Deployment of Wello Oy's wave energy converter at EMEC's wave test facility in Orkney

Environmental Statement

Prepared by Aquatera on behalf of Wello Oy

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Wello

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Non technical summary

Project outline

Wello Oy (Wello) is planning a full scale demonstration of its 'Penguin' wave energy converter (WEC) at the European Marine Energy Centre's (EMEC's) Wave Test Site facility at Billia Croo in Orkney, during summer 2011. The device will have an installed capacity of 500kW and feed electricity into the local grid via EMEC's pre-installed subsea cable. The device will be installed at a new deepwater berth (~60m) at the north end of the site (refer to Figure 1.1).

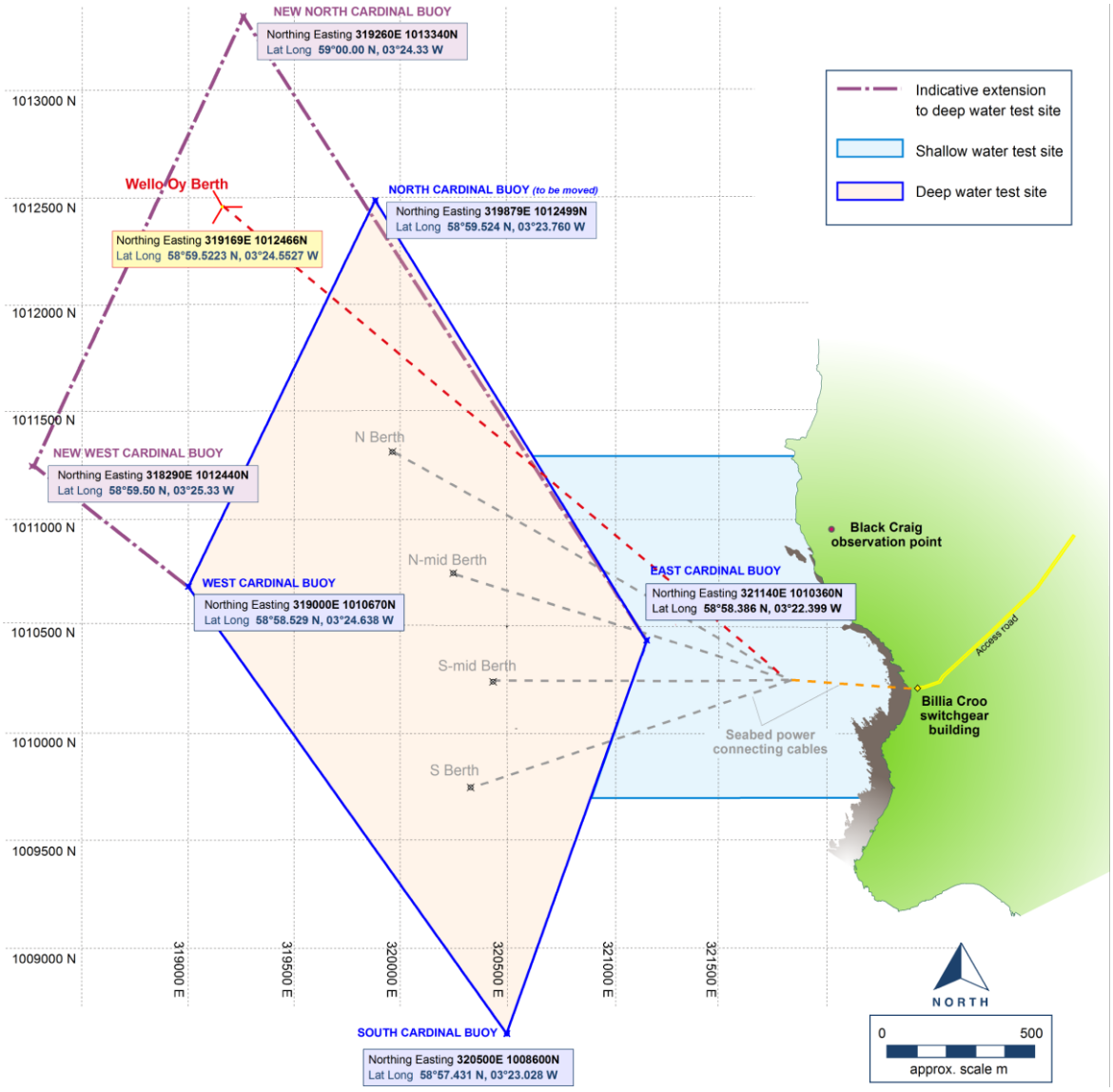


Figure 1.1 Proposed deployment location[1]

[1] Addition of the Wello test berth will require extension to the Wave Test Site and the repositioning of the site buoyage. Proposals for this have been discussed with NLB but are yet to be finalised. It is however recommended that the present south, east and west cardinal buoys should remain in position with an additional west cardinal provided and the North Cardinal moved to the north west of its present position. The current and proposed Cardinal buoy positions are illustrated.

Scope of the ES

This Environmental Statement (ES) has been produced in line with EMEC's EIA Guidance for Developers (EMEC, 2008) and covers the following tasks associated with the proposed test:

- Mooring system installation
- Device installation
- Umbilical cable installation and connection to EMEC's pre-laid subsea cable
- Operation and maintenance of all equipment
- Testing and monitoring activities
- Decommissioning of all equipment

Timescales

The work programme outlined in Table 1.1 is currently anticipated (please note allowances for contingency):

Table 1.1 Penguin deployment work programme

Task	2011								2012						
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Installation															
Mobilisation															
Moorings installation															
Device installation															
Umbilical installation															
Operation															
Connection															
Operation and monitoring															
Decommissioning															
Disconnection															
Decommissioning															
Demobilisation															

Planned timings | Contingency

Technology

The Penguin introduces a new concept for capturing wave energy with a unique working principle which is based on the shape of the device; not the internal mechanics. The device itself, in the simplest terms, resembles a moored ships 'hull' with two large 'roll plates' suspended under the hull. The mooring system will consist of embedment anchors, clump-weights and spring buoys; the final configuration of which is awaiting confirmation. The converter is designed to respond to the

movement of waves. Due to the asymmetrical shape of the 'hull' and the heavy 'roll plates' suspended from a specific attachment point on the side of the hull, waves create a gyration movement which makes the eccentric load inside the hull rotate causing a generator inside the unit to spin and generate electricity. Figure 1.2 shows an illustration of the device on its moorings and a picture of Penguin during construction in its un-ballasted condition in Latvia. Note that the final mooring design may vary slightly from that presented in Figure 1.2 depending on the results of Third Part Verification of the mooring system.

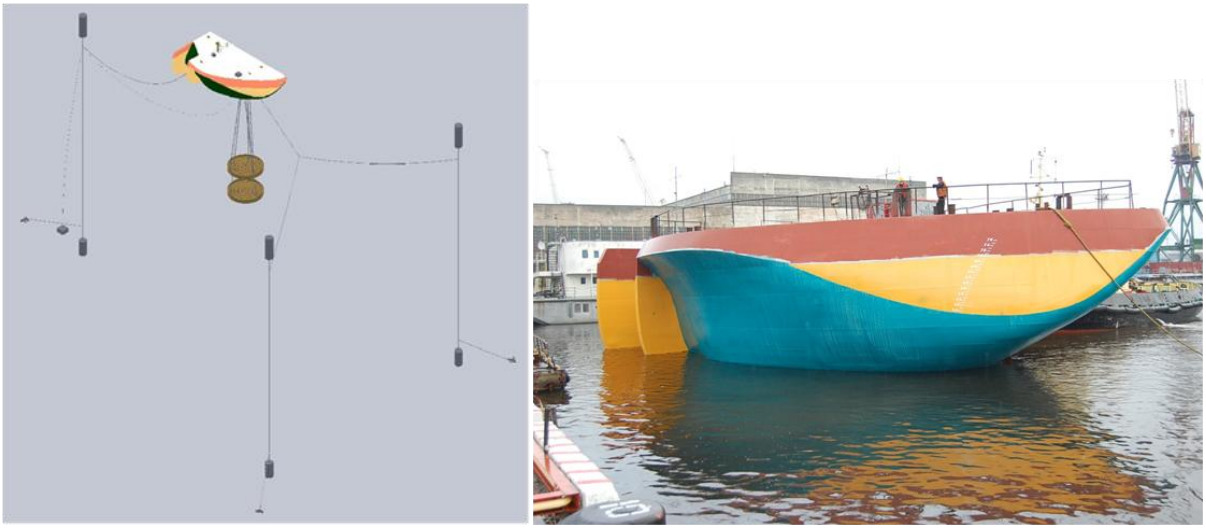


Figure 1.2 The Penguin (illustration on moorings and under construction in Latvia)

Potential key environmental issues

An Environmental Assessment (EA) was undertaken to identify the potential interactions between the proposed project and the receiving environment at the test site. Following the initial screening and classification process, the following potential issues were identified:

Table 1.2 Potential key issues and relevant classification

Ref	Issue	Potential significance (pre-mitigation)
A	Seabed disturbance during installation and removal of the mooring system	Minor
B	Disturbance to marine mammals and fish from the presence of the mooring system and device	Negligible
C	Potential disturbance of marine mammals and fish from underwater noise	Minor
D	Disturbance to other sea users from support vessel activity and sustained presence of structures offshore	Negligible
E	Change in local seascape through increased activity and sustained presence of the device	Negligible

F	Disturbance to seabed communities and during connection to and disconnection from the EMEC connector	Minor
G	Temporary change in water quality during installation and removal activities	Negligible
H	Effects on air quality from vessel emissions	Negligible
I	Effects on marine birds from vessel operations and device presence on the test site	Negligible
J	Effects on marine fish from EMF emitted during electricity transmission	Negligible
K	Effects on flows and fluxes from the presence of subsea structures	Negligible
L	Employment opportunities for local residents and businesses	Majorly positive
M	Utilisation of local infrastructure and subsequent investment in local services and economy	Positive
N	Generation of marine renewable energy will contribute towards government targets	Positive

Significant issues are defined as those with a classification of 'moderate' or above, issues raised by stakeholders during scoping and other consultations and groupings of a number of similar minor impacts. The following key issues were identified as potentially significant on this basis:

- Seabed disturbance during installation and removal of mooring system
- Disturbance to marine mammals and fish from the presence of the mooring system and device
- Potential disturbance of marine mammals and fish from underwater noise

A detailed assessment was undertaken to investigate the potential importance of these issues and the following questions were posed with regards to each:

- Why is it important?
- What is the possible range of impacts?
- What mitigation, monitoring and optimisation measures can be applied?
- What is the likely level of residual impact?

Where appropriate, suitable monitoring and adaptive management strategies were also proposed and outlined. Based on the assessment undertaken, mitigation measures proposed and the commitments made by Wello, the 'residual' impacts are anticipated in relation to the potentially significant issues identified during the initial screening process (see Table 1.3).

Table 1.3 Potential key issues and residual impact classification

Ref	Issue	Potential significance	
		Pre-mitigation	Post-mitigation
A	Seabed disturbance during installation and removal of the mooring system	Minor	Minor
B	Disturbance to marine mammals and fish from the presence of the mooring system and device	Negligible	Negligible
C	Potential disturbance of marine mammals and fish from underwater noise	Minor	Negligible
D	Disturbance to other sea users from support vessel activity and sustained presence of structures offshore	Negligible	Negligible
E	Change in local seascape through increased activity and sustained presence of the device	Negligible	Negligible
F	Disturbance to seabed communities and during connection to and disconnection from the EMEC connector	Minor	Negligible
G	Temporary change in water quality during installation and removal activities	Negligible	Negligible
H	Effects on air quality from vessel emissions	Negligible	Negligible
I	Effects on marine birds from vessel operations and device presence on the test site	Negligible	Negligible
J	Effects on marine fish from EMF emitted during electricity transmission	Negligible	Negligible
K	Effects on flows and fluxes from the presence of subsea structures	Negligible	Negligible
L	Employment opportunities for local residents and businesses	Majorly positive	Majorly positive
M	Utilisation of local infrastructure and subsequent investment in local services and economy	Positive	Positive
N	Generation of marine renewable energy will contribute towards government targets	Positive	Positive

As shown, only one issue of minor concern remains:

- Seabed disturbance during installation and removal of mooring system

Mitigation, monitoring and adaptive management

There are a number of technology and project design features which have helped to keep potential impacts to a minimum and reduce others; including:

- Embedment anchors have been selected which removes the need for any subsea excavation and minimises the footprint of the mooring system. This also allows the scale of the clump weights to be minimised - further reducing potential footprint
- The mooring system design allows the use of relatively small workboats; minimising underwater noise generated during activities
- The mooring system is also designed for rapid deployment; reducing time at sea
- Selection of mooring system lines (wire) under tension removes the possibility of entanglement
- Ensuring vessels are well maintained will reduce noise and potential for accidental events
- Noise generating cooling fans are only required as back-up therefore any effects will be temporary and minimal
- The size and character of structure should minimise the risk of collision – it has no external moving parts

A number of additional mitigation measures will be undertaken during the project:

- Vessel anchoring will be limited to when necessary
- Placement of clump weights will be as accurate as possible to ensure minimal 're-positioning' manoeuvres
- Anchors and clump weights will as far as possible, be removed in a single attempt so as to reduce the duration of noise and other forms of disturbance
- The final stages of operational planning shall minimise sea time for tugs and workboats as far as practically possible
- The back-up cooling system will only be used when absolutely necessary, normally in rough weather where the sea itself will generate most noise
- Vessel crews will keep a lookout for sea mammals and basking sharks at all times. Vessel crews will be briefed on marine life sensitivities and will have ID materials supplied (refer to Environmental Monitoring Plan)
- Vessel operations will be limited to quiet activities if marine mammals or basking sharks are sighted within close proximity (<500m) to the works, unless safety considerations require an activity to continue

A number of environmental monitoring measures have also been proposed (these will be detailed within the project's Environmental Monitoring Plan (EMP)):

- A post-deployment seabed survey will be conducted to compare with pre-installation survey footage and to investigate the status of the mooring system (refer to the EMP)
- A post-decommissioning seabed survey will be undertaken after all structures have been removed to establish the effects of the process on the seabed (refer to the EMP)
- Wello will support ongoing wildlife observations through the provision of compatible data and other mechanisms where possible and will undertake similarly suitable work in the event that EMEC activities come to an end (refer to the EMP)

- General marine mammal and other wildlife behaviour observations will be undertaken whilst team members are on site for maintenance/inspection activities (refer to the EMP)
- The noise signature of the back-up cooling system will be defined (refer to the EMP)

Accidental events

A number of potential accidental events may arise from the proposed works; all of which are fully addressed within the project's Navigational Risk Assessment (NRA). As shown in Table 1.4, these have potentially significant implications when unmanaged and without mitigation in place. It is anticipated however, that all operations can be completed with no events occurring through appropriate health and safety management and operational planning.

Table 1.4 Key issues associated with unplanned and accidental events

Ref	Key issue	Pre-mitigation	Residual impact	Post-mitigation
A	Collisions with the device or vessels	Major	It is anticipated that all unplanned and accidental events can be avoided through the careful planning, contingency awareness and mitigation measures in place.	No interaction anticipated
B	Chemical contamination following a collision event or structural failure	Major		No interaction anticipated
C	Impacts of structural debris/lost equipment	Minor	It is anticipated that the proposed activities can be undertaken without incident.	No interaction anticipated
D	Employment opportunities around contingencies and unplanned works	Positive	Mitigations reduce likelihood of unplanned works but positive impact remains for contingencies	Positive

Conclusion

Although a wide range of potential impacts were considered within the EA, no potentially significant issues were identified. Furthermore, several mitigating factors have been proposed which it is anticipated will further reduce potential impacts. Where uncertainty remains, appropriate monitoring plans have been proposed which will not only inform the management of this project through its operational phase, but will provide essential information relevant to future project development, permitting and planning processes.

Contents

Table of figures

1 Introduction

Wello is planning to deploy a full-scale demonstrator unit of its wave energy converter (WEC), the 'Penguin', at the European Marine Energy Centre (EMEC) Wave Test Site facility at Billia Croo in Orkney during the summer of 2011. The proposed project will have an installed capacity of 500 kilowatts (kW) and feed electricity into the grid via EMEC's pre-installed grid connection. The project is planned in a single phase with the moorings and device installation along with the electrical connection works planned for summer 2011. The Penguin will be deployed at EMEC's recently established berth at approximately 60m water depth. The location is shown in Figure 1.1.

Wello's technology is the result of 20 years of research and development work carried out by Heikki Paakkinen; Managing Director of Wello Oy. The Company was founded in 2008 to develop the technology from prototype to a market ready product. To date, Wello has conducted tank tests at 1:18 scale at the Ship Laboratory of Helsinki University of Technology and sea trials in the Gulf of Finland at 1:18 and 1:9 scales during the past three years.

With a maximum capacity under 1MW, the project is exempt from requiring consent under Section 36 of the Electricity Act (1989). It will however, require a number of other licences and permits. The contents of this Environmental Statement (ES) will be used to inform this permitting process as and when appropriate. Aquatera has been commissioned by Wello to assist the project team in securing the necessary permits and licences associated with the proposed deployment at EMEC. To this end, the following ES has been produced in line with EMEC's EIA Guidance for Developers (EMEC, 2008). A project specific Navigational Risk Assessment has also been undertaken (refer to supporting document, *Navigational Risk Assessment* (Aquatera, 2011).

1.1 Scope of study

The scope of this ES includes the following activities and operations:

- Installation of moorings and associated recovery system
- Installation of the Penguin onto moorings
- Installation of umbilical cable from the Penguin to EMEC's subsea connection
- Commissioning and operation of the Penguin
- Maintenance and monitoring (technical and environmental) activities
- Decommissioning (removal) of all equipment outlined above

2 Environmental description

2.1 Introduction

A detailed Environmental Description for the Billia Croo test site has been produced by EMEC (EMEC, 2009) which should be used in parallel with this ES; particularly in reference to the following topics:

- Seascape
- Coastal habitats (littoral)
- Seabed habitats (sublittoral)
- Fish and shellfish
- Birds and shore birds
- Marine mammals
- Conservation
- Other sea users
- Key environmental sensitivities

The test site has been extended further offshore to incorporate a new deepwater berth which will be used by Wello. The precise deployment location therefore lies outwith the area considered in EMEC's Environmental Description (Figure 1.1). Given the proximity of the new berth to the original boundary of the test site, many of the baseline conditions at the new berth are anticipated to be the same or similar to those described in EMEC's Environmental Description. However, there are some aspects of the baseline environment which require targeted characterisation at a site-specific level for example new survey data is required to establish which seabed habitats and communities are present at the deepwater site. The aim of this section is to provide new baseline information available for the specific test berth from project-specific surveys and to provide an update to the information provided within the existing Environmental Description using new data that has become available through ongoing monitoring activities.

Therefore, the following topics will be covered in this section:

- Seabed conditions survey results for the device testing location
- New EMEC baseline survey data for marine birds, mammals and basking sharks
- Protected sites and species
- Status of harbour seal populations in Orkney waters
- Other sea users
- Hydrographic information relating to operating conditions

2.2 Seabed conditions

The seabed in the vicinity of the test berth is relatively diverse and characterised by a number of different features. The test berth site itself is situated on the edge of a sedimentary ridge which has built up over the bedrock. This sedimentary feature is thought to be linked to the ebb tide current

which flows out of Hoy sound and it sits in the eddy formed to the east by that ebb current as the main current flows north-westwards out of Hoy Mouth. The coastal rock platform lies to the east away from the berth. To the west in deeper water there is another rocky platform, one of a number across the seabed to the west of Orkney. Lying in a SW/NE orientation to the SW of the berth site is another more linear rock feature. This may be related to a volcanic intrusion or dyke on the seabed. It could also be the remains of glacial moraine debris, left by a retreating glacier during a previous ice period. Similar features can be seen further south off Rora Head of Hoy and in other areas.

The sediment, based upon previous observations in the area, is formed by medium and coarse grained sand of a mixed rock and shell based origin. The sediment is rippled on the surface and is therefore likely to be mobile during high current and storm wave conditions.

The seabed fauna in the area is not particularly rich, in part due to the relatively high seabed mobility and the relatively low nutrient inputs in the sediments.

All of these characteristics will be investigated during an ROV survey which will be completed before deployment of the device takes place. The results of this survey will be presented as an addendum to this ES as soon as they become available.

2.3 EMEC marine wildlife observations

2.3.1 Survey strategy

To provide information on the distribution and relative abundance of marine wildlife for the Billia Croo wave site and surrounding area, EMEC commissioned an on-going programme of land-based visual observations which commenced in March 2009 (SMRU Ltd, 2008). These surveys cover a hemispherical survey area extending 5km offshore which covers the entire EMEC wave site including the new deepwater berth.

A preliminary report summarising the results of the first year of survey data shows that over 1000 hours of observations were conducted for the period March 2009 – February 2010 (DMP Statistical Solutions, 2010). The preliminary results provide valuable baseline information showing which species have been recorded within the study area for each month of the year. At the present time, further data analysis is required to determine the abundance of each species present throughout the year and the distribution of species recorded across the survey area. The following sections summarise the findings for marine birds, cetaceans, seals and basking sharks.

2.3.2 Marine birds

In over 1000 hours of observations, birds were observed in >80% of observation hours. Table 2.1 shows which SPA qualifying species have been recorded within the survey area in each month of the year. Fulmar, kittiwake, guillemot and great black-backed gull were observed in all months of the year. Gannet, great skua and red-throated diver were also recorded in most months of the year.

Puffin and razorbill were recorded most months between late winter (February) and August. Arctic tern and Arctic skua were less frequently observed with sightings during the summer months only. Cormorant was recorded in August and December only. The records for Manx shearwater and storm petrel were both one-off sightings of individual birds therefore these species are a very rare occurrence at this site.

Table 2.1 SPA qualifying species recorded during EMEC wildlife observations

SPA qualifying species	Months observed March 2009 –February 2010											
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Arctic tern												
Arctic skua												
Cormorant												
Fulmar												
Kittiwake												
Gannet												
Great black-backed gull												
Great skua												
Guillemot												
Manx shearwater												
Puffin												
Razorbill												
Red-throated diver												
Storm petrel												

Several other marine bird species were recorded during the March 2009 to February 2010 observation period (refer to Table 2.2). The most frequently recorded species were black guillemot, eider and shag present every month of the year. Herring gulls were observed all months except August and September whilst common gulls were recorded throughout the period May to July and throughout the winter from October to February. Great northern divers were recorded during mid-winter (November to January) with a one-off sighting of an individual bird in June.

The records for common scoter, grey phalarope, pomarine skua and scaup were all one-off recordings of individual birds. One group of nine lesser black-backed gulls and one group of four long-tailed ducks were one-off records for these species. Two sightings of individual little auks were recorded on the same day. All of these species can be considered as very rare users of this site.

Table 2.2 Other marine bird species recorded during EMEC wildlife observations

Other marine bird species	Months observed March 2009 –February 2010											
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Black guillemot												
Common gull												
Common scoter												
Eider												
Great northern diver												
Grey phalarope												
Greylag goose												
Herring gull												
Lesser black-backed gull												
Little auk												
Long-tailed duck												
Pomarine skua												
Scaup												
Shag												
Wigeon												

2.3.3 Marine mammals

Cetaceans

In over 1000 hours of observations, cetaceans were observed in only 89 observation hours. The most frequently recorded species was harbour porpoise with sightings in all months of the year. Risso's dolphins were recorded between April and June and between August and October. Minke whales were observed during the late summer period (July until October) and white-sided dolphins were recorded during summer months only May, July and August. Killer whales and pilot whales were recorded only in August. August was the month in which all species were recorded (refer to Table 2.3).

Table 2.3 Cetacean species recorded during EMEC wildlife observations

Species	Months observed March 2009 –February 2010											
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Harbour porpoise												
Killer whale												
Minke whale												
Pilot whale												
Risso's dolphin												
White-sided dolphin												
Unidentified cetacean												

Seals

Both harbour and grey seals were recorded within the Billia Croo survey area (Table 2.4). Grey seals were more frequently observed compared to harbour seals however, as there were unidentified seal species recorded in all months of the year, for the purposes of this assessment, it will be assumed that both species are present at the site in relatively low numbers.

Table 2.4 Numbers of seals recorded during EMEC wildlife observations

Species	Number of animals per month observed March 2009 – February 2010											
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Harbour seal	2	0	1	0	5	0	0	2	1	0	0	0
Grey seal	8	6	3	6	7	6	5	11	5	12	10	10
Unidentified seal	6	6	4	2	8	7	2	4	3	2	1	4

2.3.4 Basking sharks

No basking sharks were recorded during the March 2009 to February 2010 observation period. Recent monitoring data from the second year of observation (2010-2011) show that there have been six individual sightings of basking sharks within the study area, one of which was of an individual observed feeding. Further data analysis is required at this time to determine what time of year these animals were observed and their locations within the survey area.

