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Array deployment of Seatricity's Oceanus wave energy converter at EMEC's wave test site in Orkney

Environmental Report

Prepared on behalf of Seatricity

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Non technical summary

Project outline

Seatricity is planning to install a demonstration array of its Oceanus wave energy converter technology at European Marine Energy Centre's (EMEC) wave test site facility at Billia Croo in Orkney during early summer 2012. It is planned to install 30 Seatricity Wave Energy Converters (WEC's) with a combined total installed capacity of not more than 800kW. The planned location within the test site is shown below.

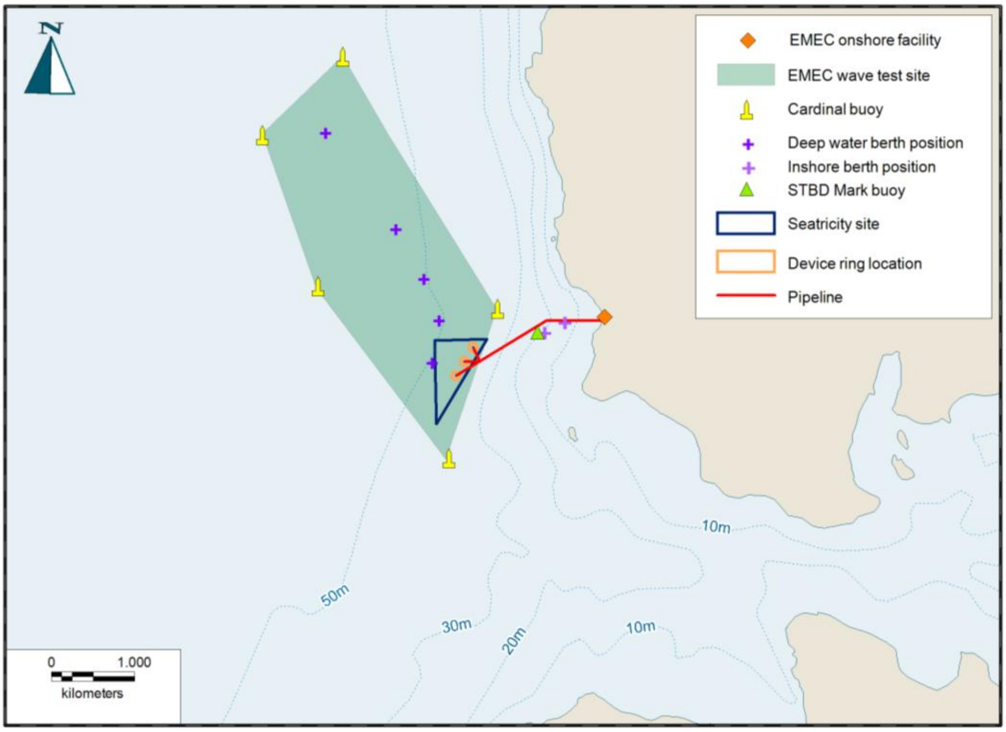
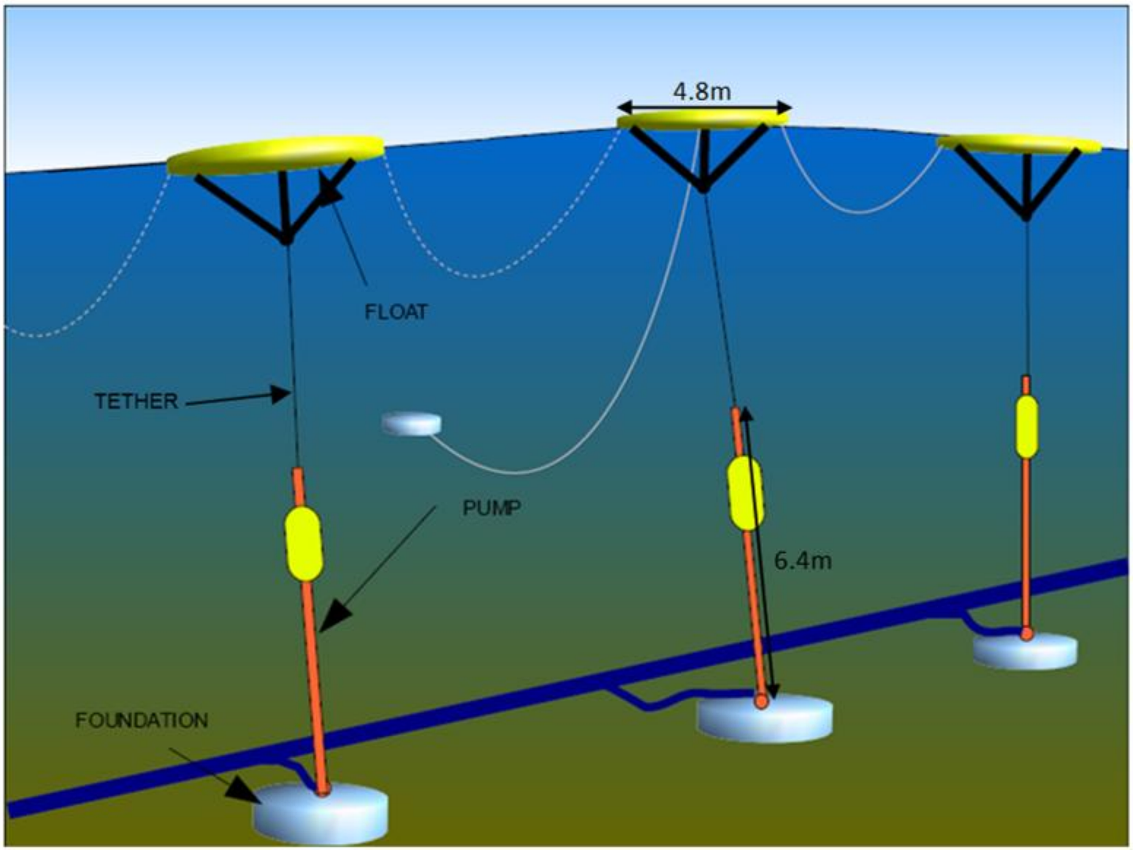


Figure 1.1 Location of the Seatricity deployment within the EMEC wave test site

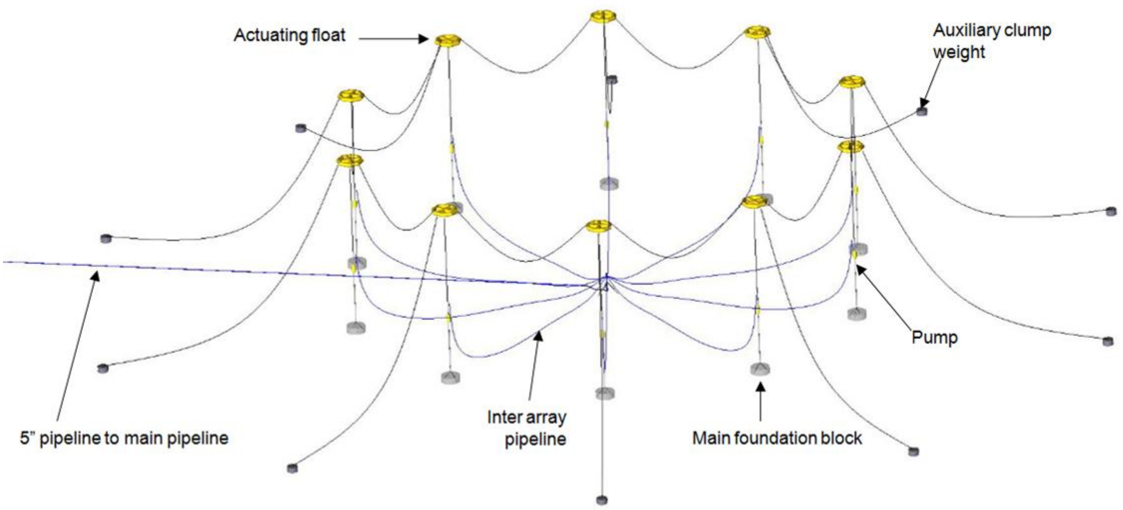
The Oceanus device consists of three main components, a foundation, a pump and an actuating float. The actuating float moves relative to the pump due to movement of the waves. This activates the pump causing it to pump seawater, which is then conveyed to shore and used to power a conventional Pelton Wheel hydro turbine (housed onshore) to generate electricity.

The units and piping system can be inter-connected together in an array form to help ensure a constant pressure is achieved in the pumped water. The main elements of the device in an array format are shown in the following figure. The blue lines indicate the pipelines on the seabed and the grey lines indicate the inter-connecting chains and mooring lines.



Oceanus wave energy converter

Three arrays will be deployed in ring formats. A new pipeline will be installed to shore through which the water will be pumped. It is planned to support the new pipeline with a series of steel fittings rock bolted into place. The array layout is shown in the following figure.



Design for each ring of devices

It is proposed to commence installation works in May 2012.

Potential environmental impacts

An environmental appraisal was undertaken following a comprehensive scoping process. The following key potential impacts were identified during scoping and subsequently assessed during the appraisal:

- Loss of habitat and direct disturbance to benthic species during foundation and pipeline installation and removal
- Impacts on benthic ecology due to dispersal of grouting chemicals
- Effect on benthic species from scour around device components on the seabed during the operational phase
- Permanent deposit of cut bolts and grout on the seabed following decommissioning
- Collision risk to diving birds from actuating floats/mooring lines
- Disturbance or displacement of birds from presence of devices
- Risk of injury to marine mammals and basking sharks from collision/entanglement with devices/mooring lines
- Changes to seabed character caused by the installation and presence of devices

The results of the appraisal are summarised in the following table:

Impact	Sensitivity/ value	Residual magnitude	Significance of residual effects
Construction			
Loss of habitat and direct disturbance to benthic species during foundation and pipeline installation and removal	Low	Low	Minor
Impacts on benthic ecology due to dispersal of grouting chemicals	Low	Low	Minor
Operation			
Effect on benthic species of scour around device components on the seabed during the operational phase	Low	Low	Minor
Permanent deposit of cut bolts and grout on the seabed following decommissioning	Low	Very Low	Negligible
Collision risk to diving birds from actuating floats/mooring lines	Very high	Very low	Minor
Disturbance or displacement of birds from presence of devices	Very high	Very low	Minor
Risk of injury to marine mammals from collision/entanglement with devices/mooring lines	Very high	Very low	Minor
Risk of injury to basking sharks from collision/entanglement with devices/mooring lines	High	Very low	Minor
Changes to seabed character caused by the installation and presence of devices	Low	Medium	Minor

Please note that potential impacts on shipping and navigation and Natura interests are considered separately within the following documents:

- Navigational Risk Assessment Summary
- Report to inform Habitats Regulations Appraisal

As shown, **no potentially significant impacts were identified in relation to the proposals**.

Environmental monitoring

The team at Seatricity has developed a plan for investigating some of the minor impacts identified during the appraisal. This will involve the following monitoring measures being undertaken following installation:

- Seabed survey using ROV and stills camera following installation and before decommissioning[1]
- Underwater noise survey during operation to define the noise signature of the development

The results of these measures will be reported following the completion of onsite works and monitoring work.

Accidental events

The potential environmental impacts of the following possible accidental and unplanned events were also appraised:

- 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 device(s)
- Loss of equipment overboard

Through this process, a number of potential key issues were identified and assessed. The results of this process are outlined in the following table:

Key issue	Ranking
Collisions with the devices or vessels	Major
Oil contamination following a collision event or structural failure	Major
Impacts of structural debris/lost equipment	Minor
Employment opportunities around contingencies and unplanned works	Positive

[1] A pre-installation Baseline seabed survey has already been completed (see section 4.1).

