

Securing foundations for underwater turbines

This project has successfully tested an innovative method of installing a turbine on the seabed to generate electricity from the energy contained in tidal currents.

The need

Harnessing the energy that is available from the sea as the tide ebbs and flows will help the Government to fulfil its commitment to provide 15% of the UK's energy needs from renewable sources by 2020. One method of doing this is to install an underwater turbine (similar to a wind turbine) that is driven by the tidal stream to produce electricity. However, for this technology to be successful, practical and cost-effective methods of installing and fixing the turbines to the seabed, and feeding the generated electricity to the grid need to be developed.

The results

The DEEP-Gen turbine developed by Tidal Generation Limited (TGL) is designed to sit on a tripod foundation that is installed on the seabed. The tripod's feet are pinned to the seabed with grouted piles and the turbine is mounted on a central column. The relatively lightweight, quickly installed, tripod foundation is one of the main innovative features of DEEP-Gen. However, the drilling technique proposed for the foundation has not been used in a deep-water environment.

The project partners, led by TGL, designed, built and tested a prototype drilling rig for use when fixing the tripod foundation to the seabed. The first stage of the testing programme was a 'dry' test. This involved installing a pile at BAM Ritchies' facility in ground conditions

similar in strength to those found on the rocky seabed off Orkney, where future trials are planned. The second stage was a submerged 'wet' test in a former quarry in Somerset where the drill was operated to give a hole to the depth required. The good drilling rate achieved during the tests gave confidence that rapid installation of piles on site was possible. Using cameras to help position and operate the rig underwater also worked well. A few minor deficiencies found with the equipment design were subsequently rectified.

Completion of the detailed design of the 500 kW prototype turbine and foundation put TGL in a strong position to proceed to the manufacture, installation and testing of DEEP-Gen.

Tidal power

There are two types of tidal power – tidal range (exploiting the size of the tides, as in the Severn Estuary) and tidal stream (using the speed of tidal currents, as off the north coast of Scotland). Britain has a practical tidal stream resource of around 18 TWh/year and between 15% and 20% of current UK electricity demand could be met by wave and tidal stream energy (Carbon Trust, 2006).



Drill rig prepared for lowering into the ground for testing

Meeting quality standards for ocean energy converters

The DEEP-Gen turbine is the first tidal turbine in the world to achieve certification at Level C (prototype) from leading maritime technical experts, Germanischer Lloyd. Obtaining certification was a major exercise, but a useful step towards the Level B and A certification that will be required for production machines.

Artist's impression of the DEEP-Gen turbine on its foundation



HOW THE TECHNOLOGY STRATEGY BOARD MADE A DIFFERENCE:

'The project has allowed us to prove one of the innovative features of our technology before committing to a site installation.'

Future activities

In a follow-on project with the same partners, a 500 kW turbine is to be built and installed at the European Marine Energy Centre's tidal test site in Orkney. TGL is also developing a 1 MW turbine and working with International Power plc to develop a 10 MW demonstration farm.

Project # 200060

Project partners

Tidal Generation Limited
BAM Nuttall Ltd t/a BAM Ritchies
Rolls-Royce plc
SLP Engineering
Garrad Hassan & Partners

Technology Strategy Board investment

£499,000

Total project investment

£998,000

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body, established by the Government. Its role is to promote and support research into, and development and exploitation of, technology and innovation for the benefit of UK business, in order to increase economic growth and improve the quality of life. It is sponsored by the Department for Business, Innovation and Skills (BIS).

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