt for each of the 4 mooring points, i.e. 4 rock bolts in total. However, subject to ground conditions analysis and detailed design, this may be revised to a larger number of smaller bolts.

Figure 4. Rockbolt



4.3.1 Scour Protection

Concrete mattresses will be placed around each anchor to prevent scour, similar to that shown in Figure 5. Each mattress will have a weight of up to 10T and size of around 6m x 3m x 0.3m. Up to 8 mattresses will be used per anchor, giving a total of 32 mattresses.



Figure 5. Scour protection concrete mattress

An additional length of cable will form the connection between the EMEC Berth 6 cable end and the Orbital O2.2 electrical termination. The additional length of cable will be up to 600m long. There will also be a permanent anchor attached to the cable at the point where it lifts off the seabed to rise through the water column to connect to the turbine. This anchor will consist of an approximately 10T steel structure.

A full list of components of the anchoring, mooring and cabling system are detailed in the Table 3 and Table 4.

Element	Description	Composition	Maximum Total weight
Anchor backets	4 x Steel 'basket' structure housing ballast @35 T each.	Fabricated steel	140 tonnes
Main anchors	4 x anchors steel ballast (or rockbolt anchors at around 40 tonnes in total weight)	Steel (blocks or scrap chain) / steel rock bolts	3600 tonnes
Cable anchor structure	To hold cable end in place	Steel	5 tonnes
Cable anchor ballast	To hold cable end in place	Steel	10 tonnes
Anchor cable ballast	Steel ballast along electrical cable	Steel	10 tonnes
Scour protection	Up to 32 concrete mattresses @ 10 T weight each	Concrete	320 tonnes
Scour protection	Up to 32 concrete mattresses, 0.1 T polypropyline per mattress	Polypropeline	3.2 tonnes
Scour protection	Rock aggregate in nylon scour bags	Aggregate	2 tonnes
Scour protection	Rock aggregate in nylon scour bags	Nylon	0.1 tonnes
Subsea Power cable	Power cable from platform mooring connection spliced to EMEC berth 6 cable, 12 kg per m, (up to 600m length)	Electrical cable	7.2 tonnes
Subsea Power cable	Cable protection (bend stiffener)	Polyethylene	0.4 tonnes
Subsea Power cable	Cable protection (bend stiffener)	Nylon	0.2 tonnes

Table 3. Anchoring and mooring system components

Table 4. Chain and rope details

Component	Weight (kg/m)	Total length required (m)	Total weight (tonnes)
95mm studlink chain	200	500	100
115mm studlink chain	315	400	126
Synthetic ropes	-	140	3.5
Steel wire (optional in lieu of synthetic ropes)	-	140	20

5 Description of proposed decommissioning approach

5.1 Proposed method of removal

The requirement for the eventual decommissioning of the O2.2 and associated mooring and anchoring infrastructure has been included in the design of the O2.2 project from the outset. All components of the project can therefore be easily removed from the site using a multicat vessel and there are a number of vessel contractors that could be appointed to carry out these activities.

Prior to any decommissioning activities being undertaken at the site, Orbital will develop detailed method statements including specific risk assessments for the work as part of the company's health and safety policy. Plans for the work will be communicated to and approved by EMEC and their consultees prior to work being undertaken. Any updates to the decommissioning methods will be reflected in subsequent interations of the decommissioning programme.

Prior to the full decommissioning method statement being developed the following provides a summary of the main activities:

- A Notice to Mariners will be issued detailing the nature and timing of the decommissioning works;
- The electrical connection for the platform will be unlocked and capped, weighted and returned to the seabed.
- The mooring connections for and aft of the Orbital O2.2 will be un-locked from the device and returned to the neutral buoyancy position marked with the approved pick-up buoy;
- The Orbital O2.2 will be towed off-site using a multicat vessel and taken to an appropriate harbour or sheltered bay location for temporary mooring.
- Each of the mooring shackles connecting the mooring lines to the mooring connectors will then be released and returned to the seabed with navigation/pick-up buoys attached to enable recovery;
- If gravity anchors are utilised, each of the anchor cages and ballasts will then be recovered including the mooring lines;
- If rockbolt anchors are utilised, they will be left in situ in the seabed.
- It is anticipated that in the first instance the anchors components will be returned to Hatston pier for re-use, recycling or disposal;
- Operations will be undertaken at slack tide, the O2.2 would be removable within one day and all anchors and remaining components within 6 months;
- Post decommissioning seabed surveys will be undertaken to ensure that all equipment has been removed from the site and the site returned to the condition in which it was received from EMEC;
- All operations will be confined to the EMEC berth 6 area and will be undertaken in safe working conditions and appropriate wind and sea state.
- A visual survey of test berth 6 and the surrounding area would be conducted upon completion of the decommissioning work with formal submission of video footage alongside an associated

report to EMEC within 15 business days of completion of the works to demonstrate that the site has been cleared to its satisfaction.