As shown, two potentially significant impacts were identified. The mitigation measures relevant to each are presented below:

Collisions with the devices or vessels:

- 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 co-ordinator 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[2] as appropriate to their activities
- Special project operating procedures will be developed to minimise risk of contact/collision by project vessels

Oil contamination following a collision event or structural failure

- 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 co-ordinator 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

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

The assessment concluded that with the planned mitigation measures in place, it is perfectly feasible for the device to be installed, monitored, maintained and removed without incident. It is therefore anticipated that the project can be undertaken without any collision or spill event arising and thus no impact or interaction is expected from these issues.

Conclusion

The environmental appraisal process identified no potentially significant environmental impacts associated with the proposals.

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1 Introduction

Seatricity is planning to install a demonstration array of its wave energy converter technology at European Marine Energy Centre's (EMEC) wave test site facility at Billia Croo in Orkney during early summer 2012. It is planned to install 30 Seatricity Wave Energy Converters (WEC's) with a combined total installed capacity of not more than 800kW. Aquatera has been commissioned by Seatricity to assist the project team in securing the necessary permits and licences associated with the proposed deployment at EMEC.

With a maximum capacity under 1 MW, 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. An environmental appraisal was undertaken and this Environmental Report (ER) was prepared to support the relevant licence applications.

Please note that the following documents have also been prepared and should be read in parallel within this ER where appropriate:

- Navigational Risk Assessment Summary (Aquatera, 2012)
- Report to inform Habitats Regulations Appraisal (Aquatera, 2012)
- Baseline seabed survey report (Aquatera, 2012)

The activities and operations considered within this ER are:

- Installation of foundations and devices
- Offshore pipeline installation
- Operation, maintenance and decommissioning of devices and associated equipment

1.1 Scoping Process

The scope of this ER was defined through a comprehensive scoping process and the following impacts were identified as those that should be considered within the ER:

- Loss of habitat and direct disturbance to benthic species during foundation and pipeline installation and removal
- Impacts on benthic ecology due to dispersal of grouting chemicals
- Effect on benthic species of scour around device components on the seabed during the operational phase
- Permanent deposit of cut bolts and grout on the seabed following decommissioning
- Collision risk to diving birds from actuating floats/mooring lines
- Disturbance or displacement of birds from presence of devices

- Risk of injury to marine mammals and basking sharks from collision/entanglement with devices/mooring lines
- Changes to seabed character caused by the installation and presence of devices

A number of other issues were raised by stakeholders. These issues were associated with navigational risk associated with normal operation and unplanned events (Orkney Fishermen's Association, Northern Lighthouse Board and Maritime and Coastguard Agency) and potential impacts on Natura interests (Scottish Natural Heritage and Royal Society for the Protection of Birds). Please note that these issues are addressed specifically within the aforementioned supporting information (NIAS and RIHRA) and therefore, not specifically within this ER. All other concerns raised by stakeholders are addressed with regards to the relevant impacts listed above.

1.2 ER contents

This ER contains the following information:

- Project description – an overview of the proposals
- Appraisal of potential impacts – an appraisal of the environmental impacts listed in section 1.1 along with possible mitigation measures and proposed monitoring measures where appropriate
- Cumulative effects – an overview of the potential cumulative issues relevant to the proposals
- Accidental and unplanned events – an overview of the potential impacts of accidental and unplanned events along with an overview of the relevant mitigation and contingency measures that will be implemented
- Commitments register – an outline of all measures that will be undertaken during works by Seatricity and all sub-contractors
- Conclusions
- References
- Appendix A – List of Material Safety Data Sheets

2 Project description

This chapter provides an overview of the proposals including basic technology design, location, methodologies for installation, maintenance (planned and unplanned), decommissioning and information regarding the individual technical components of the proposed project.

2.1 Seatricity WEC overview

The Oceanus device consists of three main components, a foundation, a pump and an actuating float. The actuating float moves relative to the pump due to movement of the waves. This activates the pump causing it to pump seawater, which is then conveyed to shore and used to power a conventional Pelton Wheel hydro turbine (housed onshore) to generate electricity.

The units and piping system can be inter-connected together in an array form to help ensure a constant pressure is achieved in the pumped water. The main elements of the device in an array format are shown in Figure 2.1 which depicts three pumping units. In Figure 2.1 the blue lines indicate the pipelines on the seabed and the gray lines indicate the inter-connecting chains and mooring lines.

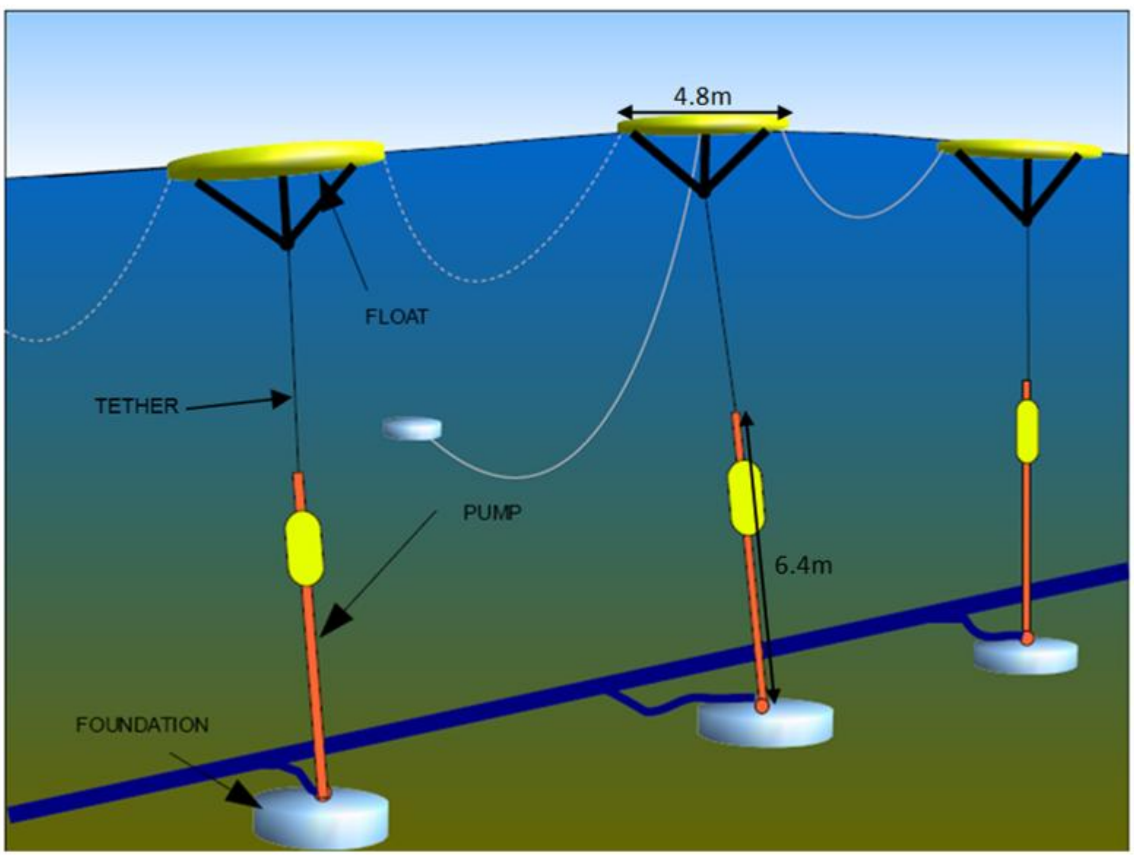

Figure 2.1 Seatricity WEC inter-connection overview

The Oceanus design is optimised to capture energy from small consistent waves. During rough seas the actuating floats can be submerged for their self protection in two ways; firstly, by closing onshore spear valves, the floats remain at the level of the lowest wave trough and secondly, by pumping seawater in reverse from shore and applying overpressure, the pumps can be fully submerged to their lowest point (4 metres below mean sea level). Figure 2.2 illustrates these self-protection procedures.

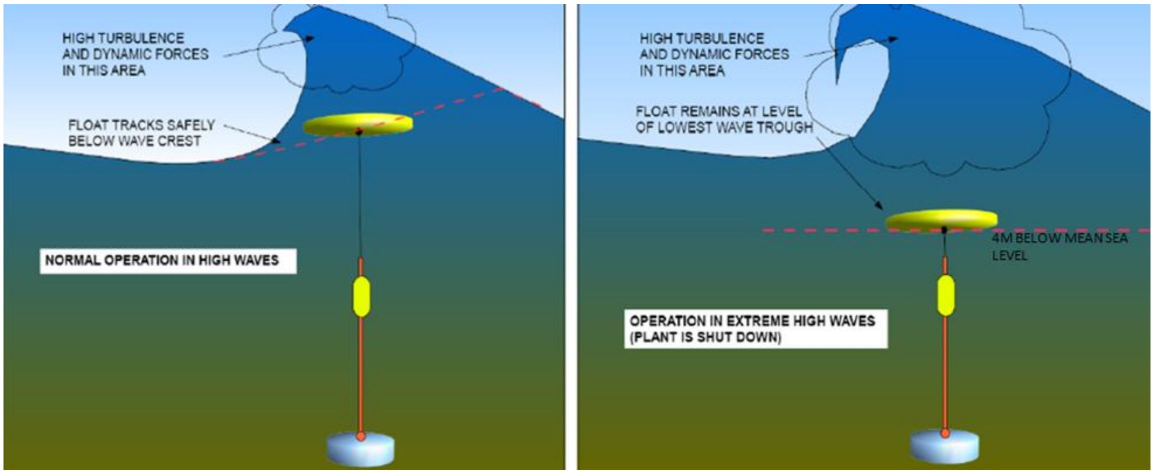

Figure 2.2 Behaviour of the Seatricity WEC in high and extreme wave conditions

Figure 2.3 below shows the actuating float of a device under test in Antigua. The smaller buoy in the background is for data collection and will not form part of the EMEC installation. The plume of spray is the high pressure seawater being pumped by the main device and in this case dumped back into the sea (this water will be pumped ashore at EMEC).

Figure 2.3 Prototype WEC under test

2.2 Project details and proposed location

It is planned to install 30 Oceanus devices with a combined total installed capacity of not more than 800kW at the wave test site. The WECs will be installed at a depth of approximately 33-38m below LAT[3]. The devices will be grouped into three 100 m diameter rings (with each ring comprising of 10 devices (refer to Figure 2.4)). The actuating floats will be interconnected by catenary chains hanging to a depth of approximately 5m between actuating floats. Auxiliary moorings (clump weights or chain) will also be installed. These will be connected by catenary chain and nylon rope to each actuating float.

Figure 2.4 shows the proposed layout of pressurised 1.5” pipes within each ring of devices. At the centre of the ring the pipes from each pump connect into a valve manifold on a 5” pipeline which will in turn connect into a 10” main pipeline to be conveyed to the connection point onshore. Absent from Figure 2.4 are tethers for deployment/retrieval of the devices. Each tether is connected to the base of the pump and the central manifold so that each device can be attached and unattached by lifting the manifold and pulling the relevant tether.

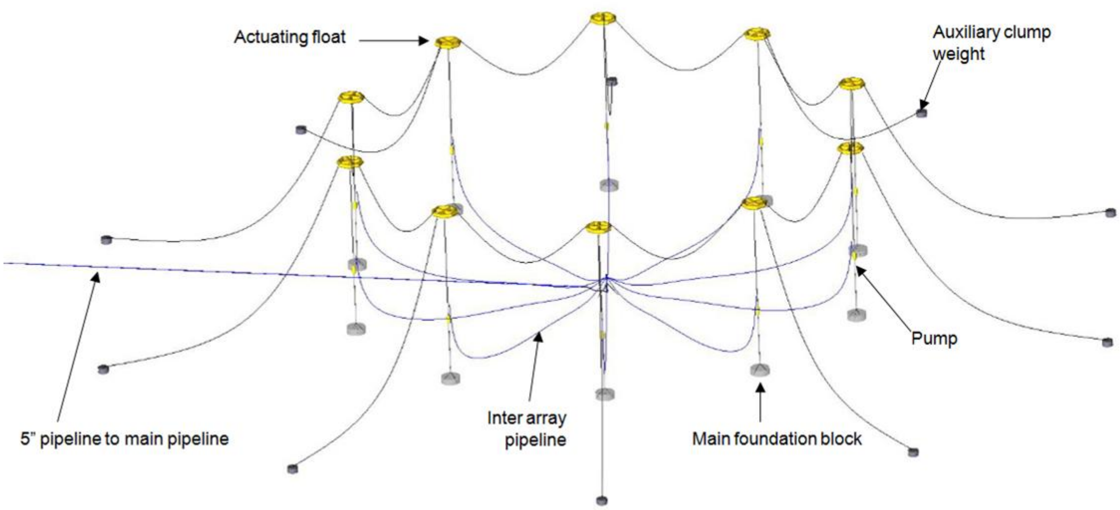

Figure 2.4 Design for each ring of devices

Figure 2.5 shows the proposed layout for the rings of devices (turquoise circles), the pipeline route from the rings to the turbine house onshore, and the location of EMEC's existing 10” diameter low pressure pipe which will be used for seawater return.

