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Technology Feature: The Oyster

Featuring: Aquamarine Power

In the latest edition of our newsletter, LRI interviewed Martin McAdam, CEO at Aquamarine Power. Their wave-powered energy converter - Oyster - is among the leading technologies in the UK's burgeoning marine energy sector. A commercial scale demonstration project is currently operational, and the sites for Aquamarine Power's prospective wave farms have been secured and fully permitted. The company is currently looking for corporate equity investors to provide £30m to complete their commercialisation program.

Sooner than you think: utility scale marine energy

Who is Aquamarine Power?

Aquamarine Power is an Edinburgh based wave energy technology and project developer which conducts their R&D with Queen's University Belfast and demonstrates their technology in the Orkney Islands, Scotland. Their unique approach to developing both the technology and the project site is aimed at easing the obstacles within the process of project development to pave the way for prospective developers and generators to invest in marine energy.

Oyster technology

Aquamarine Power's Oyster wave energy converter captures energy in near-shore waves and converts it into clean sustainable electricity. Essentially Oyster is a wave-powered pump which pushes high pressure water to drive an onshore hydro-electric turbine.

The Oyster wave power device is a buoyant, hinged flap which is attached to the seabed at depths of between 10 and 15 metres, around half a kilometre from the shore. Oyster's hinged flap - which is almost entirely underwater - pitches backwards and forwards in the near-shore waves. The movement of the flap drives two hydraulic pistons which push high pressure water onshore via a subsea pipeline to drive a conventional hydro-electric turbine.

Timeline

2001 - Professor Trevor Whittaker's research and development team at Queen's University, Belfast begins to research flap-type wave power. The R&D team's research ultimately leads to the development of the Oyster wave energy device.

2003 - Scale model testing of Oyster begins

2005 – Oyster technology attracts funding from Allan Thomson,

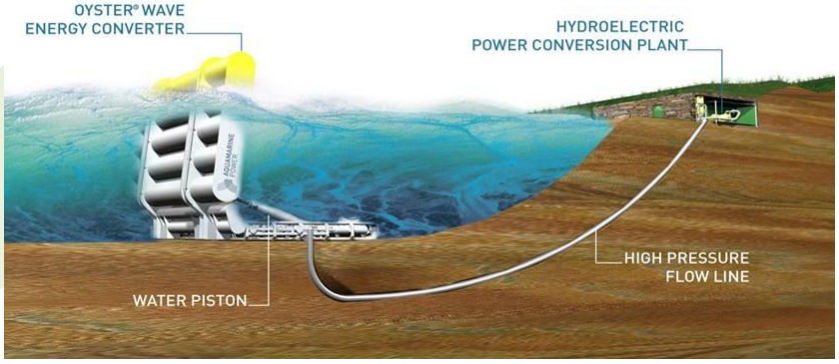

Image courtesy of Aquamarine Power

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The GTE Newsletter

Our interview-based newsletter features innovative energy technologies and businesses from around the world.

Announcements

GreenTechEurope.com has been uploading footage shot over the autumn at Renewable UK 2012 and The Rushlight Briefings. Go and check out what makes the companies we interviewed and their technologies unique.

Competitive Edge

What makes the Oyster different?

- It is the first marine energy technology to be DNV accredited. (DNV are the leading international provider of services for managing risk. Their accreditation is required before taking a technology to market).

- Its proximity to the near-shore offers ease of access for installation and O&M. Both will translate to lower cost of energy, but access for O&M in particular will ensure higher reliability of energy generation, which is significant for proving technologies in early stages of commercialisation.

- By generating electricity onshore with a hydroelectric turbine, the reliability of the system is enhanced again. Essentially this is because performing O&M on land requires less equipment and fewer procedures making it quicker and less costly to perform.

Martin McAdam is keen to emphasise that as an emerging industry, it is less the competitive edge of the individual marine technologies, but the vibrancy of the sector as a whole which is significant to commercial success. He likens it to an ecosystem in which project developers have the choice of several technologies that occupy different niches.

At present the sector is characterised by SME's. For the industry to flourish, it is important for several companies to succeed so that a mutually supportive supply chain is created. This will help pave the way to mass production of the technologies.

the retired founder of WaveGen, the UK's first ever wave power company. He co-founds Aquamarine Power to commercialise Oyster.

2009 - 2011 – The success of the Oyster 1 demonstration project confirms the feasibility of the technology in the marine environment

2012 – Sea trials of the Oyster 800 commence at the European Marine Energy Centre in Orkney (EMEC), to demonstrate the feasibility of commercial scale installations.

2013 – First period of continuous 24 hour operation. First MWhs of power delivered to the grid.

Commercial scale marine energy demonstration

Oyster 800 has a maximum generating capacity of 800kW. The machine measures 26 metres across its width, weighs around 1000 tonnes, and is installed at a depth of around 13 metres, approximately 500 metres from the shore.

