



# OYSTER 2A AND ADDITIONAL FOUNDATION PILES PROJECT

## ENVIRONMENTAL MONITORING PLAN

**OY02-DES-RH-XOD-PLN-0001**

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## NON-TECHNICAL SUMMARY

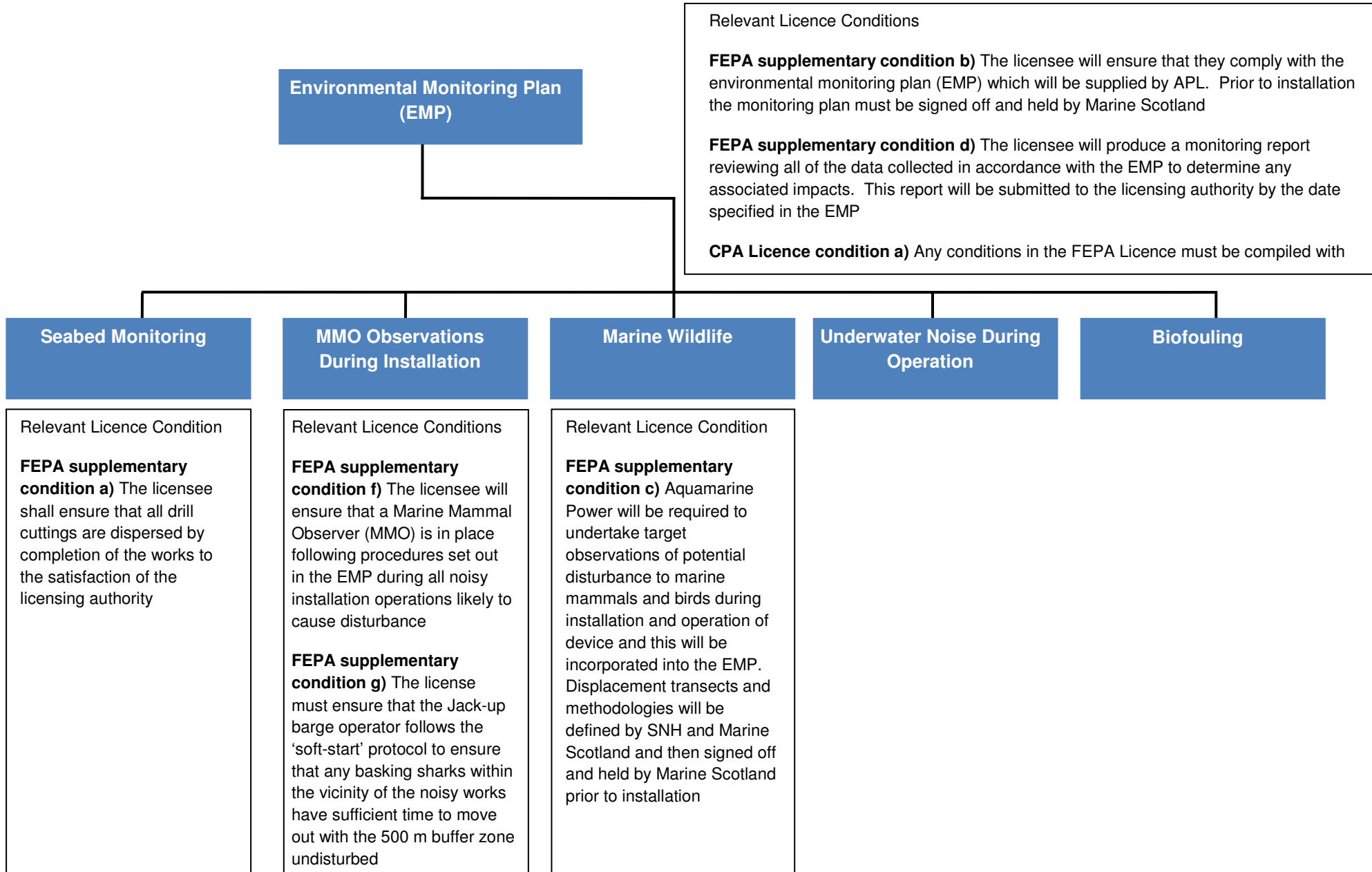
Aquamarine Power Limited (Aquamarine Power) proposes to install the second generation of the Oyster technology in the near shore area of the European Marine Energy Centre (EMEC) Wave Test Site, at Billia Croo off the west coast of mainland Orkney. This environmental monitoring programme document sets out the operational monitoring strategy of Oyster 2 (second generation wave energy device), for assessment of potential environmental impacts.