2.4 Protected sites and species

There are a number of protected sites which are relevant to the proposed deployment including the following Natura interests:

- Special Areas of Conservation (SACs)
- Special Protection Areas (SPAs)

The following section provides an overview of the relevant interests as defined by a project-specific Habitats Regulations Assessment (HRA); details of which are summarised within Section 9 of this ES.

2.4.1 Special Areas of Conservation (SACs)

As this project has no land-based operations, only those SACs with an offshore marine feature are deemed relevant to this project. All of the SACs considered relevant to this project are shown in Table 2.5 along with a complete list of their qualifying features. Each of these sites is fully considered within the HRA (see Section 9) which assesses which of these qualifying features have possible connections with the development.

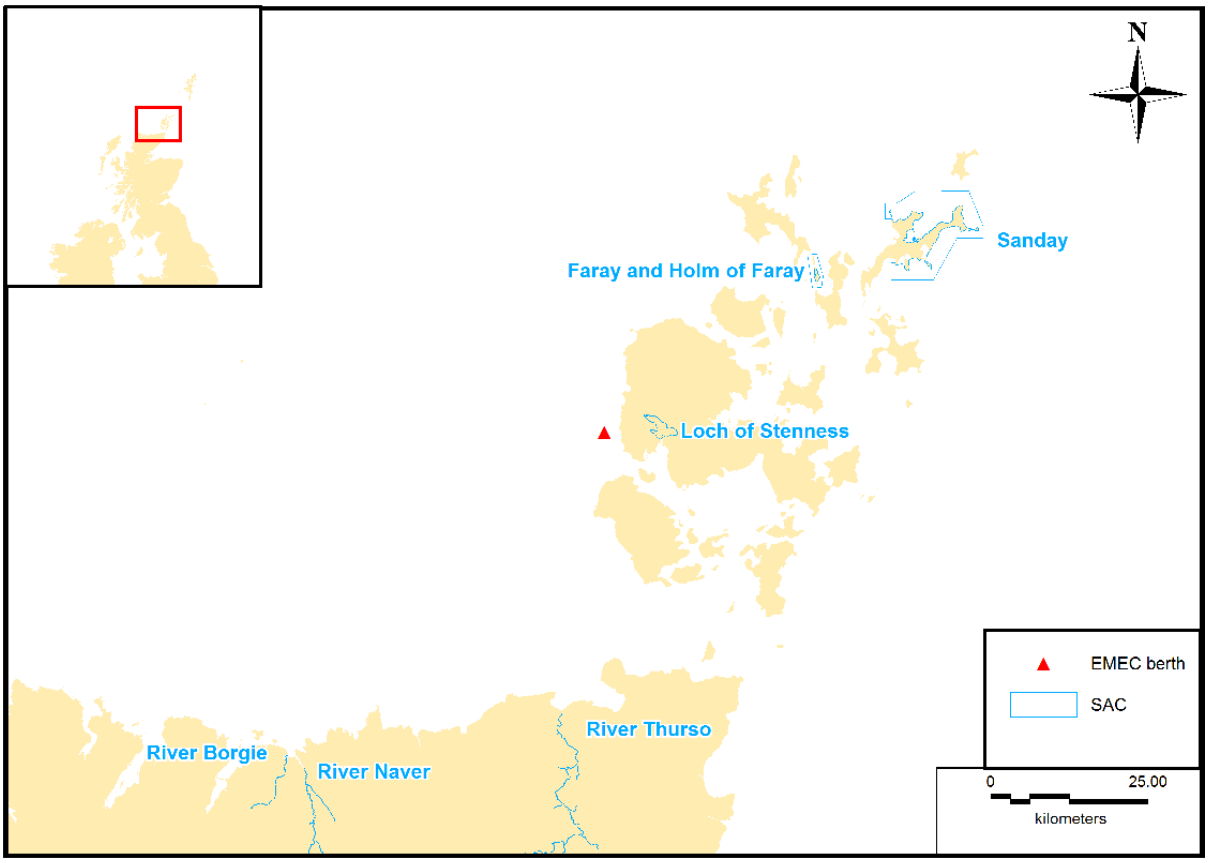


Figure 2.1 SACs relevant to the project

Table 2.5 SACs considered relevant to the proposed project

Name of SAC	Annex I Habitat –primary reason for site selection	Annex I Habitat – present as a qualifying feature but not a primary reason for site selection	Annex II Species – primary reason for site selection	Annex II Species – present as a qualifying feature but not a primary reason for site selection
Faray and Holm of Faray	N/A	N/A	Grey seal	N/A
Loch of Stenness	Coastal lagoons	N/A	N/A	N/A
River Borgie	N/A	N/A	Freshwater pearl mussel	Atlantic salmon Otter
River Naver	N/A	N/A	Freshwater pearl mussel Atlantic salmon	None
River Thurso	N/A	N/A	Atlantic salmon	N/A
Sanday	Reefs	Sandbanks which are slightly covered by sea water all the time Mudflats and sandflats not covered by seawater at low tide	Harbour seal	N/A

2.4.2 Special Protection Areas (SPAs)

All of the SPAs considered relevant to this project are shown in Table 2.6 along with a complete list of their qualifying features. These sites were identified through the HRA screening process and a full explanation of the possible connections between each of the qualifying features and the project are presented within the HRA (see Section 9).

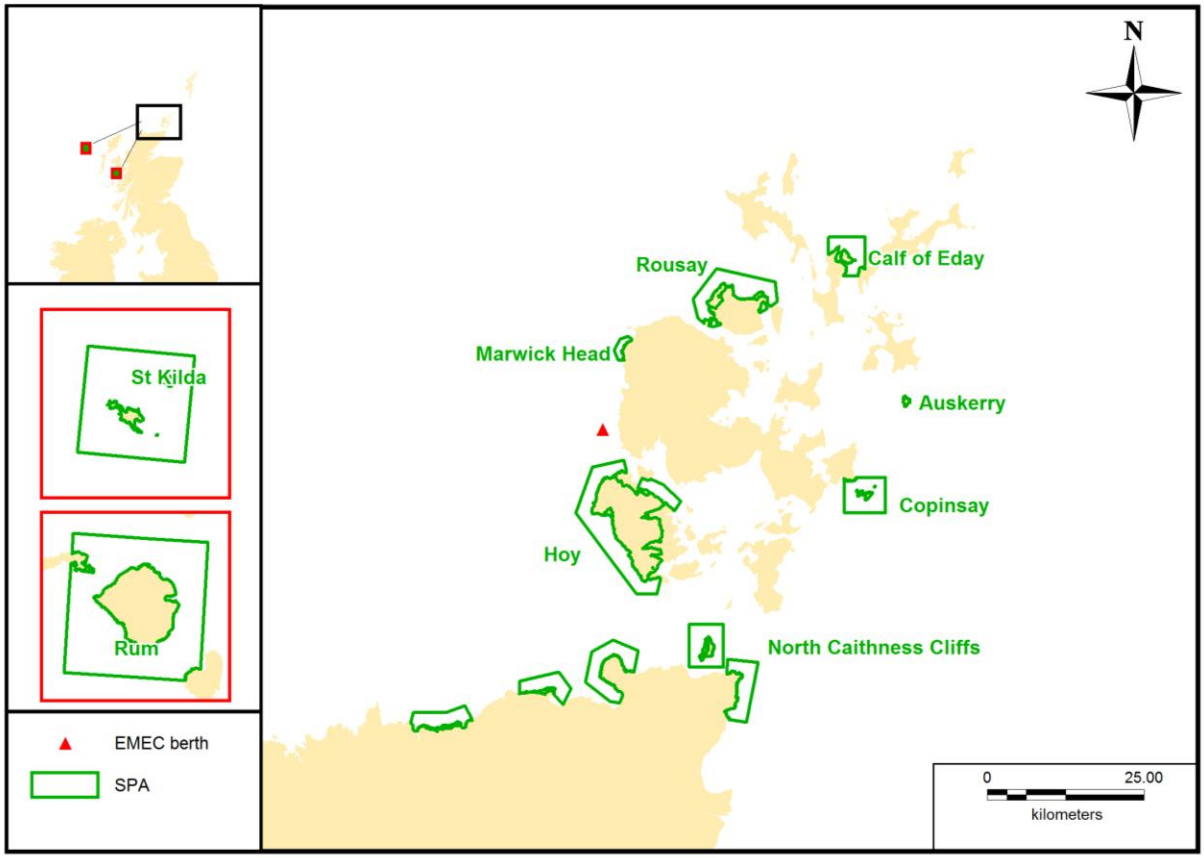


Figure 2.2 SPAs relevant to the project

Table 2.6 SPAs considered relevant to the proposed project

Name of SPA	**Relevant qualifying species** * part of seabird assemblage
Auskerry	Storm petrel Arctic tern
Calf of Eday	Seabird assemblage Fulmar* Guillemot* Kittiwake* Great black-backed gull* Cormorant*
Copinsay	Seabird assemblage Fulmar* Guillemot* Kittiwake*

Name of SPA	Relevant qualifying species * part of seabird assemblage
	Great blacked-back gull*
Hoy	Seabird assemblage Great Skua Peregrine Red-throated diver Fulmar* Kittiwake* Guillemot* Puffin* Arctic Skua* Great black-backed gull*
Marwick Head	Seabird assemblage Guillemot Kittiwake*
North Caithness Cliffs	Seabird assemblage Common Guillemot Peregrine Fulmar* Kittiwake* Razorbill* Puffin*
Rousay	Seabird assemblage Arctic tern Fulmar* Guillemot* Kittiwake* Arctic skua*
Rum	Seabird assemblage Manx shearwater Red-throated diver Golden eagle Kittiwake* Guillemot*
St Kilda	Seabird assemblage Leach's storm petrel Storm petrel Great skua Gannet Puffin Manx shearwater* Razorbill* Guillemot*

Name of SPA	Relevant qualifying species * part of seabird assemblage
	Kittiwake* Fulmar*
West Westray	Seabird assemblage Arctic tern Guillemot Fulmar* Kittiwake* Razorbill* Arctic skua*

The results of the EMEC wildlife monitoring studies at the Billia Croo site for the period March 2009 to February 2010 are presented in Section 2.3. These preliminary findings show which species have been recorded within the survey area for each month of the year. At this time, further data analysis is required to determine the abundance of species present or their distribution throughout the survey area.

2.5 Status of harbour seal populations in Orkney waters

Scottish Natural Heritage (SNH) has highlighted the current status of Orkney's harbour seal metapopulation as a key issue. Counts in Orkney and Shetland in 2006 were 42% lower than 2001. Results from 2007 confirmed the magnitude of the decline in Orkney. Counts in 2008 were 15% lower than in 2007 and 33% lower than in 2006. These latest results suggest that the Orkney harbour seal population has declined by 67% since the late 1990s and has been falling at an average rate of more than 13% per annum since 2001 (SCOS, 2009).

Consequently, the SACs within the wider area are in unfavourable condition (as assessed through site condition monitoring) and overall the conservation status for harbour seals at a UK level has been assessed as 'unfavourable-inadequate'. The Potential Biological Removal (PBR) for harbour seals in Orkney has also recently been reduced to 18 (Pers. Comm. John Baxter (SNH), 2011), indicating that there is concern that the death of 18 individuals outwith 'natural causes' may lead to the population becoming unsustainable.

2.6 Other sea users

This section provides an overview of site activity expected during 2011 and updated information regarding vessel activity in the wider area.

2.6.1 Planned test-site activities

It is understood that there will be a shallow water jack-up rig deployed into the shallow water test berth for a significant period during spring 2011, with associated support vessel activity. In total it is possible that up to four deepwater test berths may be occupied at times during 2011.

2.6.2 Latest use of the site by vessels

A comprehensive analysis of marine traffic has been completed as part of the NRA for this project. The NRA is produced as a separate document (refer to Section 5 of the NRA for analysis of marine traffic). Results of the NRA in terms of vessels using, or potentially using the area around Billia Croo (and not involved in test site related activities) are discussed in Table 2.7.

Table 2.7 Use of Billia Croo site by vessels (out with test site related activities)

Type of vessel	Use of site	Details	Potential effect
Ferries	None	No ferry routes on west of Orkney	None
RNLI lifeboat	Passing through	50% of call outs are in Hoy Sound or west coast of Orkney (5 year average 10 callouts per year)	Potential navigational obstacle
Dive boats	Transit to dive spots on the west of Orkney	Boats are small and pass inshore to the east of the EMEC test site	Potential navigational obstacle
Sailing and motor yachts	Used as a route from Stromness to Eynhallow Sound	Estimated that 20 boats per year use the route and would pass in inshore waters East of the EMEC wave test site	Potential navigational obstacle
Large vessels (cruise ships, naval vessels and commercial ships)	Passing through	Whilst a significant number of these vessels visit Orkney waters they are unlikely to pass close to the EMEC test site or through Hoy Mouth, instead they would opt to take a less challenging route into Orkney waters	Potential navigational obstacle to cruise liners sailing between Stromness and the North of Orkney
Small fishing vessels	Creeling (3 regular vessels, maximum of 10 use area)	In water depths of 15-30m. Activities outwith this zone will not affect fishing	Penguin will be deployed in water 70m deep and will not affect creeling
Large fishing vessels	None	No vessels operating within 2 miles of the coast at Billia Croo	None

Fishing activity is known to be conducted around the test site, particularly north and west of the test area; but bad weather may result in some inshore trawling. Data used for the purposes of the NRA (AIS and VMS) gives a good indication of activity but does not give a fully comprehensive database.

EMEC undergo regular consultations with local fisheries organisations regarding activity on the test site and the Project Team for the Wello deployment met with the local fisheries association during the Environmental Scoping Process and they will be consulted again on the basis of this Environmental Statement.

In addition to the vessels described above a number of ships actively involved in test site activities use the site. Past vessel types working on the EMEC site have included dynamically positioned offshore vessels (DP vessels), crane ships, tugs, multi-cats, barges, remotely operated vehicles (ROVs) and dive vessels. Other small passenger vessels, rigid hull inflatable boats (RHIBs) and survey craft are also regularly utilised by developers. There is a likelihood that, due to the desire by all developers to schedule work into periods of calm weather, there will be simultaneous operations (SIMOPS) involving multiple developers at the site.

3 Technology Briefing

3.1 General description

3.1.1 Overview

With the 'Penguin', Wello introduces a new concept for capturing wave energy with a unique working principle which is based on the shape of the device; not the internal mechanics. The converter is designed to respond to the movement of waves. Due to the asymmetrical shape of the 'hull' and the heavy 'roll plates' suspended from a specific attachment point on the side of the hull (refer to Figure 3.1), waves create a gyration movement which makes the eccentric load inside the hull rotate causing a generator inside the unit to spin and generate electricity. Figure 3.1 presents an illustration of the Penguin on its mooring system (which is currently undergoing awaiting TPV) and Figure 3.2 shows a picture of Penguin during construction in un-ballasted condition.

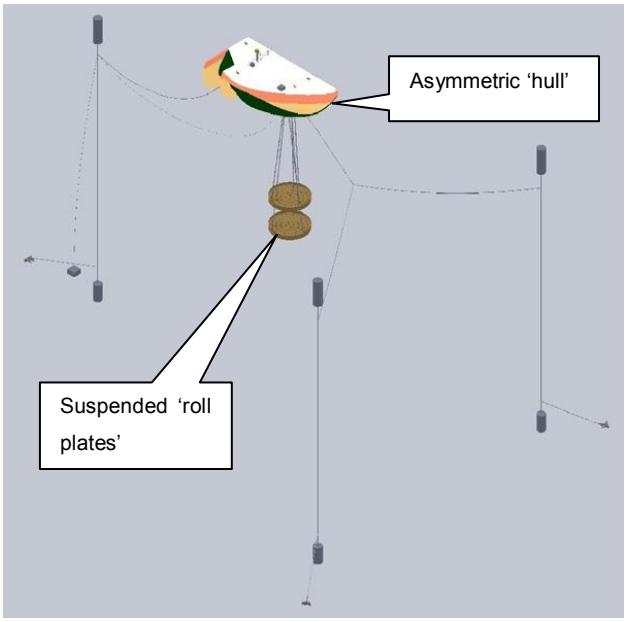


Figure 3.1 Wello WEC overview

Figure 3.2 Penguin during construction in un-ballasted condition

3.1.2 Dimensions

The key dimensions of the device are as follows:

- Hull
    - length – 29m
    - width – 15.5m
    - draft – 7.2m
    - freeboard – 1.8m
    - overall weight – approximately 1500t
- Roll plates
    - diameter – 9m
    - height 1.75m
    - depth – 35m and 40m
    - ballasted weight – 140t (each)

3.2 Device functionality / operation

The operation of the device has been demonstrated in scale models during Wello Oy's tank testing and sea trials. This is shown in Figure 3.3 where the hull, roll plates and a spinning wheel (representative of the generator) can be seen. The 'gyration movement' of the device during operation was demonstrated and this can be seen to cause the spinning wheel to rotate.

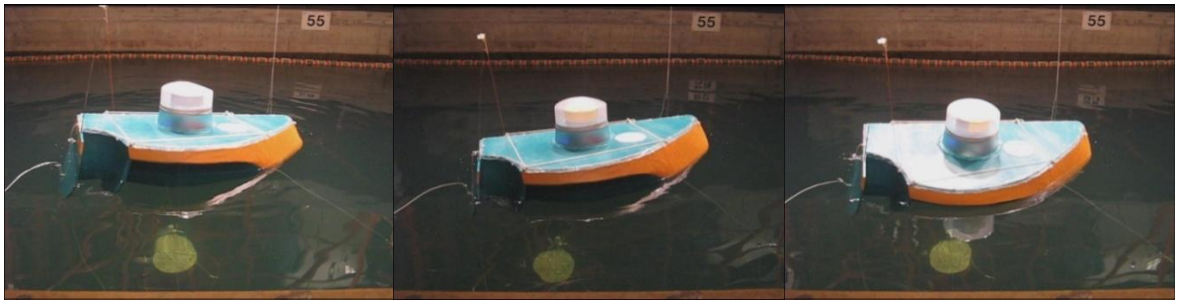


Figure 3.3 Photographs of a 1:18 scale model of the Wello Oy Penguin during tank testing

3.3 Device components

An overview of the main device components is provided in Figure 3.4.

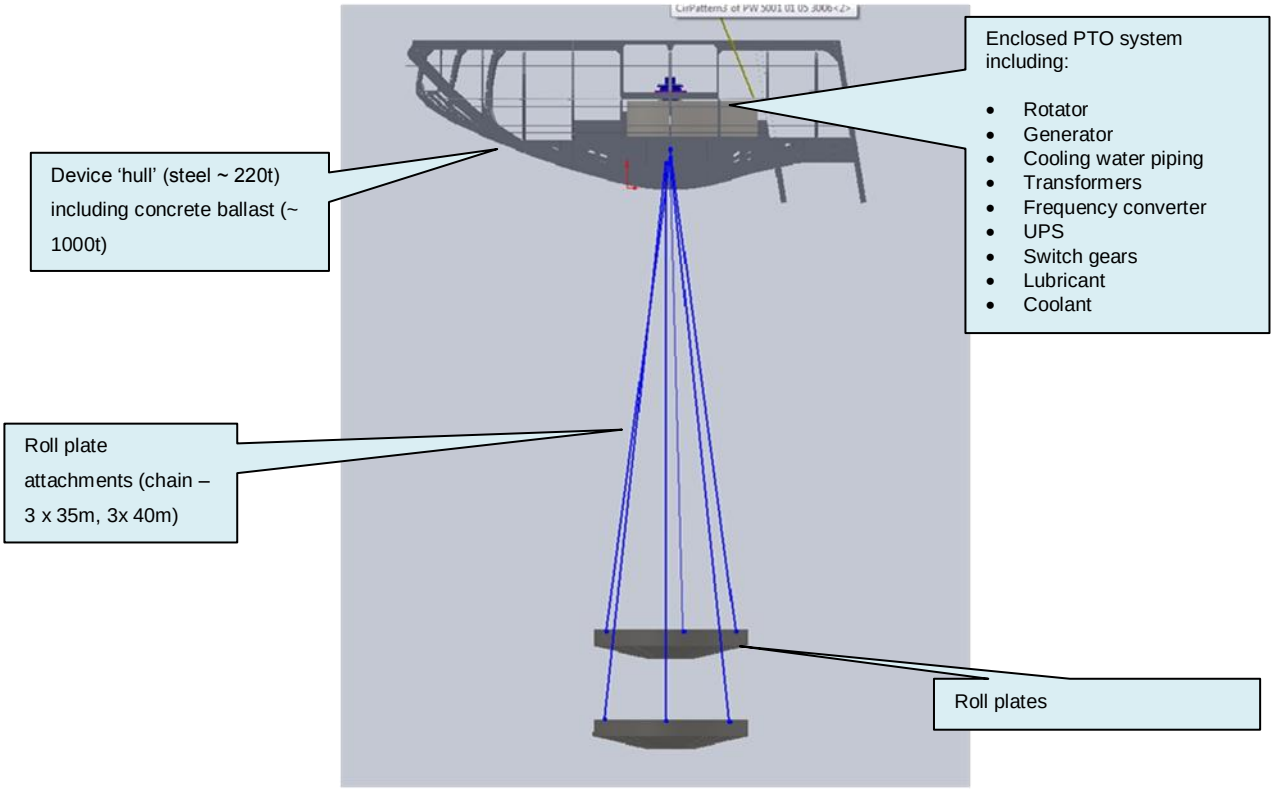


Figure 3.4 Wello WEC – main components

3.3.2 Structure

Hull - The device 'hull' is composed of steel (~220t) and includes concrete ballast (~1000t/416m^3). It measures 29m in length, has a width of 15.5m with a draft of ~7.2m and a freeboard of ~1.8m. The unique shape of the hull is key in transferring the energy from waves to the generator. Features of the hull include:

- A single permeable internal space
- Two access hatches in the deck capable of being sealed watertight with dogged hatch covers
- Ventilation pipes port and starboard
- An exhaust pipe to deck which is sealed when not in use
- A cable penetration pipe which extends above water level (when the electrical cable is deployed the end is sealed)
- A submersible hydraulic pump to remove gathering condensation and in the event sea spray or rain water ingress through open access hatches

In addition the deck of the hull is fitted with:

- Two chain pullers and a large roller used for lowering and lifting the roll plates
- Four sets of bollards with associated panama leads
- A small mast and box is provided for exhibiting navigation shapes and lights

- Two brackets are fitted for each of the roll plate chains
- A temporary/removable safety rail encloses the deck area
- A permanent steel boarding ladder is rigged on the port side

The chain puller, tugger winch and submersible pump are powered by a 44 kW hydraulic power pack which is situated below deck.

Roll plates and attachments - The roll plates are disk shaped with a 9m diameter and 1.75m height constructed using welded steel. The upper roll plate will be ballasted by sand with a concrete cap whilst the lower roll plate will be ballasted using only concrete. Each roll plate weighs 15 tonnes without ballast and when ballasted about 140 tonnes. In the operating condition the upper roll plate is suspended at 35 metres depth and the lower roll plate at 40 metres depth over the side of the hull. Each roll plate is suspended by three chains that are connected by a ring and shackles to a single length of chain close to the point of suspension. The single length of chain is run through the shackle and ring attached to a welded bracket on the hull. The single length of chain runs through the ring and up to deck and is fitted into a "Smit" bracket.

3.3.3 PTO System

Waves cause the hull to gyrate and this movement makes an eccentric load inside the hull rotate. The rotator is connected to a generator by a shaft inside the unit hence waves cause the generator to spin and generate electricity.

Rotator

The rotator consists of non-centric heavy mass, vertical rotating shaft line, shaft bearings, lubrication system, rotator braking system and safety locking system.

Mass - The eccentric heavy mass is a block of reinforced concrete, which is supported by the central shaft in the middle of the hull. The rotator tends to move around the shaft due the movements of the hull and gravity force. This rotation will do the 'work' which is converted to electric energy. The rotator mass is a very simple but essential part of the power-take-off (PTO) system. The weight of the mass is about 10% of the total displacement of the vessel (100-150 tonnes).

Shaft - The vertical shaft supports the full weight of the eccentric mass and transfers the torque to the generator. The shaft is a steel construction; the shaft and mass are stiffly bound together. The shaft also supports the weight of the generator.

Bearings - The rotating mass and shaft is supported by two bearing units. The lower unit consists of two different bearings and is designed to act as a thrust and radial bearing. It is attached to the bottom construction of the hull below the rotator deck. The upper bearing unit is attached to the generator deck and acts as a radial bearing.

Lubrication - The upper bearing unit is lubricated by an automated grease dispenser, proportional to the hours of use. The lower bearing unit is filled with oil, which is side flow filtered by a filtering aggregate.

Locking - The rotator can be stopped/locked for service and safety purposes. For this use there are different parallel and serial systems: a hydraulic disk brake in the generator, a manual parallel parking brake at the rotator floor and a chain locking system to lock the rotator in a fixed position. The disk brake is powered by a hydraulic power pack which can be controlled manually. The manual brake consists of two separate pump-piston systems, which can be tightened between the rotator mass and the rotator deck. The chain system can be locked to the park position with the rotator mass.