[3] Lowest Astronomical Tide

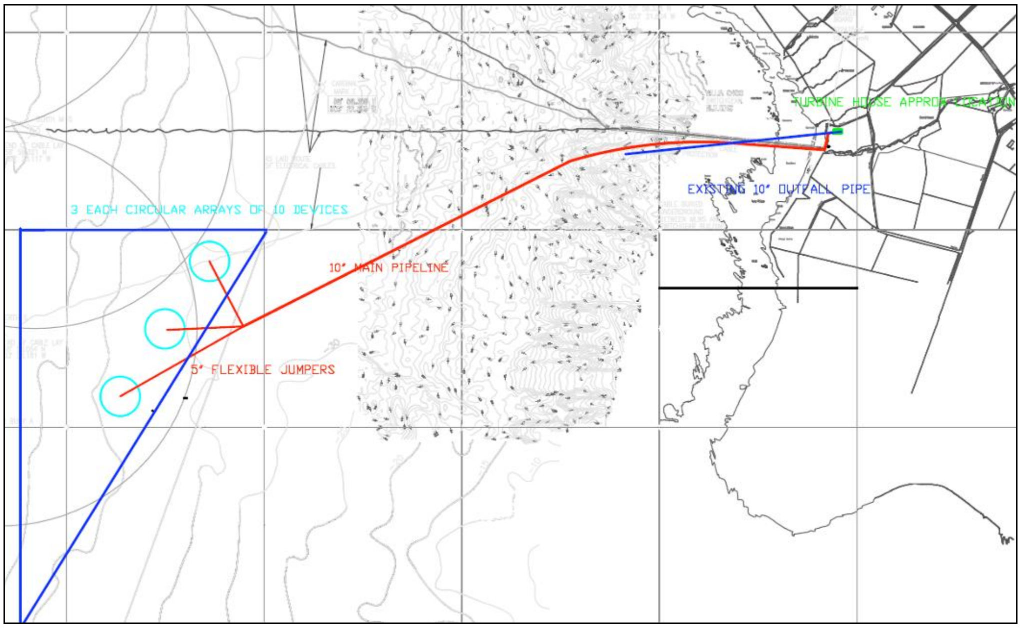

Figure 2.5 Proposed location of the Seatricity WEC's at EMEC's wave test site at Billia Croo

The main pipeline is approximately 1.8 km in length and interconnects (via flexible jumpers) into each ring of devices ranging from 150 - 300 m. Figure 2.6 shows the location of the proposals within the EMEC Billia Croo wave test site.

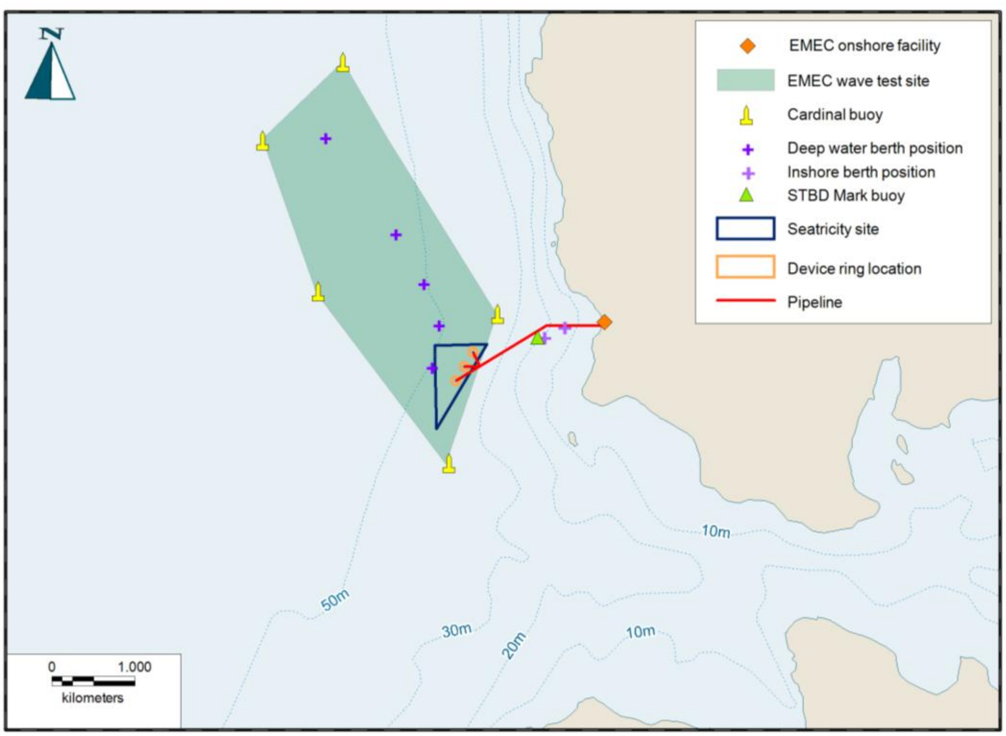

Figure 2.6 Location of the Seatricity deployment within the EMEC wave test site

Figure 2.7 provides a visualisation of a ring of devices in the water.

Figure 2.7 Visualisation of an area in the water

2.2.2 Technical components

Foundations / moorings

The foundations are comprised of the main foundation block (also known as a reaction block), which is attached to the actuating float by the pump and rope tether. The auxiliary moorings are then attached to the actuating floats by 15 m of catenary chain and nylon rope along the seabed.

The reaction block will be constructed from steel reinforced concrete, with each block having a steel attachment fitting for connection to the pump (see Figure 2.8). These blocks will be manufactured from standard reinforced Portland cement concrete. The attachment fitting includes a mechanism which can simultaneously either connect or disconnect both the pump and its associated outlet pipe connection. This mechanism allows the deployment or retrieval of the device during maintenance work. The mechanism will normally be operated by a tether attached to a small surface buoy or by ROV.

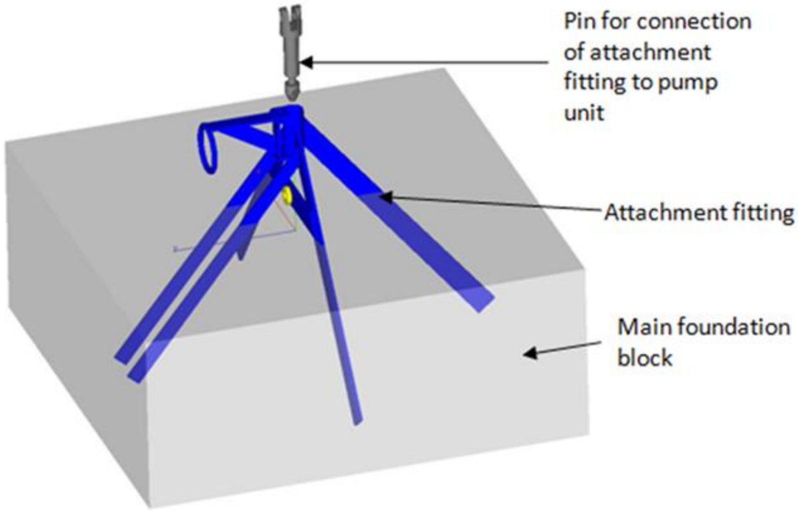

Figure 2.8 Main foundation block and pump connection

There are three options under consideration for the auxiliary moorings: either use of clump weights or chain, or a combination of both. The auxiliary moorings will each be 7.8 t in water (6 m^3 if concrete/ 1.2 m^3 if chain) and be positioned 50 m outside the ring of devices. The connection will consist of an upper chain section connected to the actuating float, a mid-section of nylon rope, and a lower section of chain attached to the auxiliary mooring.

Pumps

Seawater enters the 15 m long, 142 mm diameter, 441 kg weight pumps through a 100 µm filter. An integral backwashing system keeps these filters clean and prevents any organisms larger than plankton (or algae size) from entering the system. Seawater is then pressurised by the pumps to a nominal 60 bar. This pressurised water is then released through the underwater pipes ashore. The pumps are constructed of bronze, stainless steel and plastics. The pumps are designed to be seawater lubricated which eliminates the need for any oils or greases. The pumps have only one exposed moving part which is the upper plunger rod. The maximum pump stroke is anticipated to be 6.4 m which accommodates predicted movement of the actuating floats in waves, as well as movement due to tidal range.

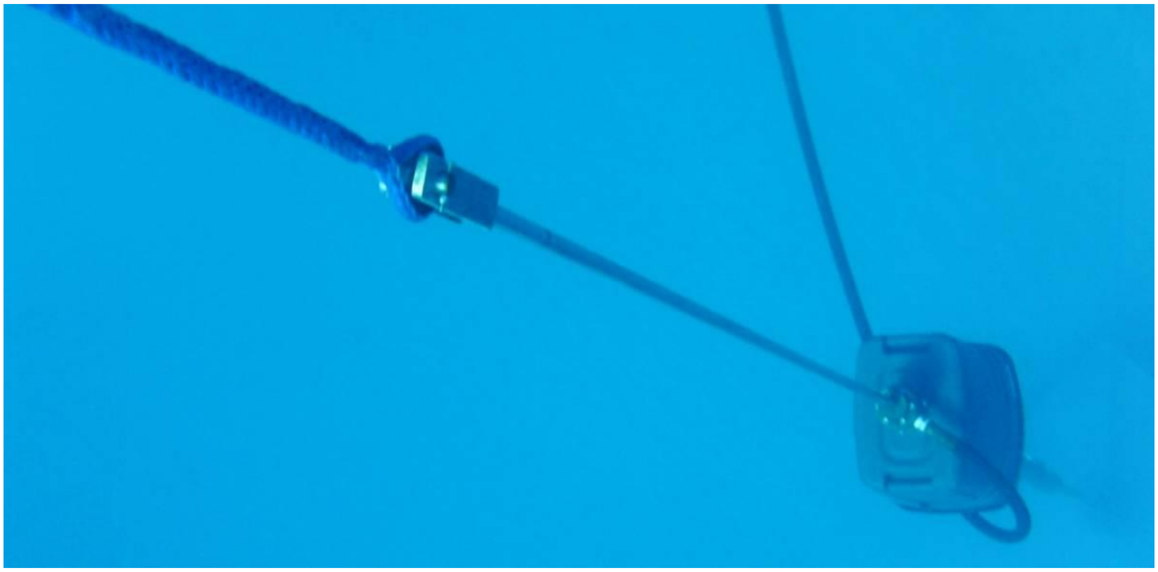

Figure 2.9 Aerial view of the pump showing the tether and pipeline connection

Actuating floats

The actuating floats will be fabricated from aluminium alloy. The actuating floats will be 4.8 m in diameter and made from 0.8 m diameter, 8 mm thick tube with each float weighing 1100 kg. Freeboard will be approximately 0.6 m. A synthetic rope (Aramid Twaron) will be attached to a universal joint assembly on the flange on the lower side of the substructure. The rope then further connects to the top of the pump unit. This rope connection is the primary, actuating, taut mooring for the actuating float. Further fittings will be added to the actuating floats for connection of the additional mooring lines and the chains connecting the actuating floats together.

