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Technology Feature: The Flumill

About Us

GreenTechEurope.com (GTE) is a production of London Research International (LRI), a global research and consulting firm with expertise in the energy, environment and infrastructure sectors. GTE is a video-based technology platform showcasing innovative technologies from Europe.

The GTE Newsletter

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

Announcements

GreenTechEurope.com has been uploading footage taken at the All-Energy Exhibition and Conference Aberdeen in May 2013. Please check our website to see videos of companies we interviewed showing their unique technologies.

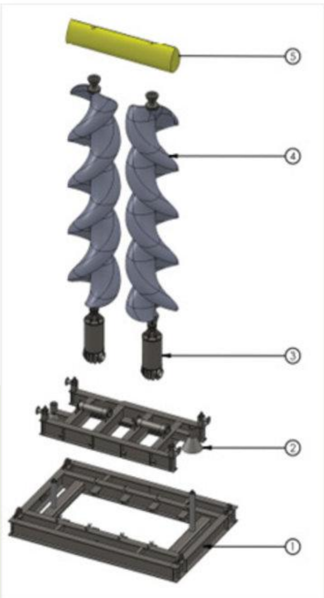
Featuring: Energy Project Management Ltd (EPM)

In the latest edition of our newsletter, LRI interviewed Paul Trayner of EPM. EPM is responsible for the commercial development of the Flumill tidal energy converter in the UK, and have completed the testing of a small-scale commercial demonstrator in the operational environment. In 2014, a large-scale 2.2MW installation will be tested in the operational environment to confirm the viability of the technology for applications in utility scale tidal arrays. EPM are currently looking for a £10m investment from a large manufacturing corporate to fund their commercial, 2.2MW, Norwegian demonstration project.

Who are EPM?

EPM are a renewables project developer, with previous experience in project development and management in oil & gas and transport sectors.

EPM has 16.5% stake in Flumill, and is involved in the technical and commercial development of the technology in the UK. The other stakeholders in Flumill are the small Norwegian hydro utility Arandals Fosse Kompani (43%) and the individual who invented the Flumill (40.5%).



Flumill technology

Flumill is unlike any other type of tidal turbine currently in operation or being tested. It is a helical device, with the appearance a screw, which is fastened to the seabed at one end, and floats buoyantly at the other end. The helix experiences drag from tidal streams, causing it to rotate. The mechanical energy is converted into electricity by a generator.

A single Flumill unit is a module consisting of 1) a foundation, which is pre-installed on the seabed, 2) a steel transition plate, which houses the helical devices, 3) two generators 4) two helical devices, and 5) a top fin which controls the buoyancy of the devices.

When there is a slack tide the device sits vertically upright in the water, and when under load from a tidal stream the device pitches at around 45°. The device pivots in two different directions allowing it to generate electricity from an ebbing or flowing tidal stream.

The transmission system between the device and generator consists of a gearbox. However, one of the more typical approaches to reducing reliability issues in energy converters is to use direct drive transmissions, which contain fewer moving components susceptible to failure. The Flumill's helical design produces slow mechanical rotation, which requires a gearbox to turn the generator to an optimal number of revolutions per minute.

Trying to fit a direct drive to a slowly rotating device would require the system to have many large magnets on the rotating component to produce electricity. The potential size of a direct drive system for

Competitive Edge

What makes the Flumill different?

Flumill's helical design gives rise to very little turbulence, reducing inefficiencies, and no vapour cavitation.

A Flumill unit can be orientated in a vertically or horizontally. This means that the Flumill can utilise shallower waters than any other tidal based renewable energy technology.

The Flumill is to be positioned 2-3km away from the shoreline. This is where the unit can maximise the strength of tidal stream that it is exposed to.

Due to the near shore location the Flumill does not require substations are required between itself and the coastline in order to transmit electricity back to the coast.

A quick release mechanism ensures that Flumills can quickly be returned to shore for repair, and at minimal cost.