At present, Aquamarine Power is focussing on the installation of a single Oyster 2 device, including its foundation piles, and installing foundation piles for a further two devices. Installation will take place in summer 2011. It is then intended that a further 2 devices will be installed over two years in 2012 and 2013 (and be subject to a separate consent application submitted in 2011). Oyster 2 is to be deployed in 10 – 15 m water depth and produces energy through the oscillating action of the waves against the ‘flap’, driving hydraulic pistons which pump fresh water back onshore through a hydro-electric plant. The electricity generation of the first Oyster 2 device will be up to 800 kW.

Installation of Oyster 2a (first device) and all foundation piles is proposed during a two month period between June and August 2011; this timing is however, weather dependent. It is anticipated that the device will operate for up to 20 years with little major interference. Small periods of maintenance will occur every 6 months, with more extensive maintenance every 5 years, likely to include the removal of one or more component parts of the device (for example, removable hydraulic modules).

Specialist environmental studies, as identified during Environmental Impact Assessment (EIA) scoping, were completed to support permit and consent applications for the offshore aspects of the Oyster 2 development. This work included consultation with relevant stakeholders. The key impacts investigated were seabed impacts, marine wildlife impacts (such as displacement and collision), and underwater noise. These issues form the basis of the proposed environmental monitoring strategy.

The details of specific protocols for monitoring of potential seabed, marine wildlife and underwater noise impacts has been developed into an environmental monitoring programme (EMP), outlined within this document. The monitoring strategy and protocol details will be developed further throughout the preparation of the EMP; in concurrence with on-going regulatory, stakeholder and advisory consultation. This EMP document provides an overview of the proposed environmental strategy and monitoring; supported by a series of separate detailed protocols that will be submitted to Marine Scotland for approval eight weeks prior to the date the monitoring activity is due to commence, unless agreed otherwise with Marine Scotland.



## 1. INTRODUCTION

### 1.1 Background to the project

To demonstrate compliance with environmental monitoring in relation to licence conditions (granted for the installation and operation of the Oyster 2 at Billia Croo, Orkney) and to further the understanding of the environmental impacts from the Oyster technology; Aquamarine Power has produced an environmental monitoring programme (EMP). This EMP also addresses conditions of the following consents:

- FEPA Licence (Ref 03987/10/0-4849): Section 5 Food and Environment Protection Act (FEPA) 1985 Part II; and
- CPA Licence (Ref 2SCP\19\19): Section 34 and Section 36: Coast Protection Act (CPA) 1949.

Aquamarine Power will be deploying the Oyster 2 wave energy device at the location outlined in Figure 1.1, within the boundaries of the EMEC Wave Test Site (Billia Croo, Orkney), prior to large-scale commercialisation. This document presents an outline of the EMP, for implementation during the operation of Oyster 2.

Aquamarine Power is keen to evaluate and manage environmental impacts: based on consultation to date and the review of licence conditions (see Appendix A) it is known that there are licensing conditions which include a requirement for environmental monitoring. Additionally, it is recognised by Aquamarine Power that the results of such monitoring will provide valuable information to inform the assessment of future commercial scale developments.

The environmental monitoring strategy for this project builds upon work at the EMEC Wave Test Site, undertaken to understand the potential environmental impacts from the deployment of Oyster 1.

#### 1.1.1 EMP review

Aquamarine Power will review the EMP on a regular basis throughout their testing programme at EMEC and will revise the EMP where necessary, coinciding with regular stakeholder and regulator consultation. The first review will take place six months after commencement of installation. It has been agreed with Marine Scotland that this initial review will be a brief summary on the progress of monitoring undertaken and any issues that have arisen.