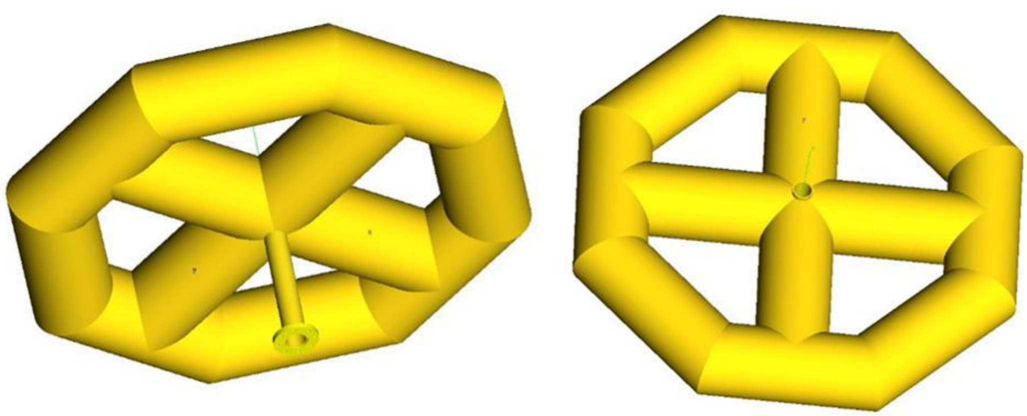

Figure 2.10 Actuating float design

Pipelines

The new main 10" pipeline will be laid directly onto the seabed and held in place over rocky areas by rock bolts (grouted into the bedrock) and clamps where necessary. The main pipeline will be comprised of interconnecting sections of steel pipe with an internal epoxy coating and an external 3LPP coating. The 5" pipeline and inter array pipelines will be constructed from flexible pipe.

Seawater leaving the onshore turbine will return to the sea via EMEC's existing 10" diameter pipe which is marked by a blue line in Figure 2.5. Due to limitations in the capacity of this pipe, it may be necessary to pump water out of the outfall during periods of high levels of electricity generation.

Onshore plant

The main pipeline will be connected to pressure accumulators and a Pelton Wheel type turbine generator housed within a standard shipping container next to the EMEC substation. A separate container will house the electrical controls and switchgear. This switchgear connects to EMEC's transformer pad for further connection to the substation. The Seatricity project will make use of existing infrastructure (previously utilised by Aquamarine Power during deployment of their now decommissioned Oyster I WEC) without the need for any major alterations. Some modifications will however be made to the equipment which will likely include upgrade to a larger generator and transformer, removal of much of the power electronics and some modifications to the pipework layout. Please note that EMEC has submitted a planning permission application to Orkney Island Council for onshore works above MLWS.

A small reverse osmosis unit will also be installed at Billia Croo to produce freshwater from a part of the pressurised seawater supply. This unit is intended for demonstration purposes only. When operational the desalinated water flow is likely to be 100 litres per hour, with the seawater flow of 200 litres per hour discharged with the main seawater return (at up to 360,000 litres per hour). The unit will be about 2 m by 0.5 m by 0.5 m and will be housed within the existing structures.

2.3 Construction materials

The construction materials are as outlined in Table 2.1. Materials Safety Data Sheets (MSDS) have been provided as appropriate (refer to Appendix A).

Table 2.1 Summary table of deposits

Installation component	Material(s)	Approx weight/volume	Duration	ISO standards or equivalent
Moorings/foundations				
Main foundations	Concrete steel	17.1 t in water each (13.2 m^3 if concrete; 2.6 m^3 if chain	Permanent	EN 206
Auxiliary moorings	Concrete OR Steel chain	7.8 t in water each (6 m^3 if concrete, 1,2 m^3 if chain)	Permanent	EN 206
Auxiliary mooring connection	Steel/nylon	1" chain for connection to actuating float (10m each), 25 mm diameter nylon rope (50m each). Thrash chain 1" (10m each)	Permanent	EN 100252
Inter float catenary chains	Steel	1/2" chain (40m each)	Permanent	EN 100252
Device				
Actuating float	5052 grade Aluminium alloy	4.8 m diameter, made from 0.8 m tube, 8 mm wall thickness, 1100 kg weight each	Permanent	
Tether (from float to pump)	Synthetic fibre - Aramid (Twaron)	Average 20 m length per device, 27 mm diameter, 0.5 kg m^{-1}	Permanent	
Pump	Bronze, stainless steel, plastic	15 m long, 142 mm diameter, 441 kg	Permanent	
Installation/removal tether	Steel	3/8" Wire rope	Permanent	
Pipelines				
Flexible pipe from pump to 5" pipeline	Fibre reinforced polyolefin	30 X 50 m, 38 mm diameter	Permanent	
5" pipeline	Aramid reinforced PE	~600 m, 100 mm diameter	Permanent	
10" pipeline to shore	Steel pipe, intertnal coating Epoxy, External coating 3LPP	1800 m, 273 mm diameter, 8 mm thick 90 tonnes	Permanent	ISO 9001:2008 DIN 30670
Rock bolts and clamps for main pipeline	Steel	Up to 180 sets of rock bolts (depending on finding suitable bolting locations) but probably less than half this	Permanent	
Grout for cementing of rock bolts	Grout	Details- type volume and MSDS sheet	Permanent	

Other waste streams entering the marine environment				
Pumped water effluent	Seawater	Seawater without any additives	Permanent	
Saline waste from reverse osmosis unit	Seawater	Volume to be determined	Permanent	
Pump filter self-cleaning	Organic material	-	Permanent	
Pigging waste	Organic material	Biofouling organisms such as mussels, barnacles etc perhaps amounting to a few m^3.	Permanent	

2.4 Proposed timeline

An outline schedule of works is provided in Table 2.2 (note that the timeline skips years 2013 to 2016 when normal operation and monitoring will continue):

Table 2.2 Proposed timeline for the Seatricity WEC deployment at Billia Croo

Task	2012								2017							
	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A
Installation																
Mobilisation	Planned	Contingency														
Foundations	Planned	Contingency	Contingency	Contingency												
Device	Planned	Contingency	Contingency	Contingency												
Pipeline	Planned	Contingency	Contingency	Contingency												
Operation																
Connection		Planned	Contingency	Contingency	Contingency											
Operation and monitoring			Planned	Planned	Planned	Planned	Planned	Planned	Planned	Planned	Planned	Contingency	Contingency			
Decommissioning																
Disconnection												Planned	Contingency	Contingency		
Decommissioning													Planned	Contingency	Contingency	
Demobilisation													Planned	Contingency	Contingency	

(blue)	Planned timings
(orange)	Contingency

2.5 Vessel requirements

The detailed methodologies associated with the installation of the devices and the associated structures are currently under development. This fact, and the difficulties in confirming availability of local vessels, means it is difficult to explicitly identify the vessels that will be used during installation. The same is true for maintenance and decommissioning activities, where inability to predict which vessels will be available in the future makes predicting specific vessel use unrealistic. Current planning, however, suggests that the vessels and vessel types outlined in Table 2.3 could be used. Note that no large construction or DP (dynamically positioned) vessels will be required at any stage of the project.

Table 2.3 Anticipated project vessel spread

Project phase	Task	Vessel type	Vessel options
Installation	Main pipeline installation	Multicat	C-Odyssey Voe Viking
	Pipeline protection installation	Dive/support vessel	Uskmoor Ocean Enterprise
	Foundation block installation	Multicat	C-Odyssey Voe Viking
	Pump and float installation	Support vessel	Ocean Enterprise Uskmoor
	Auxilliary mooring installation	Multicat or Support vessel	C-Odyssey Voe Viking Ocean Enterprise Uskmoor
	Array interconnection with catenary chains	Multicat or Support vessel	Ocean Enterprise Uskmoor Ocean Enterprise Uskmoor
	Inter-array pipeline installation	Support vessel	Ocean Enterprise Uskmoor
	Dive support/pipeline inter-connection	Support vessel	Ocean Enterprise Uskmoor
	General support	RHIB	TBC
Operation and maintenance	Pump/actuating float changeover	Support vessel	Ocean Enterprise
	General support	RHIB/ standard workboat	TBC
Decommissioning	Dive support/pipeline disconnection	Support vessel	TBC
	Inter-array pipeline decommissioning	Support vessel	TBC
	Array interconnection with catenary chains detachment and removal	Multicat or Support vessel	TBC
	Auxiliary mooring decommissioning	Multicat or Support vessel	TBC
	Pump and float decommissioning	Support vessel	TBC
	Foundation block decommissioning	Multicat	TBC
	Pipeline protection decommissioning	Support vessel	TBC
	Main pipeline decommissioning	Multicat	TBC
	General support	RHIB	TBC

The Ocean Enterprise, as listed in Table 2.3 above, is a purpose built vessel, which has been used during much of the prototype testing in Antigua. The vessel will be transported to Orkney for use in operations at the EMEC wave test site. The vessel will be cleaned and painted before shipment to the UK and has no internal ballast tanks. The vessel is shown alongside a prototype WEC during testing in Antigua in Figure 2.11 below.

Figure 2.11 The Ocean Enterprise alongside a Seatricity prototype WEC

2.6 Mobilisation

All the major components will be manufactured and/or assembled in Orkney:

- Floats and ancillary equipment - Ness Boatyard
- Pipeline construction - Billia Croo EMEC land site
- Reaction and mooring blocks - Finstown Quarry
- Generator installation and associated works - Billia Croo EMEC land site

Other components are expected to be delivered to Orkney by road and ferry, including tubulars for pipeline construction, pumps, and rigging.

The reaction and foundation blocks will be manufactured in the quarry at Finstown and delivered individually by road to the load out point in Stromness. Due to the weight of the blocks and to avoid handling crane lifts at sea, it is likely they will be hung off the bow of a multi-cat or similar vessel for transport out to the site.

The floats and riser assemblies can be loaded out directly from the Ness boatyard. The floats are relatively small and a workboat can be utilised for the tow out. Pilotage will not be required, provided the combined length of the tow is less than 65 metres. Extreme tides through Hoy Sound, even in clam weather will pose difficulty for a tow and wind against tide will exacerbate the situation.

A towing plan and deck plan will be required and approved by the Master of the vessels involved in operations, for the load out of the three different types of clump weight and the buoy and riser arrangement.

2.7 Pipeline installation

The main pipeline (11" diameter) will arrive in Orkney in 12 metre sections. Three sections will be assembled into one 36 metre length ready for deployment of the pipeline. The assembly line at the Billia Croo shore site will assemble two 36 metre lengths during the pipeline installation process.

Approximately nine pipeline guides (steel weldments rock bolted in place) will be installed at the point of curvature of the pipeline. When all guides are in place and a suitable weather window is identified, the pipe pulling line will be inserted through the guides. One end of the line will be secured on the beach in readiness to attach to the pipeline pulling head and the other end will be buoyed off.

The pull will be achieved by a multi-cat or similar vessel moored on a standard mooring system at pre-determined locations. Divers will be used to guide the pipe through the guides.

2.8 Device array installation

The foundation blocks and auxiliary moorings will be installed onto the seabed using a multicat-type vessel. Connection to the auxiliary moorings will be performed by a support vessel or multicat.

The pump will be connected to the float onshore prior to each float being towed to site using a small workboat. Each pump will then be attached to the main foundation by use of a tether operated latch mechanism on the foundation. This will be performed by a support vessel without the need for divers. The interconnector chains will then be installed from a small workboat, completing the ring of devices.

The inter array pipelines will be 5” diameter flexible pipeline installed generally from the surface. Divers may be required for making final connections to the main export pipe.

2.9 Operation and maintenance

2.9.1 Normal operation

All controls for the plant are located onshore. The offshore pumping units are self regulating and require no electrical control systems. This eliminates the use of electrical/electronic equipment in the marine environment. The pumping units are designed for a 5 year maintenance programme however a large part of the EMEC testing programme is to confirm this and make modifications if necessary.