Flumill means that a gearbox is a more attractive option.

The operational expenditure associated with using a gearbox in place of a direct drive design does not significantly affect the overall levelised cost of energy of a Flumill project. The other features of the Flumill device retain a simplistic design. The Flumill unit does not include an inverter in its electrical system (inversion of the current is performed onshore) and the helical design does not require systems to control pitch and yaw as on other tidal turbine devices.

Timeline

2002 – Initial concept design by Flumill's inventor

2010 – Computer models of the Flumill design completed.

2011 – Flumill tests a 200mm diameter device at a scale of 1:40 of the eventual large-scale design in a test tank. Flumill then tow a 2m diameter device at a scale of 1:4 of the eventual large-scale design, behind a barge to replicate the effect of the tidal stream.

2012 – Flumill test a 2m diameter, 20m long 300kW Flumill in its operational environment.

2014 – Flumill will test a large-scale commercial demonstrator in Norway. The 2.2MW device will be 8m in diameter, 32m long, weigh 160 tonnes and produce 5GWh of grid-connected electricity per annum.

Commercial Prospects for Flumill

Paul Trayner commented that the capacity of a commercial scale array is highly dependent on the site conditions. At present there are no commercial tidal projects developed by project developers. Prospective Flumill arrays in the next 2-3 years could be around 10MW in size. As an approximation, Paul Trayner suggested that in around 5 years' time Flumill devices could be used in 50MW tidal energy arrays and in 10 years' time, 100MW arrays could be feasible.

The Flumill is a device that is conducive to deployment in large numbers. The helical shape of the device produces relatively little cavitation of the water, meaning the tidal stream to recover shortly after being impeded by the device. As a result, Flumills can be placed in close proximity to one another allowing greater energy density (than devices that produce greater cavitation of the water.)

Installation

The 2.2MW Flumill unit requires adequate depth to fully submerge the unit, 40m, and an additional margin to allow for a typical low tide shipping depth, 10m. A 50m depth in total. The Flumill can also be installed horizontally which requires a depth of just 30m; furthermore EPM has suggested that there is substantial potential for a smaller horizontal unit requiring only a 10m depth, in shallower waters. The depth at which Flumills can be installed is restricted by the necessity of a diver to finalise the installation.

The Flumills are to be, ideally, installed 2-3km from shorelines as this is where tidal streams are strongest and is not so far away that substations are required in order to get electricity transmitted back to the shore. A foundation unit is secured to the ground with four pins, for which no piling is required.

The Flumill device is fixed to the foundation, and due to the small impedance of the buoyant attachment, in the tidal stream, stresses on the foundation unit are minimised. The horizontal unit puts a higher stress on the foundation as it rotates about a different axis.

The Flumills can be towed out to their installation point by multi-cat vessels. The Flumills, including the generators and buoyancy device, are then connected to the foundation unit in a short, 20 minute, process completed by a diver.

Maintenance

The Flumill has a quick release and reconnection mechanism with its foundation unit so that the Flumill can be easily detached and returned to shore for maintenance and repair. In the meantime a secondary Flumill can be deployed to the same site to minimise downtime.

Cost of maintenance is minimised by chartering a multi-cat vessel for transport, which is more financially viable than DP vessels used in the oil and gas industry. Although pre-commercial units have not been installed for long enough to demonstrate the survivability of the device EPM are confident that the Flumill can sustain long periods of reliable operation.

Business Model

In contrast to other forms of

renewable energy, tidal energy is both a reliable, and predictable, source. The Flumill design possesses an advantage over other tidal technologies; its horizontal model can operate in shallow waters of approximately 10m. This is something that competing technologies have yet to exploit.

After the initial 2014 development of the 2.2MW unit EPM hope to reduce the cost per unit from £10m to £5m. EPM estimate the LCOE of a developed commercial scale product to fall in the range of 8-18p per kWh.