Assuming successful approval of Oyster 2b and 2c, this EMP will be updated as appropriate to include environmental monitoring of the additional flap prior to installation of Oyster 2b in 2012. A subsequent update, if appropriate, will happen prior to installation of Oyster 2c in 2013.

Monitoring progress and effort will be reviewed at the same time as updating the EMP for Oyster 2b and Oyster 2c.

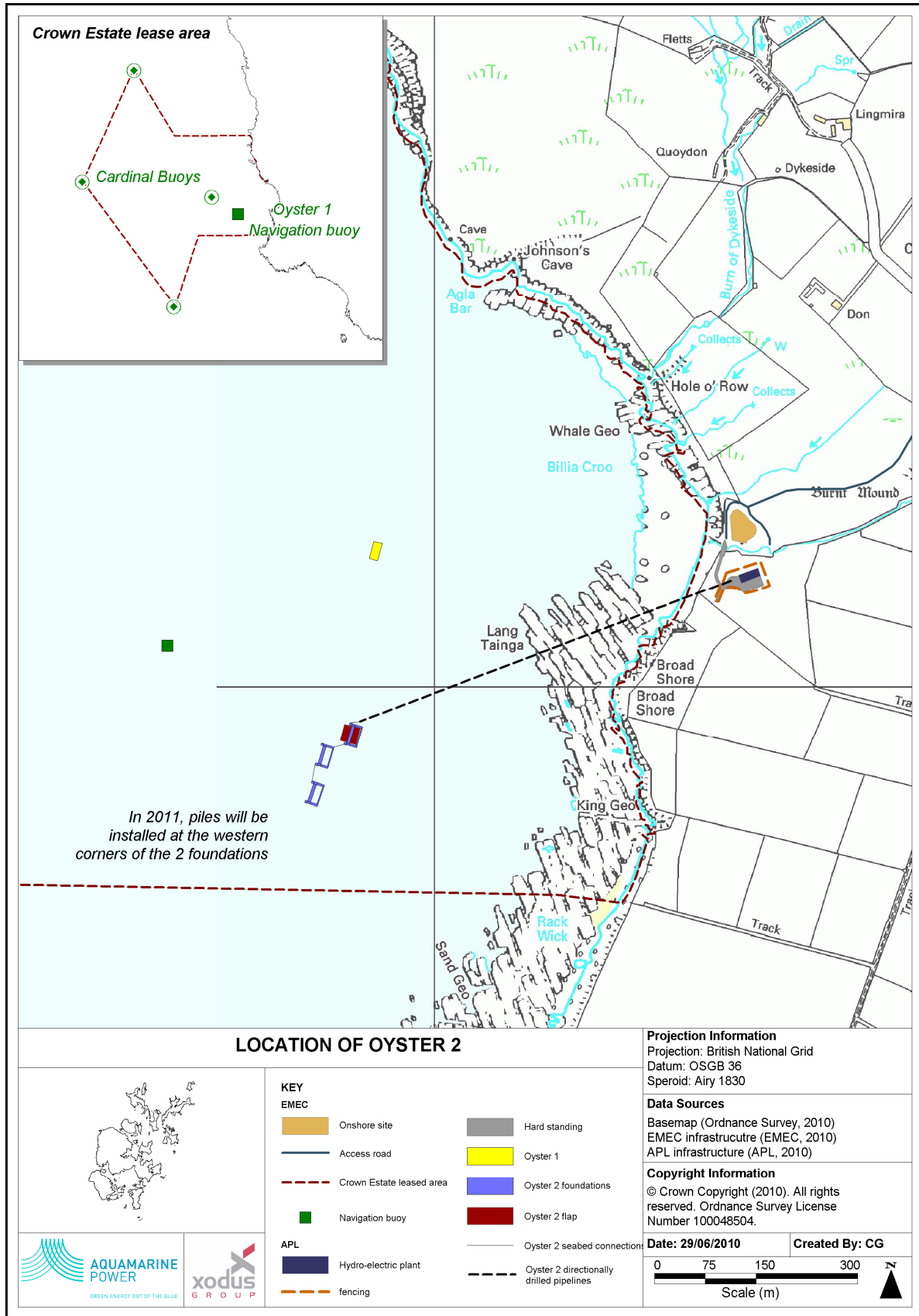


Figure 1.1 Location of Wave Test Site and proposed Oyster 2 deployment location

## 1.2 Monitoring to date

Aquamarine Power has commenced testing of the first generation technology, Oyster 1, at the EMEC Wave Test Site. Environmental monitoring undertaken to date is summarised in

Table 1.1, below.