Electrical drive

Generator - The generator is a slow rotating, direct driven permanent magnet generator. It is directly connected to the rotator system with a flange, and the weight is fully supported by the rotator shaft. The counter torque of the generator is taken by a symmetric torque arm on top of the generator. The torque arm is connected to the hull at both sides with hydraulic pistons acting as a movement equaliser, but giving a rigid torque connection. The generator has two bearings of its own and they are lubricated by automated grease dispenser.

Frequency converter - The energy is transferred to the grid via a 1MW / 690V full power converter connected to a step-up transformer and an 11kV cable to the shore. The converter makes it possible to control the generator torque continuously, which is an important part of the PTO.

Cooling system

Power losses generated by the PTO system are transferred to the sea through the vessel hull. Primary cooling is achieved using a liquid glycol assisted cooling system inside the hull. Sea water is not directly used for cooling and therefore no pipes are penetrated through the hull structures. Electrical devices inside the vessel hull are equipped with anti-condensation heaters supplied from shore when the Penguin is not in operation.

A secondary backup cooling system using two 2kW fans is also incorporated into the design. The fan system will only be used if additional cooling is needed. It is likely that this will be required in high energy sea states when the device is at maximum output, which might be expected about 10% of the time.

PTO control

Hardware - The PTO is controlled by the plant Programmable Logic Controller (PLC), and the main variable controlled is the generator torque. Torque instruction is fed to the converter continuously over the bus. The PLC also controls diverse secondary modes like starting, stopping and parking. In

the prototype the PLC is a Simatic S-400. Principal transducers used for the PTO control are: position and acceleration sensors x-y and rotator position sensor.

Software - The program to control the rotator and PTO is specially designed for this type of PTO. It will in principle, control the mechanical position of the rotator continuously so that it will give an advantageous torque in each phase of the rotation. The rotator is loosely connected to the wave period, and will make one turn over each wave period.

3.4 Mooring system

The Penguin will be secured using a three-point mooring system which each point consisting of an AC14 type embedment anchor, a ground chain running from the embedment anchor, single or multiple clump weights (1-2 at each point)[2], a riser wire attached to single or multiple sub surface buoy(s), and a mooring pennant which runs from the buoy to the device. The two bow parts of the mooring arrangement have a 120 degree spread and are connected to a triangle plate which is in turn connected through a single leg chain bridle to the bracket on the bow of the Penguin. The stern mooring is connected directly to a single length of chain bridle to the connection bracket on the hull on the stern of the device. An overview of the moorings system is provided in Figure 3.5 with an aerial view shown in Figure 3.6.

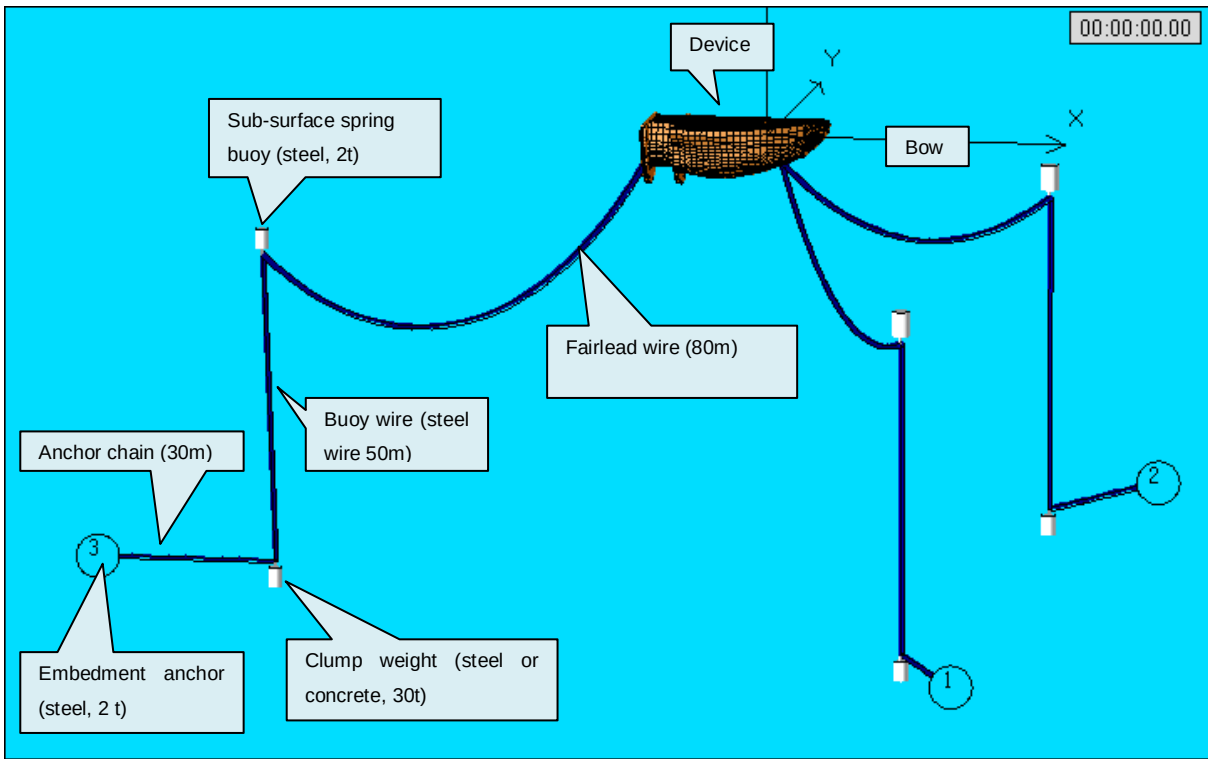


Figure 3.5 Indicative mooring system overview

[2] The number of clump weights is yet to be determined based on detailed survey work and mooring system design.

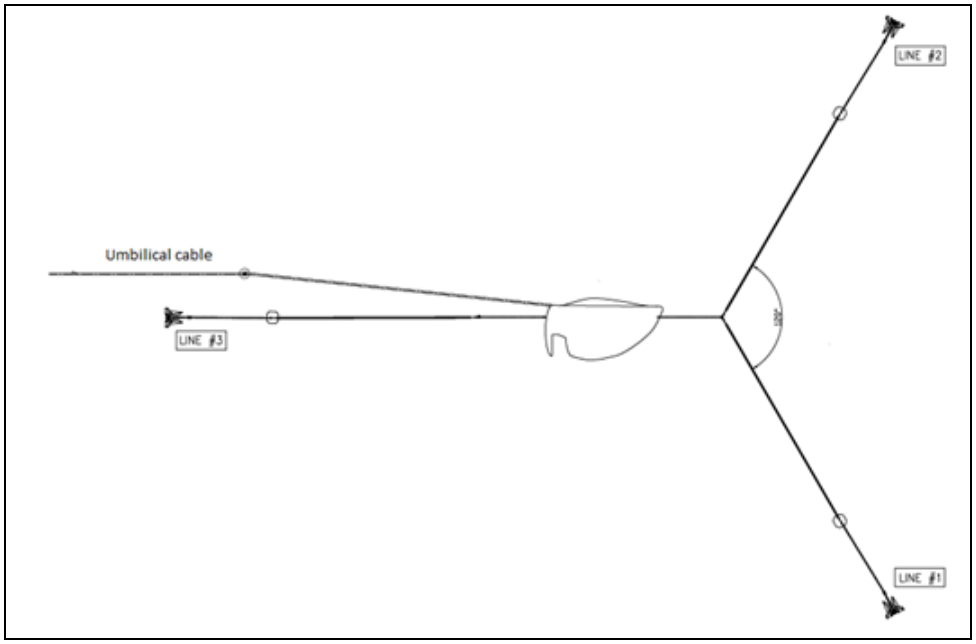


Figure 3.6 Mooring arrangement (aerial view)

Mooring components – Details including the size and weight of the mooring components are summarised in Table 3.1.

Table 3.1 Mooring components

	Details	Safe working load (tension)	Length / volume	Wet weight
Embedment anchor	Drag type HHP AC-14 or similar,	Holding capacity 640kN	Max dimensions 2.1m by 1.9m by 0.6m	2 tonne each
Anchor chain	28mm R3 stud chain	642kN	30m	115kg/m
Clump weight	Concrete (steel basket)	N/A	TBC (likely to be 2.5m by 2.5m cylinder)	TBC (approximately 30t)
Buoy wire	32mm unsheathed galvanised six strand wire rope	715kN	50m	2.7kg/m
Spring buoy	TBC	Buoyancy about 200kN	3.4 m x 5.2 m	4.5 tonne each
Fairlead wire (pendant chain and mooring wire)	32mm unsheathed galvanised six strand wire rope (65m) then Spelter socket and triplate to 28mm R3 stud pendant chain (15m)	Wire rope - 715kN Pendant chain - 642kN	80m	2.7kg/m

Area of coverage – Two mooring lines will extend approximately 80m from the bow 120^{o} apart with the third line extending approximately 80m directly from the stern, 120^{o} away from the two bow lines.

Note: DNV has been commissioned to conduct an Independent Third Party Verification of design and construction of the device and moorings system which will be presented to EMEC prior to

commencement of works. Depending on the outcome of the TPV the final design on the moorings may differ slightly from that presented here.

3.5 Other technical specifications

3.5.1 Power conversion system

Device generation capacity

It is anticipated that the device will generate nominal power of 500kW. Peak power production may be higher but will in any case be limited to less than 1 MW.

Energy capture area

Installation at EMEC will be the first full scale deployment of the Penguin and as such detailed information regarding the efficiencies of the device are not yet known. The Penguin has maximum dimensions of 29m in length, 15.5m in width and 9m in height. It is essentially a single point absorber and as such it is anticipated that it will not have a perceived effect on the wave regime.

Frequency/speed of moving parts

The enclosed 'rotator mass' rotating frequency is between 5 to 15 rpm; one revolution for each wave. The working principle ensures that rotation is continuous and synchronised to the wave period (Wave Synchronous Rotating (WSR) Converter). Therefore, rotation speed is generally highest with small waves and lowest with large waves. The device will cease to operate in very small sea states; this will be a key focus of the test deployment. These features limit the maximum speed and maximum power to the planned level.

3.5.2 Power requirements

Power may occasionally be drawn by the Penguin to enable the rotator to be in continuous rotation, allowing maximum energy generation overall. External auxiliary power requirement in the vessel is at 35 kVA.

Electrical power may be also be required on the device for operation of the chain puller, tugger winch and submersible pump. This will be provided by a 44kW hydraulic power pack situated below deck within the Hull.

3.5.3 Electrical systems

Voltage and current patterns from power generated in umbilical, impressed currents corrosion systems, and frequency and harmonics of electrical systems will fulfill requirements as established by EMEC.

Lightning protection

The inherent design of the Penguin means that if it were to be struck by lightning then it would be conducted through the hull causing no damage to the device.

3.5.4 Hydraulic systems

The following hydraulic systems will be onboard the Wello device:

- 44kW hydraulic power pack
- Chain puller
- Winch
- Hydraulic brake

3.5.5 Corrosion protection

All interior and exterior surfaces will be painted to marine standards. Deck paint will include non-slip additives. Steel ladders, platforms, gratings, stair treads, handrails and cable trays will be hot dipped galvanised in accordance with ASTM A123. No cathodic protection (such as sacrificial anodes) will be applied.

3.5.6 Antifouling System

Antifouling will only be used around hinges and brackets on the Penguin and the roll plates. The surface area painted with antifouling is not expected to exceed $10m^2$. During the planned test period there will be no reapplication of antifouling. It is not anticipated that any management or removal of fouling will be required during the test period but it is planned to monitor fouling during the test period and remove it after decommissioning.

3.5.7 Device markings

Above surface visibility

The Penguin is 29m long and 15.5m wide and will have a freeboard of 1.8m.

Colour

The Penguin will be painted predominantly in yellow.

Lighting arrangements

Lighting arrangements will be compliant with the NLB response to the NRA of this project. If there are any proposed changes to recommendations then these will be agreed with the NLB.

Low visibility warning signals

Low visibility warning signals will be compliant with the NLB response to the NRA of this project. If there are any proposed changes to recommendations then these will be agreed with the NLB.

3.5.8 Communication systems

A fibre optic cable will be used for communication with the device as is standard at EMEC. The Pengiun will also have GSM capability as backup.

3.5.9 Energy storage

Within the Penguin hull there are reserve batteries to be used in case of power failure for navigation lights and safety lights. These can be charged using the shore connection, but it is not expected that they will need regular charging.

3.5.10 Energy sink

Not applicable.

3.5.11 Moorings

Materials

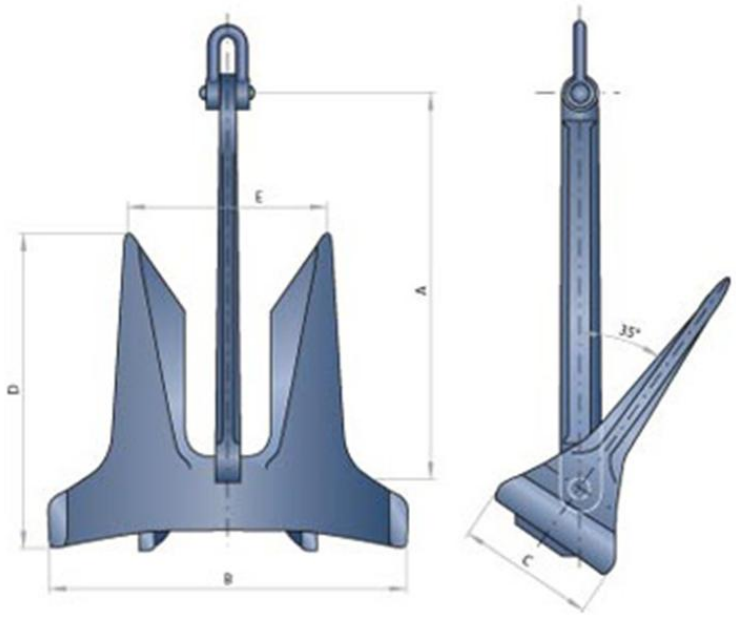
Materials used for the moorings are as outlined in Section 3.5.12.

Movement of device around moorings

The device will be slack moored, weathervane and orientate itself to the predominant swell direction by rotating around the forward, central mooring point. The maximum excursion of the device around the mooring is 90°.

Chains, anchors, blocks, subsea connections

Three steel drag embedment anchors weighing 2t each will be used (see Figure 3.7). They will each be connected to a mooring line tensioned between a single or multiples clump weights (to be confirmed) on the seabed and a single or multiple 4.5t sub-surface buoys. The sub-surface buoys will be connected to the hull by 32mm unsheathed galvanised six strand wire rope.



A	B	C	D	E
2100mm	1920mm	630mm	1820mm	1030mm

Figure 3.7 AC14 2 tonne anchor schematic

Clump weight requirement

A number of clump weights will be required; most likely 1-2 at each mooring point. The clump weights will be cylindrical in shape, constructed of concrete and have a steel basket. The diameter and height of the clump weights are likely to be about 2.5m.

3.5.12 Materials

The construction materials are as outlined in Table 3.2. Each will be fully considered within the ES and Materials Safety Data Sheets provided as appendices where appropriate (refer to Appendix D).

Table 3.2 Summary table of deposits

Installation component	Material(s)	Approx weight/volume	Duration	ISO standards or equivalent
Moorings				
Embedment anchors	Steel	3 anchors – 2t each	Temporary	EN 100252
Clump weights	Concrete (steel basket)	3 -6 weights – 30t each	Temporary	EN 100252 EN 206
Buoys	Steel	4.5t each	Temporary	EN 100252
Steel wire	Steel	800m	Temporary	EN 100252
Chain	Steel	150m	Temporary	EN 100252
Device				
Hull	Steel	220t	Temporary	EN 100252
Rotator	Steel	20t	Temporary	EN 100252
	Concrete	150t	Temporary	EN 206
Ballast	Concrete	~ 1000t	Temporary	EN 206
Roll plates	Steel/concrete	2 roll plates – 140t each	Temporary	EN 100252 EN 206
Chain	Steel	8 t	Temporary	EN 100252
Paint	High solids epoxy (with non-slip additives on main deck)	160kg	Temporary	ISO 12944
Lubricant	Grease	25 kg	Temporary	
	Oil	40 litres	Temporary	
Antifouling	TBC – will be marine standard	20kg	Temporary	
Generator				
Casted steel frame	Steel	60t	Temporary	DIN EN 60034 DIN EN 61800 IEC 60279 DIN EN 50347 DIN EN 60146 DIN EN 61800
Copper windings	Copper	2t	Temporary	
Cast resin treatment on windings	Resin	100kg	Temporary	
Brake system and torque are support	Hydraulic fluid	25 litres	Temporary	
Cooling water piping	Plastic	200kg	Temporary	
Coolant	Glycol 40% Water 60%	600 litres	Temporary	EN 55011 DIN 50160 DIN EN 60076
Transformers				
Iron core	Iron	5t	Temporary	
Aluminium winding	Aluminium	200kg	Temporary	
Steel frame	Steel	300kg	Temporary	EN 100252
Frequency converter	Steel	300kg	Temporary	EN 100252
	Aluminium	50kg	Temporary	
	Copper	150kg	Temporary	
	Plastic	10kg	Temporary	
	Iron	-	Temporary	
UPS				
Steel frame	Steel	150kg	Temporary	EN 100252
Lead batteries	Lead	50kg	Temporary	

Switch gears LV/HV				
Steel frame	Steel	200kg each (2pc´s)	Temporary	EN 100252
Copper/aluminium bus bars	Copper/aluminium	50kg	Temporary	
SF6 gas breakers on HV SW	Copper/steel/plastic	100kg	Temporary	
Plastic	Plastic	20kg	Temporary	
Tubing	Steel	300kg	Temporary	EN 100252
Electrical converter	Steel	200kg	Temporary	EN 100252
Additional equipment				
Powerpack (44kW)	Steel	1 t	Temporary	EN 100252
	Hydraulic fluid	630 litres	Temporary	
	Diesel engine oil	12 litres	Temporary	
	Gas oil (diesel)	150 litres	Temporary	
Chain puller	Steel	9.5 t	Temporary	EN 100252
Winch	Steel	750kg	Temporary	EN 100252
Power Cable (Penguin – EMEC umbilical)				
Copper	Copper	250kg	Temporary	DIN EN 60664-1 DIN VDE 0298 VDE 0100 DIN EN 60947
PVC plastic	Plastic	30kg	Temporary	
Bending restrictor	Polyester/rubber	4x50kg	Temporary	

4 Project description

The following section provides an overview of the project including the location, methodologies for installation, maintenance (planned and unplanned) and decommissioning. It should be noted that at this early stage of the project, a number of the methodologies and procedures are under development. All marine works will be conducted in compliance with Marine Guidance Note MGN 371 and assessed in the project Navigational Risk Assessment (NRA) as well as addressed in the ES.

4.1 Developer's management system/structure

- Heikki Paakkinen, CEO
- Timo Lotti, Projects Manager
- Antti Paakkinen, CTO
- Mikko Karhu, Project Engineer

4.1.1 Communication plan with EMEC

Wello Oy and its subcontractors plan to cooperate fully with EMEC throughout the project with particular regards to operational planning, health and safety management and environmental monitoring. The team will have regular progress meetings with the relevant personnel at EMEC.

4.2 Testing schedule

The work programme outlined in Table 1.1 is currently anticipated (note contingency allowances):

4.3 Proposed location

The WEC will be installed within EMEC's wave test site at a new deepwater berth (shown in Figure 1.1 at a depth of approximately 60m LAT. The exact location within the berth is yet to be determined but the location of the cable-end (laid by EMEC in 2010) is shown in Figure 1.1 at 319169E 1012466N (58° 59.500N, 003° 24.500W).

The functions of the Penguin are optimal in deep water i.e. at place where the waves do not break. At the chosen location the depth is 70m and the wave spectrum should be as clean as possible without reflected waves interfering. These factors make the berth an ideal location for testing the Penguin at full scale which led Wello Oy to pursue the proposed deployment at EMEC.

4.4 Vessel requirements

Several types of vessel will be required throughout the various stages of the project; as outlined in Table 4.1.

Table 4.1 Vessel spread for Wello Oy Penguin installation, operation and decommissioning

Name and type of vessel	Illustration	Stage of project	Outline of role	Specification
Survey vessel		Installation / operation	Undertake ROV surveys of the device and moorings	Specific vessel not yet identified
Orkney Towage tug boat (Einar, Erlend or Harald)		Installation, decommissioning, unplanned maintenance	Act as stern tug from Lyness to Billia Croo, assist with mooring connection, provide safety/emergency response backup.	e.g. Harald Length: 32m Bredth:10m Draught 4.78m GRT: 410 IMO: 9044334
Large Multicat		Mooring and device installation, decommissioning, unplanned maintenance	Lay moorings, Main tow from Lyness to Billia Croo, assist with mooring and unmooring the device and with electrical connections.	Specific vessel not yet identified
RHIB		Mooring and device installation, decommissioning, planned maintenance	Transfer crew to and from the penguin, safety response.	Specific vessel not yet identified
General purpose Multicat		To be used if large Multicat is unavailable	To be used if large Multicat is unavailable	Specific vessel not yet identified

4.5 Pre-deployment activities

The main base for mobilisation will be at Lyness on the island of Hoy within the Orkney Islands. There are approximately 240m of quay space at Lyness which is undergoing complete refurbishment by OIC Marine Services. Prior to deployment at EMEC, the Penguin must first be transported from Riga Shipyard in Latvia to Lyness. Upon arrival at Lyness some preliminary works and testing will be carried out both at the dock and within Scapa Flow. These activities are described below to give a complete view of the testing and preparation that will be undertaken before deployment at EMEC. Licences for these operations are provided by the relevant harbour authorities. Therefore, the activities do not form part of the environmental assessment in this ES.

4.5.1 Transportation from Riga Shipyard to Lyness

The Penguin will be towed from Riga Shipyard in Latvia to Orkney using a tug connected to the bow mooring connection point. The MCA will be regularly updated with the vessels estimated time of arrival (ETA) on route. Orkney Islands Council Harbour Authority Marine Services will be advised in

advance with berthing requirements and will be contacted with pre arrival information in good time. The Harbour Office will be advised of the tug and tow's departure from Riga and regularly updated with ETA's. On arrival in Orkney waters an escort tug will be despatched from Orkney to meet up with the device at a pre-arranged designated point before entering the Pentland Firth. The tug and tow and escort tug will proceed to the berth at Lyness through Switha Sound.

The mooring equipment, roll plates and buoys will be delivered to Lyness separately.

4.5.2 Pre-deployment works and testing

Preparatory works at Lyness

The Penguin and associated ancillary equipment will be checked for integrity and any damage. The roll plates will be ballasted and attached to the Penguin at the quayside.

Penguin under tow with roll plates attached test

During passage between Lyness and Bring Deeps the towing characteristics of the Penguin with roll plates attached will be ascertained and if necessary the towing arrangement will be adjusted.

Roll plate lowering and raising test

The Penguin will be towed to a suitable depth of water in Scapa Flow (Bring Deeps) and temporarily anchored. The roll plates will be lowered until supported by the roll plates chains. The roll plates will then be raised back under the hull of the Penguin and the Penguin towed back to Lyness to berth or placed at a suitable mooring close to Lyness.

4.6 Installation at Billia Croo

Mobilisation and installation at the test site marks the starting point for the following ES. Installation will be undertaken in three stages:

- Installation of the moorings
- Device deployment
- Electrical connection

Each stage is described in turn below following a review of the vessel spread required for the development.

4.6.1 Installation of the moorings

The mooring system will be pre-laid at the test berth. This will be completed using a multicat-type support vessel. The process is expected to take 1-3 days. During this process, the following will be installed:

- Embedment anchors (which will be pulled into position)
- Clump weights and chains attaching each to an embedment anchor
- Subsurface buoys and associated lines/wires attached to clump weights

- Recovery lines and small surface buoys (to allow access to the subsurface buoys when attaching device tethers during device installation)

Each section of mooring spread will be taken out and deployed using the anchor handling winch and roller of the multicat. The anchor will be rendered out to the required position on the seabed followed by the ground chain clump weight(s) and riser wire, the main buoy will be deployed followed by small mooring pennant and marker buoy and lastly a suitable messenger line to facilitate pick up of the marker buoy. This process will be repeated for each of the three moorings. Once the anchors and sections of mooring are deployed the anchors will be allowed to "soak" for at least 24 hours. On completion of the soaking in period a tug will be deployed and will proceed to each pick up buoy and secure the short mooring pennant to its tow wire and then a suitable sustained pull will be applied to ensure the each of the anchors is fully bedded in. The precise location of the anchors and clump weights within the berth are yet to be determined and will be confirmed during installation.

Please note that the mooring design is awaiting Third Party Verification. Should the design be altered as a result of this then the installation method may differ slightly from that described above.

4.6.2 Device deployment

The Penguin will be towed from Lyness to the pre-laid moorings at the EMEC test site at Billia Croo. The Penguin will have a lead tug (multicat) and a stern tug to facilitate control during the tow and while connecting the moorings. A RHIB will also be in attendance throughout on safety standby duties.

