

ENVIRONMENTAL EFFECTS METADATA SURVEY FORM

Name

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Project name: EMEC Billia Croo Grid-Connected Wave Test Site

Planned In Operation Completed

Project description:

Project Developer: European Marine Energy Centre Ltd

Technology Developer: European Marine Energy Centre Ltd

Technology type: Multiple

Resource (wave, tidal): Wave

Project scale (test site, prototype, array, commercial): Test site with six berths

Installed capacity (MW): Each of the six berths has a cable with 2.2MW capacity

Project Website: <http://www.emec.org.uk/facilities/wave-test-site/>

Launch Date: October 2003

Additional Description: In 2003 the Highlands and Islands Enterprise proposed to construct the infrastructure which would allow wave energy devices to be tested under working conditions. The purpose of the project was to allow the generating capacity of wave devices to be verified, in order that further investment could be obtained for establishing the technology on other offshore sites. Three main drivers governed the design of the project; firstly the facility had to function satisfactorily for the purpose for which it is designed, secondly, it had to be constructed to a pre-defined budget and thirdly it had to minimise adverse impacts on the existing environment.

After a site selection study, Billia Croo was identified as the most suitable location for the test site. This site is an area with one of the highest wave energy potentials in Europe with an average significant wave height of 2 – 3 metres, reaching extremes of up to 17m. The site has a total of six berths; five cabled test berths in up to 70m water depth (four at 50m, one deeper), located approximately 2km offshore and 0.5km apart and one nearshore berth situated closer to the substation for shallow water projects.

Two waverider buoys are located on site measuring the wave height, period and direction, and a purpose-built weather station provides real-time met data for the site. This data is fed into a sophisticated SCADA (Supervisory, Control and Data Acquisition) system, with live data feeds on the marine and met conditions available to view on the EMEC website .

The test site berths are monitored by CCTV situated at an observation point at the Black Craig - a former coastguard lookout station which has been converted to house powerful cameras for monitoring the activity out at sea. This is controlled remotely from the data centre and office facilities.

Export Cables: Each of the six berths has an 11kv cable on the seabed to export electricity to the onshore substation. These cables are wet-type composite cables consisting of three EPR-insulated stranded copper power cores designed for alternating current, three 2.5mm² copper signal/pilot trip cables and a 12-core single-mode fibre-optic bundle. The cable is then armoured with two layers of galvanised steel wire. Cables were provided by AEI (wave test site cables) & Pirelli (tidal test site cables). The conductors on these cables are 50mm², giving a nominal rating of 2.2MW.

The cables were laid as standard sub-sea cables on the sea bed. As the cables approached the shore, in 15m of water, ductile iron cable protectors were attached. At the low water spring tide mark, each cable passes into a trench dug 12m into the seabed and beach. On shore, the cables are fed into a manhole and then into the substation. At the offshore mooring positions, a seabed anchor, of reinforced concrete, is installed to anchor the end of the cable, before it rises to connect to the wave energy device. A fibre optic communications cable will be incorporated within each of the armoured cables.

Onshore Infrastructure:

The substation at Billia Croo is broadly similar to that at the tidal test site at the Fall of Warness. Each cable coming from the test site terminates in the substation at an 11kV circuit breaker, along with the tripping cable. This provides an isolation switch for the devices under test and operates as the interface between EMEC and the UK national grid. The electrical output performance of each of the devices is measured by equipment within the substation and transmitted to the data centre. The quality of the electricity can then be analysed by EMEC to demonstrate that the devices can provide a smooth and reliable supply of electricity to the grid. The metered data is also provided to the developer through the Supervisory Control and Data Acquisition (SCADA) system and the power data is logged in the data historian to be made available for historical trending. EMEC ensures the confidentiality of the data collected.

Vessel Spread:

Vessels used in the installation of the EMEC wave test site are:

Vessel type	Activity	Comment
Cable lay vessel	Installation of sub-sea export cables	CS Sovereign

		
Survey vessel	Benthic and bathymetric surveys	Exact vessel used unknown
Dive vessel	Used to deploy divers for benthic surveys	Exact vessel used unknown

Location: EMEC’s wave test facility is ideally placed on the western edge of the Orkney mainland, Billia Croo, Stromness. Subjected to the powerful dynamic forces of the North Atlantic Ocean, it is an area with one of the highest wave energy potentials in Europe with uninterrupted Atlantic waves of up to 17m. Four of the test berths are at 50m depth, while the fifth is located at 70m depth, all situated 1-2 km from the shore and .5 km apart. Shallow water test facilities situated close to the substation are also available.

Coordinates: 58 58.14 N, 03 21.45 W

Process status: The Centre was established with around £30 million of funding from the Scottish Government, Highlands and Islands Enterprise, the Carbon Trust, the UK Government, Scottish Enterprise, the European Union and Orkney Islands Council. Construction of the wave test facility was completed in October 2003 and operational activities commenced shortly after.