Topic	Oyster 1	Oyster 2 (monitoring undertaken to date)
Seabed	Pre and post-installation seabed monitoring of the seabed at and around the Oyster 1 device and associated seabed infrastructure.	A pre-installation seabed survey was undertaken in May 2010.
Marine Wildlife Interactions	Shore based marine wildlife observations of the Billia Croo inner bay area (supplementary to EMEC commissioned marine wildlife observations) – began in April 2010.	Shore based marine wildlife observations of the Billia Croo inner bay area (supplementary to EMEC commissioned marine wildlife observations) – began in April 2010.
Underwater Noise	Marine Mammal Observations (MMOs) undertaken during what were considered the 'noisiest' installation activities. Monitoring of operational noise to understand the underwater acoustic signature of the Oyster technology is planned to be part of EMEC commissioned research, However, measurements not yet taken.	
Antifouling	Anecdotal observations on biofouling: levels of marine growth are present but were not substantial enough to prevent device operation and maintenance.	

**Table 1.1 Summary of monitoring**

In addition to EMEC's ongoing wildlife monitoring of the Wave Test Site, Aquamarine Power has instigated an additional monitoring project to observe the inner bay area which is shielded from view from the Black Craig vantage point. This area of the inner bay includes the area where Oyster 1 is deployed and the entire Oyster 2 deployment area (i.e. the area where all three of the Oyster 2 devices would be sited). Observers are collecting data which will enable the two data sets (EMEC and Aquamarine Power) to be analysed and compared. These data will provide a baseline for the marine wildlife present in the inner bay area and will also confirm the assumed insignificance of collision risk, displacement and disturbance impacts from the Oyster technology.

Aquamarine Power also has plans in place to establish the underwater acoustic signature of the Oyster technology, to assess potential impacts of underwater noise.

## 1.3 Consultation

The development and preparation of the Oyster 2 EMP has included consultation with the regulatory authority and statutory advisor outlined below in Table 1.2.



Organisation	Meeting and Date
Marine Scotland	Telephone conference meeting 16 <sup>th</sup> May 2011
Marine Scotland	Meeting 8 <sup>th</sup> February 2011
SNH	Meeting 8 <sup>th</sup> February 2011

**Table 1.2** Details of consultation with the regulatory authority and its statutory advisors

Consultation with the regulatory authority and relevant statutory advisors and stakeholders will be ongoing throughout the development of the EMP.

## 1.4 Document structure

This document outlines Aquamarine Power's monitoring plans for the operation of Oyster 2. This document structure is summarised below in Table 1.3.

Section	Title	Description
2	Seabed	Protocol for assessment of benthic impacts from project installation and drill cuttings discharge.
3	MMO Observations During Installation	Protocol for Marine Mammal Observations (MMO) during installation.
4	Marine Wildlife Collision/ Displacement	Protocol for assessment of marine wildlife impacts from the installation and operation of the Oyster technology.
5	Underwater Noise During Operation	Protocol for the establishment of the underwater noise signature of the Oyster technology.
6	Other	Details of other potential environmental impacts that it are proposed will be monitored.

**Table 1.3** Details of document structure

Where appropriate, as discussed in each section, separate protocols will be developed for particular monitoring activities in support of the strategy presented in this document. If a separate protocol is necessary, it will be submitted to Marine Scotland eight weeks in advance of the monitoring activity commencing unless agreed otherwise.

## **2. SEABED**

### **2.1 Background**

Pre-installation seabed surveys designed to inform the environmental assessment and comply with EMEC survey requirements were undertaken in May 2010 in the area of and surrounding the proposed Oyster 2 device locations. The area of coverage of the survey and the detailed survey methodology is summarised in the Aquamarine Power document: A4619 ROV Report.

The results of the survey were reported in the impact assessment that was produced to support the licence applications for Oyster 2.

