MARINE ENERGY WALES

MARINE ENERGY TEST AREA (META)

Environmental Impact Assessment: Appendices

Appendix 2.1. - Summary of Device Types

EOR0730

Marine Energy Test Area

Rev: 02

June 6, 2019

Document Status

Version	Date	Authored by	Reviewed by	Approved by	Review date
Rev00	11/02/19	RDS	NS	NS	29/04/2019
Rev01	22/02/19	RDS	JH	JH	28/05/2019
Rev02	06/06/19	ST			

Approval for issue

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Prepared for:

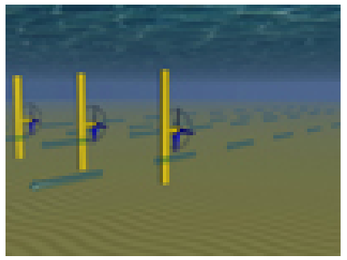
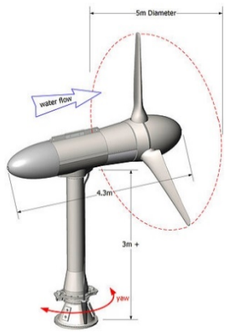
Marine Energy Wales

A.2.1.1. Device Technologies

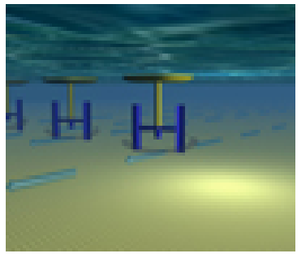
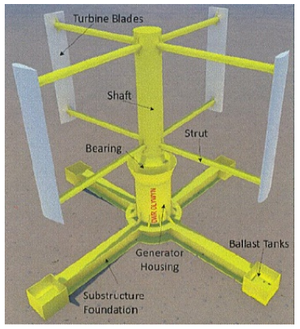
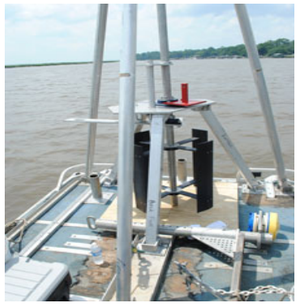
A.2.1.1.1. The following tables outline the potential wave and tidal technologies that are currently available or in development as marine energy converters. The information provided below illustrates the range of device/technology types available in the marine energy industry. The META project may support some of these devices or similar technology, however it should be noted that tidal devices that may be deployed at Warrior Way (site 6) are micro-scale/scaled devices, and full-scale tidal devices will not be supported at Warrior Way (site 6). Full scale tidal devices are provided below for information.

A.2.1.2. Tidal Stream Technologies

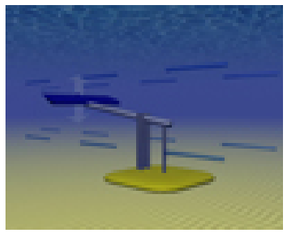
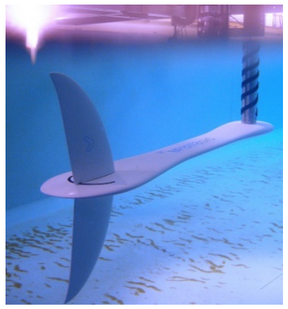
A.2.1.2.1. Horizontal Axis Turbines

Infographic	Information
	Horizontal axis turbines work in a similar manner to wind turbines. The turbine is placed in the water and the tidal stream causes the rotors to rotate around the horizontal axis and generate power.
	Real Device Example: Verdant Power Photo: https://www.verdantpower.com/free-flow-system Dimensions: • 5 m Rotor Diameter • 3 m Pylon • 4.3 m width • Approximately 32 revolutions per minute (rpm)

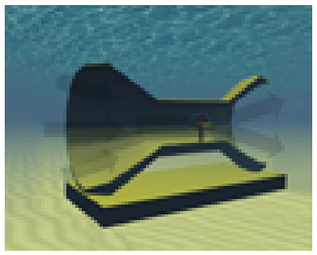
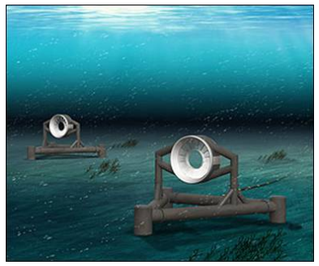
A.2.1.2.2. Vertical Axis Turbines