The following is a list of all EMEC wave clients:

- Pelamis Wave Power P1 Demonstration, Pelamis Wave Power - Installed August 2004 to 2007
- Wave Roller, AW Energy - Installed 2005 to 2005
- [Oyster 1, Aquamarine Power - Installed November 2009 to March 2011](#)
- [Pelamis Wave Power P2 Demonstration, E.ON & Scottish Power Renewables - Installed October 2010 & May 2012](#)
- [Penguin, Wello Oy - Installed June 2011](#)
- [Oyster 800, Aquamarine Power - Installed June 2012](#)
- Oceanus 1, Seatricity - Installed 2013 to 2014

Licensing Information:

The European Marine Energy Centre (EMEC) has been accredited with the UK Accreditation Service (ISO 17025) since 2005. EMEC has been granted the consents required to install an agreed 'envelope' of device types at these sites.

Licences held by EMEC include:

- Town and Country Planning (Scotland) Act 1997
- Crown Estate Act 1971
- Food & Environment Protection Act 1985 Part II Deposits in the sea (FEPA)
- Coast Protection Act 1949 (section 34) (CPA)
- Electricity Act 1989 (section 36)

Each developer is required to submit device-specific information to support amendment of these consents to allow installation of their device. This information includes a project summary and details on how the specific device details align with the EMEC environmental description and navigational risk assessment.

Licensing conditions: N/A

Key Environmental issues:

Several potential environmental issues were identified in the Environmental Impact Assessment, these were:

- Disturbance/modification to benthic habitats/communities as a result of cable and anchor laying in inshore waters;
- Disturbance to intertidal environment from cable laying activities;
- Effects of energy removal on adjacent marine biotopes;
- Device noise;
- Hydro acoustic signals from subsea cables;
- Physical presence of devices interacting with birds and mammals; and
- Colonization of subsea infrastructure and antifouling effects

Environmental webpage: <http://www.emec.org.uk/facilities/wave-test-site/environmental-description-wave/>

Mitigation measures:

During installation, general good civil engineering practices were adhered to in an attempt to reduce and contain disturbance to the shore and seabed habitats within as small an area as possible.

Due to the limited knowledge on certain potential impacts arising from the presence of test devices, further research was encouraged. In particular in relation to:

- Impacts on shoreline ecology from the removal of energy from the marine environment. The presence of *Fucus distichus subsp. anceps*. provides a useful sentinel species on the shore, which can be simply and cheaply monitored.
- Characterisation of background noise prior to device installation and an attempt to determine the zones over which device sound signatures may be detectable.

The presence of the CCTV cameras at the coastguard lookout enable any significant effects on general marine life and ecology to be observed, and more generally provide data of interest to SMRU, the Orkney Field Club, local recorders and the Orkney Whale and Dolphin Group.

At the time of decommissioning, a BPEO study (best practicable environmental option) should be undertaken to fully investigate the impacts associated with different decommissioning options.

Baseline studies and project effects studies: EMEC Tidal Test Site

General description				
The following field surveys were undertaken (or commissioned by) the developer to inform baseline characterisation.				
Receptor	Study description	Design and methods (brief description)	Results (brief description)	Status (planned, underway, completed, with dates)
Physical environment	Bathymetric survey	Multibeam bathymetry at 1m spacing for wave site test area and 4m spacing for inner wave site test area. Sidescan conducted for both test area and inner test area.	General bathymetry maps show bedrock substrata to be characteristic of the shoreline of this region and extend steeply into the infratropical zone. The underlying bedrock continues to dominate the circalittoral zone, with the predominantly offshore sublittoral sediment reached at around 45-47m.	Completed (2002)
Benthos	Dive surveys	A dive transect survey, undertaken by ICIT, Heriot-Watt University, extending shoreward from 20 m (video and stills photography) and for seven stations within the wave site test area (video, still photography and fine sediment cores for future biological reference)	<p>Surveys of the area have indicated that there appears to be a transition from bedrock to a broken boulder/stone seabed to a sediment dominated seabed with distance from shore.</p> <p>Dense kelp forests thinning to kelp park exist between the low water mark and to a depth of approximately 20-25m. Fauna typical of hard substrata and exposure to water movement were common on the bedrock, boulder and stone seabed. Sites with broken boulder/stone substrata supported more diverse communities, with <i>F. foliacea</i> and brittlestar biotopes.</p> <p>Analysis of core samples taken from the offshore sedimentary area indicate that the sediments are</p>	Completed (2002)

			dominated primarily by polychaete worms followed by nematode worms, although in some samples polychaetes accounted for over 80% of sample species composition.	
Intertidal communities	Intertidal survey	Littoral survey undertaken by ICIT in conjunction with Dr Martin Wilkinson of Heriot-Watt University (transects and species list)	<p>Species characteristics of extreme wave exposure were found. Sparse furoid growth is evident in the very upper reaches of the littoral area.</p> <p>The boulder beach consists of a steep upper-littoral zone, which levels out through the mid- and lower-littoral/sublittoral areas. Although not immediately apparent, there was a fairly abundant presence of plants and animals in the mid to lower reaches of the littoral zone, especially in the spaces between boulders, suggesting their size may provide a degree of shelter for some species.</p>	Completed (2002)
Reports or papers	<ul style="list-style-type: none"> • Environmental statement for the Billia Croo Wave Energy Test Centre. 2002. Available [Online] http://www.emec.org.uk/services/consents/. Accessed 08/10/2014 • Billia Croo Environmental Description, Available [Online] http://www.emec.org.uk/services/consents/ Accessed 08/10/2014 			