2.9.2 Maintenance

Actuating float replacement

Whilst no major maintenance is anticipated, Seatricity plans to stock spare units so that they can be changed out as necessary. Changing a pump/actuating float combination can be carried out by the Ocean Enterprise service vessel without the need for divers and experience has shown that this can be safely achieved in up to 2m wave height in less than one hour.

Pipe cleaning

It is difficult to predict the fouling rate of the plant by marine organisms. This varies dramatically from one place to another and is highly dependent on water depth and temperature. The fouling rate of the equipment mounted on the seabed is not expected to have any significant effect on plant performance. There is a potential for the fouling of the inside of the main pipeline and for this reason the pipelines will be designed so that they can be cleaned periodically by 'pigging'. To facilitate this process an access tee will be fitted to the high pressure pipeline ashore. A gate or ball valve will be fitted at the offshore end of the pipe and will be either diver or ROV operated. A cleaning pig formed of multiple polyurethane rubber discs mounted on a shaft can then be inserted through the onshore access tee and driven to the offshore end by pressurised water. Note that the flow rate in the smaller diameter pipelines will be such that fouling will not take place.

Actuating float fouling

The underside of the actuating floats will attract fouling organisms. Initially, it is not planned to use any antifouling paint on the actuating floats. The operation of the actuating floats will not be affected by moderate amounts of fouling and it is anticipated that annual cleaning may suffice. If it transpires that cleaning the actuating floats becomes too frequent a requirement, then other options may be investigated.

2.10 Technical and environmental monitoring

During the operational phase, Seatricity will monitor the devices and carry out any necessary maintenance. During this time Seatricity will conduct a full spectrum of demonstration testing and monitoring activities, including:

- Power output
- Power quality to grid
- Pressures and flow stability in interconnecting pipelines
- Mechanical stresses
- Corrosion, wear and biological fouling

An Environmental Monitoring Plan (EMP) has been developed for the proposed project. Proposed monitoring measures are outlined in the project Commitments Register (refer to section 10).

2.11 Decommissioning

Because the individual components involved are small, decommissioning will be a relatively straightforward operation carried out by small vessels within a short timeframe.

During decommissioning, all structures deposited during installation will be removed from the test site except for the rock bolts used to stabilise the pipe, which will be cut as close to the seabed as is practical and left in the seabed/grout cement. Floats and pumps will be recovered followed by the pipes and the mooring system. Seatricity and its marine operations contractor will carry out the decommissioning procedures, which will be outlined within the Initial Decommissioning Programme in line with the relevant guidelines (DECC Decommissioning of Offshore Renewable Energy Installations under the Energy Act 2004 – Guidance notes for Industry) and presented in full within the Decommissioning Plan. In addition, Seatricity will also decommission the onshore infrastructure associated with the deployment. The existing pipe which will be used for outflow of water from the onshore turbine is owned by EMEC and decommissioning of this pipeline is not therefore, the responsibility of Seatricity.

2.12 Chemical use and management

2.12.1 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 will kept together with a description of the potential for discharge to the environment. Material Safety Data Sheets (MSDSs) are provided in support of this report. Note that the Seatricity device uses no lubricants, antifoulants or paints and that the only chemicals for consideration are coatings for the main pipeline and grout for the rock bolts.

Table 2.4 List of chemicals

Name	Reason for use	Type
Grout	Cementing of rock bolts securing the main pipeline	Portland Cement Grout
Pipeline coating	Equipment protection	CORRO-COAT EP-F 2002 HW 3M™ Scotchkote™ Epoxy Coating 62HB Borealis Polypropylene Borcoat BB127E Borealis Polypropylene BB108E

2.12.2 Spill prevention and response plan

All project locations on and offshore 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.

2.12.3 Potential discharges to sea

The pumps will make discharges to sea due to the self cleaning filters however the material built up on these filters would be organic material from the sea. Pipe cleaning or ‘pigging’ of the main pipeline will lead to the release of natural organic compounds/organisms built up inside the pipeline into the sea. It is not possible to estimate the level of discharge, as it is difficult to predict the fouling rate inside the pipeline. It is possible that the relatively fast flows of water through the pipelines may limit the rate of fouling.

2.12.4 Potential discharges to air

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

3 Appraisal of potential impacts

3.1 Potential impacts considered within the appraisal

The Scoping Report and subsequent consultation process identified several impacts as being appropriate for consideration in the environmental appraisal. Since the Scoping Report was completed, some additional design considerations have arisen with the potential for environmental effects. The rock bolts holding the main pipeline in position will be grouted and cut at decommissioning leaving a permanent deposit from the development (of cut bolts and grout).

A number of issues were raised during the consultation period by stakeholders for the most part relating to navigational risk along with the impacts on protected habitats and species; primarily Natura interests. Please note that these issues are dealt with in the following documents as appropriate:

- Array deployment of Seatricity's Oceanus wave energy converter at EMEC's wave test site in Orkney – Report to Inform Habitats Regulations Assessment (Aquatera, 2012)
- Array deployment of Seatricity's Oceanus wave energy converter at EMEC's wave test site in Orkney – Navigational Risk Assessment Summary (Aquatera, 2012)

The potential impacts that have been considered in this appraisal are listed in Table 3.1.

Table 3.1 Potential impacts

Receptor	Impact	Reason for inclusion
Benthic ecology	Loss of habitat and direct disturbance to benthic species during foundation and pipeline installation and removal	Identified in scoping report
	Impacts on benthic ecology due to dispersal of grouting chemicals	Additional design consideration
	Effect on benthic species of scour around device components on the seabed during the operational phase	Identified in scoping report
	Permanent deposit of cut bolts and grout on the seabed following decommissioning	Additional design consideration
Birds	Collision risk to diving birds from actuating floats/mooring lines	Identified in scoping report
	Disturbance or displacement of birds from presence of devices	Identified in scoping report
Marine mammals	Risk of injury to marine mammals and basking sharks from collision/entanglement with devices/mooring lines	Identified in scoping report
Seabed character	Changes to seabed character caused by the installation and presence of devices	Identified in scoping report

3.2 Methodology

The appraisal of predicted effects on receptors is based on both the sensitivity of a receptor and the nature and magnitude of the effect that the development will have on it. Effects may be direct (e.g. the loss of species or habitats), or indirect (e.g. effects on prey species). Table 3.2 defines the sensitivity for the various receptors considered in this chapter.

Wherever possible, the magnitude of the effect has been quantified. Professional judgement has been used to assign the potential impacts on the receptors to one of four levels of magnitude, defined in Table 3.3.

Finally, Table 3.4 provides the overall classification scheme for impacts on ecology and nature conservation, considering the sensitivity of the receptor and the magnitude of the impact.

The methodology used to assess the significance of potential effects on ecological receptors has considered guidelines produced by the Institute of Ecology and Environmental Management (IEEM, 2010; IEEM, 2006). The IEEM guidance recommends that the predicted impacts on the receptors be described and quantified, giving consideration to the following parameters: confidence in predictions, positive or negative, extent, magnitude, duration, reversibility and timing and frequency. These factors are brought together to assess the magnitude of the effect on the 'conservation status' of the particular valued ecological receptors, and on the 'integrity'[4] of the habitats that support them.

Conservation status is defined as:

- for habitats, conservation status is determined by the sum of the influences acting on the habitat and its typical species, that may affect its long-term distribution, structure and functions as well as the long-term survival of its typical species within a given geographical area; and
- for species, conservation status is determined by the sum of influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within a given geographical area.

[4] 'the coherence of a site's ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified' (EC Habitats Directive)

Table 3.2 Definitions of sensitivity

Level of value	Examples of criteria
Very high	Internationally important sites include: SACs, SPAs and Ramsar sites. Candidate SACs, potential SPAs and proposed Ramsar sites should be given the same consideration as designated sites A qualifying feature of an SAC, SPA or Ramsar site or notified feature of a SSSI A regularly occurring population or individuals of an internationally important species (listed on Annex I of the Birds Directive or Annex II or IV of the Habitats Directive) Rare, easily disturbed, low populations, threatened populations or distribution
High	A nationally important designated site e.g. SSSI, or a site considered worthy of such designation A viable area of a habitat type listed in Annex I of the habitats directive or smaller areas of such habitat which are essential to maintain the viability of a larger whole A regularly occurring population of a nationally important species, e.g. Listed on schedules 1 and 5 of the Wildlife and Countryside Act (1981) (as amended) Priority marine features Uncommon, quite easily disturbed, declining or diminished population or distribution Seabed features that are vulnerable to change and damage, which are not subject to other forms of disturbance, and which may in turn support rare and valued communities, which will often be designated at international levels; these areas may also be quite restricted in extent
Medium	Sites supporting species in nationally important numbers (>1% of Scottish population) UK BAP Priority species and habitats Areas of internationally or nationally important habitats which are degraded but are considered readily restored A regularly occurring, nationally significant population of a species listed as being nationally scarce Abundant, normal response to disturbance, stable population and distribution Seabed features that are reasonably robust to change and are likely to be subject to modest existing disturbance and may support species and communities of national and local importance
Low	A site designated as a non statutory designated site Any species or habitats for which there are no designations A good example of a common or widespread habitat in the local area Very common, resilient to disturbance, rapidly rising population and distribution Areas of internationally or nationally important habitats which are degraded and have little or no potential for restoration Species of national or local importance, but which are only present very infrequently or in very low numbers within the subject area Seabed features not particularly vulnerable to change/damage, often subject to existing natural/long term disturbance; features that are distributed extensively within the study area

Table 3.3 Definitions of magnitude of effect

Level of value	Examples of criteria
High	A permanent or long-term effect on the integrity of a site or conservation status of a habitat, species assemblage / community, population or group; if adverse, this is likely to threaten its sustainability Major loss or major alteration to key elements of the baseline (pre-development) conditions such that the post-development character / composition / attributes will be fundamentally changed a change that affects more than 5 km^2 of the seabed Multiple mortalities to marine mammals or larger sea life, change in regional distribution of marine mammal population
Medium	A permanent or long-term effect on the integrity of a site or conservation status of a habitat, species assemblage / community, population or group; if adverse, this is unlikely to threaten its sustainability A moderate shift from the baseline conditions, e.g.: Loss or alteration to one or more key elements / features of the baseline conditions such that post-development character / composition / attributes will be partially changed a change that affects 0.5 km^2 to 5 km^2 of seabed A single mortality to a marine mammal or larger sea life, change in local distribution to marine mammal population
Low	A short-term but reversible effect on the integrity of a site or conservation status of a habitat, species assemblage / community, population or group that is within the range of variation normally experienced between years Minor shift away from baseline conditions over a local area; Change arising from the loss / alteration will be discernable but underlying character / composition / attributes of the baseline condition will be similar to the pre-development situation A change that affects 0.05 km^2 to 0.5 km^2 of seabed Change in behaviour of marine mammals or larger sea life
Very low	A short-term but reversible effect on the integrity of a site or conservation status of a habitat, species assemblage / community, population or group that is within the normal range of annual variation Very slight change to the baseline condition; change barely distinguishable, approximating the 'no change' situation (change that affects up to 0.05 km^2 of seabed) A noticeable response from marine mammals or large sea life

Table 3.4 Assignment of impact significance based on sensitivity of receptor and magnitude of effect

Sensitivity of receptor	Magnitude of effect								
	High	Medium	Low	Very low	None	Very low	Low	Medium	High
Very high	Major	Major	Moderate	Minor	Neutral	Minor Positive	Moderate positive	Major positive	Major positive
High	Major	Moderate	Moderate	Minor	Neutral	Minor Positive	Moderate positive	Moderate positive	Major positive
Medium	Major	Moderate	Minor	Minor	Neutral	Minor Positive	Minor Positive	Moderate positive	Major positive
Low	Moderate	Minor	Minor	Negligible	Neutral	Negligible Positive	Minor Positive	Moderate positive	Moderate positive

In the following sections these definitions are applied to the assessment of possible significant impacts associated with the proposals.