Infographic	Information
	Vertical axis turbines work in a similar manner to horizontal axis turbines, but the tidal stream causes the rotors to rotate around the vertical axis in order to generate power.
	Real Device Example: DWR Offshore Ltd. Overall Dimensions: 20 m x 20 m
	Real Device Example: Repetitive Energy http://www.repetitiveenergy.com/our-technology/

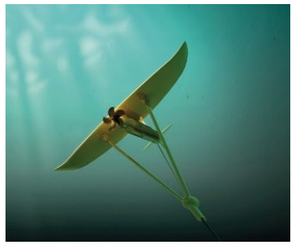
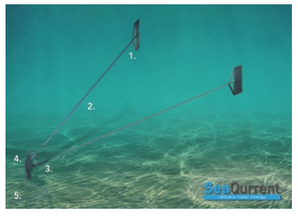
A.2.1.2.3. Reciprocating Hydrofoils

Infographic	Information
	Reciprocating Hydrofoils have a hydrofoil attached to an oscillating arm. The lift caused by the tidal stream causes the arm to oscillate, thereby generating power.
	Real Device Example: Biostream http://bps.energy/biostream

A.2.1.2.4. Venturi Effect Devices

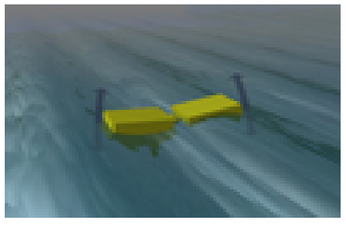
Infographic	Information
	Venturi Effect Devices are devices which funnel the water through a duct, increasing the water velocity. The resultant flow can drive a turbine directly or the induced pressure differential in the system can drive an air turbine.
	Real Device Example: Open Hydro 2 MW http://tidalpower.co.uk/openhydro • Turbine rotor diameter: 16 m

A.2.1.2.5. Tidal Kite

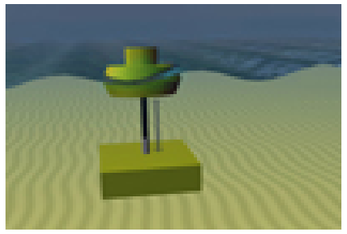
Infographic	Information
	A tidal kite is tethered to the sea bed and either carries a turbine below the wing or is tethered to a rotating shaft on the sea bed. The kite 'flies' in the tidal stream, swooping in a figure-of-eight shape either to increase the speed of the water flowing through the turbine or to drive the shaft. Real Device Example: Minesto
	Real Device Example: SeaQurrent

A.2.1.3. Wave Technologies

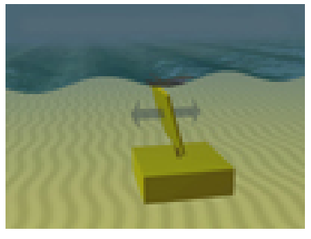
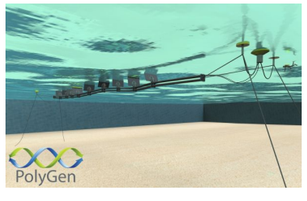
A.2.1.3.1. Attenuator

Infographic	Information
	Attenuators are floating devices that are aligned perpendicular to the waves. These devices capture energy from the relative motion of the two arms as the wave passes them.
	Real Device Example: Pelamis P2 Dimensions: 180 m long x 4 m in diameter

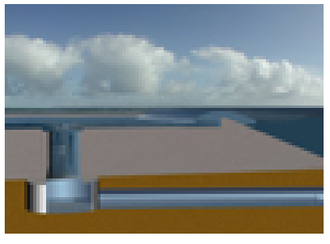
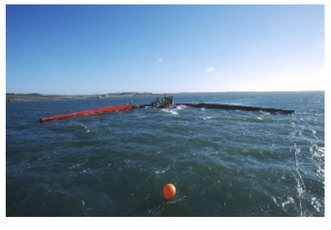
A.2.1.3.2. Surface Point Absorber