Monitoring and adaptive management:

General description	The following mitigation and monitoring measures are proposed within the project ES. The project team, along with Marine Scotland and other key stakeholders are currently preparing a Preliminary Environmental Monitoring Plan (PEMP) which will outline the proposed monitoring strategy in more detail.			
Receptor	Monitoring program description	Design and methods (brief description)	Results (brief description)	Status (planned, underway, completed, with dates)
Mammals and birds	Land based wildlife observations	The Billia Croo wildlife observation project commenced in July 2005, with the Scottish Government funding the current contract. During the period between the 1 st of April 2013 to 31 st of March 2014, a total of 886 hours of observations were completed.	Seasonal peaks in grey and harbour seal abundances corresponding with pupping seasons, which is mirrored in the data collected to date at the site. During this reporting period the majority of cetacean sightings have been of White-beaked Dolphin, whereas typically the most sighted cetacean is Harbour Porpoise. A typically diverse range of marine birds has also been observed, although for several species, numbers in April and May 2013 fell below the mean. This could be due to the enduring winter of 2012/2013 and resultant late spring experienced in Orkney as was the case for the rest of the UK. See http://www.scotland.gov.uk/Resource/0045/00455816.pdf for further detail on methods and results..	On-going
		Land-based observations take place from a look-out shelter on Black Craig, Billia Croo (58°58.746'N 03°21.499'W), approximately 110m above sea level. The observations for birds and marine mammals commenced at Billia Croo on 11th March 2009, with a four-hour watch format, five days per week (i.e. approximately 80 hours of observation per month), which are timetabled to cover different tidal states and times of day. This analysis will use data collected over a period of two years	Almost all species showed spatial variation in their use of the Billia Croo site. There are slight differences in the locations of hotspots and the extent to which different species used the wave test site. However, for a number of species (e.g. shag, auks and eider), sightings were concentrated between the Black Craig observation Tower and/or off Breck Ness. Many species also showed seasonal	

			<p>variation in their use of the site, which reflected the breeding and wintering habits that are typical for the species. Fulmar, gannet, Arctic tern, black guillemot and puffin, were found to vary in their usage of the site throughout the day.</p> <p>Encounter rates for some species were found to vary with tidal state and also under different environmental conditions, including wind strength, direction and glare extent. See http://www.snh.org.uk/pdfs/publications/commissioned_reports/592.pdf for further detail on methods and results.</p>	
Reports or papers	<ul style="list-style-type: none"> • EMEC Billia Croo Wave Test Site: Wildlife Observations Project Annual Report (Marine Scotland) 2014. Available [Online] http://www.scotland.gov.uk/Resource/0045/00455816.pdf. Accessed 04/11/2014 • Analysis of Bird and Marine Mammal Data for Billia Croo Wave Test Site (SNH) 2012. Available [Online] http://www.snh.org.uk/pdfs/publications/commissioned_reports/592.pdf. Accessed 04/11/2014 			
Research projects	<p>EMEC has carried out or has been involved with a number of research projects. These include national, international and site specific projects. More information about these can be found at the following location: http://www.emec.org.uk/research/</p> <p><i>Site specific projects:</i></p> <ul style="list-style-type: none"> • Acoustic monitoring • ReDAPT • Inshore crustacean fisheries • Hydrodynamic modeling • Wave resource monitoring • Surface Interactions with Wave Devices: Remote Observations • Marine safety course <p><i>National projects</i></p> <ul style="list-style-type: none"> • Underwater Acoustic Monitoring at Wave and Tidal Energy Sites: Guidance Notes for Regulators • The provision of guidance to inform the simplification of marine renewable energy development application • A review of the potential impacts of wave and tidal energy development on Scotland's marine environment • Flow, Water Column and Benthic Ecology 4D (FLOWBEC) • Understanding how marine renewable device operations influence fine-scale habitat use and behaviour of marine vertebrates (RESPONSE) • Optimising array form for energy extraction and environmental benefit (EBAO) 			

- PerAWaT
- Pentland Firth and Orkney Waters (PFOW) strategic data study
- The consolidation of wave and tidal EIA/HRA issues and research priorities

International projects

- MaRINET
- Equimar
- SOWFIA