For each receptor, the following information is provided:

- classification of the sensitivity on the basis of baseline information;
- a summary of the potential impacts considered and the expected magnitude of these impacts;
- any agreed mitigation commitments to reduce the magnitude of impacts
- a discussion of the residual effects, considering agreed mitigation commitments;
- a summary table of potential impacts and residual effects; and
- an overview of the proposed monitoring and optimisation measures which will be applied.

4 Benthic Ecology

4.1 Baseline description and sensitivity

Baseline information for benthic ecology is provided in EMEC's environmental description for Billia Croo (EMEC, 2009). In addition a site specific ROV survey has been undertaken for the footprint of the installation including pipeline routes. The results of this survey are provided in the supporting document – Baseline seabed survey report (Aquatera, 2012).

Any possible seabed sensitivities with regards to the proposals relate to seabed communities that are visible on the surface of the seabed. Visual means of characterising seabed habitats and associated communities were therefore employed. The seabed conditions recorded in the proposed device deployment area were highly variable. The seabed in the northern part of the site was predominantly composed of exposed bedrock. A large proportion of the area was covered by ridged and stepped bedrock slabs. However, areas of broken rock, boulders and cobbles, and medium sand deposits were also recorded, most notably in the area immediately to the north of the escarpment indicated by earlier bathymetric survey work. The seabed recorded in the southern part of the proposed deployment area was dominated by mobile, rippled medium sands with occasional bedrock outcrops and/or boulders. Water depths in the areas ranged from approximately 35 to 40m.

Along the pipeline route, the seabed ranged from the uneven bedrock with large gullies and crevices in the shallow water depths (approximately 20 - 30 m) found relatively close to the coast, through an area of relatively flat, scoured bedrock slabs to more mixed conditions (exposed bedrock, boulders and sand patches) in the vicinity of the device deployment area.

The rocky seabed conditions found in the north of the deployment site supported a diverse community of encrusting fauna and echinoderms, typical of many areas located off the west coast of the Orkney mainland (Moore, 2009). The areas of mobile, sandy sediments found in the southern part of the deployment site did not support a great abundance or diversity of benthic animals. No sensitive species or communities were recorded. The habitats recorded along the pipeline route, to a minimum depth of approximately 20m were similar to the rocky areas located in the deployment area.

The findings of the ROV survey are summarised in Figure 4.1.

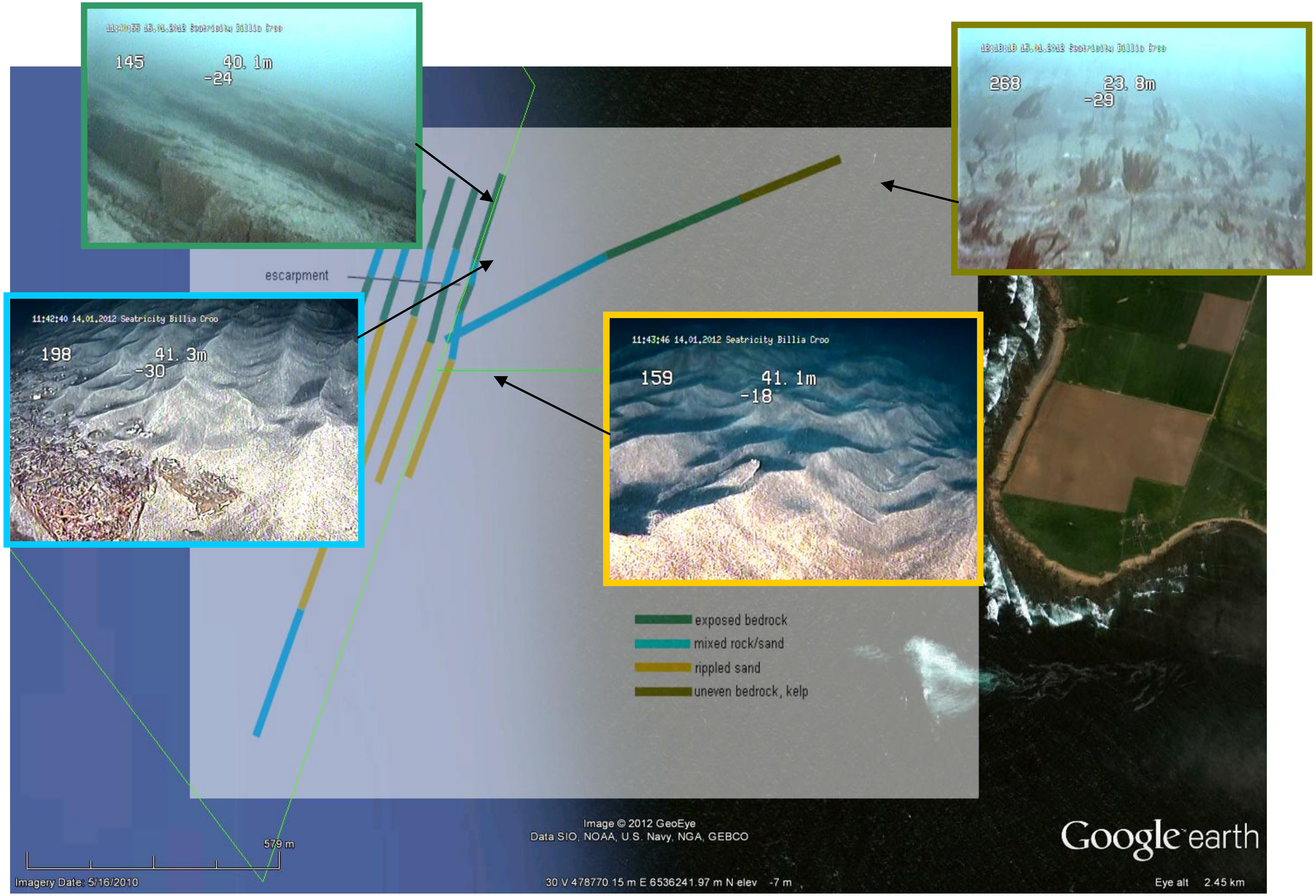

Figure 4.1 Seabed habitats recorded in deployment area and pipeline route (with example video stills), Seatricity baseline ROV survey, January 2012

These surveys showed that in the vicinity of the Seatricity deployment the seabed habitats and associated communities were unremarkable and typical of conditions in the wider area. The species observed are considered to be common, widespread and resilient to disturbance. Sensitivity of benthic ecology in the area has therefore been scored as low.

4.2 What are the potential impacts

The potential impacts identified during the scoping process for further consideration in the environmental appraisal are:

- loss of habitat and direct disturbance to benthic species during foundation and pipeline installation and removal;
- impacts on benthic ecology due to dispersal of grouting chemicals;
- effect on benthic species of scour around device components on the seabed during the operational phase; and
- permanent deposit of cut bolts and grout on the seabed following decommissioning.

Each of these impacts is discussed in more detail below.

4.2.1 Loss of habitat and direct disturbance to benthic species during foundation and pipeline installation and removal

Description of impact (including magnitude and classification)

The magnitude of the impact on benthic communities in terms of habitat and direct disturbance is largely determined by the footprint of the development on the seabed. The components of the development on the seabed include foundation blocks, auxiliary moorings (either clump weights or chain), and the chains attached to the auxiliary moorings as well as a series of pipes (refer to chapter 2). The footprint for each element of the proposals and the total seabed footprint are outlined in Table 4.1.

Table 4.1 Seabed footprint of the proposals

Item	Details	Area
Foundation blocks	Approx 9 m^2 footprint per foundation. 30 devices.	270 m^2
Auxiliary moorings	Approx 4 m^2 footprint per mooring. 30 devices.	120 m^2
Chains attached to auxiliary moorings	Approx 15 m length, assume 100 mm chain, 30 moorings	45 m^2
Main pipeline (25 cm)	25 cm main pipe will run for 1.7 km	425 m^2
13 cm pipe from main pipe to rings	Total length estimated at 600 m	75 m^2
4 cm pipelines within rings	Running from devices to centre of ring (30 devices, 50 m radius of ring).	56 m^2
Tethers	Will run from each device along seabed either to centre of ring or outside ring (50 m). Assume 5 cm rope.	75 m^2
Total seabed footprint	**Using conservative estimates where appropriate**	**1066 m^2 (0.1ha)**

The total seabed footprint of the project is therefore conservatively calculated at 1066 m^2 or approximately 0.1 ha, and the magnitude of the impact is therefore scored as low.

Section 4.1 identifies that the sensitivity of the receptor is low. Combined with the magnitude score of low, this potential impact is classified as minor

What mitigation measures can be applied?
No mitigation measures are planned for this minor impact.

What are the residual effects?
The residual effects are also considered to be minor (see Table 4.2).

What monitoring and optimisation measures can be applied?
A post installation, pre decommissioning and post decommissioning ROV survey will be undertaken which will aid in monitoring the effects of the development on the seabed and associated habitats and species.

4.2.2 Impacts on benthic ecology due to dispersal of grouting chemicals

Description of impact (including magnitude and classification)

The rock bolts holding the main pipeline in position will be grouted. Dispersal of grouting chemicals into the seabed environment could lead to a potential impact on benthic ecology in the immediate area. Given the small area to be impacted, the magnitude of this impact is anticipated to be low, and this activity is not expected to result in any significant impacts on benthic ecology.

What mitigation measures can be applied?
No mitigation or minimisation measures are anticipated for this minor impact.

What are the residual impacts?
The residual effects are also considered to be minor (see Table 4.2).

What monitoring and optimisation measures can be applied?
A post installation, pre decommissioning and post decommissioning ROV survey will be undertaken which will aid in monitoring the effects of the development on the seabed and associated habitats and species.

4.2.3 Effect on benthic species of scour around device components on the seabed during the operational phase

Description of impact (including magnitude and classification)

Placement of items onto the seabed including foundation blocks, auxiliary moorings and chains, can cause the sediment on the seabed surrounding the item to be washed away, thus adversely impacting any benthic communities in the area. However, much of the area where the devices will be installed is bedrock (see Section 4.1), limiting the amount of sediment that will be affected. As outlined in Section 4.2.1, the total seabed footprint of the project is some 1066 m^2 or approximately 0.1 ha. As the potential zone of effect is so small, and much of the area is bedrock, the magnitude of the impact on benthic communities is considered to be low, and the resulting impact classification is considered to be minor.

What mitigation measures can be applied?

No mitigation or minimisation measures are anticipated for this minor impact.

What are the residual impacts?

The residual effects are also considered to be minor (see Table 4.2).

What monitoring and optimisation measures can be applied?

A post installation, pre decommissioning and post decommissioning ROV survey will be undertaken which will aid in monitoring the effects of the development on the seabed.

4.2.4 Permanent deposit of cut bolts and grout on the seabed following decommissioning

Description of impact (including magnitude and classification)

The rock bolts will be cut at decommissioning leaving a permanent deposit from the development (of cut bolts and grout). Given the small area to be impacted, the magnitude of this impact is anticipated to be very low, and no significant impacts are expected to the environment.

What mitigation measures can be applied?

No mitigation or minimisation measures are anticipated for this minor impact.

What are the residual impacts?

The residual effects are also considered to be minor (see Table 4.2).

What monitoring and optimisation measures can be applied?

No monitoring measures are proposed.

4.3 Overview of residual effects on benthic ecology

Table 4.2 Summary of potential impacts and residual effects on seabed communities

Impact	Sensitivity/ value	Residual magnitude	Significance of residual effects
Construction			
Loss of habitat and direct disturbance to benthic species during foundation and pipeline installation and removal	Low	Low	Minor
Impacts on benthic ecology due to dispersal of grouting chemicals	Low	Low	Minor
Operation			
Effect on benthic species of scour around device components on the seabed during the operational phase	Low	Low	Minor
Permanent deposit of cut bolts and grout on the seabed following decommissioning	Low	Very Low	Negligible

5 Birds

5.1 Baseline description and sensitivity

Since March, 2009, there has been an on-going programme of land-based visual observations to provide information on the distribution and relative abundance of marine wildlife for the Billia Croo wave site and surrounding area. These surveys cover a hemispherical area extending 5km offshore which covers the entire EMEC wave site.