Infographic	Information
	Surface point absorbers are floating structures that can absorb energy from all directions. They convert the motion of the buoyant top relative to the base into electrical power.
	Real Device Example: CorPower Ocean 250 kW device

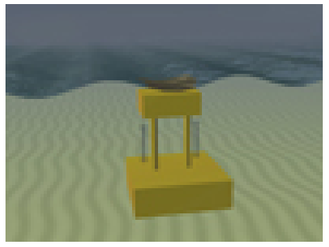
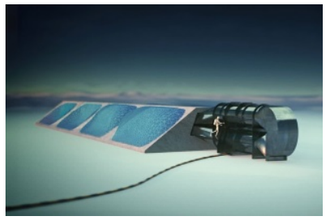
A.2.1.3.3. Oscillating Wave Surge Converters

Infographic	Information
	Oscillating wave surge converters are near-surface collectors, mounted on an arm which pivots near the sea bed. The water particles in the waves cause the arm to oscillate and generate power.
	Real Device Example: Polygen Volta Waveflex

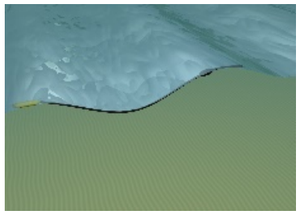
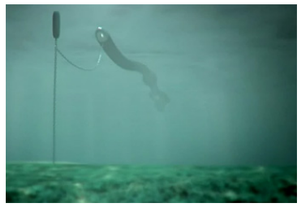
A.2.1.3.4. Overtopping Devices

Infographic	Information
	Overtopping devices have a wall over which waves break into a storage reservoir which in turn creates a head of water. The water is released back to the sea through a turbine which generates power.
	Real device example: Wave Dragon Dimensions: • Platform Width: 106 m • Platform Length: 75 m • Platform max height: 15.5 m

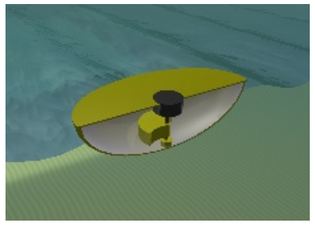
A.2.1.3.5. Submerged Pressure Differential Devices

Infographic	Information
	Submerged pressure differential devices capture energy from pressure change as the wave moves over the top of the device, causing it to rise and fall.
	Real device example: Bombora Wave Power Dimensions: • Length: 80 m • Height: 5.5 m • Width: 17 m

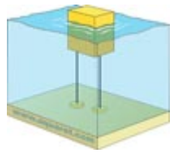
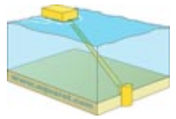
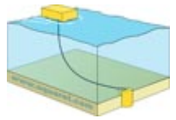
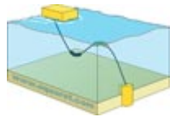
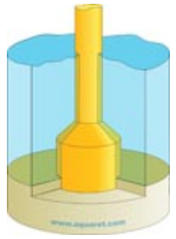
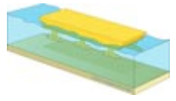
A.2.1.3.6. Bulge Wave Technologies

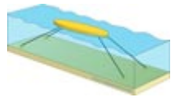
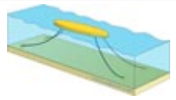
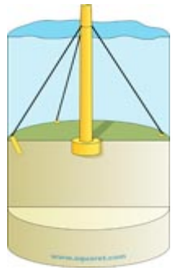
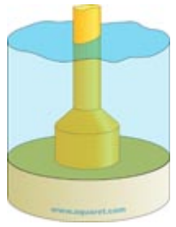
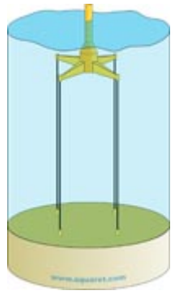
Infographic	Information
	Bulge wave technology consists of a rubber tube filled with water, moored to the seabed and directed into the predominant wave direction. The water enters through the stern and the passing wave causes pressure variations along the length of the tube, creating a 'bulge'. As the bulge travels through the tube it grows, gathering energy which can be used to drive a standard low-head turbine located at the bow, where the water then returns to the sea.
	Real Device Example: Anaconda Wave Energy Converter Photo: Checkmate SeaEnergy Ltd.