Prior to departure, the roll plates will be drawn up close under the hull using the on-board chain puller. For transport of the device from Lyness to Billia Croo two potential tow routes have been identified:

- Option 1: The tow will leave Lyness passing through the narrow channel between Fara and Hoy, and out into Switha Sound. The tow will then proceed through Cantick Sound out into the Pentland Firth. It will then roughly follow the coast along the south end of Hoy before turning in a north-westerly direction somewhere off Tor Ness. It will then transit along the coast off the west side of Hoy before passing Hoy Mouth and finally onto the test site at Billia Croo. The length of this route is approximately 55km.

- Option 2: The tow will leave Lyness and pass through Gutter Sound out into the Bring Deeps. It will then pass through Hoy Sound to the west side of Graemsay and out into Hoy Mouth, from where it will proceed to the test site at Billia Croo. The distance between Lyness and the test site via this route is approximately 23 km.

Option 1 is the preferred route however Option 2 may be used depending on weather, sea conditions and other operational constraints.

On arrival at the Billia Croo the device will be connected to the pre-laid mooring system. Once the moorings are set and in place and attached to the Penguin, the roll plates can be lowered to their full extent using the chain puller. Roll plate lowering is expected to take less than 3 hours.

4.6.3 Electrical connection

An ROV will be deployed with manipulator and attach a pick-up line from the EMEC cable connector to a pick up buoy on the surface (refer to Figure 4.1). The Penguin's umbilical cable is 51mm in diameter, 200m long and stowed on a drum beneath the deck of the Penguin. It is anticipated that only a few metres will lie along the seabed.

Figure 4.1 EMEC cable connector

The connector will be recovered using a multicat (or similar vessel) with a temporary mooring spread. A workboat will transport the Penguin's umbilical end over to the moored multicat for splicing into the connector. This operation is scheduled to take 24 to 36 hours. Technicians will be accommodated on the multicat or another vessel or ashore. On completion of the works the cable connector with attached cables will be lowered to the sea bed while the multicat pulls out on moorings to stretch the cable. The multicat crane will then lower the connector to the sea bed and the connection will be released by remote or slip sling.

4.7 Maintenance requirements

4.7.1 Planned maintenance

The device has been designed so that regular maintenance is not required. However it is anticipated that during testing, maintenance and inspection will be required approximately once a month. This will essentially involve using a RHIB or small workboat to transfer personnel onto the device where maintenance and inspection will be conducted within the hull. Maintenance will only be carried out in calm sea conditions (with a wave height less than ~1m to ensure safe access to the device).

4.7.2 Unplanned maintenance

Should the device need to undergo major maintenance/repair, the roll plates will be raised under the hull and the device towed to quayside (most likely at Lyness) using a multicat-type vessel or a tug. Once ready for redeployment, the methods outlined in Section 4.6.2 will apply again.

4.8 Environmental monitoring

A suitable Environmental Monitoring Plan will be developed and agreed with the relevant authorities prior to the commencement of works. Monitoring objectives are outlined in Section 9 of this report.

4.9 Technical monitoring and testing

Wello will be conducting a full range of tests whilst the device is installed at EMEC. Testing plans will be submitted to EMEC within the project specific 'Testing Plan'.

4.10 Decommissioning

All structures will be removed from the test site during summer 2012. A draft Decommissioning Plan will be prepared in line with the relevant Guidance Notes (DECC, 2011). This will be issued to DECC following the receipt of a Notice to Decommission.

4.10.1 Electrical disconnection

A workboat equipped with an ROV and diver team will be used to recover the umbilical and the bend resistor to the deck of the workboat. The umbilical will then be returned to the water whilst a multicat (or similar vessel) sets a three point mooring spread. The multicat will then recover the EMEC connector from the seabed to the deck whilst moored.

After the necessary electrical isolation permits are confirmed to be in place the electrical technicians can then proceed to unsplice the Penguin power cable from the EMEC connector and seal the connector. When this is completed the connector is lowered back to the sea bed while adjusting the position of the multicat using on board winches so that the connector and cable is laid back in a straight line on the sea bed. The position of the touchdown point of the connector will be recorded. The umbilical is returned to the Penguin.

4.10.2 Removal of the Penguin

The Penguin will be boarded by two crewmen from the RHIB who will proceed to lift the roll plates to a suitable draft using the chain pullers and secure. The multicat will be attached by towline to the stern of the Penguin and take the weight off the aft mooring. The aft mooring and one of the bow mooring connections will be severed and the tug will make fast a towline to the bow of the Penguin. The last remaining bow mooring will then be disconnected.

When the Penguin is free of its moorings the bow tug will proceed to tow the Penguin to Lyness. The stern tug will remain attached to assist in manoeuvring back to Lyness.

4.10.3 Removal of Moorings

All moorings will be removed using an anchor handling vessel or similar. The moorings will be transported to Lyness.

4.10.4 Seabed survey

On completion of the recovery of all materials from the site an ROV survey will be undertaken. Areas which have previously been identified as the lay down points for the anchors and clump weights including sufficient overlap to ensure the excursion radii of the clump weights have not been exceeded will be visually surveyed by an ROV and the findings recorded. An ROV visual survey will be undertaken of the EMEC cable and connector and the position of each verified and recorded.

4.11 Additional operational information

4.11.1 Accidental events

Please refer to Section 13.

4.11.2 Generation of waste

Project procedures for the Wello Oy project will require that all vessels taking part in marine operations for the project collect and retain waste, garbage and litter for proper disposal onshore. No waste water, garbage or litter will be discharged into the sea. Any wastes generated at onshore locations as a result of the project will be disposed of properly onshore.

4.11.3 Noise and vibration levels

Installation noise

No drilling or piling will be associated with installation and thus noise sources will be from the vessels on site and from deposit of moorings into the sea. Activities such as pulling of chains and lowering of the roll plates may also cause some temporary noise but overall levels will be low and of a very temporary nature.

Operational noise

No measurements of the noise levels for the device are available. Wello Oy plans to characterise the noise signature of the Penguin during testing (refer to the EMP).

4.11.4 Device stationing verification

Following installation of the device the precise location of the device and moorings will be accurately recorded by GPS. The footprint will then be notified to the authorities so that it can be added to navigation charts. Notices to mariners will be issued following EMEC's Maritime Safety Information SOP which includes notification to local fisherman's associations.

4.11.5 Possible device failure modes

Please refer to Section 13.

4.11.6 Shore connections

An umbilical cable will connect Penguin into EMEC's pre-laid cable; no new shore connections are proposed.

4.11.7 Shore facilities

No new shore facilities are proposed.

4.11.8 Chemical use and management

Details of chemical management system

The project chemical use and management system requires all chemicals proposed for use on the project to be evaluated for their utility and for their potential environmental and safety impacts. A register of chemicals proposed is kept together with a description of the potential for discharge to the environment. MSDSs are provided within Appendix D of this report.

Table 4.2 List of chemicals

Name	Reason for use	Type	Potential for discharge
On board the Penguin			
Hydraulic fluid	Torque arm support	NESTE HYDRAULI 46 SUPER	10 litres
	Brake system	NESTE HYDRAULI 46 SUPER	15 litres
	Power pack	Mobil EAL Hydraulic oil 32	630 litres
		Mobil EAL Hydraulic oil 46	
Lubricating oil	Bearing and filter	MOBILGEAR SHC XMP 320	40 litres
Diesel engine oil	Diesel engine (power pack)	Mobil Devlac MX 15W-40	12 litres
Gas oil (diesel)	Power pack	Esso	150 litres
Glycol	Cooling	Telko ZERO HD	600 litres
Paint	Protection and safety	Interzone 1000	160kg
		Interzone 954	
		Intergard 269	
		Interthane 990	
		Intergard 475HS	
Antifouling	Protection	TBC	20kg
Grease	Bearing lubrication	Arcanol LOAD400	25kg

Spill prevention and response plan

All project locations on and off-shore will have a spill prevention and response plan in place. This will cover the transport and storage of chemicals, provision of MSDS sheets nearby, together with equipment and materials for containing any spillage.

4.11.9 Potential discharges to sea

The Penguin will make no discharges to sea.

4.11.10 Potential discharges to air

The only emissions to air associated with the project will be those associated with standard support vessel operations.

5 Screening and classification of potential environmental interactions

The proposed project has the potential to interact with the receiving environment both positively and negatively. The key aim of the Environmental Assessment (EA) process is to identify where these interactions may occur, identify the route for interaction and assess how severe/beneficial their influence may be (based on the assessment criteria presented in Table 5.1). Potential key issues are then assessed, and proposed mitigation and monitoring measures identified as and when appropriate. Finally the anticipated level of residual impact, with all mitigation being successfully implemented, is identified. The process is summarised in Figure 5.1.

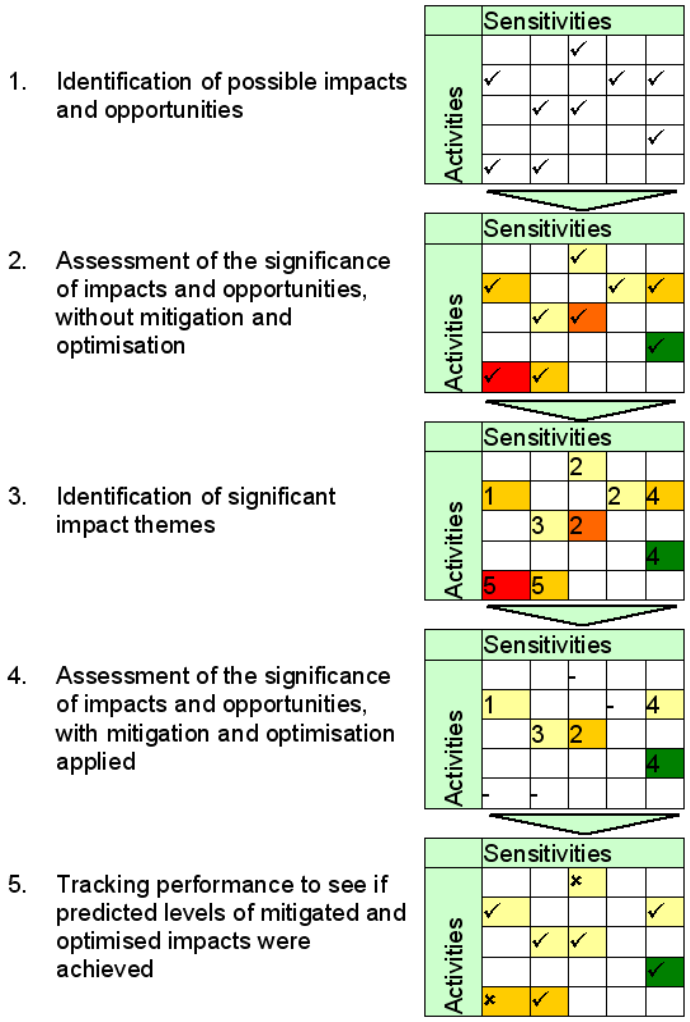


Figure 5.1 Overview of impact screening process

These worst case (before mitigation) and best case (with full mitigation) scenarios essentially define the two extremes of performance that could be achieved by the project. The overall aim is to ensure that as far as practical the best case scenario is obtained by implementing the mitigation measures described.

The classification system used during the EA process is based on that provided within EMEC's EIA Guidance for Developers (EMEC, 2008) and is presented for reference in Table 5.1.

Table 5.1 Impact classification criteria

	Ecological effects	Socio-economic effects	Stakeholder concerns	Consequence for developers
Major	Degradation to the quality or availability of habitats and/or wildlife with recovery taking more than 2 years *(e.g. widespread seabed excavations, erosion)*	Change to commercial activity leading to a loss of income beyond normal. Potential short term effect upon public health / well-being, real risk of injury *(e.g. loss of important fishery area, creation of seabed or floating debris)*	Concern leading to active campaigning locally or wider a field *(e.g. current national wind farm applications)*	Introduce measures to avoid these impacts wherever possible, closely monitor and control areas of residual impact
Moderate	Change in habitats or species beyond natural variability with recovery potentially within 2 years *(e.g. seabed excavations in a small area)*	Change to commercial activity leading to a loss within normal business variability/risk. Unlikely effect upon public well-being. Remote risk of injury *(e.g. small exclusion area away from or small part of actively used areas)*	Widespread concern, some press coverage, no campaigning *(e.g. local small scale wind developments)*	Actively work to minimise scale of impacts
Minor	Change in habitats or species which can be seen and measured but is at same scale as natural variability *(e.g. low level noise from devices)*	Possible nuisance to other activities and some minor influence on income or opportunity. Nuisance but no harm to public *(e.g. short term congestion at harbours)*	Specific concern within a limited group *(e.g. underwater noise effects on cetaceans)*	Be aware of potential impacts, manage operations to minimise interactions
Negligible	Change in habitats or species within scope of existing variability and difficult to measure or observe *(e.g. localised avoidance of structures by wildlife)*	Noticed by, but not a nuisance to other activities. Noticed by but no effects upon the health and well-being of the public *(e.g. additional shipping at sea)*	An awareness but no concerns *(e.g. exclusion of sea user group from non-critical sea areas)*	No positive intervention needed, but ensure they do not escalate in importance
No interaction	None	None	None	Ensure changes do not lead to new impacts
Positive	An enhancement of ecosystem or popular parameter *(e.g. enhance biodiversity, save in CO_2 emissions)*	Benefits to local community *(e.g. large scale contract to use local skills and expertise on a project)*	Benefits to stakeholder issues and interests *(e.g. prospects of new jobs and local spending)*	Actively work to maximise specific benefits

5.2 Identification of potential interactions

The matrix illustrated in Appendix A shows the areas where possible interactions between the proposed operations and the local environment could be anticipated. The selection of interactions reflects feedback from consultees, key regulatory requirements and EMEC's own policy stance as well as previous experience of similar works. It can be seen that each stage of the process has some potential for interaction with the environment. It can also be seen that these interactions have the potential to influence a wide spectrum of environmental features.

For each of the possible interactions identified, the significance of the interaction has been determined using the scale of effect based on the criteria outlined in Table 5.1. For this first analysis the "worst

case" situation was assumed where no special mitigation had been introduced and planned operations were completed to the legal minimum standards. The outcome of this screening process is presented within the matrix in Appendix A. The 'score' applied to each interaction, the justification/rationale and any relevant design/project planning features which have contributed to the score at each stage of the project are outlined in the series of tables presented within Appendix B.

The interactions were then grouped into categories; or 'key issues'. The outcome of this process is shown in Table 5.2 and for each specific interaction outlined within Appendix B.

Table 5.2 Potential issues – pre-mitigation

Ref	Issue	Potential significance	Comment
A	Seabed disturbance during installation and removal of the mooring system	Minor	Refer to Section 6
B	Disturbance to marine mammals and fish from the presence of the mooring system and device	Negligible	Refer to Section 7
C	Potential disturbance of marine mammals and fish from underwater noise	Minor	Refer to Section 0
D	Disturbance to other sea users from support vessel activity and sustained presence of structures offshore	Negligible	Not considered further – refer to Appendix B
E	Change in local seascape through increased activity and sustained presence of the device	Negligible	Not considered further – refer to Appendix B
F	Disturbance to seabed communities and during connection to and disconnection from the EMEC connector.	Minor	Not considered further – refer to Appendix B
G	Temporary change in water quality during installation and removal activities	Negligible	Not considered further – refer to Appendix B
H	Effects on air quality from vessel emissions	Negligible	Not considered further – refer to Appendix B
I	Effects on marine birds from vessel operations and device presence on the test site	Negligible	Not considered further – refer to Appendix B
J	Effects on marine fish from EMF emitted during electricity transmission	Negligible	Not considered further – refer to Appendix B
K	Effects on flows and fluxes from the presence of subsea structures	Negligible	Not considered further – refer to Appendix B
L	Employment opportunities for local residents and businesses	Majorly positive	Not considered further – refer to Appendix B

M	Utilisation of local infrastructure and subsequent investment in local services and economy	Positive	Not considered further – refer to Appendix B
N	Generation of marine renewable energy will contribute towards government targets	Positive	Not considered further – refer to Appendix B

Significant impacts are defined as those with a classification of moderate or above, issues raised by consultees during scoping and other consultations or groupings of a number of similar minor impacts. Based on this and the assessment outlined in previous sections, the following issues are considered to be potentially significant in relation to the proposed project:

- A – Seabed disturbance during installation and removal of the mooring system
- B – Disturbance to marine mammals and fish from the presence of the mooring system and device
- C – Temporary disturbance to marine mammals and fish from underwater noise

These issues are addressed fully in the following Sections of this ES (Sections 6, 7 and 0).

Other issues identified were:

- D – Disturbance to other sea users from support vessel activity and sustained presence of structures offshore
- E – Change in local seascape through increased activity and sustained presence of the device
- F – Disturbance to seabed communities and during connection to and disconnection from the EMEC connector
- G – Temporary change in water quality during installation and removal activities
- H – Effects on air quality from vessel emissions
- I – Effects on marine birds from vessel operations and device presence on the test site
- J – Effects on marine fish from EMF emitted during electricity transmission
- K – Effects on flows and fluxes from the presence of subsea structures

These issues are not assessed further within the ES (refer to Appendix B).

Potential opportunities and benefits identified were:

- L - Employment opportunities for local residents and businesses
- M - Utilisation of local infrastructure and subsequent investment in local services and economy
- N - Generation of marine renewable energy will contribute towards government targets

These issues are also not assessed further within the ES (refer to Appendix B).

6 Issue A – Seabed disturbance during installation and removal of the mooring system

Why is this issue important?

The seabed community is an important part of many marine ecosystems. Some seabed communities can be very rich and diverse in their own right, they can also contain species of key conservation value. Seabed species can act as an important food source for seabirds, fish and marine mammals. The physical nature of the seabed can link with currents and wave induced turbulence. The seabed may also be an important sink for nutrients and source of sediment itself.

The significance of seabed impacts is often mitigated by the small footprint of any disturbance compared to the much larger areas of habitat present.

The mooring system for the Penguin device will involve temporary installation of structures onto the seabed. It is possible that introduction of these structures could cause a change in seabed character or have a negative effect on seabed communities.

Sources of information

The sources of information used for this assessment are:

- Detailed bathymetry data sourced from Seazone and transformed into a seabed morphology map
- EMEC Environmental Description (EMEC, 2009)
- Results from a geophysical survey of the area

What are the potential impacts?

There are several impacts that may arise from the planned operations. These include:

- Change to or loss of habitat for benthic organisms
- Re-suspension of sediment into the water column during installation and removal of embedment anchors and clump weights
- Displacement of benthic organisms during installation and removal including demersal fish species

Mooring of the Penguin will be achieved by installation of three 2 tonne embedment anchors and approximately 3-6 30 tonne clump weights on the seabed. Based on a standard gravel concrete weight of 2403kg per cubic metre (www.simetric.co.uk), each 30 tonne clump weight would require 12.5m^3 of concrete. Assuming a cylindrical clump weight where the diameter is equal to the height, this equates to a footprint of 4.9m^2 and a height of 2.5m. The footprint of three clump weights will therefore be in the region of 15 - 30m^2. The chain or cable linking the clump weights and linking the weight to the Penguin device may also lie along the seabed. These chain and wire corridors will lead

to abrasion of the surface of the seabed from the cyclical lifting and lowering of the links as the waves pass by. The clump weights may also move a little if they are lifted and lowered by larger wave sets. Taking all of these factors into account the overall footprint for the moorings on the seabed may reach 2000-3000m^2. Given that a test berth has a radius of 400m, and an area of around 500,000m^2, footprint equates to less than 1% of the total berth area. The footprint of the three embedment anchors and multiple clump weights will therefore be negligible in ecological terms.

During installation and removal of the anchors there will be localised habitat disturbance and sediment suspension around the anchors. Sediment suspension will be limited to installation and removal whilst habitat loss will be small in scale and recover to its original state in the medium term of months to years. There may be a temporary, highly localised change in seabed character due to buried sediment layers being brought to the surface as anchors and clump weights are removed. These physical disturbances will also recover over the medium term of months to years.

Seabed mooring and cable lay activities during installation and decommissioning may also cause displacement in benthic organisms and demersal fish species. This could arise from noise, vibrations, or direct disturbance. Evidence from many other types of seabed engineering works, including mooring activities, show there are no visible signs of marine life moving away from such activities. Furthermore, It is likely that during the operational phases of the project benthic organisms and demersal fish may actually congregate around the clump weights and other parts of the mooring spread possibly due to the physical protection and shelter that they may provide.

Table 6.1 Overview of potential impacts

Key issue	Ranking	Reasoning
Habitat loss for benthic organisms	-2	Deposit of 3-6 clump weights will reduce habitat by approximately 15 - 30m^2 and could cause localised habitat damage.
Suspension of sediment into water column during installation and removal of embedment anchors and clump weights	-2	Sediment suspension could cause disturbance to benthic species. During installation anchors will be given 1 day to sink into seabed and should cause negligible sediment suspension, removal of embedment anchors has potential to produce sediment but removal method will minimise impact. Installation and removal of clump weights may cause a localised sediment plume.
Displacement of benthic organisms during installation and removal including demersal fish species	-2	Installation and removal of objects onto and from the seabed may cause temporary displacement in benthic organisms. During operation benthic organisms may congregate around the clump weights.

What mitigation, monitoring and optimisation measures can be applied?

Mitigation measures:

- The test berth does not hold sensitive habitats or species, this will be verified by a pre-installation ROV seabed survey
- Vessel anchoring will not normally be required and will be limited to when necessary
- Placement of clump weights will be as accurate as possible to ensure minimal 're-positioning' manoeuvres
- Anchors and clump weights will as far as possible, be removed in a single attempt so as to reduce the duration of noise and other forms of disturbance

Monitoring measures:

- A post-deployment seabed survey will be conducted to compare with pre-installation survey footage and to investigate the status of the mooring system
- A post-decommissioning seabed survey will be undertaken after all structures have been removed to establish the effects of the process on the seabed

What are the residual impacts?

Table 6.2 Overview of residual impacts

Key issue	Pre-mitigation	Residual impact	Post-mitigation
Habitat loss for benthic organisms	-2	Unchanged	-2
Suspension of sediment into water column during installation and removal of embedment anchors and clump weights	-2	Careful placement and removal of mooring structures will help to reduce this impact	-1
Displacement of benthic organisms during installation and removal including demersal fish species	-2	Unchanged	-2

7 Issue B – Disturbance to marine mammals and fish from the presence of the mooring system and device

7.1 Why is this issue important?

The introduction of new structures into the environment has the potential to disturb protected species including marine mammals and basking sharks which may adversely affect international conservation objectives.

7.2 Sources of information

The following sources of information were used:

- JNCC cetacean atlas
- Local sea mammal records
- EMEC monitoring data
- Aquatera staff specialist local knowledge

7.3 Baseline conditions

7.3.1 Cetaceans

All cetaceans are protected by the Conservation of Habitats and Species Regulations 2010 and are listed in Annex IV of the EC Habitats and Species Directive, which notes that:

"Member states shall take all the requisite measures to establish a system of strict protection for the animal species listed in Annex IV (a) in their natural range, prohibiting:

(a) All forms of deliberate capture or killing of specimens of these species in the wild;

(b) Deliberate disturbance of these species, particularly during the period of breeding, rearing, hibernation and migration"

Harbour porpoise (*Phocoena phocoena*) are known to regularly feed in the area between April and September; they are often seen at other times of year and may therefore be resident. There are also regular sightings of minke whale (*Balaenoptera acutorostrata*) and Risso's dolphin (*Grampus griseus*) and as well as occasional sightings of white-beaked dolphin (*Lagenorhynchus albirostris*) in the area. There are further indications that white-sided dolphin (*Lagenorhynchus acutus*), killer whale (*Orcinus orca*) and pilot whale (*Globicephala melas*) use the area further offshore for passage. These larger cetaceans are not thought to be resident in the study area (refer to Section 2.3).

7.3.2 Seals

Orkney holds 12% of the UK harbour seal (*Phoca vitulina*) population. This species has been in significant decline in recent years, with reductions of up to 67% since the late 1990s in Orkney. This population trend has led to the implementation of area-specific Conservation Orders by the Scottish Government, providing harbour seals with year-round protection. The nearest known harbour seal

haulout is at Warbeth Beach, 1km from the Billia Croo test site boundary and about 4.5km from the Penguin test berth. There is also a Special Area of Conservation (Sanday SAC) with harbour seals as a qualifying feature in Orkney but this is some 60km from Billia Croo by sea. SNH has recently reduced the Potential Biological Removal (PBR) for harbour seals in Orkney to 18 (Pers. Comm. John Baxter (SNH), 2011).

The nearest known grey seal (*Halichoerus grypus**)*** haulout is near Muckle Head on Hoy, 3.5km from the Billia Croo test site boundary and about 7.5km from the Penguin berth. There is one SAC for grey seals in the wider study area, namely the Faray and the Holm of Faray SAC, two uninhabited islands in the northern part of Orkney that support the second-largest breeding colony in the UK, contributing around 9% of annual UK pup production. This site is some 50km from the Billia Croo test site by sea.