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 April 2009 – March 2010 (DMP Statistical Solutions, 2010). Table 5.1 shows which species have been recorded within the survey area and the months in which they were observed. The average number of birds recorded per observation period for each month is also given. This number was derived from the total number of a species observed in a month divided by the number of observation periods in that month. It should be noted that these numbers do not reflect the total number of birds at the site, as a single bird could be observed multiple times. It should also be noted that these birds were not all necessarily foraging at the site.

Table 5.1 Monthly average numbers of birds recorded during EMEC wildlife observations

Species	Months observed March 2009 –February 2010											
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Plunge divers												
Arctic tern	0.0	55.8	6.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gannet	6.2	5.8	12.4	42.1	73.0	75.6	139.5	144.3	8.7	5.8	0.0	0.1
Pursuit or surface divers												
Black guillemot	11.3	6.1	6.7	4.9	2.2	0.1	0.5	1.1	0.2	0.9	10.6	11.0
Common scoter	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Cormorant	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eider	1.9	1.0	0.0	0.6	2.1	0.6	1.8	8.0	5.6	8.6	16.3	7.8
Great northern diver	0.0	0.0	0.04	0.0	0.0	0.0	0.0	0.06	0.2	0.3	0.0	0.0
Guillemot	14.7	89.8	81.8	59.6	0.1	0.6	2.3	2.4	0.4	10.1	16.9	12.9
Little auk	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Long-tailed duck	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Puffin	1.7	4.4	3.3	5.7	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Razorbill	2.6	5.8	1.0	0.9	0.0	0.0	0.0	0.1	0.0	0.0	0.4	0.2
Red-throated diver	0.4	0.1	0.2	0.1	0.1	0.0	0.2	0.1	0.4	0.3	0.1	0.1
Shag	23.3	11.2	35.6	95.8	67.0	133.1	347.5	335.3	279.2	327.0	94.4	68.4
Surface feeders												
Common gull	0.0	0.05	0.08	0.2	0.0	0.0	2.9	32.31	2.3	0.3	0.4	0.1
Fulmar	357.1	425.3	137.8	894.2	326.7	259.2	470.5	642.9	498.4	198.5	64.1	314.7
Great black-	3.0	0.8	9.3	3.6	3.7	1.2	6.3	11.8	8.3	3.6	3.8	2.5

Species	Months observed March 2009 –February 2010											
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
backed gull												
Greylag goose	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.1	0.0
Grey phalarope	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Herring gull	3.5	1.4	0.2	0.2	0.0	0.0	2.9	7.6	1.5	0.3	0.7	0.9
Kittiwake	15.2	85.9	10.2	24.5	0.6	0.3	0.6	0.6	1.9	0.2	0.1	0.0
Lesser black-backed gull	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Manx shearwater	0.0	0.0	0.0	0.0	0.05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scaup	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8
Storm petrel	0.0	0.0	0.0	0.0	0.05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wigeon	0.0	0.0	0.0	0.0	0.0	0.0	13.1	10.6	0.0	0.0	0.3	0.0
Other												
Arctic skua	0.0	0.2	0.0	0.4	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Great skua	1.5	3.6	7.5	10.5	10.5	2.4	3.5	2.8	0.1	0.0	0.0	0.0
Pomarine skua	0.0	0.0	0.0	0.0	0.0	0.1	0.08	0.06	0.0	0.0	0.0	0.0

The most numerous species observed was the fulmar with high numbers recorded throughout the year. Other species present year-round included gannet with highest numbers recorded between August and November; and shag with highest numbers observed during October to January. Guillemots and kittiwakes were also recorded throughout the year however only very low numbers were recorded outwith the breeding season (April – July).

Manx shearwater, storm petrel, cormorant, grey phalarope, 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.

There are a number of Special Protection Areas (SPAs) within the wider area. Qualifying species from these sites could be affected by the project. An overview of these sites, the qualifying features, conservation objectives and the potential connections to the project are presented within Aquatera's, 2012 Array deployment of Seatricity's Oceanus wave energy converter at EMEC's wave test site in Orkney: Report to inform Habitats Regulations Appraisal (RIHRA).

Internationally protected species (qualifying features of SPAs) have been observed at the site. Therefore, the sensitivity of birds has been classified as 'very high'.

5.2 What are the potential impacts?

The potential impacts identified during the scoping process for further consideration in the EA are:

- Collision risk to diving birds from actuating floats/mooring lines
- Disturbance or displacement of birds from presence of devices

Each of these is discussed in more detail below.

5.2.1 Collision risk to diving birds from actuating floats/mooring lines

Description of impact (including magnitude and classification)

There is limited knowledge of the behaviour of seabirds in the vicinity of renewable energy devices. The floats will normally be on the sea surface (except in high sea states) and will remain uncoated and be fitted with visibility strips. Within the water column, main mooring lines will be taught but chains interconnecting actuating floats and supplementary mooring lines will be under less tension.

It is possible that birds may avoid the area altogether due to the visual presence of the actuating floats. It is also possible, however, that birds will be attracted to the devices if there are aggregations of fish present.

The floats themselves are not considered to present any collision risk to diving birds. It is possible that if unable to detect submerged components or take avoidance action, diving birds could collide with submerged structures such as interconnecting chains and mooring lines whilst foraging. It is considered unlikely that pursuit divers would be unable to detect and avoid submerged mooring lines or chains in open water. In the unlikely event that collision did occur, given the relatively low swim speeds of pursuit divers and the nature of the submerged components any collision would be unlikely to result in more than a minor injury.

The risk of collision is considered greatest for plunge divers, in particular, gannet, as it is unknown whether this species would be able to detect and avoid submerged mooring lines or chains when diving at speed from heights up to 40m. Gannets dive to depths between 8 – 15 m, but commonly 1 – 4 m, however they have been recorded diving as deep as 30 m (Birdlife International[5]). As the risk of collision is considered greatest for gannet, the following discussion focuses on this species.

The nearest gannet colony is at Noup Head in Westray, some 36km from the Billia Croo site. The colony established in 2003 and has grown from three nesting pairs in 2003 to 583 nesting pairs in 2010 (Williams, 20116). Gannets have large foraging distances (up to 310 km; see RIHRA, Aquatera 2012) and there is potential that gannets from SPAs (e.g. Sule Stack and Sule Skerry SPA, 57 km from the site or any other SPAs within this buffer distance) could be foraging in the area. There are some 5,900 pairs of gannet at Sule Skerry and Sule Stack SPA (SPA Citation, 2009). Adding the population of these two sites together, the total breeding population in Orkney can be estimated at some 6,500 breeding pairs. This is considered to be an increasing population.

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[5] http://seabird.wikispaces.com/

6 Williams, J. (Ed.), (2011) Orkney Bird Report 2010. Orkney Bird Report Committee

On a proportionate area basis the chains associated with the three device rings will take up 300 m^2 of sea area, amounting to only 0.4% of the 611ha EMEC test site. Given the relative scale of the proposed deployment area and the size and character of the structural components with which collision could theoretically occur, it is considered that risk of collision to gannets is very low.

What mitigation measures can be applied?
No mitigation measures are proposed for this minor impact.

What are the residual effects?
There is no change to the classification of residual effects, which is considered to be minor (see Table 3.2).

What monitoring and optimisation measures can be applied?
No monitoring or optimisation measures are proposed.

5.2.2 Disturbance or displacement of birds from presence of devices

Description of impact (including magnitude and classification)
The presence of an array of actuating floats with visibility strips on the sea surface could cause displacement of birds from the area for the duration of the operational phase. However, individually the devices are small in size, similar to other structures (e.g. buoys), which seabirds do not appear to avoid, and the arrangement of the array means that there is ample space around the devices for foraging or resting seabirds. Therefore, it seems unlikely that birds would avoid the arrays to any great extent. In a worst case scenario, however, all birds could potentially be displaced outwith the approximately 2.35 ha footprint of the three arrays. It seems very unlikely that if displacement occurred, it would extend very far beyond the actual arrays. As seabirds normally forage in different locations depending on prey availability, a displacement from an area of this size would not be outside the normal range of daily variation. Therefore, the magnitude of this impact is considered to be very low, and the resulting impact classification is minor

What mitigation measures can be applied?
No mitigation measures are proposed for this minor impact.

What are the residual effects?
There is no change to the classification of residual effects, which is considered to be minor (see Table 5.2).

What monitoring and optimisation measures can be applied?

It is proposed to make targeted observations to investigate bird behaviour around the devices during sensitive periods.

5.2.3 Overview of potential impacts and residual effects on birds

Table 5.2 Summary of potential impacts and residual effects on birds

Impact	Sensitivity/ value	Residual magnitude	Significance of residual effects
Operation			
Collision risk to diving birds from actuating floats/mooring lines	Very high	Very low	Minor
Disturbance or displacement of birds from presence of devices	Very high	Very low	Minor

6 Marine mammals and basking sharks

6.1 Baseline description and sensitivity

EMEC has implemented an on-going programme of land-based visual observations at Billia Croo since 2009. The results of this ongoing monitoring programme have been used as far as possible in defining the baseline environment and in the appraisal of potential impacts on the relevant receptors.

6.1.1 Cetaceans

All cetaceans are listed under Annex IV[7] of the Habitats Directive (92/43/EEC) which affords all species strict protection within their natural range and specifically prohibits deliberate disturbance.

In over 1000 hours of observations at the EMEC test site, cetaceans were observed in only 89 observation hours. The species observed and the months in which they were sited are given in Table 4.1. The most frequently recorded species was harbour porpoise with sightings in all months of the year.

Table 6.1 Cetacean species recorded during EMEC wildlife observations

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

Due to their international importance, all cetaceans are considered to be of very high sensitivity.

6.1.2 Seals

All seals are listed under Annex II[8] of the same Directive which identifies species whose conservation requires the designation of Special Areas of Conservation (SAC). Three SACs with seals as qualifying features have been identified as being of relevance in relation to this project[9] (refer to the project Report to Inform Habitats Regulations Appraisal, Aquatera 2012). These are the Sanday SAC

[7] Animal and plant species of community interest in need of strict protection (92/43/EEC)

[8] Animal and plant species of community interest whose conservation requires the designation of Special Areas of Conservation (92/43/EEC)

[9] Bottlenose dolphin and harbour porpoise are also listed under Annex II but there are no SACs for these species in Orkney

designated for common (harbour) seal, the North Rona SAC designated for grey seal and the Faray and Holm of Faray SAC designated for grey seal. Whilst these sites are approximately 62 km, 150km and 50 km away respectively from the proposed deployment area, seals from within the sites may possibly forage within the wider area.

Seals are also provided further protection under the Marine (Scotland) Act 2010, in that it is an offence to kill, injure or take a seal at any time of year except to alleviate suffering, or where a licence has been issued to do so by Marine Scotland under Part 6 of the Act. It will also be an offence to intentionally or recklessly harass seals at 'significant haul-out sites' which are currently being identified by the Sea Mammal Research Unit (SMRU) on behalf of the Scottish Government.

Both harbour and grey seals were recorded within the Billia Croo survey area (Table 6.2). 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 will be present at the site in relatively low numbers.

Table 6.2 Numbers of seals recorded during EMEC wildlife observations

Species	Number of animals per month observed April 2009 – March 2010											
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Harbour seal	0	1	0	5	0	0	2	1	0	0	0	0
Grey seal	6	3	8	7	6	5	11	6	14	11	11	5
Unidentified seal	6	4	2	9	7	2	4	5	2	2	4	1

Due to their international importance, all seals are considered to be of very high sensitivity.

6.1.3 Basking sharks

Basking sharks are known to use the west coast of Orkney for passage and feeding. They have historically been recorded at Billia Croo; however there were none recorded during the monitoring period from April 2009 to March 2010.