Markets and regions

After an operational period of 6 to 12 months of the Norwegian demonstration project EPM envisage installing a 4-10 unit array in UK waters, with the intention of developing the area into a multi system tidal park.

In search of investment

According to Paul Trayner, in order for the Norwegian demonstration project to go ahead, a £10m investment would be required from a large manufacturing corporate. This would give Flumill the opportunity to demonstrate its survivability under continual operational for a substantial period of time.

The ideal investor would be someone that provides added value, this could be in the direct development of Flumill, design, engineering, construction, drive systems, installation and operation, or by their sheer size giving international location support in key tidal areas for development.

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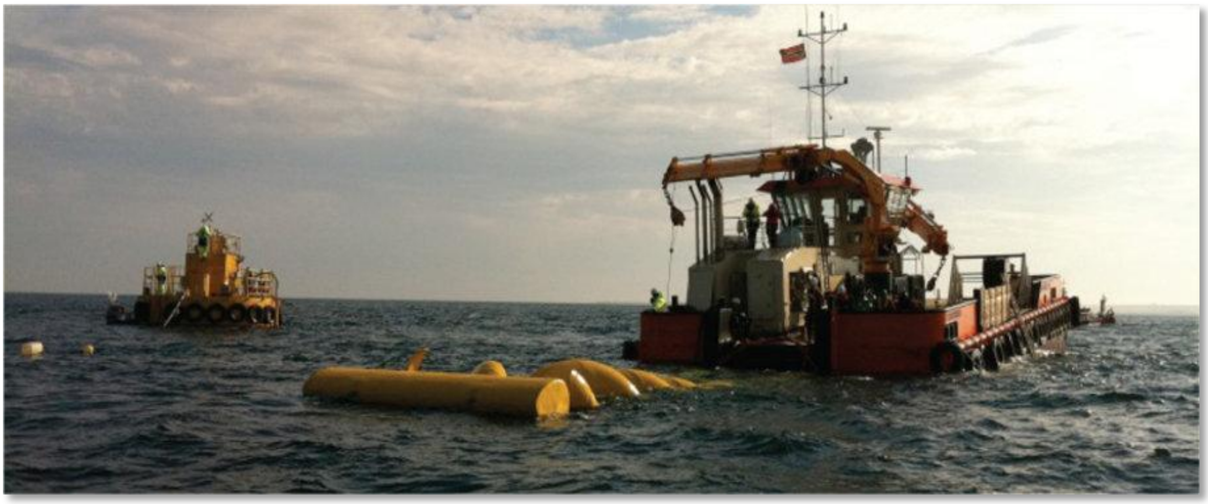

The Flumill in Summary

Survivable

- Robust offshore structure
- Operates even in storm conditions
- Only very small amounts of turbulence generate
- Buoyant top fin contains no moving parts
- No potential for vapour cavitation

Simple

- Mechanical offshore device
- No complex offshore electronics
- No transmission substations

energy project management

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LRI's latest, and most comprehensive, marine energy publication is coming soon.

The world renewable power sector has achieved a significant progress in technological development to harness renewable energy. As more and more offshore wind farm projects are being implemented, more attention is being made to the final major renewable source of power, namely the tide and wave. In fact, many governments have prepared the biggest incentives for tidal and wave power projects, and hundreds of companies are involved in the development of tidal and wave power generation devices in the world.

Tidal and wave power generation is more predictable than wind or solar power and practically an unlimited number of suitable sites are available for it.

As unpredictable wind power is becoming a larger share in the power generation mix in many countries, tidal and wave power is welcome, particularly with anticipation that the tidal and wave generation is cost-competitive against offshore wind power.

Despite various obstacles technology developers face, power from tidal and wave energy remains important for the future low carbon society, and importantly, it is expected to be of much lower cost to produce than offshore wind power. Compared with other renewable power technologies, tidal and wave power devices often differ in concept. This fact can be interpreted as a greater flexibility in terms of capacity size and location suitability.

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