SNH has noted in previous consultation responses that foraging ranges for harbour seals can be as far reaching as 50-60km of haul-outs so it is possible that seals from the Sanday SAC may forage within the project area. Grey seals have a wider foraging range so it is possible that animals from the Faray and Holm of Faray SAC could also be foraging within the area. The same can be said for seals using the smaller, more local haul-outs however, EMEC observational studies do not suggest that the project area is heavily used by either species (refer to Section 2.3). It should be noted that seals from the designated sites some 50-60km away, are much more likely to forage in suitable areas near to the haul-outs and would only expend the energy required to travel long distances when necessary. It is therefore most like that any seals observed within the test site area are from smaller haul-outs near to Billia Croo.

7.3.3 Fish

Whilst a range of fish including saithe, pollack, ling, cod, whiting, haddock, herring and mackerel may be present in the area, the only protected species of fish likely to be within the area are basking sharks (*Cetorhinus maximus)* and Atlantic salmon *(Salmo salar)*.

Basking sharks are known to use the west coast of Orkney for passage and feeding. They have also been recorded at Billia Croo during EMEC's monitoring programme. Basking sharks have full protection from capture or disturbance in British waters (up to 12 nautical miles from shore) under Schedule 5 of the Wildlife and Countryside Act (1981). They are also listed under the Convention on International Trade in Endangered Species **(**CITES) Appendix III in UK waters.

Migrating salmon are known to swim along the Orkney coast at Black Craig (Pers. Comm. Gareth Davies (Aquatera), 2011) although it is less clear where they are heading to/from. The designated sites for salmon and the dependent freshwater pearl mussel that are in the region are:

- River Thurso SAC - Atlantic salmon
- River Borgie SAC - Freshwater pearl mussel, Atlantic salmon
- River Naver SAC - Freshwater pearl mussel, Atlantic salmon

Salmon have a homing instinct that draws them back to spawn in the river of their birth after spending 1-3 years in feeding grounds to the south west of Greenland or near the Faroe Islands (Mills *et al,* 1999). Adult salmon return to freshwater from April to November. Returning adult Atlantic salmon swimming depth has been shown to be linked to light, with an average depth of 5m through the day and 1m at night (*Sturlaugsson et al*, 2009). Unlike their Pacific cousins, Atlantic salmon do not necessarily die following spawning, and some survive and make their way back to sea, where they can regain condition and repeat their spawning migration. The evidence strongly suggests that both migrating adult fish and smolts use surface waters.

As shown, a number of internationally protected species have been observed within the test site; some of which are critically endangered. It is therefore essential that any interactions that the proposed activities may have with these species are considered fully.

7.4 What are the potential impacts?

The potential for collision with the device or the mooring system is a possible impact on marine mammals and basking sharks from the presence of the device and mooring system.

Installation of the Penguin involves the placement of several objects into the marine environment. There is concern that cetaceans, seals and large fish may be unable to detect and therefore collide with these structures; causing injury and potentially death. The following structures may pose a risk of collision within the water column and at the surface:

- The hull
- The two roll plates
- The chains attaching the roll plates to the hull
- The mooring lines
- The clump weights
- The spring buoys

The hull is similar to many other obstacles in the sea and does not provide any particular collision risk above that of an anchored ship. The same can be said for the mooring lines, which will be tensioned between the clump weights and spring buoys and have some slack between the spring buoys and the hull. The separation between mooring points will aid in the safe passage of animals through the test berth. The roll plate chains will be under tension due to the weight of the roll plates and will be similar in nature to an anchor chain. The clump weights will be cylindrical, probably measuring about 2.5m in diameter and 2.5m high. The spring buoys will also be cylindrical measuring 5.2m by 3.4m and submerged at 10m water depth. The buoys and clump weights will be stationary and marine mammals and basking sharks would be expected to be able to detect their presence. The roll plates are larger than the spring buoys (115m^3 each) and at a deeper depth (35m and 40m). Again marine mammals and basking sharks would be expected to detect their presence and avoid collision.

Nonetheless the clump weights, spring buoys and the roll plates pose an additional collision risk and are structures which marine mammals and basking sharks may be unfamiliar with.

Migrating salmon are known to swim through the area around the EMEC test site. This species is generally surface swimming during its migration, often restricted to within 5m of the surface. Salmon have been observed in small shoals, often swimming along under the cliffs. Given the nature of the journey they are undertaking and the general behavioural traits of salmon it seems highly unlikely that they would be significantly disturbed by the presence of a device and associated moorings. There is also sufficient separation between the device and the coast and a vast sea area to the west which provides ample space through which migrating fish can pass.

Table 7.1 Overview of potential impacts

Key issue	Ranking	Reasoning
Collision between a marine mammal, basking shark or Atlantic salmon and the device or mooring system	-1	Whilst addition of new structures into the marine environment will increase collision risk for marine mammals and basking sharks it is likely that animals will be capable of detecting structures in the water, and should be broadly familiar with similar types of structures. If a collision were to occur it is possible that a marine mammal or basking shark may be injured. But given the relatively static nature of the device and its lack of surface features any harm would be very limited.

7.5 What mitigation, monitoring and optimisation measures can be applied?

No specific mitigation measures are planned but it is thought that the risk of marine mammals or basking sharks colliding with elements of the device or mooring are unlikely as these species are not present in large numbers and are capable of detecting structures in the water, and should be broadly familiar with similar types of structures.

Monitoring activities will however be carried out and will help to identify any issues should they arise. Monitoring measures will include:

- Wello Oy will support ongoing wildlife observations at EMEC through the provision of compatible data and other mechanism where possible and will undertake similarly suitable work in the event that EMEC activities come to an end
- General marine mammal and other wildlife behaviour observations will be undertaken whilst team members are on site for maintenance/inspection activities

Table 7.2 Overview of residual impacts

Key issue	Pre-mitigation	Residual impact	Post-mitigation
Collision between a marine mammal, basking shark or Atlantic salmon and the device or mooring system	-1	Unchanged	-1

8 Issue C – Potential disturbance of marine mammals and fish from underwater noise

8.1 Why is this issue important?

As discussed previously (refer to Section 7), a number of internationally protected marine mammals are known to periodically utilise the test site and surrounding area. Marine mammals, in particular cetaceans, have highly-developed acoustic sensory systems, which enable them to communicate, navigate, orientate, avoid predators and forage (SMRU, 2007). As a result, each species may be vulnerable in some degree to changes in background noise levels and will have a 'threshold' relating to effects on each of these essential activities.

Fish generally have less developed hearing sensitivity, although there is a great deal of variation between species (Thomsen *et al.,* 2006). Basking shark and Atlantic salmon are of key concern as species defined as specific conservation interests.

It is recognised that there remains a great deal of uncertainty regarding the potential effects of anthropogenic sounds on marine mammals and fish. As such, a cautious approach is required when evaluating the potential effects of subsea noise from offshore projects.

Given the protective status of the species known to utilise or simply pass through the area, it is important to fully consider any potential interactions between the proposed operations and these species.

Sources of information

The following sources of information have been used:

- Penguin device design and operation plans
- JNCC Cetaceans Atlas
- EMEC monitoring data
- Aquatera staff personal observation during vessel operations in Orkney

8.2 What are the potential impacts?

There are two mechanisms from which an impact on marine mammals and fish resulting from the generation of underwater noise may arise:

- Potential disturbance from vessels required to install and remove the device and mooring system
- Potential disturbance from device components during installation, operation and removal

These issues are considered further within this section.

8.2.1 Potential responses to noise

The potential impact on a given species will depend on the hearing sensitivity of that species, the intensity, frequency and duration of the sound generated, the extent of sound propagation underwater and the likelihood of animals being within a range at which an impact could occur.

There are five recognised levels of response to noise (Vella *et al.* 2001):

- Detection level – the noise level that the species would normally be able to detect in a quiet sea state
- Avoidance level – the noise level at which the species would start to exhibit active avoidance behaviour, such as swimming away, in order to avoid the noise level that it was experiencing
- Temporary hearing damage level – the noise level that would cause a temporary but reversible shift in the individual's hearing sensitivity, also known as a temporary threshold shift (TTS)
- Permanent hearing shift level – the noise level that would cause a permanent shift in the individual's hearing sensitivity, also known as a permanent threshold shift (PTS)
- Physical damage level – the noise level or pressure level that would result in gross physical damage to the organism's auditory system, other organs or tissue

Each species has a different hearing sensitivity. This is commonly expressed by means of an audiogram which plots the species threshold hearing level at different frequencies. This indicates the range of frequencies at which the species has the ability to hear and also the frequency range at which the species hearing is most acute. Sensitivity of species may be influenced by previous experience (i.e. sensitisation/habituation) and by the level of background ambient noise in the area (DECC, 2009).

8.2.2 Predicted noise sources and levels

A number of the proposed activities will generate underwater noise over the course of the project; from installation to decommissioning. Table 8.1 outlines the timing, source, duration and anticipated levels of noise that will be generated at relevant stages of the project.

Table 8.1 Project noise profile

Activity	Source of noise	Timing and duration	Output
Installation of moorings	Multicat	1-3 days during summer 2011	Medium sized support and supply vessel 130 to 160dB re 1µPa at 1m (Richardson *et al.*, 1995)
Installation of device	Multicat	Several days during summer 2011	Medium sized support and supply vessel 130 to 160dB re 1µPa at 1m (Richardson *et al.*, 1995)
	Tug boat	Several days during summer 2011	Tug pulling loaded barge 161-170dB re 1µPa (Richardson *et al.*, 1995)
	RHIB	Several days during summer 2011	Twin outboard 7m vessel 156dB re 1µPa (Richardson *et al.*, 1995)

Activity	Source of noise	Timing and duration	Output
	Chain pullers	3 hours during summer 2011	Standard chain (anchor) puller noise on deck
Operation of device	Back-up cooling system (2 X 2kW fans)	Throughout deployment (12 months) in high energy sea states (approximately 10% of the time)	Standard cooling fans inside hull in high sea states
Planned maintenance and monitoring	RHIB	Approximately once per month during deployment	Twin outboard 7m vessel 156dB re 1µPa (Richardson *et al.*, 1995)
	Small survey vessel	Once following deployment and prior to decommissioning	Medium sized support and supply vessel 130 to 160dB re 1µPa at 1m (Richardson *et al.*, 1995)
Unplanned maintenance	Tug	Unplanned	Tug pulling loaded barge 161-170dB re 1µPa (Richardson *et al.*, 1995)
	RHIB	Unplanned	Twin outboard 7m vessel 156dB re 1µPa (Richardson *et al.*, 1995)
	Chain pullers	Unplanned (2 hours)	Standard chain (anchor) puller noise on deck
Removal of device	Workboat	Several days during summer 2012	Medium sized support and supply vessel 130 to 160dB re 1µPa at 1m (Richardson *et al.*, 1995)
	RHIB	Several days during summer 2012	Twin outboard 7m vessel 156dB re 1µPa (Richardson *et al.*, 1995)
	Chain pullers	2 hours during summer 2012	Standard chain (anchor) puller noise on deck
Removal of moorings	Workboat	Several days during summer 2012	Medium sized support and supply vessel 130 to 160dB re 1µPa at 1m (Richardson *et al.*, 1995)

During installation and decommissioning of the Penguin there will be more than one vessel at the Penguin site. Specifically it is planned to have a multicat and a tug on site for several operations. The introduction of more than one noise source is not directly cumulative but rather it has been shown by Norton (1989) that if both vessels generate similar levels of noise then the overall increase in sound is likely to be 3dB. If there is a difference of more than 10dB between the noise levels generated by the two sources then there will be no addition to overall noise perceived underwater. Hence as a worst case the maximum noise from vessels anticipated at the Penguin site is 170dB re 1µPa at 1m (from source).

Another source of noise will be from the chain pullers on deck used to lower the roll plates during installation and lift them at decommissioning. Operation of the chain pullers will involve use of a 44kW hydraulic power pack. Based on the speed of operation of the chain puller and the depth of the roll plates, lowering is expected to take 2-3 hours and lifting 2 hours. It is not anticipated that the chain pullers will require the use of ear defenders and therefore the level of noise generated will be less than 85 dB(A)[3].

The Penguin has two cooling systems to maintain a safe working temperature in the generator. The primary system uses fluid. Device operation using this cooling system is predicted to be quiet. In

[3] UK noise at work regulations (2005): if noise levels are above 85dB then workers are required to use ear protection.

high energy wave conditions it may be necessary to use a secondary backup cooling system to maintain operating temperature in the generator. This will be achieved by use of two 2kW fans. The fans are located within the hull of the device. The noise within the operating space is anticipated to be sufficient that ear defenders are required when working inside the hull and therefore the source noise level inside the hull during times when the back-up cooling system is in operation are likely to exceed 85 dB(A).

It is not yet known what level of noise will be transmitted through the hull and into the surrounding area; both above and below surface, but it will be considerably less than the source level noise. The fan system will only be in operation during high energy wave conditions and it is not anticipated that they will be operational for more than 10% of the time. The hull is constructed using 220 tonnes of steel and contains about 1000 tonnes of concrete. It is therefore likely that much of the noise will be absorbed within the hull. It should also be noted that the levels of background noise at the wave site in sea states where this system would be required will be significant and potentially greater than that generated by the system. General noise at sea predictions suggest noise levels of around 70-80 dB (at 100-1000 Hz) from waves during rough conditions (Richardson *et al*, 1995).

8.2.3 Likely responses to noise

Using a methodology outlined in Nedwell and Howell (2004) this source noise level would not be sufficient to exert an avoidance reaction in marine mammals but it may cause a behavioural response. Although the methodology is widely used it is questioned by some who highlight that it relies on imperfect knowledge.

Thiele (2006) used a more standard approach to investigate the potential impact of noise from ships used to construct offshore wind turbines. The finding was that the zone of responsiveness for harbour seal and harbour porpoises from a source noise level of 160dB re 1µPa at 1m, would be within 400m (depending on the frequency) and that TTS would only be possible at very close distances (<10 m).

In either case however, it is suggested that there would only be minor behavioural responses to the noise levels anticipated and that the workboats preset during installation and other operations will be the main, and only significant, source of noise.

Whilst noise sensitivity has been considered in terms of pressure for mammals, the same analysis cannot be performed for basking shark. Most fish (including the sharks) primarily hear by detecting particle motion and use an accelerometer-like system as the basis for hearing. This system limits hearing sensitivity. Some fish may also be able to detect sound pressure if they have anatomical structures that bring the inner ear and an air bubble into close proximity, enhancing the ability of a fish to detect and use sound pressure signals. Specific experiments are necessary to demonstrate that a given species is sensitive to sound pressure. At present, there is no reliable way to classify them as sound pressure sensitive or not based on comparative anatomy; only specific functional experiments

can do this (Popper and Fay, 2010). Thomsen *et al.* (2006) review studies of the effect of shipping on fish and conclude that "*The data currently available on the response of fish to sounds is not yet sufficient to develop scientifically supportable guidance on exposure to sound that will not harm fish*".

There is limited research on Atlantic salmon hearing sensitivity and no known literature on basking shark hearing sensitivity. Fish are generally less sensitive to sound on an anatomical basis than marine mammals (Nedwell *et al*, 2004). It can be therefore be assumed that zones of responsiveness for fish will be less than those calculated for marine mammals. Direct observation by Aquatera staff of basking sharks near to operating ships and smaller boats has over the years shown them to be unresponsive to even close encounters with such craft. This further suggests that they are not a noise sensitive species.

The noise generated by the chain pullers would be similar to that generated by pulling in an anchor whilst the hydraulic power pack is of a lower power than most ships engines so noise levels would be expected to be lower than from a medium sized ship. These types and levels of noise are common in the marine environment and thus are not considered to cause a response in marine mammals or basking sharks above that expected by regular shipping small-scale activities commonly undertaken in Orkney's coastal waters.

Noise levels from the backup fan cooling system are not yet known but any detectable noise will only be generated for short periods during the project. Given the relative sensitivity of the site in terms of marine mammals and fish activity, it is not anticipated that any response above localised and temporary behaviour changes, such as increased alertness, would occur.

Table 8.2 Overview of potential impacts

Key issue	Ranking	Reasoning
Potential disturbance from vessels required to install and remove the device and mooring system	-2	Noise levels generated by vessels are predicted to be of level that would at most cause a temporary avoidance reaction in marine mammals and fish. Any disturbance will be limited in level and duration.
Potential disturbance from device components during installation, operation and removal	-1	Noise levels generated by roll plate lowering are likely to be similar in level and composition as noise generated by raising and lowering an anchor on a ship. Any disturbance will be limited in level and duration. Noise levels penetrating underwater from the backup cooling system are unknown but will be intermittent in nature and are unlikely to cause more than a localised avoidance reaction.

8.3 What mitigation, monitoring and optimisation measures can be applied?

Mitigation measures:

- The final stages of operational planning shall minimise sea time for tugs and workboats as far as practically possible.
- The back-up cooling system will only be used when absolutely necessary, normally in rough weather where the sea itself will generate most noise.
- Vessel crews will keep a lookout for sea mammals and basking sharks at all times. Vessel crews will be briefed on marine life sensitivities and will have ID materials supplied.
- Vessel operations will be limited to quiet activities if marine mammals or basking sharks are sighted in close proximity (<500m) to the works, unless safety considerations require an activity to continue.

Monitoring measures:

- General marine mammal and basking shark observations will be recorded during all onsite activities
- The noise signature of the back-up cooling system will be defined (refer to the EMP)
- Wello will support ongoing wildlife observations and will undertake similarly suitable work in the event that EMEC activities come to an end (refer to the EMP)
- General marine mammal and other wildlife behaviour observations will be undertaken whilst team members are on site for maintenance/inspection activities

8.4 What are the residual impacts?

The possible residual impacts are outlined in Table 8.3. It can be seen that whist the low level of device noise cannot be easily mitigated, the levels of vessel noise can be controlled so as to reduce and avoid any harmful disturbances. The residual impacts from noise are therefore judged to be minor.

Table 8.3 Overview of residual impacts

Key issue	Pre-mitigation	Residual impact	Post-mitigation
Potential disturbance from vessels required to install and remove the device and mooring system	-2	Avoiding any powerful manoeuvring whilst sea mammals or basking sharks are close by will avoid more disturbing noise levels	-1
Potential disturbance from device components during installation, operation and removal	-1	Unchanged	-1

9 Mitigation Plan and Commitments Register

Based upon the potential key issues associated with the proposed development, the impact assessment process undertaken and stakeholder consultation, the following Mitigation Action Plan and Commitments Register has been developed (Table 9.1).

Table 9.1 Mitigation action plan and commitments register

Commitment	Action holder	Status
All stages		
Local contractors will be used as far as practically and economically possible	Developer and all subcontractors	Underway
Local facilities will be used as far as practically and economically possible	Developer and all subcontractors	Underway
Ensure vessel engines are working efficiently and minimise fuel use as much as possible. All vessels will operate to IMO standards (refer to MARPOL Annex VI)	Vessel operators and Operations Manager	Yet to start
Planning and construction		
Regular press updates leading up to deployment and suitable public consultation should generate interest and a degree of support around the project	Developer	Yet to start
Vessel anchoring will be limited to when necessary	Vessel operators and Operations Manager	Yet to start
The final stages of operational planning shall minimise sea time for tugs and workboats as far as practically possible	Project team	Underway
Design device and moorings to allow the use of small workboats, reducing the potential for disturbance	Developer	Completed
Plan operations to reduce vessel time at sea	Project team	Completed
Design device with no external moving parts to minimise potential for disturbance	Developer	Completed
Design mooring system with minimal profile to reduce risk of collision from animals	Mooring system design team	Underway
Design mooring system with embedment anchors to remove the need for subsea excavation and minimise the footprint of the mooring system, reducing the impact on seabed habitat and benthic species	Mooring system design team	Underway
Select mooring system with lines under tension and with sufficient bend ratio to remove the risk of entanglement	Mooring system design team	Underway

Installation		
ROV survey will be undertaken as soon as possible following installation of moorings to assess the level of impact on the seabed and to inspect the moorings and umbilical connection	Developer	Yet to start
NTMs will be issued in accordance with EMEC SOP	Operations Manager	Yet to start
Placement of clump weights will be as accurate as possible to ensure minimal 're-positioning'	Vessel operator	Yet to start
Anchors and clump weights will as far as possible, be removed in a single attempt so as to reduce disturbance	Vessel operator	Yet to start
Device operation		
Power output and efficiency will be monitored during testing	Developer	Yet to start
Wildlife observations at test site	Wello (through EMEC)	Underway
Seabed survey will be conducted prior to decommissioning to investigate any effects on seabed character, benthic communities, colonisation patterns	Developer	Yet to start
Wello will support ongoing wildlife observations at EMEC through the provision of compatible data and other mechanisms where possible and will undertake similarly suitable work in the event that EMEC activities come to an end (refer to Environmental Monitoring Plan)	Developer	Yet to start
General marine mammal and other wildlife behaviour observations will be undertaken whilst team members are on site for maintenance/ inspection activities	Offshore team	Yet to start
The back-up cooling system will only be used when necessary	Developer	Yet to start
The noise signature of the back-up cooling system will be defined	Developer	Yet to start
Decommissioning		
Post-decommissioning seabed survey will be undertaken after all structures have been removed to establish the effects of the process on the seabed	Developer	Yet to start
Regular press updates leading up to decommissioning should generate interest and a degree of support around the project	Developer	Yet to start

Wello is fully committed to cooperating and liaising with EMEC at all times throughout the proposed deployment. Based on the findings of this ES and future consultation with key stakeholders, a standalone Environmental Monitoring Plan will be developed and implemented as and when appropriate.

10 Overview of residual impacts

No potentially significant impacts are anticipated to manifest from the proposed deployment and associated operations. However, a number of measures have been identified which have the potential to further reduce the likelihood or consequences of the potential interactions with the receiving environment; further reducing the overall potential impact of the project (refer to Section 9). Wello is committed to undertaking these measures and the outcome of doing so in relation to the potential issues identified is presented within the updated impact assessment matrix in Appendix C and summarised below:

Ref	Issue	Potential significance	
		Pre-mitigation	Post-mitigation
A	Seabed disturbance during installation and removal of mooring system	Minor	Minor
B	Disturbance to marine mammals and fish from the presence of the mooring system and device	Negligible	Negligible
C	Potential disturbance of marine mammals and fish from underwater noise	Minor	Negligible
D	Disturbance to other sea users from support vessel activity and sustained presence of structures offshore	Negligible	Negligible
E	Change in local seascape through increased activity and sustained presence of the device	Negligible	Negligible
F	Disturbance to seabed communities and during connection to and disconnection from the EMEC connector.	Minor	Negligible
G	Temporary change in water quality during installation and removal activities	Negligible	Negligible
H	Effects on air quality from vessel emissions	Negligible	Negligible
I	Effects on marine birds from vessel operations and device presence on the test site	Negligible	Negligible
J	Effects on marine fish from EMF emitted during electricity transmission	Negligible	Negligible
K	Effects on flows and fluxes from the presence of subsea structures	Negligible	Negligible
L	Employment opportunities for local residents and businesses	Majorly positive	Majorly positive
M	Utilisation of local infrastructure and subsequent investment in local services and economy	Positive	Positive
N	Generation of marine renewable energy will contribute towards government targets	Positive	Positive

11 Potential effects on Natura interests

European Directives and supporting UK and Scottish Regulations have afforded special protection to a number of habitats and species that are considered to be of prime importance for conservation. A key component of the strategy is the establishment of a network of sites which hold representatives of many of these habitats and species. This is known as the Natura Network.

Under the regulations regarding this network, there is a requirement for the Competent Authority to consider the potential effects of any proposed plan or project upon the primary and qualifying features of Natura Sites as well as the relevant conservation objectives. This is achieved by undertaking a Habitat Regulation Assessment (HRA) which consists of the following tasks:

1. The identification of possible Natura Sites that could be affected by a proposed plan/project
2. A test of Likely Significant Effect (LSE) on primary and qualifying features as well as the relevant conservation objectives
3. An Appropriate Assessment (where it is anticipated that LSE is possible)

In order to identify the Natura Sites relevant to the proposed project, the team has drawn significantly from the "Report to Inform Appropriate Assessment for the Pentland Firth Strategic Area (PFSA) Leasing Round" (ABPmer, 2010) as commissioned by the Crown Estate. This report considers the potential effects on Natura Sites of the Crown Estates' wet renewable leasing work within the PFSA (which constitutes a 'plan' and must undergo its own HRA).

Please note that this section draws on the conclusions made within the main body of this Environmental Statement; particularly those in Sections 6, 7 and 0.