5.2 Planned phased integration

Owing to the long timescales involved, there are no plans to phase/integrate any O2.2 decommissioning activity with any other operation at the EMEC test site. Each operator at the test site is working to an individual timescale and has many unique operations depending on the design of the device and anchoring system. For this reason it is unlikely that it will be possible to integrate decommissioning activities associated with the O2 device with those of any other operator at the site however if an opportunity arose where sharing resources could be advantageous then Orbital will investigate such opportunities further.

5.3 Proposed waste management solutions

The design life of the O2.2 turbine is 20 years therefore it is likely that the turbine will be recycled on completion of decommissioning at the EMEC tidal site. Components of the mooring and anchoring system may be redeployed or recycled.

Where the decommissioning process does generate waste all waste management will be carried out in accordance with the relevant legislation at the time of decommissioning.

5.4 Items remaining in situ after decommissioning

It is proposed that if rock bolts are utilised that they will remain in the seabed. The rationale for leaving these components *in situ* has been considered in accordance with the guidance Decommissioning of Offshore Renewable Energy Installations under the Energy Act 2004, BEIS and the standards set out by the International Maritime Organisation (IMO) which recommends consideration of the following matters:

- Any potential effect on the safety of surface or subsurface navigation, or other uses of the sea;
- The rate of deterioration of the material and its present and possible future effect on the marine environment;
- The potential effect on the marine environment, including living resources;;
- The risk that the material will shift from its position at some future time
- The costs, technical feasibility, and risks of injury to personnel associated with removal of the installation or structure; and
- The determination of a new use or other reasonable justification for allowing the installation or structure or parts thereof to remain on the sea-bed.

With regard to the above considerations, the rockbolts would have neglible impact on the safety of surface or subsurface navigation, or other uses of the sea. The bolts, 0.6m in diameter, would only protrude around 1m above the seabed and therefore represent 4 very minor features on the seabed or a similar scale of the boulders already naturally present at the Fall of Warness test site.

The rockbolts would be comprised of a sea-water corrosion resistant grade of steel that would be deisgned to degrade at no more than 0.25mm per year. No significant impact on the marine

environment is therefore predicted from the associated corrosion and there would be minimal risk of the rockbolts moving from their position in the hard substrate.

Rockbolt technology in the offshore tidal environment is in its relative infancy versus more standard offshore anchor techniques such as hammer piled installations. This single technology however could reduce the generating cost of tidal stream energy by around 15% versus gravity anchors in line with the objectives of Scotland's National Marine Plan and offers a low environmental impact solution for tidal stream energy with a footprint 300 times smaller than gravity anchors and a low noise installation approach versus piling.

Finally, there is no currently identifiable way of cost effectively designing a rockbolt solution of the scale required for Orbital's O.2.2. tidal turbine that can be cost effectively removed and/or technically removed without resorting to environmentally destructive methods. Currently, even the design processes themselves around a removable rock bolt anchor cannot be verified or certified.

6 Environmental Impact Assessment

The development of the O2.2 turbine is the result of over 15 years of incremental technology testing encompassing small-scale physical models, numerical models and large scale prototype testing. All of the prototype testing has been carried out in consultation with Marine Scotland and NatureScot (previously Scottish Natural Heritage) and has included environmental monitoring, where appropriate. The most recent scale turbine, the SR2000 2MW device, was tested at the EMEC Fall of Warness test site Berth 5 between March 2017 to September 2018.

The EMEC Fall of Warness test site has previously been the subject of a site-wide Environmental Appraisal in 2014⁴ which was undertaken to secure a site-wide Section 36 consent under the Electricity Act 1989.