The basking shark is of conservation importance as an internationally recognised endangered species. They are classed as Vulnerable[10] on the IUCN Red List and are also on the OSPAR List of Threatened and/or Declining Species and Habitats, although they are not listed under the Habitats Directive. In the UK they are a BAP priority species and classed as a protected animal under Schedule 5 of the Wildlife and Countryside Act 1981. In Scotland they are recognised as a Priority Marine Feature. Their sensitivity is therefore considered to be high.

[10] The term Vulnerable is used for IUCN Red List species considered to be facing a high risk of extinction in the wild

6.2 What are the potential impacts?

The potential impacts identified during the scoping process for further consideration in the EA are:

- Risk of injury to marine mammals and basking sharks from collision/entanglement with devices/mooring lines

This potential impact is discussed in more detail below.

6.2.1 Risk of injury to marine mammals and basking sharks from collision / entanglement with devices/mooring lines

Description of impact (including magnitude and classification)

Installation of the Seatricity development involves the placement of several objects into the marine environment. There is concern that marine mammals and basking sharks 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 actuating floats;
- the foundation blocks and auxiliary moorings;
- the chains attaching the actuating floats to each other; and
- the mooring lines and pump unit.

The relative size of a minke whale (and a human diver) to the array is illustrated in Figure 6.1 below.

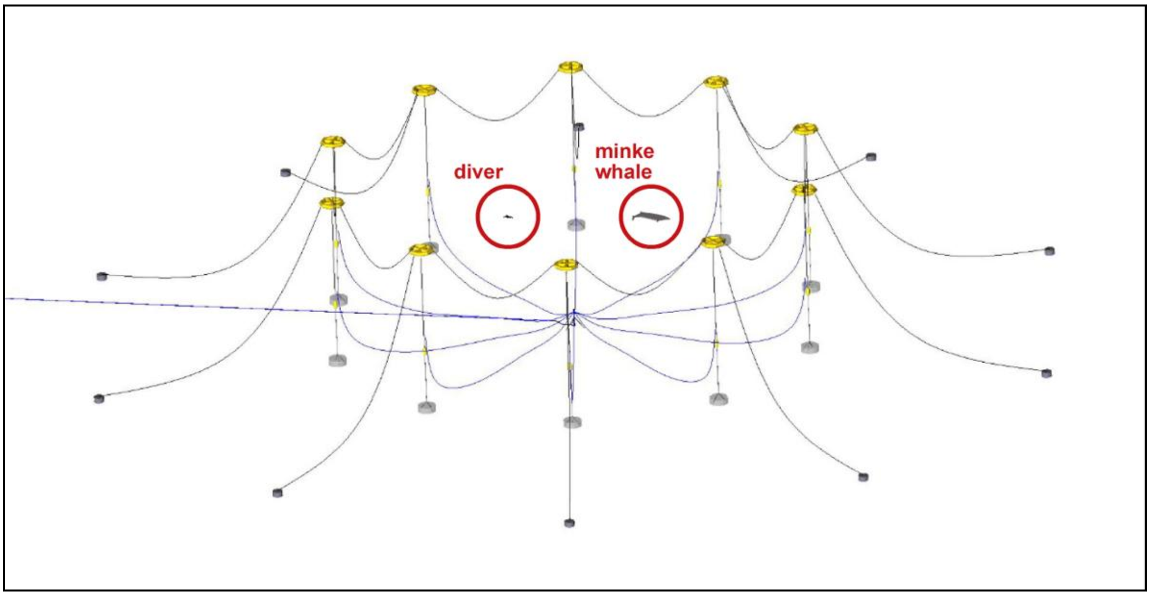

Figure 6.1 Scale illustration to aid in assessment of collision risk

The actuating buoy is similar to many other obstacles in the sea and does not provide any particular collision risk above that of a navigational buoy. The same can be said for the mooring lines, which will be tensioned between the actuating float and the foundation block and have some slack between the actuating float and the auxiliary moorings. The separation between mooring points will aid in the safe passage of animals through the test berth. The buoys and moorings will be stationary and marine mammals and basking sharks would be expected to be able to detect their presence. Nonetheless the foundation blocks, auxiliary moorings, actuating floats and mooring lines pose an additional collision risk within the area and are structures which marine mammals and basking sharks may be unfamiliar with.

The consequence of collision is also reduced due to the fact that all components in the water column will have an element of 'give'. In the unlikely event that a marine mammal or basking shark was unable to detect a component of the development and collided with it then the consequence would be unlikely to result in more than a minor surface injury.

Considering the above the overall magnitude has been scored as very low and the resulting impact is therefore scored as minor.

What mitigation measures can be applied?

No mitigation measures are proposed.

What are the residual effects?

The residual effects are therefore also considered to be minor.

What monitoring and optimisation measures can be applied?

No monitoring or optimisation measures are proposed.

6.2.2 Overview of potential impacts and residual effects on marine mammals and basking sharks

Table 6.3 Summary of potential impacts and residual effects on marine mammals and basking sharks

Impact	Sensitivity/ value	Residual magnitude	Significance of residual effects
Operation			
Risk of injury to marine mammals from collision/entanglement with devices/mooring lines	Very high	Very low	Minor
Risk of injury to basking sharks from collision/entanglement with devices/mooring lines	High	Very low	Minor

7 Seabed Character

7.1 Baseline description and sensitivity

General details on seabed, bathymetry and seabed sediments are provided in the EMEC Environmental Statement for the Billia Croo test site (Carl Bro, 2002). A site specific ROV survey (refer to Baseline seabed survey report, Aquatera 2012) was also performed which showed that the seabed in the development area is typical of the region with no specific features of importance noted. The sensitivity has therefore been scored as low.

7.2 What are the potential impacts?

The potential impacts identified during the scoping process for further consideration in the EA are:

- Changes to seabed character caused by the installation and presence of devices

The potential significance of this impact is discussed below.

7.2.1 Changes to seabed character caused by the installation and presence of devices

Description of impact (including magnitude and classification)

The proposals will involve deployment of a number of items onto the seabed which could impact on seabed character. It is likely that seabed character would return to previous conditions shortly after removal of the devices at decommissioning. The level of impact on seabed character is largely determined by the surface area of device components on the seabed. This has been calculated at 1066 m^2 or 0.1 ha (see Table 4.1). The magnitude has therefore been scored as Medium, resulting in an overall impact score of minor.

What mitigation measures can be applied?

No mitigation measures are proposed.

What are the residual effects?

The residual effects are also considered to be minor.

What monitoring and optimisation measures can be applied?

A post installation, pre-decommissioning and post-decommissioning ROV survey will be undertaken which will aid in monitoring any effects of the development on the seabed.

7.2.2 Overview of potential impacts and residual effects on Seabed Character

Table 7.1 Summary of potential impacts and residual effects on Seabed Character

Impact	Sensitivity/ value	Residual magnitude	Significance of residual effects
Operation			
Changes to seabed character caused by the installation and presence of devices	Low	Medium	Minor

8 Cumulative effects

Best information to date would suggest that there are very few impacts likely to arise from the deployment of the Seatricity devices. 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 operations, considered to comprise Aquamarine's operation of Oyster II, EONs operation of P2, SPR's operation of P2 and the deployment of the Wello Penguin.
- PFOW lease activity, which within the timescales of the Seatricity deployment is likely to be limited to survey work or the initial phases of installation
- Other project activities such as installing a new transmission cable, and improvements to Stromness Harbour (Copland's Dock)
- 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 Seatricity deployment during 2012 to 2017 should avoid interactions with the main 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.

9 Accidental and unplanned events

In addition to the potential impacts and opportunities associated with the Seatricity project that are anticipated to arise from planned activities, there are a number of accidental or unplanned events which could possibly 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 the following methodology:

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

9.1 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 device(s)
- Loss of equipment overboard

Each event has been screened for potential environmental interactions and each potential interaction has been classified (see Table 9.1) as per the impact classification criteria outlined in EMEC (2011). Impact scores therefore represent the worst case scenario 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 9.1 and Table 9.2).

Note – the overview provided within this section should be read in parallel with the project Navigational Risk Assessment Summary (Aquatera, 2012) report which addresses all issues around navigational risk and presents the relevant mitigation measures and any appropriate emergency response plans (ERPs).

Table 9.1 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	C	D					C	B	B		B	
Mooring failure resulting in errant device									B	B					A	A				-	D		A								
Support vessel collision with 3rd party vessel			B		B				B	B	B	B	B	B	A	A				-	D		A					B			
Support vessel/3rd party vessel collision with device(s)			B		B				B	B	B	B	B	B	A	A				-	D		A					B			
Loss of equipment overboard	C		C		C				C	C									C	-	D		C								

Table 9.2 Key issues around unplanned and accidental events

Ref.	Key issue	Ranking
A	Collisions with the devices or vessels	Major
B	Oil 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 devices or vessels
- Fuel oil contamination following a collision event or structural failure

Each impact mechanism is discussed further in Sections 9.2 to 9.3.

9.2 Collisions with the devices or vessels

9.2.1 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:

- An actuating float becoming errant and a collision event with a passing vessel
- A third party vessel becoming errant and colliding with a device in the array
- A support vessel becoming errant and colliding with a third party vessel or a device in the array

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 a 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 or nearby vessels or spillage of pollutants which are harmful to the environment.

9.2.2 What are the potential impacts?

Installation and decommissioning of the Oceanus devices and associated moorings and pipelines 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 weeks. During the operational phase it is unlikely that more than one support vessel (small workboat or RHIB) will attend the array at any one time.

If a collision between a support vessel and another vessel or a 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
- 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 outwith the main shipping lanes of the Pentland Firth. The devices 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 devices. 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. 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 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. 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 Navigational Risk Assessment Summary (Aquatera, 2012) 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 devices 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.***

9.2.3 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 co-ordinator 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[11] as appropriate to their activities
- Special project operating procedures will be developed to minimise risk of contact/collision by project vessels
- Adherence to EMEC's Standard Operating Procedures (SOPs) and Emergency Response Procedures (ERPs)

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.

9.2.4 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.*

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

9.3 Fuel oil contamination following a collision event or structural failure

9.3.1 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.

9.3.2 What are the potential impacts?

There is potential for vessel-vessel collision or vessel-device collision to cause the release of pollutants. The quantities of fuels held on the installation support vessels are in the order of single to tens of tonnes and no oils or fuels are used in the devices. The quantities of fuels held on the installation support vessels 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**.*

9.3.3 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 co-ordinator 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

9.3.4 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.

9.4 Summary of residual impacts

Table 9.3 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 Navigational Risk Assessment Summary (Aquatera, 2012).

10 Commitments register

Based upon the potential key issues associated with the proposed development, the impact assessment process undertaken and stakeholder consultation, the following Commitments Register has been developed:

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 boats 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
Design device with minimal external moving parts to minimise potential for disturbance	Developer	Completed
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

Commitment	Action holder	Status
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
General offshore wildlife observations at test site	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
Seatricity 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	Developer	Yet to start
Vessel crew(s) and project team members will also record all noteworthy sightings of marine mammal and other wildlife behaviour within the immediate area of works whilst team members are on site for maintenance / inspection activities. These boat-based incidental observations will help build a picture of marine mammal behaviour around wave energy converters and installation vessels.	Developer	Yet to start
The noise signature of the project will be investigated	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

11 Conclusions

The installation of the Seatricity array 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 new concept for wave energy extraction, 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 emerging 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 Seatricity'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, Seatricity can build itself to become a key player within the international marine energy sector.

A Commitments Register has been developed, which Seatricity and all sub-contractors will adhere to during the installation, operation, maintenance and recovery of all components. Furthermore, an Environmental Monitoring Plan has been developed based on this Environmental Report which will be implemented as and when appropriate.

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Appendix A – 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 Seatricity device. MSDS for the following chemicals are included:

- Portland cement grout
- Pipeline coating:
  - CORRO-COAT EP-F 2002 HW
  - 3M™ Scotchkote™ Epoxy Coating 62HB
  - Borealis Polypropylene Borcoat BB127E
  - Borealis Polypropylene BB108E