11.1 Identification of relevant sites and features

11.1.1 Identification of Special Areas of Conservation

The Crown Estate report (ABPmer, 2010) identified a number of SACs for which there is a potential LSE. Each Site was considered within the context of four assessments:

- Potential for adverse effects on habitat features
- Potential for adverse effects on marine mammal features
- Potential for adverse effects on otter features
- Potential for adverse effects on fish and freshwater pearl mussel features

Within each of these categories, a number of habitats and species were identified with which there was the potential for the leasing round to have a LSE. These are summarised below:

- Habitat features
    - Reefs
    - Subtidal sandbanks

    - Intertidal mudflats and sandflats
    - Supralittoral dune habitats
- Marine mammal features
    - Common (harbour) seal (*Phoca vitulina*)
    - Grey seal (*Halichoerus grypus*)
    - Bottlenose dolphin (*Tursiops truncates*)
- Otter features
    - Otters (*Lutra lutra*)
- Fish and freshwater pearl mussel features
    - Freshwater pearl mussel (*Margaritifera margaritifera*)
    - Atlantic salmon (*Salmo salar*)
    - Sea lamprey (*Petromyzon marinus*)

Based on these conclusions, the following criteria were developed for identifying the SACs relevant to the proposed development:

- Habitat features – SACs within a 100km buffer zone with relevant qualifying features
- Marine mammal features – SACs for seals and cetaceans within 100km of the proposed development area (buffer zone defined within the Crown Estate report (ABPmer, 2010))
- Otter features – none – no onshore works planned, no cable lay and all works in excess of 50m water depth offshore
- Fish and freshwater pearl mussel features – SACs along the north coast of Scotland from/to which migratory fish could feasibly be passing through the proposed development and adjacent areas during migration

Note – given the type and scale of development, it is considered highly unlikely that any salmon migrating to/from the SACs along the North Coast of Scotland would be hindered in any way by the development and associated operations. Therefore, it is proposed that these sites are not considered further than the initial assessment (refer to Table 11.1); but should SNH/Marine Scotland advise that either identifies a potential link between the proposed development and these sites, they can be included.

The map presented in Figure 11.1 was used to confirm site locations and proximity to buffer zone limits.

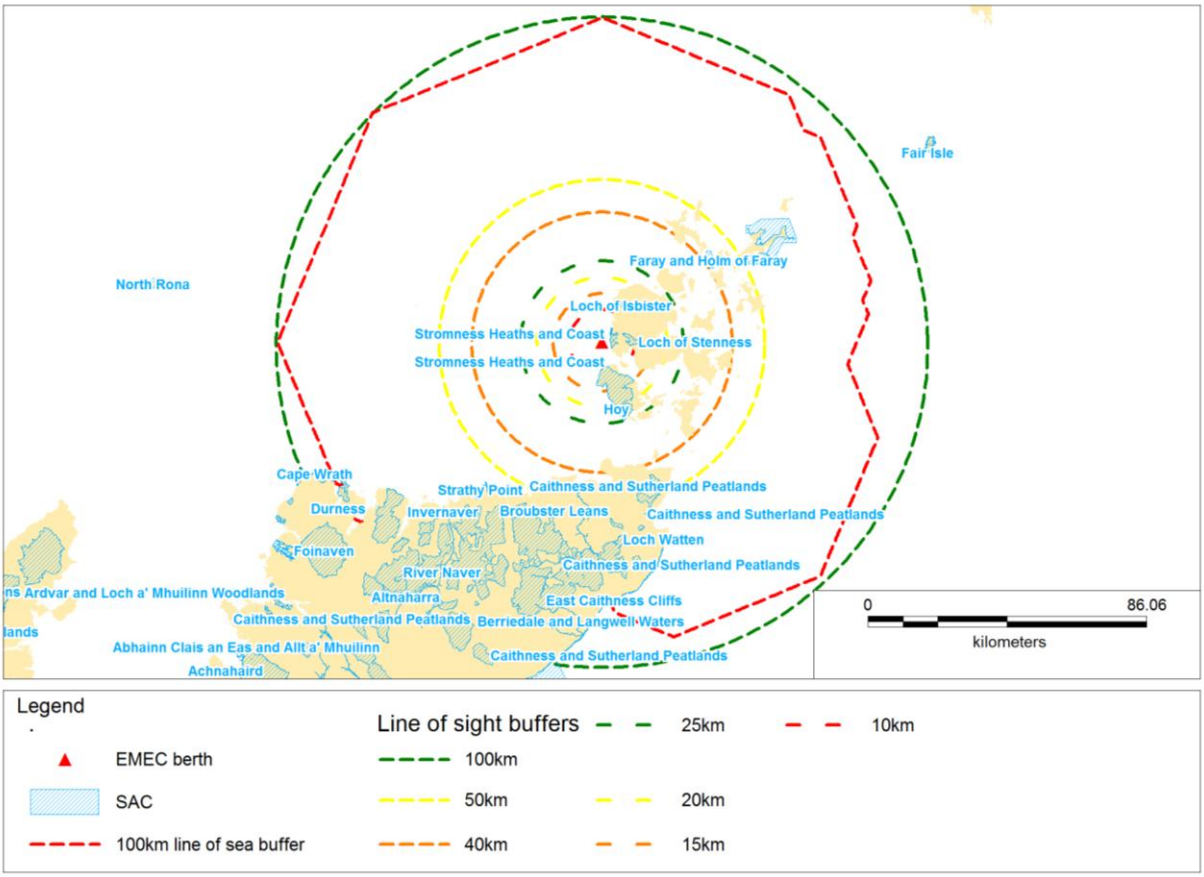


Figure 11.1 SACs and buffer zones

Through this process, the SACs presented within Table 11.1 are deemed to be potentially relevant to the proposed development and will undergo screening. The sites identified through this process, will undergo an LSE test within the ES and any potential impacts on qualifying features/conservation objectives, will be fully considered and assessed.

Table 11.1 SACs considered relevant to the proposed project

Protected site	Annex I Habitat – primary reason	Annex I Habitat – qualifying feature	Annex II Species – primary reason	Annex II Species – qualifying feature	Comment
Faray and Holm of Faray	None	None	Grey seal	None	It is theoretically possible that seals from this SAC forage/utilise the area proposed for deployment.
River Borgie	None	None	Freshwater pearl mussel	Atlantic salmon Otter	Given the distance to the site no link has been identified between the qualifying features and the conservation objectives of this SAC
River Naver	None	None	Freshwater pearl mussel Atlantic salmon	None	Given the distance to the site no link has been identified between the qualifying features and the conservation objectives of this SAC
River Thurso	None	None	Atlantic salmon	None	Given the distance to the site no link has been identified between the qualifying features and the conservation objectives of this SAC
Sanday	Reefs	Sandbanks which are slightly covered by sea water all the time. Mudflats and sand flats not covered by sea water at low tide	Common seal	None	It is theoretically possible that seals from this SAC forage/utilise the area proposed for deployment.

Therefore, the SACs that will be considered further are:

- Faray and Holm of Faray SAC (grey seal)
- Sanday SAC (common (harbour) seal)

11.1.2 Identification of Special Protection Areas

The Crown Estate report (ABPmer, 2010) identified a number of SPAs for which there is a potential LSE from the PFSA Leasing Round. This report concluded that there was a possibility of a LSE (or that it was not possible to conclude no LSE) for eighteen breeding seabird species that were qualifying features of these sites. These species, along with their buffer zones (based on foraging distance) are presented in Table 11.2.

Table 11.2 SPA features and presented buffer zones

Species	Presented buffer (km)
Red-throated diver	13
Fulmar	50
Manx Shearwater	330
European Storm Petrel	100
Leach's Storm Petrel	100
Gannet	-
Cormorant	35
Shag	17
Common Scoter	-
Arctic Skua	10
Great Skua	31
Herring Gull	54
Great Black-backed Gull	40
Kittiwake	50
Arctic Tern	25

Common Guillemot	50
Razorbill	50
Puffin	50

The map presented in Figure 11.2 was used to confirm site locations and proximity to buffer zone limits. These buffer zones have been used to identify the SPAs considered relevant to the proposed project (Table 11.3). Those species identified as having a possible LSE with the development site (those with foraging distances that could potentially overlap with the proposed development site) are highlighted in green for each site (Table 11.3). Qualifying species not deemed relevant by the AA (ABPmer) are listed in *blue italics*.

Note – 'seabird assemblage' is not included as the specific relevant species within the assemblage are considered individually (those marked *).

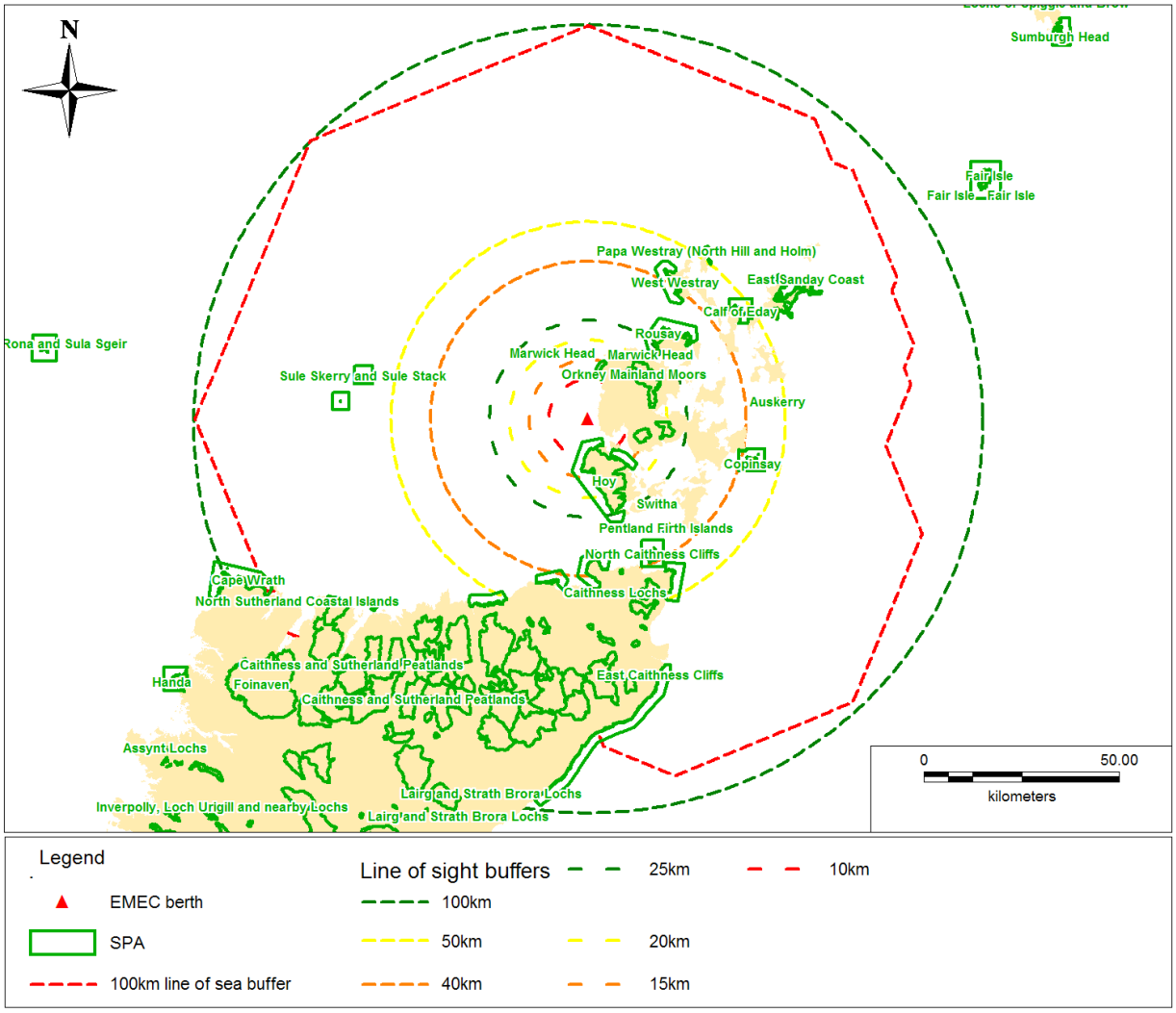


Figure 11.2 SPAs and buffer zones

Table 11.3 SPAs considered relevant to the proposed project

SPA	Relevant qualifying species * part of seabird assemblage
Auskerry	Storm petrel Arctic tern
Calf of Eday	Fulmar* Guillemot* Kittiwake* Great black-backed gull* Seabird assemblage Cormorant*
Copinsay	Fulmar* Guillemot* Kittiwake* Great blacked-back gull* Seabird assemblage
Hoy	Fulmar* Kittiwake* Common guillemot* Puffin* Red-throated diver Arctic Skua* Great Skua Great black-backed gull* Seabird assemblage *Peregrine*
Marwick Head	Guillemot Kittiwake* Seabird assemblage
North Caithness Cliffs	Fulmar* Kittiwake* Razorbill* Puffin* Common Guillemot Seabird assemblage *Peregrine*
Rousay	Arctic tern Fulmar* Guillemot* Kittiwake* Seabird assemblage Arctic skua*
Rum	Manx shearwater Seabird assemblage Red-throated diver Kittiwake* Guillemot* *Golden eagle*
St Kilda	Manx shearwater* Gannet Seabird assemblage Leach's petrel Storm petrel Great skua Puffin Razorbill* Guillemot* Kittiwake* Fulmar*
West Westray	Fulmar* Guillemot Kittiwake* Razorbill* Seabird assemblage Arctic tern Arctic skua*

Therefore, each of these SPAs will be considered within the ES with particular focus on those species identified (highlighted in green).

11.2 Assessment of potential connectivity

11.2.1 Special Areas of Conservation

Table 11.4 outlines the SACs identified in Section 11.1.2 as relevant to the proposed project, the relevant qualifying features and conservation objectives.

Table 11.4 Relevant SACs, qualifying feature(s) and conservation objective(s)

SAC	Relevant qualifying feature(s)	Relevant conservation objectives(s)
Sanday	Common (harbour) seal	To avoid deterioration of the habitats of qualifying species (Common seal *Phoca vitulina*) or (Grey seal *Halichoerus grypus*)or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying interest. To ensure for the qualifying species that the following are maintained in the long term: • Population of the species as a viable component of the site • Distribution of the species within site • Distribution and extent of habitats supporting the species • Structure, function and supporting processes of habitats supporting the species • No significant disturbance of the species
Faray and Holm of Faray	Grey seal	

As discussed in Sections 7 and 0, whilst both harbour and grey seals have been observed within the test site, this assessment has concluded that no adverse impacts on either species are anticipated. There are no recognised mechanisms for injury other than highly unlikely collision events which are highly improbable given the position, scale and character of the device and its mooring system along with the proximity of the sites to the deployment location. It is proposed that the project will not adversely affect the qualifying features or the conservation objectives of the Sanday SAC or the Faray and Holm of Faray SAC.

11.2.2 Special Areas of Protection

Table 11.5 outlines the SPAs identified in section 11.1.1 as relevant to the proposed project, the relevant qualifying features and conservation objectives.

Table 11.5 Relevant SPAs, qualifying feature(s) and conservation objective(s)

SPA	Relevant qualifying feature(s)	Relevant conservation objectives(s)
Auskerry	Storm petrel	To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and To ensure for the qualifying species that the following are maintained in the long term: • Population of the species as a viable component of the site • Distribution of the species within site • Distribution and extent of habitats supporting the species • Structure, function and supporting processes of habitats supporting the species • No significant disturbance of the species
Calf of Eday	Fulmar Guillemot Kittiwake	
Copinsay	Fulmar Guillemot Kittiwake	
Hoy	Fulmar Kittiwake Common guillemot Puffin Red-throated diver Arctic Skua Great Skua Great black-backed gull	
Marwick Head	Guillemot Kittiwake	
North Caithness Cliffs	Fulmar Kittiwake Razorbill Puffin	
Rousay	Arctic tern Fulmar Guillemot Kittiwake	
Rum	Manx shearwater	
St Kilda	Manx shearwater Gannet	
West Westray	Fulmar Guillemot Kittiwake Razorbill	

Based upon this list the following individual species are of key interest if they frequent the area:

- Fulmar
- Guillemot
- Kittiwake
- Puffin
- Razorbill
- Gannet
- Arctic tern
- Red-throated diver
- Arctic Skua
- Great black-backed gull
- Storm petrel
- Manx shearwater
- Great Skua

Possible impact mechanisms

The Wello device is essentially an unusually shaped, non-powered ship, permanently anchored in place. The installation of the device will take place over 4 phases; installation of the moorings, attachment of the device, lowering of the roll plates and connection of the cable. The anticipated duration of the installation phase is around 1-2 weeks, currently timetabled from June 2011. The fundamental question is therefore whether there is any credible pathway for such a device and its

deployment activities to affect the conservation objectives associated with any qualifying species from SPAs that could be in the area.

An overview of the possible influences that the Penguin device could have on the defined conservation objectives for the relevant sites is provided in Table 11.6.

Table 11.6 Potential for the Penguin deployment to influence defined conservation objectives

Conservation objectives	Potential for Penguin device to influence conservation objectives	Potential for support operations to influence conservation objectives	Conclusion on impacts on integrity of sites
Maintain population of the species as a viable component of the site	Device is a smooth hulled single body, mooring lines will always be tensioned, no evidence of entanglement in mooring lines from any industrial sector	Small work vessels are planned for this deployment, they may have bow thrusters and traditional propellers but are unlikely to be fitted with ducted power systems	No mechanism for harm or mortality to individual animals, nor to disturbance within any site which could alter distribution and therefore populations
Maintain distribution of the species within site	The device will not be noisy, any wave slap will be less than the turbulence from the waves themselves	There will be no affects on designated sites	The device lies away from any sites and will not affect distribution of species within any sites
Maintain distribution and extent of habitats supporting the species	Deployment of, device, 3 anchors, chain and cable will not alter habitats, supporting qualifying species	There will be no affects on habitats at designated sites	The device will have no significant effects upon habitats supporting any species
Maintain structure, function and supporting processes of habitats supporting the species	Deployment of, device, will have negligible effects upon the structure and function of areas where qualifying species forage or migrate	General vessel operations and deployment of 3 anchors, chain and cable will have negligible effects upon the structure and function of areas where qualifying species forage or migrate	Very localised changes to the behaviour of nearby fish and mobile seabed fauna, through aggregation or minor reef affects may result from deployment of the device. This will not affect the ability of the sea area to provide suitable functions and processes
No significant disturbance of the species	Deployment of, device will be a small scale localised operation, lasting at most a few years	Vessel operations will be little different to existing work boat and creeling operations along the coast. No noticeable impacts noted	The device will not be noisy, it will move rhythmically in the sea, it has no outer moving parts and will therefore not disturb any species. Vessels are of a type typically working in the area

The only mechanism where there is a possible connection between the technology and local species relates to a possible reef affect on local fish and mobile seabed species, these may then become prey

for certain qualifying species. Such an effect is only going to affect a relatively small area and may even be transient or seasonal.

The observations of the relevant species across the area (refer to section xxxx) show that although the test site is used by a variety of species, it does not hold particularly high concentrations or serve any particularly important function for any of the relevant species.

Given the lack of obvious impact stimuli, wide distribution of the relevant species of interest and the evidence from coastal observations that this site area is not particularly sensitive in relation to key Natura Interests, then it is concluded that no Likely Significant Effects will arise from the proposed activities.

In combination effects

Given the conclusion reached above, that there are no likely significant effects from this Wello deployment, for any significant cumulative effects to arise it would be necessary for the non significant effects to interact with other similar or connected impacts to reach a significant threshold. It is unlikely that such synergies exist with other projects to lead to cumulative issues.

Other deployments at the EMEC test site will be of single devices. Some of these may happen whilst the Wello device is deployed, however, the combined impacts from such co-current deployment activity is still likely to be insignificant.

12 Cumulative effects

Best information to date would suggest that there are very few impacts likely to arise from the deployment of the Wello device. The potential for cumulative effects is therefore expected to be limited.

The other projects and activities that could lead to possible interactions as follows:

- Other EMEC deployments, considered to comprise Aquamarine's installation of Oyster II, EONs deployment of P2, SPR's deployment of P2 and the possible deployment of Ocean Power Technologies' Powerbuoy
- PFOW lease activity, which within the timescales of the Wello deployment is likely to be limited to survey work
- Other project activities such as installing a new transmission cable, and improvements to Stromness Harbour
- Existing activities, such as fishing shipping and recreational activity

The extent of activity associated with the EMEC site, even with up to five developers, will be co-ordinated by EMEC through their permit to work system. This is primarily established to manage safety issues but does give a mechanism for controlling activities should the need arise. The planned timing of the Wello deployment during 2011 and 2012 should avoid interactions with the PFOW project activities. The other project activities are so distant from the proposed deployment that even if they were concurrent in timing there will not be any potential for cumulative impacts.

Existing activities in the vicinity of the deployment include: shipping activity which, as is presented in the NRA, mostly transits to the west of the test site; creel fishing which takes place mostly along the coast to the east of the test site and recreational boating/sea angling which is a less intense activity, again mostly along the coast.

13 Accidental and unplanned events

In addition to the potential impacts and opportunities associated with the Wello project that are anticipated to arise from planned activities, there are a number of accidental or unplanned events which may occur during the lifetime of the project. Whilst the likelihood of such an event occurring is extremely low, the consequences could be significant. It is therefore, important to understand the potential effects of such events and to identify the measures put in place to help ensure that they do not occur as well as to have contingencies in place to action in the unlikely event that they do.

This section addresses the potential accidental and unplanned events associated with the proposed project using a similar process to that used to identify and assess the key issues associated with planned activities in previous sections. The methodology involves:

1. Identification of potential high level events
2. Screening of events for potential environmental interactions
3. Scoring of interactions using EMEC's assessment criteria
4. Grouping of impacts into key issues
5. Identification of mitigation, optimisation and contingency measures
6. Identification of residual impacts

13.1 Identification, screening and classification of high level events

Based on previous experience, consultation with key stakeholders, and the outcomes of the project specific Navigational Risk Assessment (NRA), the following accidental and unplanned events were identified as appropriate for further consideration:

- Support vessel grounding/foundering
- Mooring system failure resulting in the device becoming errant
- Support vessel collision with third party vessel
- Support vessel or third party vessel collision with the Penguin
- Loss of equipment overboard

Each event has been screened for potential environmental interactions and each potential interaction has been classified (see Table 13.1) as per the impact classification criteria outlined in EMEC EIA guidance for developers (2008), shown Table 5.1. Impact scores therefore represent the worst case impact should the accidental or unplanned event occur and do not make allowance for the likelihood of a given event occurring (see note below). Each potential interaction was then grouped into a potential 'key issue' (refer to Table 13.1 and Table 13.2).

Note – the overview provided within this section should be read in parallel with the project Navigational Risk Assessment (NRA) report which addresses all issues around navigational risk and presents the relevant mitigation measures and any appropriate emergency response plans (ERPs).

Table 13.1 Identification and assessment of unmitigated accidental and unplanned events and identification of 'key issues'

Phase/Activity	Seabed character	Hydrography	Seabed sediment quality	Air quality	Water quality	Climate	Coastal processes	Coastline character	Seabed communities	Intertidal communities	Plankton	Marine fish	Marine birds	Marine mammals	Commercial fishing	Shipping	MOD operations	Oil and gas activities	Cables and pipelines	Local residents	Local supply chain	Local infrastructure	Amenity /leisure	Archaeology	Air traffic	Seascape	Protected habitats	Protected species	Geological areas	Landscape designations	Built heritage
Support vessel grounding/foundering	B		B		B			B	B	B	B	B	B	B	A	A		A	A	C	D		A			C	B	B		B	
Mooring failure resulting in errant device	B		B		B			B	B	B	B	B	B	B	A	A		A	A	C	D		A			C	B	B		B	
Support vessel collision with 3rd party vessel	B		B		B			B	B	B	B	B	B	B	A	A		A	A	C	D		A			C	B	B		B	
Support vessel/3rd party vessel collision with device	B		B		B			B	B	B	B	B	B	B	A	A		A	A	C	D		A			C	B	B		B	
Loss of equipment overboard	C		C		C			C	C	C	C			C					C	C	D		C				C	C			

Table 13.2 Key issues around unplanned and accidental events

Ref.	Key issue	Ranking
A	Collisions with the device or vessels	Major
B	Chemical contamination following a collision event or structural failure	Major
C	Impacts of structural debris/lost equipment	Minor
D	Employment opportunities around contingencies and unplanned works	Positive

As shown, there are two issues which would result in potentially significant effects (defined as moderately negative or greater) which will be addressed further. These are:

- Collisions with the device or vessels
- Chemical contamination following a collision event or structural failure

Each impact mechanism is discussed further in Sections 13.2 to 13.3.

13.2 Collisions with the device or vessels

13.2.1 Why is this issue important?

This issue was considered to be the most important by local fishing representatives during consultation and therefore, has been considered in some detail. There are three mechanisms for collision:

- The Penguin becoming errant and a collision event with a passing vessel
- A third party vessel becoming errant and colliding with the Penguin on station
- A support vessel becoming errant and colliding with a third party vessel or the device on station

The types of vessels that operate within surrounding waters include:

- Dive boats
- Creel boats
- RNLI lifeboat
- Visiting and local recreational boats
- Large vessels (passenger ferries, cruise liners, tankers, naval vessels)

Any collision between an errant vessel and the device or vice versa, could lead to costly damage to the device in addition to damage and danger to the vessel(s) concerned. Collisions can lead to hull damage and therefore, the risk of vessel foundering. The impact of a collision could also lead to injuries to people onboard the vessel/device/nearby vessels or spillage of pollutants which are harmful to the environment.