The pre installation survey identified the benthic habitat likely to be affected by the device was predominantly kelp forest. Assessment of potential impacts on this habitat suggested that following installation, natural kelp restoration would take place over 2-3 years (potentially 1-2 years longer for establishment of more mature plants), throughout the operation of the device.

The assessment of potential impacts noted that due to the dynamic environment within which the device will be located, it is anticipated that drill cuttings generated during the installation of the pile foundations will be widely dispersed with little significant deposition on the seabed.

### **2.2 Post-installation and post-decommissioning surveys**

A post-installation seabed survey will be undertaken to enable understanding of potential impacts from physical seabed disturbance during installation and to confirm satisfactory dispersion of the drill cuttings. This survey will also meet EMEC contractual requirements. This survey will be undertaken 3-4 months following completion of installation.

In order to assist in the interpretation of the post installation seabed survey data, records of the following will be kept during the drilling operations; observations of drill cuttings behaviour during discharge (e.g. photos from jack-up rig); amount of cuttings discharged and also time periods over which drill cuttings discharge takes place. This will be reported as part of the drilling operator's daily log during drilling operations.

A post decommissioning survey will also be undertaken. The timing for the post decommissioning survey will be specified as part of the finalisation of the Decommissioning Programme.

Post installation and post decommissioning surveys are expected to follow a similar survey methodology as the pre installation survey, supplemented if necessary with still images.

The survey methodologies will be sent to Marine Scotland for review at least eight weeks prior to subsequent surveys taking place.

### **2.3 Analysis and reporting**

Survey analysis will include identification of any Annex 1 or UKBAP habitats or species and biotopes will be described in line with JNCC Marine Habitats Classification system.

All analysis and reporting will be undertaken by an appropriately qualified marine biologist(s).

On completion of the post installation seabed survey a report summarising the results of the pre and post installation surveys will be compiled and submitted to Marine Scotland and EMEC

within 3 months of completion of the survey. The results of the post decommissioning survey will be added to this report and the final report submitted to Marine Scotland and EMEC within 3 months of completion of the survey.

### **3. MARINE MAMMAL OBSERVATIONS (MMO) DURING INSTALLATION**

#### **3.1 Background**

One of the licence conditions of the FEPA licence requires Aquamarine Power to undertake Marine Mammal Observations (MMO) during the 'noisy' operations associated with the installation of the Oyster 2a and additional piles project. Such a procedure is required in order to observe and record marine mammals and large or unusual fish species (e.g. basking shark) in the area around the works and prevent them being harmed during 'noisy' installation activities.

#### **3.2 Outline MMO protocol**

The MMO protocol is based on the EMEC developed protocol.

Aquamarine Power will have a vessel based MMO. The nominated MMO will be suitably experienced and will not simultaneously carry out any other duties.

MMO procedures will be followed for the identified 'noisy' activities during the installation period. The 'noisy' activities will be identified during the development of the detailed MMO protocol (see below).

The procedure will follow the key stages identified in the EMEC MMO protocol;

- Commence observations at least 30 minutes prior to the commencement of the identified 'noisy' activity;
- If target species are observed commencement of operations will be delayed and adequate time allowed for the species to leave the area prior to the commencement of operations; and
- When operations can commence, employment of the 'soft start' procedure.

The MMO observer and installation contractor will have defined and tested the communication procedure in advance of the commencement of the works.

The detailed MMO protocol will be sent to Marine Scotland for review prior to commencement of installation.

#### **3.3 Reporting**

The recording forms as detailed in EMEC MMO protocol will be completed and returned to Marine Scotland and EMEC within 8 weeks of the completion of installation operations.

## **4. MARINE WILDLIFE MONITORING**

### **4.1 Background**

Currently, there is no standard and accepted methodology for the monitoring of displacement or collision of marine wildlife in relation to wave energy devices. Aquamarine Power has employed the services of Dr Nigel Harding (Craigton Ecological Services) to advise on marine wildlife monitoring protocols for Oyster projects in Orkney. Marine wildlife monitoring of the Inner Bay area at Billia Croo commenced in April 2010. This monitoring has two aims:

1. Collect baseline environmental data for the Oyster 2 project; and
2. Collect data that can be used to assess potential operational impacts from the operation of Oyster 1.