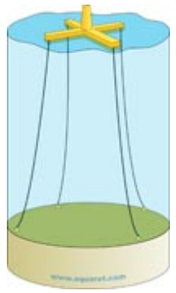
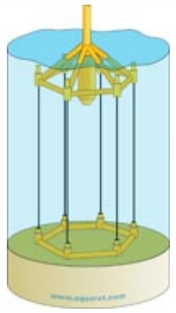
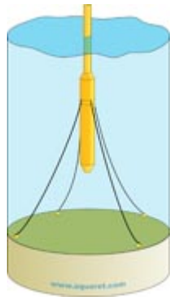
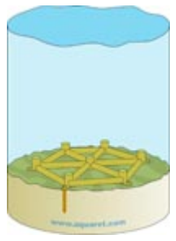
A.2.1.3.7. Rotating Mass

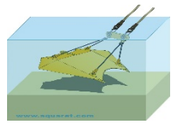
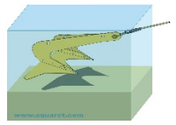
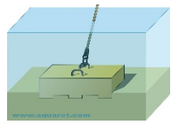
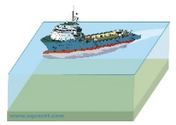
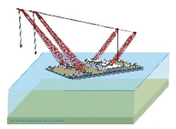
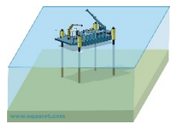
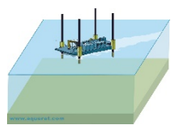
Infographic	Information
	Two forms of rotation are used to capture energy by the movement of the device heaving and swaying in the waves. This motion drives either an eccentric weight or a gyroscope, causing precession. In both cases the movement is attached to an electric generator inside the device.
	Real Device Example: Penguin, Wello Dimensions: • Length: 30 m • Height: 9 m • Draft: 7 m

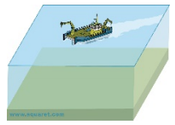
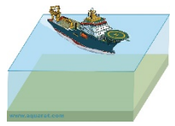
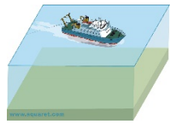
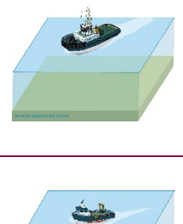
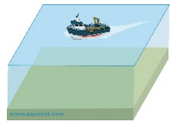
A.2.1.4. Moorings, Foundations and Vessels

Moorings and Foundations	Information
	Tension legged mooring; the buoyancy of the surface structure keeps the mooring lines under tension
	Solid structural link between the device and the anchor.
	Simple catenary link between the device and the anchor.
	Lazy “S” link between the device and the anchor.
	Gravity base with a penetration skirt, suitable for a sedimentary seabed.
	Barge based deployment platform.

Moorings and Foundations	Information
	Four-point tension-legged mooring.
	Four-point catenary mooring.
	Guyed tower; suitable in shallow sediments and rock.
	Gravity base; wide-spread suitability.
	Tension-legged mooring with a piled foundation.

Moorings and Foundations	Information
	Floating mooring with catenary anchors.
	Tension-legged mooring with a gravity base foundation.
	Spar buoy concept where catenary anchors hold a buoyant tower in place.
	Structural base secured to seabed by rock pins/anchors.

Moorings and Foundations	Information
	Vertical loaded anchor
	Embedment anchor
	Gravity anchor
	Anchor Handling Tug Supply (AHTS) vessels
	Crane barge
	Jack-up barge
	Jack-up barge underway

Moorings and Foundations	Information
	Multicat underway
	Offshore Construction vessel
	Survey vessel
	Tug
	Work boat

References

Illustrations courtesy of Aquaret:
http://www.aquaret.com/indexea3d.html?option=com_content&view=article&id=203&Itemid=344&lang=en

Device images and graphic representations as available online via technology developer websites as provided.