13.2.2 What are the potential impacts?

Installation and decommissioning of the Penguin device and its moorings will involve the presence of up to three vessels at the Billia Croo wave test site (a tug boat, a multicat and a RHIB) at any one time over a few days. During the operational phase it is unlikely that more than one support vessel (small workboat or RHIB) will attend the Penguin berth at any one time. Maintenance is scheduled on site once a month and monitoring vessels may also visit the site. There is potential that unplanned maintenance will involve removal of the device to Lyness.

If a collision between a support vessel and another vessel or the device and a vessel occurs, there are a number of consequences that may arise. These include:

- Hull damage to vessel and subsequent fuel leaks
- Impact/momentum injuries
- Device damage and subsequent structural failure/chemical leaks
- Damage to support vessels
- Project delays

Although the potential for collision exists, the likelihood of a collision event occurring within the period of exposure has an impact upon the actual risk that arises. The EMEC test site lies out with the main shipping lanes of the Pentland Firth. The device will be located within the test site which is clearly marked on all navigational charts as an area to be avoided and on site by cardinal buoys as required by the Northern Lighthouse Board (NLB). There is however a limited amount of commercial shipping in the vicinity of the device. All larger vessels usually pass at substantial distance from the test site, but there are the up to 10 local creel boats that use the nearby area. The most recent Marine Accident Investigation Branch (MAIB) statistics report that the incident rate for any collisions in fishing vessels under 15m length is 1 incident per 919 vessel years (MAIB, 2009) for frequency of any collision with any structure during all of the vessel's activities, this return rate is clearly outside of the time span envisaged for device deployment and indicates that an incident is very unlikely. The small size of these vessels should also strongly restrict the consequence of a potential collision.

A Health and Safety Executive database and report (HSE, 2003) into vessel collisions with offshore oil installations in the North Sea is summarised by vessel type in Figure 13.1.

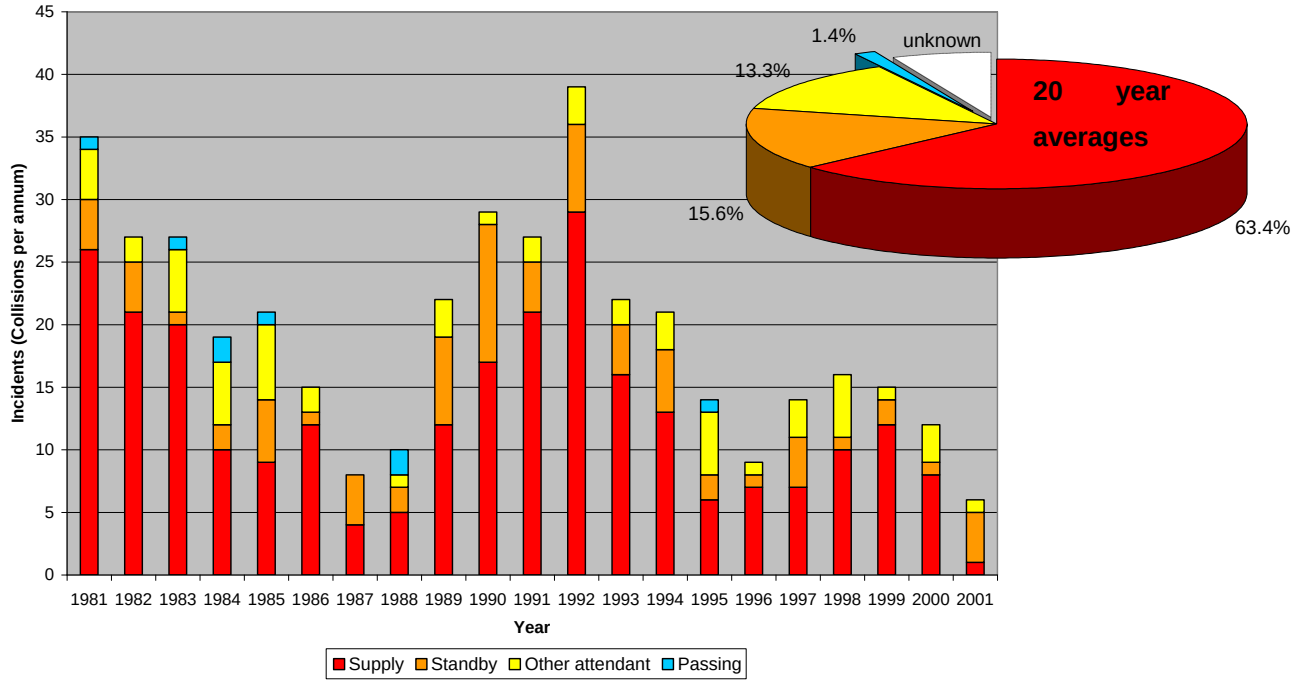


Figure 13.1 Vessel collision with North Sea Oil platforms 1981-2001 by vessel activity type

This indicates that, during over 20 years of operation of more than 100 platforms, only 1.4% of recorded collisions involved vessels that were not either supply, support or other attendant vessels directly involved in the operation of the installation. This factor implies that the risk to third party vessels in this instance is significantly lower than the mean collision frequencies quoted.

A catastrophic failure of the mooring system would have to occur in order for the device to become errant. As such, it could founder or ground itself and pose an additional navigational risk to a passing vessel. The final stages of the mooring design process are underway and will go through the required third party verification (TPV) process (similar to that of the device itself). The system will have sufficient built in redundancy to ensure that, should a single component fail, the remaining system will be able to hold the device until the relevant Emergency Response Procedures (ERPs) are put into action. Such an event would be a major setback in the development of the technology and every measure possible will be put in place to ensure that system failure does not occur. Please refer to the NRA (section reference) for further consideration of this issue.

There are a number project specific factors that will serve to minimise the potential for a collision or other accidental event with the device. These include:

- The device will be marked as per NLB recommendations
- The device and mooring system will be Third Party Verified
- All mariners will be notified regarding the presence of the device as per EMEC's Notifications Procedure
- Support vessels will be travelling at slow speeds

In addition the availability of locally based tugs and other support vessels to respond to any emergencies will help to minimise the risk of collision and the impacts of a collision.

Given that the consequence of a collision or similar event could be very serious; even though the frequency is low, the possible level of impact is judged to be ***major.***

13.2.3 What mitigation and optimisation measures can be applied?

A number of factors will serve to minimise the potential for a collision or other accidental interaction with support vessels including:

- Only vessels appropriate for the task and in good condition will be used
- The lead contractor will contact the Hydrographical Office, who will then communicate the location and nature of the activities and potential obstruction though the Notices to Mariners
- Appropriate communications with Marine Services and relevant vessel operators
- Competent crew familiar with Orkney waters or similar will be utilised where available
- Vessels will be marked appropriately in accordance with IRPCS requirements
- Both installation and decommissioning operations are of limited duration and will only be undertaken in fair conditions

- Detailed method statements will be applied during all phases of the installation
- The installation will be overseen by a marine coordinator with significant experience relevant to the types of operation being carried out
- Specific task risk assessment and tool box talks will be carried out before crucial tasks
- The tow tug will be available to assist third party vessels in the event of lost power or control
- The vessel(s) involved are marked/lit in accordance with COLREGS[4] as appropriate to their activities
- Special project operating procedures will be developed to minimise risk of contact/collision by project vessels

It is expected that these measures will reduce the likelihood of an incident still further than that outlined above and it will be perfectly feasible for the device to be installed, monitored, maintained and removed without incident.

13.2.4 What are the residual impacts?

*It is anticipated that the project can be undertaken without any collisions arising and thus **no** impact or interaction is expected from this issue.*

13.3 Chemical contamination following a collision event or structural failure

13.3.1 Why is this issue important?

The west coast of Orkney can be a hazardous area for shipping. The conditions mean that mechanical failure or human error could quickly lead to an incident. Such an incident could cause chemical contamination with associated environmental implications. Suitable precautions must therefore be taken to avoid accidents in the first instance and also to ensure that, in the unlikely event of their occurrence, an effective response can be mounted.

13.3.2 What are the potential impacts?

There is potential for vessel-vessel collision, vessel-device collision, or structural failure of the device to cause the release of pollutants. The quantities of fuels held on the installation support vessels and the device are in the order of single to tens of tonnes. These are relatively small quantities but in the event of a spill, they could lead to localised but serious impacts. The effects that could arise include shoreline smothering and the coating of birds and other marine wildlife. Additionally, other sea users within the wider area may also be affected by any offshore pollution. Coastal use by local residents and visitors may be affected by any shoreline pollution.

*Given the relatively small amount of fuel involved, but also given the hazardous nature of the area and the range of sensitivities present the possible level of impact is judged to be **major**.*

[4] Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs)

13.3.3 What mitigation and optimisation measures can be applied?

A number of factors will serve to minimise the potential for incidents:

- Only vessel appropriate for the task and in good condition will be used
- Detailed method statements will be applied throughout all phases of the installation
- Appropriate communications will be maintained throughout the operation
- Competent crew familiar with Orkney waters or similar will be utilised where available
- Both installation and decommissioning operations are of limited duration and will only be undertaken in fair conditions
- The installation will be overseen by a marine coordinator with significant experience relevant to the types of operation being carried out
- Specific task risk assessment and tool box talks will be carried out before crucial tasks
- All vessels will work to EMEC's operational requirements
- All vessels will have their own oil spill contingency plans in place
- Where practicable fuel use and engine exhaust emissions will be minimised
- Third party verification of the device and associated structures

13.3.4 What are the residual impacts?

Based upon these measures it is anticipated that the planned operations can be completed without incident and that in the occurrence of such an unlikely event, intervention would be swift and effective.

Since it is expected that the operation can proceed without incident **no** residual impact is anticipated.

13.4 Summary of residual impacts

Table 13.3 Summary of residual effects of accidental and unplanned events

Ref.	Key issue	Pre-mitigation	Residual impact	Post-mitigation
A	Collisions with the device or vessels	Major	It is anticipated that all unplanned and accidental events can be avoided through the careful planning, contingency awareness and mitigation measures in place.	No interaction
B	Chemical contamination following a collision event or structural failure	Major		No interaction
C	Impacts of structural debris/lost equipment	Minor	It is anticipated that the proposed activities can be undertaken without incident.	No interaction
D	Employment opportunities around contingencies and unplanned works	Positive	Mitigations reduce likelihood of unplanned works but positive impact remains for contingencies	Remains positive

Accidental and unplanned events have been fully addressed from a navigational and safety standpoint within the project specific NRA.

14 Conclusions

The installation of Wello's Penguin will be an event of international significance; signalling yet another step in the commercialisation of the marine renewable energy industry which has the potential to significantly reduce our dependence on fossil fuels. The project will not only demonstrate a completely new concept for wave energy extraction in the form of the Penguin, but also help develop the offshore skills associated with working in harsh wave climates, develop and facilitate understanding regarding the potential effects on the environment from wave energy developments and help to build the local skills base required for future projects within the local and wider area. These are key national drivers which are essential for ensuring the success of this nascent industry.

A number of potential interactions were identified that could potentially arise from the proposed deployment; however, none of these were anticipated to have a significant effect on the particular receptors within the receiving environment. More specifically, no potential significant effects on the qualifying features or conservation objectives of any Natura sites were identified. This clearly demonstrates the benefits of Wello's approach to technology design and operational planning. The general character of the device and its mooring system, along with the ability to use vessels which are relatively small and can be locally sourced mean that the project is relatively benign in its nature and can bring significant benefits to local maritime support businesses. These features will ensure that following a successful demonstration at EMEC, Wello can build itself to become a key player within the international marine energy sector.

A Commitments Register has been developed which Wello will adhere to during the installation, operation, maintenance and recovery of all components. Furthermore, an Environmental Monitoring Plan will be developed based on this ES and further stakeholder consultation.

15 References

ABPmer (2010), Report to inform Appropriate Assessment for the Pentland Firth Strategic Aera (PFSA) Leasing Round, The Crown Estate, February 2010.

DECC (2009), UK Offshore Energy Strategic Environmental Assessment. Future Leasing for Offshore Wind Farms and Licensing for Offshore Oil & Gas and Gas Storage. Environmental Report. January 2009. Department of Energy and Climate Change.

DECC (2011), Decommissioning of offshore renewable energy installations under the Energy Act 2004: Guidance notes for industry, January 2011. Department of Energy and Climate Change.

DMP Statistical Solutions (2010), Power analyses for the visual monitoring scheme at the Billia Croo site. Report prepared for the Sea Mammal Research Unit (SMRU) Ltd., 2010.

EMEC (2009), Environmental Description for the EMEC Wave Test Site Billia Croo, Orkney, 2009

EMEC (2008), Environmental Impact Assessment (EIA) guidance for developers at the European Marine Energy Centre, EMEC, 2008.

HSE (2003), Ship/platform collision incident database 2001, Research Report 053, prepared by Serco Assurance for the Health and Safety Executive, 2003.

MAIB (2009), Marine Accident Investigation Branch Annual Report 2009, Marine Accident Investigation Branch, 2009.

Nedwell and Howell (2004), A review of offshore windfarm related underwater noise sources. Subacoustech Report Reference: 544R0308, November 2004, to COWRIE.

Nedwell et al (2004), Fish and Marine Mammal Audiograms: A summary of available information, Subacoustec Report Reference: 534R0214, September 2004

Norton, M.P. (1989), Fundamentals of noise and vibration analysis for engineers, Cambridge University Press, Cambridge.

Popper, A.N., Fay, R.R., (2010), Rethinking sound detection by fishes, Hearing Research, doi:10.1016/j.heares.2009.12.023.

Richardson *et al.* (1995), Marine mammals and noise, Academic Press, London, 576pp.

SCOS (2009), Scientific advice on matters related to the management of seal populations: 2009, Special Committee on Seals Main Advice Report, SCOS, 2009.

SMRU Ltd. (2008), Land-based Visual Observations – Data collection protocols: Billia Croo Wave Site, Sea Mammal Research Unit, 2008.

SMRU (2007). Assessment of the potential for acoustic deterrents to mitigate the impact on marine mammals of underwater noise arising from the construction of offshore windfarms. Commissioned by COWRIE Ltd (project reference DETER-01-07).

Thiele, R. (2002), Propagation loss values for the North Sea, Handout fachgeesprach: Offshore windmills sound emissions and marine mammals, De Spil Publ, Woerden, Netherlands, 81-93

Thomsen, F., Lüdemann, K., Kafemann, R. and Piper, W. (2006). Effects of offshore wind farm noise on marine mammals and fish, biola, Hamburg, Germany on behalf of COWRIE Ltd.

Vella *et al.* (2001), Assessment of the effects of noise and vibration from offshore windfarms on marine wildlife. A report for the UK DTI by ETSU, reference W/13/00566/REP.

Appendix A – Impact screening matrix

	Seabed character	Hydrography	Seabed sediment quality	Air quality	Water quality	Climate	Coastal processes	Coastline character	Seabed communities	Intertidal communities	Plankton	Marine fish	Marine birds	Marine mammals	Commercial fishing	Shipping	MOD operations	Oil and gas activities	Cables and pipelines	Local residents	Local supply chain	Local infrastructure	Amenity /leisure	Archaeology	Air traffic	Seascape	Protected habitats	Protected species	Geological areas	Landscape designations	Built heritage
Construction and installation																															
Moorings installation		-1		-1	-1				-2			-2	-1	-2		-1				-1	2	1				-1 1		-2		-1 1	
Device installation		-1		-1								-2	-1	-2		-1				-1	2	1				-2 1		-2		-1 1	
Roll place lowering												-1		-1														-1			
Umbilical installation to device																					2	1									
Connection of umbilical to EMEC subsea connector				-1	-1				-2			-2	-1	-2							2	1				-1 1		-2			
Device commissioning												-1		-1														-1			
Operation, maintenance and monitoring																															
Device operation						1						-1	-1	-1		-1				-1						-2 1		-1		-1 1	
Sustained presence of moorings									-2			-1	-1	-1														-1			
Planned maintenance and inspection (*in situ*)				-1																	1	1									
Unplanned device maintenance (*ex situ*)				-1								-1 1	-1	-1 1							2	2				1		1			
Technical monitoring				-1																											
Environmental monitoring				-1																											
Decommissioning																															
Disconnection of umbilical from EMEC subsea connector	-2			-1	-1				-2			-2	-1	-2							2					-1 1		-2			
Removal of umbilical from device				-1								1	-1	1							2					-1 1		1			
Roll plate lifting												-1		-1														-1			
Removal of device from moorings and berth to Lyness				-1								-1 1	-1	-1 1							2	2				1		1			
Removal of moorings	-2 1			-1					-2 2			-1 1	-1	-1 1							2	1				-1 1		1			
Seabed survey				-1																											

Appendix B – Impact Assessment

Seabed character impact screening summary

Activity	Sensitivities	Score		Issue	Interaction	Mitigating design features
Disconnection of umbilical from EMEC subsea connector	Seabed character	-2		F	The vessel connecting the device to the EMEC subsea connector will have a three-point mooring spread which will disrupt the seabed character at anchor points. Lifting the connector to the surface will also lift at least 70m of EMEC cable and several metres of umbilical cable off the seabed causing some disruption	None
Removal of moorings	Seabed character	1	-2	A	Removal of three embedment anchors and three clump weights from the seabed during mooring installation will impact upon seabed character. Pre-installation conditions likely to be restored over a short period of time	Embedment anchors have been selected which removes the need for any subsea excavation and minimises the footprint of the mooring system

Hydrography impact screening summary

Activity	Sensitivities	Score	Issue	Interaction	Mitigating design features
Moorings installation	Hydrography	-1	K	There will be a slight change to water flow around mooring equipment and lines immediately following installation. It is anticipated that due to local flows and fluxes, that this will be minimal and not lead to any adverse effects over the course of the project	Mooring system has a minimal profile within the water column
Device installation	Hydrography	-1	K	There will be a slight change to water flow around the single device. It is anticipated that due to local flows and fluxes, that this will be minimal and not lead to any adverse effects over the course of the project	None

Air quality impact screening summary

Activity	Sensitivities	Score	Issue	Interaction	Mitigating design features

Moorings installation	Air quality	-1	H	Vessels used during mooring installation will exhaust green house gases and other contaminants affecting air quality	Ensure engines are working efficiently and minimise fuel use as much as possible. All vessels will operate to IMO standards (refer to MARPOL Annex VI)
Device installation	Air quality	-1	H	Vessels used during device installation will exhaust green house gases and other contaminants affecting air quality	Ensure engines are working efficiently and minimise fuel use as much as possible
Connection of umbilical to EMEC subsea connector	Air quality	-1	H	Vessels used during connection to EMEC subsea connector will exhaust green house gases and other contaminants affecting air quality	Ensure engines are working efficiently and minimise fuel use as much as possible. All vessels will operate to IMO standards (refer to MARPOL Annex VI)
Planned maintenance and inspection (in situ)	Air quality	-1	H	Vessels used during planned maintenance and inspection (in situ) will exhaust green house gases and other contaminants affecting air quality	Ensure engines are working efficiently and minimise fuel use as much as possible. All vessels will operate to IMO standards (refer to MARPOL Annex VI)
Unplanned device maintenance (ex situ)	Air quality	-1	H	Vessels used during unplanned device maintenance (ex situ) will exhaust green house gases and other contaminants affecting air quality	Ensure engines are working efficiently and minimise fuel use as much as possible. All vessels will operate to IMO standards (refer to MARPOL Annex VI)
Technical monitoring	Air quality	-1	H	Vessels used during technical monitoring will exhaust green house gases and other contaminants affecting air quality	Ensure engines are working efficiently and minimise fuel use as much as possible. All vessels will operate to IMO standards (refer to MARPOL Annex VI)
Environmental monitoring	Air quality	-1	H	Vessels used during environmental monitoring will exhaust green house gases and other contaminants affecting air quality	Ensure engines are working efficiently and minimise fuel use as much as possible. All vessels will operate to IMO standards (refer to MARPOL Annex VI)
Disconnection of umbilical from EMEC subsea connector	Air quality	-1	H	Vessels used during disconnection of umbilical from EMEC subsea connector will exhaust green house gases and other contaminants affecting air quality	Ensure engines are working efficiently and minimise fuel use as much as possible. All vessels will operate to IMO standards (refer to MARPOL Annex VI)
Removal of umbilical from device	Air quality	-1	H	Vessels used during removal of umbilical will exhaust green house gases and other contaminants affecting air quality (umbilical may not be removed from device until after decommissioning)	Ensure engines are working efficiently and minimise fuel use as much as possible. All vessels will operate to IMO standards (refer to MARPOL Annex VI)
Removal of device from moorings and berth to Lyness	Air quality	-1	H	Vessels used during removal of device from moorings and berth to Lyness will exhaust green house gases and other contaminants affecting air quality	Ensure engines are working efficiently and minimise fuel use as much as possible. All vessels will operate to IMO standards (refer to MARPOL Annex VI)
Removal of moorings	Air quality	-1	H	Vessels used during removal of moorings will exhaust green house gases and other contaminants affecting air quality	Ensure engines are working efficiently and minimise fuel use as much as possible. All vessels will operate to IMO standards (refer to MARPOL Annex VI)
Seabed survey	Air quality	-1	H	Vessels used during seabed surveys will exhaust green house gases and other contaminants affecting air quality	Ensure engines are working efficiently and minimise fuel use as much as possible. All vessels will operate to IMO standards (refer to MARPOL Annex VI)

Water quality impact screening summary

Activity	Sensitivities	Score	Issue	Interaction	Mitigating design features
Moorings installation	Water quality	-1	G	Small amounts of sediment will be temporarily re-suspended immediately following the placement of each anchor	None
Connection of umbilical to EMEC subsea connector	Water quality	-1	G	Connection to EMEC subsea connector may affect water quality due to localised turbidity created by lifting the subsea connector and adjoining EMEC cable from the seabed	None
Disconnection of umbilical from EMEC subsea connector	Water quality	-1	G	Disconnection from the EMEC subsea connector may affect water quality due to localised turbidity created by lifting the subsea connector and adjoining EMEC and umbilical cables from the seabed	None

Climate impact screening summary

Activity	Sensitivities	Score	Issue	Interaction	Mitigating design features
Device operation	Climate	1	N	Device will generate carbon free renewable energy, offsetting use of fossil fuels. This deployment will also help progress the marine renewables energy industry towards large scale deployments.	None

Seabed communities impact screening summary

Activity	Sensitivities	Score	Issue	Interaction	Mitigating design features
Moorings installation	Seabed communities	-2	A	Deposit of three embedment anchors and three clump weights onto the seabed during mooring installation could cause localised habitat damage, sediment suspension and directly impact sessile benthic organisms resulting in temporary avoidance by mobile species	Embedment anchors have been selected which removes the need for any subsea excavation and minimises the footprint of the mooring system. This also allows the scale of the clump weights to be minimised further reducing potential footprint

Connection of umbilical to EMEC subsea connector	Seabed communities	-2	F	The vessel connecting the device to the EMEC subsea connector will have a three-point mooring spread which will disrupt seabed communities at anchor points. Lifting the connector to the surface will also lift about 70m of cable off the seabed causing some disruption	None
Sustained presence of moorings	Seabed communities	-2	A	Sustained presence and footprint of three embedment anchors and three clump weights on the seabed will reduce habitat and potentially impact upon seabed character. Clump weights and lines are likely to become colonised by opportunistic species	Embedment anchors have been selected which removes the need for any subsea excavation and minimises the footprint of the mooring system
Disconnection of umbilical from EMEC subsea connector	Seabed communities	-2	F	The vessel connecting the device to the EMEC subsea connector will have a three-point mooring spread which will disrupt seabed communities at anchor points. Lifting the connector to the surface will also lift about 70m of EMEC cable several metres of umbilical cable off the seabed causing some disruption	None
Removal of moorings	Seabed communities	1 -2	A	Removal of three embedment anchors and three clump weights from the seabed during mooring installation could cause localised habitat damage and sediment suspension and impact upon seabed communities. Pre-installation conditions likely to be restored over a short period of time	Embedment anchors have been selected which removes the need for any subsea excavation and minimises the footprint of the mooring system

Marine fish impact screening summary

Activity	Sensitivities	Score	Issue	Interaction	Mitigating design features
Moorings installation	Marine fish	-2	C	Vessel activity may result in temporary avoidance of the immediate area by fish. This may cause temporary, localised avoidance. Benthic fish may temporarily avoid immediate area surrounding anchors and clump weights during installation.	Moorings system design allows the use of relatively small workboats; minimising underwater noise generated during activities. Mooring system also designed for rapid deployment; reducing time at sea
Device installation	Marine fish	-2	C	During device installation marine fish may be affected by noise from vessels. This may cause temporary, localised avoidance	Ensure vessels are well maintained