The above Aquamarine Power collected data are supplemented by the EMEC marine wildlife data that has been collected over the wider wave test site over the past two years.

FEPA licence supplementary condition C requires Aquamarine Power to undertake target observations of potential disturbance to marine mammals and birds during installation and operation of the Oyster 2a device and additional piles.

### **4.2 Marine wildlife survey outline protocol**

The marine wildlife survey protocol for Billia Croo has been developed to enable identification of seabird displacement by recording dispersal and behavioural data, in addition to assessing potential interactions between wildlife and the devices.

The initial year of data collected will be analysed and reported in a stand alone report expected to be available in Q2 2011. Where appropriate the EMEC collected data will be used to supplement the analysis of the Aquamarine Power collected data. However, based on a review of the data collected by EMEC undertaken by Craigton Ecological Services (and already submitted to EMEC and SNH for their consideration), it is likely that these data will only be able to be used qualitatively and not quantitatively.

Marine wildlife monitoring of the inner bay area by Aquamarine Power will continue during installation and for at least 12 months following installation of the Oyster 2a device. The results of this monitoring will be used to determine the monitoring effort and methodology going forward, including during the installation and operation of Oyster 2b and Oyster 2c (assuming consent).

### **4.3 Reporting**

On completion of the 12 months of operational marine wildlife monitoring a report summarising the results of the monitoring will be compiled and submitted to Marine Scotland and EMEC within 3 months of completion of the survey.

### **4.4 Relevant documentation**

- Harding, N. 2010. Review of seabird and cetacean monitoring around the proposed demonstration wave energy array at Marwick Head. Craigton Ecological Services.
- Xodus Aurora. 2010. Revised protocol for seabird and cetacean monitoring at Billia Croo, Orkney.

## **5. UNDERWATER NOISE MEASUREMENT**

### **5.1 Background**

Assessment of underwater noise is not required as a consent condition; however, where possible measurements of underwater noise from the installation and operation of the Oyster device will be used to inform future impact assessments and will aid understanding for future Oyster projects.

### **5.2 Underwater noise survey protocol**

In order to be able to ascertain the potential significance of underwater noise generated from the operation of the Oyster device there is a need to establish the underwater acoustic signature of the device. This baseline monitoring will be undertaken following installation and commissioning of the device.

Aquamarine Power is in the process of considering how best to establish the acoustic signature of the Oyster device. Its first choice would be to take part in the ongoing EMEC research project, which is characterising the baseline noise conditions of the wave test site and investigating underwater noise impacts from wave energy devices. Aquamarine Power has already been in discussions with EMEC about taking part in this programme and it is hoped that this will be possible for the Oyster 2a project.

Should for any reason it not be possible to be part of the EMEC research project, Aquamarine Power would appoint a contractor suitable to undertake the required underwater noise monitoring.

Aquamarine Power also understands that it may be useful to take measurements of underwater noise during installation activities. Aquamarine Power is therefore in the process of addressing how underwater noise measurements may be undertaken during installation.

Prior to the commencement of this work the proposed monitoring methodology would be sent to Marine Scotland and SNH for review. Whilst the protocol for underwater noise measurements during operation will be submitted for review eight weeks in advance of the monitoring activity commencing, it has been agreed with Marine Scotland that the protocol for measurements during installation, if they go ahead, may be supplied to Marine Scotland only two weeks in advance of installation.

Once the acoustic signature of the Oyster device has been established, the results will be considered by an underwater noise specialist in order to understand the potential significance of impacts from underwater noise. This would include comparison of the data collected with baseline measurements already collected by EMEC.

### **5.3 Reporting**

A short report summarising the results of the work will be produced and distributed to Marine Scotland and EMEC. The timescale for reporting will be established once the schedule for underwater noise monitoring has been established.

## **6. BIOFOULING**

### **6.1 Background**

Anecdotal evidence from Aquamarine Power engineers has assessed the success of antifouling measures used for Oyster 1. Indications from spring 2010 were that antifouling measures were not as successful as had been hoped, but that the level of marine growth was not substantial enough to prevent operation and maintenance of the Oyster device.