As described above, the procedures required for decommissioning the O2.2 are the same as those used for installation and the regular operations and maintenance of the device. The decommissioning of the anchoring and mooring system will be essentially the reverse of the installation process and is therefore likely to produce similar predicted impacts to the installation process. It is not anticipated therefore that the decommissioning of the project will have any additional or significant environmental impacts. The project is the subject of a Project-specific Environmental Monitoring Plan (PEMP) which will be revisited and updated throughout the testing period. Any significant findings from this work can therefore be incorporated in the decommissioning procedures if required nearer the time. Potential impacts specific to the decommissioning phases detailed in the PEMP are outlined below. Further information regarding specific impact pathways are detailed further in the PEMP which can be resquested directly from Orbital Marine Power Limited.

⁴ EMEC Fall of Warness Test Site, Environmental Appraisal, August 2014.

Potential impact pathway	Receptor	Proposed mitigation / monitoring measure
Disturbance – Noise from vessel activity (including transiting to and from site)	Cetaceans, Basking shark, Seals	Mitigation : The Scottish Marine Wildlife Watching Code (SMWWC) will be adhered, including the following measures:
		 Vessel speeds will be reduced to 6 knots when a cetacean is sighted in close proximity to the immediate vessel transit route. A steady speed and vessel course will be maintained if a cetacean approaches a vessel involved in marine operations. Utmost care will be taken in ensuring groups and mothers and young are not split up by vessels. Sudden changes in speed and direction will be avoided to reduce the likelihood of any further disturbance to cetaceans in the vicinity. The completion of this mitigation measure will be dependent on ensuring safe navigation throughout activities, crew safety and completion
		of marine operations which are constrained by tidal or weather windows.
Disturbance – Presence or noise from mooring decommissioning works and vessel presence onsite	Cetaceans, Basking sharks, Seals	Mitigation : The SMWWC will be adhered to throughout all operations, where possible.
Harassment/Disturbance – Presence of vessel activity (including transiting to and from site)	Harbour and grey seals	Mitigation : SMWWC will be adhered to including the measures outlined above. In addition, during all vessel activity a minimum approach distance will be complied with when passing designated seal haul-outs.
Disturbance – Presence of vessel activity (including transiting to and from site)	Seabirds	 Mitigation: SMWWC will be adhered to including following particular measures: Rafts of birds will not be intentionally flushed.

Table 5. Decommissioning phase identified potential impacts as described in PEMP

Potential impact pathway	Receptor	Proposed mitigation / monitoring measure
		During seabird breeding season (April to August inclusive), vessel transit corridors will be at least 50m from shore in the vicinity of cliff-nesting seabirds to avoid disturbance.
Seabed loss due to the direct footprint	Benthic communities	Monitoring: Pre-installation and post- installation seabed survey will be conducted to understand the extent of the effect on the benthic ecology and seabed character caused during installation activities.
Colonisation and loss of new habitat	Benthic communities	Monitoring: Pre-decommissioning seabed survey will be conducted 2 months prior to decommissioning the anchors. The survey results will be used alongside the results from the surveys conducted when the mooring blocks were initially installed to investigate any effects on the benthic ecology and seabed character during the device deployment period.
Recolonisation	Benthic communities	Monitoring: Post-decommissioning (within 3 months) seabed surveys will be conducted to investigate the effects on the benthic ecology and seabed character caused during decommissioning activities. There is also an opportunity to investigate the likelihood of recolonisation when analysing these results.
Biofouling and the introduction of non-native species	Benthic communities	Mitigation : Compliance with good practice measures detailed in the 'Alien invasive species and the oil and gas industry – Guidance for prevention and management' produced by the IPIECA in 2010, 'Guidance for minimizing the transfer of invasive aquatic species as biofouling (hull fouling) for recreational craft' produced by the IMO in 2012 and the 'Code of Practice on Non-Native Species' made by Scottish Ministers under section 14C of the Wildlife and Countryside Act 1981.

Potential impact pathway	Receptor	Proposed mitigation / monitoring measure	
Biofouling, introduction of non- native species and habitat creation for biofouling species	Sessile communities	Mitigation: Local vessels will be used throughout all installation, maintenance and decommissioning operations therefore there is not likely to be any potential for the introduction of NNS than those NNS already present in Orkney waters. Mitigation: Antifouling paints will be used which comply with the IMO International Convention on the Control of Harmful Anti-fouling Systems on Ships and national legislation. Mitigation: Opportunistic inspections of biofouling will be implemented	
		for removing biofouling species from the device. The organisms removed will be analyzed by experts to ensure a comprehensive species list is compiled.	
Habitat removal for biofouling species	Sessile communities	A full device biofouling inspection may be conducted as the device is decommissioned. This inspection will be conducted by an expert in the biofouling field to ensure that a comprehensive species list is compiled.	