Aquamarine Power has been able to make significant design improvements through lessons learned from Oyster 1. This means that Oyster 800 offers a reduced cost of power achieved through increased power generation, a simplified marine installation process and easier routine maintenance. Martin McAdam also suggests that improvements in hydrodynamic performance and reducing the losses in converting captured energy into electricity, will allow Oyster installations to exceed 1MW in capacity in the next 3-4 years.

Aquamarine Power plans to install the next-generation Oyster 801 next to Oyster 800 at EMEC. The two machines will be connected to the same onshore hydroelectric power station, which will be the first step in showing how a wave farm of multiple Oysters will operate. The second-generation Oyster 801 will maintain the three key selling points of the first Oyster machine. These are simplicity, survivability and shore-based electricity generation.

Installation

Oysters are installed in two stages. The first stage is to install a monopole foundation into the seabed using a jack up barge, in a similar manner to offshore wind turbines. The second stage is to tow the Oyster machine over this foundation and then engage it with the pile using small work boats such as tugs. For Oyster 800, the connection to the foundation piles is permanently grouted, but future Oysters will be placed on their foundations with mechanical connections. This will be a prepared socket in the seabed, which will allow the easy detachment and reconnection of Oysters before and after onshore maintenance.

Maintenance

Oyster 800 was designed to have removable modules to allow maintenance to be carried out onshore wherever possible. This has been demonstrated successfully on several occasions. For future Oyster machines, Aquamarine Power intends to use the same philosophy of removing modules for small repairs, but will also be able to remove the entire Oyster for more major maintenance activities. Divers are used for minor interventions and inspection, although Aquamarine Power is always looking at ways to reduce this.

Markets and regions

Most immediately, Aquamarine Power has leased the seabed and is on the verge of gaining permissions for a 40MW wave farm off the coast of the Isle of Lewis, Scotland. In partnership with the energy company SSE, they have also secured a lease on the seabed off the west coast of Orkney. These locations are at an advanced stage of preparation for the development of marine energy installations. Aquamarine Power is also conducting more preliminary site assessments off the coast of Ireland and in the USA. This indicates the confidence the company has in the prospects of the technology and their ambitions to have a range of possible locations available when commercial roll-out becomes viable. In addition to this, Martin McAdam envisages Oyster being applied in the context of island communities, which not only require off grid energy sources, but require solutions to obtaining fresh water. Oyster offers this solution by providing pumped water at the high pressures required in the reverse osmosis process used in desalinisation.

Industry perspective

Martin McAdam suggests that progress in the offshore wind industry is helping to pave the way for the marine industry. It has provided a learning experience for project developers and contractors operating in the offshore environment that should be at least partially transferable.

Images courtesy of Aquamarine Power

In spite of this there are always teething problems in the supply and service chains of any early stage industry when it comes to the first steps of commercial roll-out. However, in their Marine Energy Roadmap, the Scottish Government has taken significant steps to identify and address obstacles facing the industry's supply chain, as well the issues surrounding finance, planning and the grid. Martin McAdam is unequivocal about the positive impact the support provided by the government strategy will have on the speed the industry matures. He also looks at the early days of the offshore wind industry and envisages that there will be parallels in how marine projects are developed. This will initially see technology manufacturers developing projects whilst their technology is still being proven at commercial scale, maturing to a model where project developers become more heavily involved.

The wider perspective is that we should expect to see an industry with an installed capacity approaching 1 GW in the early 2020's

Business model

Aquamarine Power will approach project development by preparing the site - through obtaining the various permissions from near-shore stakeholders – to then be taken on by an actual project developer. They will license the project developer the use of the technology, and will assist them in a consulting capacity as opposed to developing the project themselves.

Martin McAdam suggests a crucial target for the success of marine technology is initially matching the cost of offshore wind; an industry which is aiming to reduce costs by 30% by 2020, to £100 per MWh. Aquamarine Power is aiming to undercut this cost by the mid-2020s.

Martin McAdam points to the credibility of their financial forecasting and the strong support the industry receives from the Scottish Government as evidence that this target is attainable.

In search of investment

To take Oyster from the current demonstration phase to a full-scale commercial roll-out, Martin McAdam sees it necessary to gain the continued investment from public funds, existing shareholders, and acquire a new corporate equity investor.

Aquamarine Power requires **additional investment of approximately £30m** to complete their commercialisation program. The ideal corporate investor will be comfortable with large scale machine fabrication, possess manufacturing capability, knowledge of operating in the offshore environment and capable in the logistics associated with

The Oyster in Summary

Simple

- Mechanical offshore device
- Minimal underwater moving parts
- No control system, gearbox or shut-down mode
- No complex offshore electronics

Survivable

- Hinged flap ducks under largest waves
- Nearshore location
- Robust offshore structure
- Operates even in storm conditions

Shore-based electricity generation

- Keeps electricity out of the water
- Minimal ecological impact on marine environment
- Easy to access
- Reliable proven hydro-electric plant

For More Information on Aquamarine Power

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