Roll plate lowering	Marine fish	-2	C	During roll plate lowering marine fish may be affected by noise from chain pullers. This may cause temporary, localised avoidance. Noise is common in the marine environment and chain pullers are regularly used in anchor handling. Noise generated above surface at a distance from shore of approximately 2km	None
Connection of umbilical to EMEC subsea connector	Marine fish	-2	C	During connection of umbilical to EMEC subsea connector marine fish may be affected by noise from vessels. This may cause temporary, localised avoidance	Small vessels used and operations designed to reduce time at sea
Device commissioning	Marine fish	-1	J	Low level EMF emitted during power transmission may affect behaviour of marine fish however, levels of EMF from a deployment of this scale are unlikely to trigger a response or cause an adverse effect	None
Device operation	Marine fish	-1	B/C	Some avoidance of the operating area by marine fish may occur due to noise from the back-up fan cooling system. However, it is anticipated that the levels of any noise produced will be extremely low and only when the back-up cooling system is operational (estimated to be approximately 10% of the time). Given the levels of background noise in the upper reaches of the water column together with the depth of the berth (~70m), it is highly unlikely, that any significant adverse impacts will occur around a single device of this type The device may become an added collision risk for marine fish There is a perceived risk that marine fish may collide with underwater structures including the device hull	Noise generating components only required as back-up therefore any effects will be temporary and minimal Size and character of structure should minimise risk of collision. No moving parts and minimal noise generating components
Sustained presence of moorings	Marine fish	-1	B	There is a perceived risk that large marine fish may collide with underwater structures including mooring lines and buoys, etc. The span of the moorings allows adequate passage through the system should an individual not simply manoeuvre around the system The physical probability of an entanglement event with tensioned wire moorings is extremely unlikely	Selection of mooring system lines (wires) under tension

Unplanned device maintenance (ex situ)	Marine fish	1	-1	B	Vessel activity may result in temporary avoidance of the immediate area by marine fish Removal of device may reduce any disturbance/risk arising from the presence of the device	Device design and operational planning allow the use of small workboats, reducing the potential for disturbance
Disconnection of umbilical from EMEC subsea connector	Marine fish	-2		C	During disconnection of umbilical from EMEC subsea connector marine fish may be affected by noise from vessels. This may cause temporary, localised avoidance	Ensure vessels are well maintained
Removal of umbilical from device	Marine fish	1		B	Removal of umbilical at decommissioning will re-establish pre-operational conditions for marine fish (may be removed after decommissioning)	None
Roll plate lifting	Marine fish	-2		C	During roll plate lifting marine fish may be affected by noise from chain pullers. This may cause temporary, localised avoidance. Noise is common in the marine environment and chain pullers are regularly used in anchor handling. Noise generated above surface at a distance from shore of approximately 2km	No specific mitigations are required
Removal of device from moorings and berth to Lyness	Marine fish	1	-1	B	Vessel activity may result in temporary avoidance of the immediate area by marine fish Removal of device from moorings and berth to Lyness at decommissioning will re-establish pre-operational conditions for marine fish	None
Removal of moorings	Marine fish	1	-1	B	Vessel activity may result in temporary avoidance of the immediate area by marine fish Removal of moorings at decommissioning will re-establish pre-operational conditions for marine fish	None

Marine birds impact screening summary

Activity	Sensitivities	Score	Issue	Interaction	Mitigating design features
Moorings installation	Marine birds	-1	I	Presence of vessels during mooring installation may lead to temporary localised avoidance of the area by marine birds	Small vessels used and operations designed to reduce time at sea

Device installation	Marine birds	-1	I	Presence of vessels during device installation may lead to temporary localised avoidance of the area by marine birds	Small vessels used and operations designed to reduce time at sea
Connection of umbilical to EMEC subsea connector	Marine birds	-1	I	Presence of vessels during connection to EMEC subsea connector may lead to temporary localised avoidance of the area by marine birds	Small vessels used and operations designed to reduce time at sea
Device operation	Marine birds	-1	I	Presence of the device may disturb normal marine bird activities in the area including possible localised avoidance The device may also be used as a roost for some marine bird species in the area The device may act as an artificial reef which could result in increased foraging activity by diving birds around subsea structures	None
Sustained presence of moorings	Marine birds	-1	I	There is a perceived risk that diving birds may collide with underwater structures including mooring lines and buoys, etc The physical probability of an entanglement event with tensioned wire moorings is extremely unlikely	Selection of mooring system lines (wires) under tension.
Unplanned device maintenance (ex situ)	Marine birds	-1	I	Presence of vessels during unplanned device maintenance (ex situ) may lead to temporary localised avoidance of the area by marine birds	Device design and operational planning allow the use of small workboats, reducing the potential for disturbance
Disconnection of umbilical from EMEC subsea connector	Marine birds	-1	I	Presence of vessels during disconnection of umbilical from EMEC subsea connector at decommissioning may lead to temporary localised avoidance of the area by marine birds	None
Removal of umbilical from device	Marine birds	-1	I	Presence of vessels during removal of umbilical at decommissioning may lead to temporary localised avoidance of the area by marine birds (umbilical may not be removed at decommissioning)	None
Removal of device from moorings and berth to Lyness	Marine birds	-1	I	Presence of vessels during removal of device from moorings and berth to Lyness at decommissioning may lead to temporary localised avoidance of the area by marine birds	None
Removal of moorings	Marine birds	-1	I	Presence of vessels during removal of moorings at decommissioning may lead to temporary localised avoidance of the area by marine birds	None

Marine mammals impact screening summary

Activity	Sensitivities	Score	Issue	Interaction	Mitigating design features
Moorings installation	Marine mammals	-2	C	Vessel activity may result in temporary avoidance of the immediate area by marine mammals. Presence of vessels during mooring installation may lead to temporary localised avoidance of the area by marine mammals	Selection of mooring system lines (wires) under tension. Moorings system design allows the use of relatively small workboats; minimising underwater noise generated during activities. Mooring system also designed for rapid deployment; reducing time at sea.
Device installation	Marine mammals	-2	C	Presence of vessels during device installation may lead to temporary localised avoidance of the area by marine mammals	Small vessels used and operations designed to reduce time at sea
Roll plate lowering	Marine mammals	-2	C	During roll plate lowering marine mammals may be affected by noise from chain pullers. This may cause temporary, localised avoidance. Noise is common in the marine environment and chain pullers are regularly used in anchor handling. Noise generated above surface at a distance from shore of approximately 2km	None
Connection of umbilical to EMEC subsea connector	Marine mammals	-2	C	Vessel activity may result in temporary avoidance of the immediate area by marine mammals	Device design and operational planning allow the use of small workboats, reducing the potential for disturbance.
Device operation	Marine mammals	-1	B/C	Some avoidance of the operating area by cetaceans and seals may occur due to noise from the back-up fan cooling system. However, it is anticipated that the levels of any noise produced will be extremely low and only when the back-up cooling system is operational (estimated to be approximately 10% of the time). Given the levels of background noise in the upper reaches of the water column together with the depth of the berth (~70m), it is highly unlikely, that any significant adverse impacts will occur around a single device of this type The device may become an added collision risk for marine mammals The device may act as an artificial reef which could result in fish aggregation and increased foraging activity by marine mammals around subsea structures	Noise generating components only required as back-up therefore any effects will be temporary and minimal. Size and character of structure should minimise risk of collision. No moving parts and minimal noise generating components.

Device commissioning	Marine mammals	-1	J	Low level EMF emitted during power transmission may affect behaviour of marine mammals however, levels of EMF from a deployment of this scale are unlikely to trigger a response or cause an adverse effect	None
Sustained presence of moorings	Marine mammals	-1	B	There is a perceived risk that cetaceans may collide with underwater structures including mooring lines and buoys etc. The span of the moorings allows adequate passage through the system should an individual not simply manoeuvre around the system. The physical probability of an entanglement event with tensioned wire moorings is however, extremely unlikely.	Selection of mooring system lines (wires) under tension.
Unplanned device maintenance (ex situ)	Marine mammals	1 -1	B	Vessel activity may result in temporary avoidance of the immediate area by marine mammals Removal of device may reduce any disturbance/risk arising from the presence of the device	Device design and operational planning allow the use of small workboats, reducing the potential for disturbance
Disconnection of umbilical from EMEC subsea connector	Marine mammals	-2	C	Vessel activity may result in temporary avoidance of the immediate area by marine mammals	Device design and operational planning allow the use of small workboats, reducing the potential for disturbance
Removal of umbilical from device	Marine mammals	1	B	Removal of umbilical at decommissioning will re-establish pre-operational conditions for marine mammals (may be removed after decommissioning)	None
Roll plate lifting	Marine mammals	-2	C	During roll plate lifting marine mammals may be affected by noise from chain pullers. This may cause temporary, localised avoidance. Noise is common in the marine environment and chain pullers are regularly used in anchor handling. Noise generated above surface at a distance from shore of approximately 2km.	None
Removal of device from moorings and berth to Lyness	Marine mammals	1 -1	B	Vessel activity may result in temporary avoidance of the immediate area by marine mammals Removal of device from moorings and berth to Lyness at decommissioning will re-establish pre-operational conditions for marine mammals	None

Removal of moorings	Marine mammals	1	-1	B	Vessel activity may result in temporary avoidance of the immediate area by marine mammals Removal of moorings at decommissioning will re-establish pre-operational conditions for marine mammals	None

Shipping impact screening summary

Activity	Sensitivities	Score	Issue	Interaction	Mitigating design features
Moorings installation	Shipping	-1	D	Mooring installation could impact upon shipping as support vessels and moorings will create an additional obstacle to other vessels in the area. The test site is marked as an 'area to be avoided' and as standard; Notices to Mariners will be issued prior to any operations. All operations will adhere to EMEC's SOP.	None
Device installation	Shipping	1-	D	Device installation could impact upon shipping as support vessels and moorings will create an additional obstacle to other vessels in the area. The test site is marked as an 'area to be avoided' and as standard; Notices to Mariners will be issued prior to any operations. All operations will adhere to EMEC's SOP.	None
Device operation	Shipping	-1	D	Device operation could impact upon shipping as the device will cause an additional obstacle to other vessels in the area. The area is a recognised test site and marked as 'an area to avoid'. All operations will adhere to EMEC's SOP.	Activities are within test site marked as area to be avoided. Mariners will be informed of activities

Local residents impact screening summary

Activity	Sensitivities	Score	Issue	Interaction	Mitigating design features
Moorings installation	Local residents	-1	E	Temporary change in seascape due to increased vessel presence in area during moorings installation could affect local residents. Area is designated as a National Scenic Area (NSA)	Small vessels used and operations designed to reduce time at sea

Device installation	Local residents	-1	E	Temporary change in seascape due to increased vessel presence in area during device installation could affect local residents. Area is designated as a National Scenic Area (NSA)	Local residents will be informed by EMEC prior to installation, area is designated wave test site
Device operation	Local residents	-1	E	Change in seascape for about one year due to presence of device could affect local residents. It is likely that the device, like all others installed to date, will generate positive local interest	Local residents will be informed by EMEC prior to installation, area is designated wave test site

Local supply chain impact screening summary

Activity	Sensitivities	Score	Issue	Interaction	Mitigating design features
Moorings installation	Local supply chain	2	L	Opportunity for employment for local seafarers, specialists, divers and support vessels from activities relating to mooring installation	None required
Device installation	Local supply chain	2	L	Opportunity for employment for local seafarers, specialists, divers and support vessels from activities relating to device installation	None required
Umbilical installation to device	Local supply chain	2	L	Possible opportunity for employment for local seafarers, specialists, divers and support vessels (umbilical may be pre- installed on device)	None
Connection of umbilical to EMEC subsea connector	Local supply chain	2	L	Opportunity for employment for local seafarers, specialists, divers and support vessels from activities relating to umbilical installation (umbilical may be pre-installed)	None
Planned maintenance and inspection (in situ)	Local supply chain	1	L	Opportunity for employment for local seafarers, specialists, divers and support vessels	None
Unplanned device maintenance (ex situ)	Local supply chain	2	L	Opportunity for employment for local seafarers, specialists, divers and support vessels from activities relating to unplanned device maintenance (ex situ)	None
Disconnection of umbilical from EMEC subsea connector	Local supply chain	2	L	Opportunity for employment for local seafarers, specialists, divers and support vessels	None
Removal of umbilical from device	Local supply chain	2	L	Opportunity for employment for local seafarers, specialists, divers and support vessels from activities relating to removal of umbilical at decommissioning (may not be removed at decommissioning)	None

Removal of device from moorings and berth to Lyness	Local supply chain	2	L	Opportunity for employment for local seafarers, specialists, divers and support vessels from activities relating to removal of device from moorings and berth to Lyness at decommissioning	None
Removal of moorings	Local supply chain	2	L	Opportunity for employment for local seafarers, specialists, divers and support vessels from activities relating to removal of moorings	None

Local infrastructure impact screening summary

Activity	Sensitivities	Score	Issue	Interaction	Mitigating design features
Moorings installation	Local infrastructure (ports?)	1	M	Project equipment and personnel requirements for mooring installation will lead to increased business for local infrastructure	None required
Device installation	Local infrastructure (ports?)	1	M	Project equipment and personnel requirements for device installation will lead to increased business for local infrastructure	None required
Umbilical installation to device	Local infrastructure (ports?)	1	M	Project equipment and personnel requirements for umbilical installation will lead to increased business for local infrastructure (may be pre-installed)	None
Connection of umbilical to EMEC subsea connector	Local infrastructure (ports?)	1	M	Project equipment and personnel requirements for connection to EMEC subsea connector will lead to increased business for local infrastructure	None
Planned maintenance and inspection (in situ)	Local infrastructure (ports?)	1	M	Project equipment and personnel requirements will lead to increased business for local infrastructure	None
Unplanned device maintenance (ex situ)	Local infrastructure (ports?)	2	M	Project equipment and personnel requirements for unplanned device maintenance (ex situ) will lead to increased business for local infrastructure	None
Removal of device from moorings and berth to Lyness	Local infrastructure (ports?)	2	M	Project equipment and personnel requirements for removal of the device from it's moorings and berth to Lyness will lead to increased business for local infrastructure	None
Removal of moorings	Local infrastructure (ports?)	1	M	Project equipment and personnel requirements for removal of moorings will lead to increased business for local infrastructure	None

Seascape impact screening summary

Activity	Sensitivities	Score		Issue	Interaction	Mitigating design features
Moorings installation	Seascape	1	-1	E	Temporary increased vessel presence in area during moorings installation could affect seascape. Area is designated as a National Scenic Area (NSA) Workboats are a common sight throughout Orkney and if noticed, most likely to be a point of interest	Area is a recognised wave test site
Device installation	Seascape	1	-2	E	Temporary increased vessel presence in area during device installation could affect seascape. Area is designated as a National Scenic Area (NSA) Workboats are a common sight throughout Orkney and if noticed, most likely to be a point of interest	Area is a recognised wave test site
Connection of umbilical to EMEC subsea connector	Seascape	1	1-	E	Temporary increased vessel presence in area during connection to EMEC subsea connector could affect seascape. Area is designated as a National Scenic Area (NSA)	Area is a recognised wave test site
Device operation	Seascape	1	-2	E	Change in seascape for about one year due to presence of device. Area is designated as a National Scenic Area (NSA) It is likely that the device, like all others installed to date, will generate positive local interest	When ballasted, the device has relatively shallow freeboard (therefore sits approximately 1.5m above the surface)
Unplanned device maintenance (ex situ)	Seascape	1		E	Removal of device due to unplanned device maintenance (ex situ) will re-establish pre-operational conditions for seascape. Area is designated as a National Scenic Area (NSA)	None
Disconnection of umbilical from EMEC subsea connector	Seascape	1	-1	E	Temporary increased vessel presence in area during disconnection of umbilical from EMEC subsea connector at decommissioning could affect seascape. Area is designated as a National Scenic Area (NSA)	Area is a recognised wave test site
Removal of umbilical from device	Seascape	1	-1	E	Temporary increased vessel presence in area during removal of umbilical at decommissioning could affect seascape (umbilical may not be removed at decommissioning). Area is designated as a National Scenic Area (NSA)	Area is a recognised wave test site
Removal of device from moorings and berth to Lyness	Seascape	1		E	Removal of device at decommissioning will re-establish pre-operational conditions for seascape. Area is designated as a National Scenic Area (NSA)	None

Removal of moorings	Seascape	1	-1	E	Temporary increased vessel presence in area during removal of moorings at decommissioning could affect seascape. Area is designated as a National Scenic Area (NSA)	Area is a recognised wave test site

Protected species impact screening summary

Activity	Sensitivities	Score	Issue	Interaction	Mitigating design features
Moorings installation	Protected species	-2	C	During mooring installation basking shark may be affected by noise from vessels. This may cause temporary, localised avoidance Vessel activity may result in temporary avoidance of the immediate area by marine mammals Presence of vessels during mooring installation may lead to temporary localised avoidance of the area by marine birds	Device design and operational planning allow the use of small workboats, reducing the potential for disturbance
Device installation	Protected species	-2	C	During device installation protected species may be affected by noise from vessels. This may cause temporary, localised avoidance by marine mammals and fish Presence of vessels during mooring installation may lead to temporary localised avoidance of the area by marine birds	Device design and operational planning allow the use of small workboats, reducing the potential for disturbance
Roll place lowering	Protected species	-2	C	During roll plate lowering protected species may be affected by noise from chain pullers. This may cause temporary, localised avoidance. Noise is common in the marine environment and chain pullers are regularly used in anchor handling. Noise generated above surface at a distance from shore of approximately 2km	None
Connection of umbilical to EMEC subsea connector	Protected species	-2	C	During connection of umbilical to EMEC subsea connector protected species may be affected by noise from vessels. This may cause temporary, localised avoidance	Small vessels used and operations designed to reduce time at sea

Device commissioning	Protected species	-1	J	Low level EMF emitted during power transmission may affect behaviour of protected species however, levels of EMF from a deployment of this scale are unlikely to trigger a response or cause an adverse effect	None
Device operation	Protected species	-1	B/C	Some avoidance of the operating area by protected species may occur due to noise from the back-up fan cooling system. However, it is anticipated that the levels of any noise produced will be extremely low and only when the back-up cooling system is operational (estimated to be approximately 10% of the time). Given the levels of background noise in the upper reaches of the water column together with the depth of the berth (~70m), it is highly unlikely, that any significant adverse impacts will occur around a single device of this type The device may become an added collision risk for marine mammals and basking shark Presence of the device may disturb normal marine bird activities in the area including possible localised avoidance The device may also be used as a roost for some marine bird species in the area Increased foraging activity may result from fish aggregation around subsea structures	Noise generating components only required as back-up therefore any effects will be temporary and minimal Size and character of structure should minimise risk of collision. No moving parts and minimal noise generating components. None required
Unplanned device maintenance (ex situ)	Protected species	1 -1	B	Vessel activity may result in temporary avoidance of the immediate area by protected species Removal of device may reduce any disturbance/risk arising from the presence of the device	Device design and operational planning allow the use of small workboats, reducing the potential for disturbance
Disconnection of umbilical from EMEC subsea connector	Protected species	-2	C	During disconnection of umbilical from EMEC subsea connector protected species may be affected by noise from vessels. This may cause temporary, localised avoidance	Ensure vessels are well maintained

Removal of umbilical from device	Protected species	1	-1	B	Presence of vessels during removal of umbilical at decommissioning may lead to temporary localised avoidance of the area by marine birds Removal of umbilical at decommissioning will re-establish pre-operational conditions for protected species (may be removed after decommissioning)	None
Roll plate lifting	Protected species	-2		C	During roll plate lifting, protected species may be affected by noise from chain pullers. This may cause temporary, localised avoidance. Noise is common in the marine environment and chain pullers are regularly used in anchor handling. Noise generated above surface at a distance from shore of approximately 2km	No specific mitigations are required
Removal of device from moorings and berth to Lyness	Protected species	1	-1	B	Vessel activity may result in temporary avoidance of the immediate area by protected species. Removal of device from moorings and berth to Lyness at decommissioning will re-establish pre-operational conditions for protected species	None
Sustained presence of moorings	Protected species	-1		B	There is a perceived risk that protected species may collide with underwater structures including mooring lines and buoys etc. The span of the moorings allows adequate passage through the system should an individual not simply manoeuvre around the system. The physical probability of an entanglement event with tensioned wire moorings is however, extremely unlikely. There is a potential chance that diving birds might collide with mooring lines or spring buoys when foraging. The nature of the mooring system with its minimal profile through the water column helps minimise this risk.	None required beyond selection of mooring system lines (wire) under tension.

Removal of moorings	Protected species	1	-1	B	Presence of vessels during removal of moorings at decommissioning may lead to temporary localised avoidance of the area by protected species Removal of moorings at decommissioning will re-establish pre-operational conditions for protected species	None

Landscape designations impact screening summary

Activity	Sensitivities	Score		Issue	Interaction	Mitigating design features
Moorings installation	Landscape designations	1	-1	E	Temporary increased vessel presence in area during moorings installation could affect seascape (area is designated NSA). Workboats are a common sight throughout Orkney and if noticed, most likely to be a point of interest.	Area is a recognised wave test site
Device installation	Landscape designations	1	-1	E	Temporary increased vessel presence in area during device installation could affect seascape (area is designated NSA). Workboats are a common sight throughout Orkney and if noticed, most likely to be a point of interest.	Area is a recognised wave test site
Device operation	Landscape designations	1	-1	E	Change in seascape for about one year due to presence of device (area is designated NSA) It is likely that the device, like all others installed to date, will generate positive local interest.	When ballasted, the device has relatively shallow freeboard (therefore sits approximately 1.5m above the surface)

Please note that no interactions were identified with the following receptors:

- Seabed sediment quality
- Coastal processes
- Coastline character
- Intertidal communities
- Plankton
- Commercial fishing
- MOD operations
- Oil and gas activities
- Cables and pipelines
- Amenity/leisure
- Archaeology
- Air traffic
- Protected habitats
- Geological areas
- Built heritage

Appendix C – Impact assessment matrix: residual impacts

	Seabed character	Hydrography	Seabed sediment quality	Air quality	Water quality	Climate	Coastal processes	Coastline character	Seabed communities	Intertidal communities	Plankton	Marine fish	Marine birds	Marine mammals	Commercial fishing	Shipping	MOD operations	Oil and gas activities	Cables and pipelines	Local residents	Local supply chain	Local infrastructure	Amenity /leisure	Archaeology	Air traffic	Seascape	Protected habitats	Protected species	Geological areas	Landscape designations	Built heritage
Construction and installation																															
Moorings installation		-1		-1	-1				-2			-1	-1	-1		-1				-1	2	1				-1 1		-1		-1 1	
Device installation		-1		-1								-1	-1	-1		-1				-1	2	1				-2 1		-1		-1 1	
Roll place lowering												-1		-1														-1			
Umbilical installation to device																					2	1									
Connection of umbilical to EMEC subsea connector				-1	-1				-2			-1	-1	-1							2	1				-1 1		-1			
Device commissioning												-1		-1														-1			
Operation, maintenance and monitoring																															
Device operation						1						-1	-1	-1		-1				-1						-2 1		-1		-1 1	
Sustained presence of moorings									-2			-1	-1	-1														-1			
Planned maintenance and inspection (*in situ)*				-1																	1	1									
Unplanned device maintenance (*ex situ*)				-1								-1 1	-1	-1 1							2	2				1		1			
Technical monitoring				-1																											
Environmental monitoring				-1																											
Decommissioning																															
Disconnection of umbilical from EMEC subsea connector	-1			-1	-1				-2			-1	-1	-1							2					-1 1		-1			
Removal of umbilical from device				-1								1	-1	1							2					-1 1		1			
Roll plate lifting												-1		-1														-1			
Removal of device from moorings and berth to Lyness				-1								-1 1	-1	-1 1							2	2				1		1			
Removal of moorings	-1 1			-1					-2 2			-1 1	-1	-1 1							2	1				-1 1		1			
Seabed survey				-1																											

Appendix D – Material Safety Data Sheets

Material Safety Data Sheets (MSDS) are provided as a separate document. These MSDS's provide information pertaining to the chemicals to be present on the Penguin. MSDS for the following chemicals are included:

- Telko ZERO HD glycol coolant
- Neste HYDRAULI 46 SUPER hydraulic fluid
- MOBILGEAR SHC XMP 320 lubricating oil
- Mobil Devlac MX 15W-40
- Mobil EAL Hydraulic oil 32
- Mobil EAL Hydraulic oil 46
- Arcanol LOAD400 grease
- Esso gas oil
- Interzone 1000 paint (Grey and black)
- Interzone 954 paint (grey, white, water blue and melon yellow)
- Intergard 269 paint (Red)
- Interthane 990 paint (traffic white and dahlia yellow)
- Intergard 475HS paint (light grey)

Note that for paints where more than one colour of the same type of paint is used then only the MSDS for one colour has been provided.