Staff involved in decommissioning operations will be trained in the Scottish Marine Wildlife Watching Code (SMWWC) and vessels involved in the work will adhere to the code. In the event of a marine mammal being recorded in the vicinity of the decommissioning operation, appropriate mitigation and monitoring measures will be implemented, in consultation with NatureScot and Marine Scotland.

7 Stakeholder consultation

The following organisations will be consulted as part of the development of this decommissioning programme:

- Crown Estate Scotland
- Maritime and Coastguard Agency
- Northern Lighthouse Board
- NatureScot
- Historic Environment Scotland
- The UK Chamber of Shipping
- Orkney Marine Planning Partnership (Orkney Islands Council)

- Orkney Islands Council Marine Services (Harbour Authority)
- Royal Yachting Association
- Scottish Fishermen's Federation
- European Marine Energy Centre
- Orkney Fisheries Association
- Orkney Fisherman's Society

8 Costs and financial security

The licence holder is required under the provisions of the Energy Act 2004 to provide financial security to cover the costs associated with decommissioning.

The costs and proposed financial security details for the decommissioning of the O2.2 project are considered commercially sensitive by Orbital Marine Power Limited. The cost estimates developed and proposed financial security arrangements are therefore provided as a confidential annex for consultation directly with Marine Scotland and Scottish Government.

9 Schedule

It is anticipated that the O2.2 project will operate from end 2023 – 2037. After this time it is likely that the O2.2 will be dismantled and recycled. Details of the removal and decommissioning schedule will be finalised closer to the end of the project, however, it is anticipated that removal of the turbine and mooring and anchoring system will take up to six months.

Should the O2.2 project be brought to a close earlier than anticipated, either through the device become non-functioning, damaged or for commercial reasons, decommissioning operations would be undertaken following the same procedure as outlined above.

An overview of the project schedule is provided below.

Activity	Location	Approximate duration	Approximate timescale
Mooring installation	Berth 6	8 weeks in 12 months window	June 2022 – June 23
Dynamic cable installation	Berth 6	1 week	March – April 2023
Turbine delivery to Orkney		5 days	June 2023
Install on moorings	Berth 6	2 days	July 2023
First grid connection	Berth 6	2 days	August 2023
Commissioning	Berth 6	12 weeks	August – October 2023
Operation	Berth 6	14 years	November 2023 – Dec 2037
Decommissioning	Berth 6	6 months	2038

Table 6. Project Schedule

10 Seabed clearance and site restoration

Once the project is complete all anchoring materials will be removed from the site with the exception of rockbolts which if employed will remain in situ. At the end of the project an ROV or drop camera survey will be undertaken to ensure that all anchoring materials have been removed from the site. The post decommissioning survey will also record any potential impacts to the seabed at the anchoring points and also along the mooring lines where there has been contact with the seabed. Currently all evidence indicates that given the nature of the seabed and proposed non-invasive works, no restoration works will be required.

11 Post-decommissioning monitoring, maintenance and management

Due to the limited extent of the project it is unlikely that any post-decommissioning monitoring, maintenance and management will be required at the site. If remedial action is determined to be required, the programme for any additional monitoring, maintenance or management of the site will be agreed with Marine Scotland.

It is expected that the rockbolts which if employed and would retain in situ would degrade by around 0.25mm in diameter per year. The rockbolts will be monitored for the entire 14 year operational lifetime of the O2.2 operational project. This will in turn validate these assumptions around degradation and inform any future monitoring, if required.

12 Supporting studies

The following documents have been produced in conjunction with the project:

- O2.2 Project Information Document, Feburary 2021
- O2.2 Project Environmental Monitoring Programme, February 2021;
- MARICO 2021. O2.2 Navigational Risk Assessment, Fall of Warness Berth 6, Marico Marine Limited, Feb 2021
- EMEC Fall of Warness Test Site, Environmental Appraisal August 2014

All documents are available on request from Orbital Marine Power Limited or the European Marine Energy Centre.