### **6.2 Biofouling monitoring**

Following the deployment of Oyster 2a at Billia Croo, if it is found that the biofouling is becoming an issue (i.e. fast growing and preventing crucial operation and maintenance of the device) then the operations team will implement a process to record biofouling of the device. If required, it is likely that levels of biofouling would be monitored using a section of steel which could be lifted out of the water for measurements.

At present it is not the intention to undertake specific biofouling monitoring activity that would require a protocol. If a biofouling monitoring protocol is deemed necessary following deployment of Oyster 2a a protocol will be prepared and submitted to Marine Scotland for approval.

### **6.3 Reporting**

If any biofouling monitoring other than observational goes ahead then a short report summarising the results of the work will be produced and distributed to Marine Scotland and EMEC for input to any relevant research projects.

**APPENDIX A LICENCE CONDITIONS**

Licence Condition Number	Licence Condition Details
2	The licensee shall ensure that all substances or articles deposited during the execution of the works are inert and do not contain toxic elements which may be harmful to the marine environment, the living resources which it supports or human health.
3	The licensee shall ensure that any debris or waste materials arising during the course of the works are removed from the site of the works for disposal at an approved location above the tidal level of Mean High Water Springs.
11	Should the licensing authority consider it necessary or expedient to remove all deposits made under the authority of this license, for the purpose of protecting the marine environment, the living resources it supports and human health, or of preventing interference with legitimate uses of the sea, the licensee shall undertake to remove those deposits in accordance with the requirements of the licensing authority.
10	The licensee shall ensure that the substances or articles described in Part 1 of the Schedule are located on the sea bed within the authorised deposit area, and shall undertake regular maintenance operations to relocate or remove any deposits that are located out with this area. Any deposits permanently removed from the sea bed shall be disposed of at an appropriate location above the tidal level of Mean High Water Springs
11	The licensee shall ensure that ancillary equipment deployed or deposited during the course of the works, such as buoys, wires, ropes, ballast weights, anchors and lifting bags, etc. is removed as soon as it is no longer required to prevent interference with other legitimate uses of the sea.
Supplementary Condition (a)	The licensee shall ensure that all drill cuttings are dispersed by completion of the works to the satisfaction of the licensing authority.
Supplementary Condition (b)	The licensee will ensure that they comply with the environmental monitoring plan (EMP) which will be supplied by Aquamarine Power. Prior to installation the monitoring plan must be signed off and held by Marine Scotland.
Supplementary Condition (c)	Aquamarine Power will be required to undertake target observations of potential disturbance to Marine Mammals and birds during installation and operation of device and this will be incorporated into the EMP. Displacement transects and methodologies will be defined by SNH and Marine Scotland and then signed off and held by Marine Scotland prior to installation.
Supplementary Condition (d)	The licensee will produce a monitoring report reviewing all of the data collected in accordance with the EMP to determine any associated impacts. This report will be submitted to the licensing authority by the date specified in the EMP.
Supplementary Condition (e)	The licensee shall ensure that all mitigation measures outlined within the Offshore Supporting Document (OY02-DES-RH-XOD-REP-0001) provided in support of the FEPA application and any subsequently agreed for avoiding, mitigating or monitoring wildlife impacts must be adhered to in full.
Supplementary Condition (f)	The licensee will ensure that a Marine Mammal Observer (MMO) is in place following procedures set out in the EMP during all noisy installation operations likely to cause disturbance.

Licence Condition Number	Licence Condition Details
Supplementary Condition (g)	The licensee must ensure that the Jack-up barge operator follows the 'soft-start' protocol to ensure that any basking sharks within the vicinity of the noisy works have sufficient time to move out with the 500m buffer zone undisturbed.
Supplementary Condition (h)	The licensee will comply with section 2.6 which describes the installation methodology in the Offshore Supporting Document (OY02-DES-RH-XOD-REP-0001) provided in support of the FEPA application. In addition, a detailed method statement of the installation must be submitted to Marine Scotland prior to commencement of works.

**Table A.1** FEPA licence conditions relevant to the EMP