

Scotrenewables uses integrated control solution from Beckhoff

EtherCAT in a tidal turbine

Utilising the tidal power of the North Sea as a source of alternative energy is attracting increasing attention from academia and industry. The young Scottish company Scotrenewables Tidal Power Ltd., founded in 2002, has developed an innovative tidal current turbine that is specially designed for the demanding conditions in the North Sea. Unlike conventional systems it requires no elaborate structural anchoring on the seabed, but floats on the water. All control functions are handled by an integrated PC- and EtherCAT-based control platform.







Construction of the tidal turbine, which was specially developed for the demanding conditions in the North Sea.

Scotrenewables Tidal Power, technology developer for marine renewables based in Stromness, Scotland, has developed a floating tidal current turbine, the SR250. Its innovative system design leads to significant cost reduction, so that tidal power could start playing an important role for renewable energy in the near future.

Robust, innovative design

A system that is to function under the harsh conditions in the North Sea must be robust and highly reliable, with minimum maintenance requirements. A 250 kW prototype of the SR250 is currently undergoing a thorough, two-year test programme at the Fall of Warness tidal power test centre off the Orkney islands, which is operated by the European Marine Energy Centre (EMEC).

Two counter-rotating rotors pick up kinetic energy from the tidal current, which is converted to electrical energy by a generator and brought ashore through a cable buried in the sea bed. The tidal turbine essentially consists of a cylindrical tube, to which the rotors are attached parallel to the horizontal axis via folding struts. The struts enable the tidal turbine to assume two positions: In operating mode the rotors are extended under water. In transport and survival mode, which the plant assumes in heavy seas, for example, the rotors are retracted in order to protect them from excessive loads.

Low operating costs ensure viability in a competitive industry

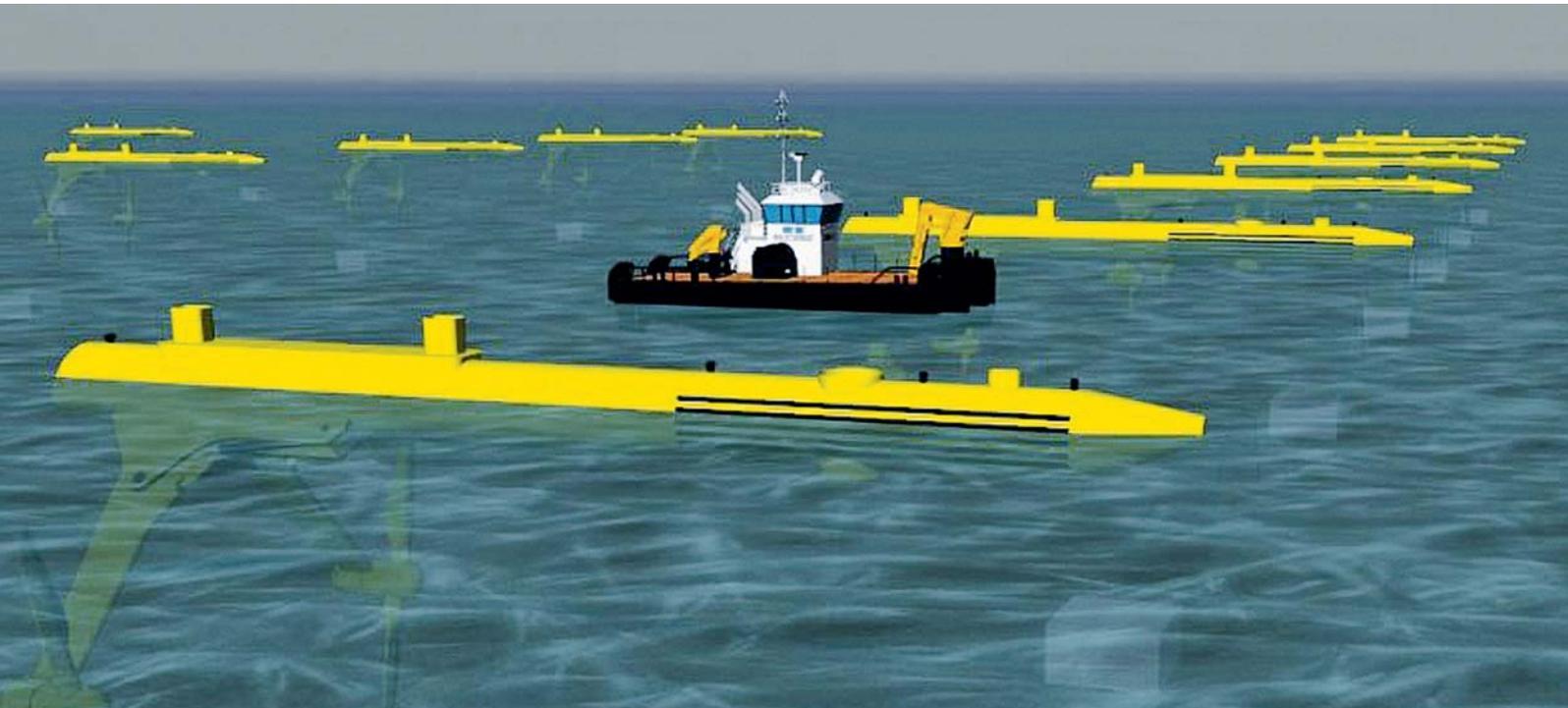
The main aims of Scotrenewables in the development of the tidal turbine were simple installation and operation, ease of access, straightforward maintenance and robustness. Scotrenewables is convinced that running costs are the main factor for the competitiveness of tidal power compared with other renewable energy sources. Conventional tidal power plants generally have a rigid structure

with associated foundations and require costly special equipment and transportation facilities for installation and maintenance on the high seas, including heavy lift crane vessels etc. In contrast, the floating tidal turbine developed by Scotrenewables can be installed with a general-purpose workboat, which makes the process much cheaper. Once operational, the plant can be towed quickly and cost-effectively to the operating site or back to port for maintenance.

Integrated PC-based control

The SR250 uses a fully integrated Beckhoff control platform, including an Industrial PC, EtherCAT I/Os in protection class IP 67 and the TwinCAT automation software. It controls all operating functions of the plant, including movement of the turbine arms, data logging, operational and remote monitoring. "The system communication of the SR250 is based on an EtherCAT ring topology, which offers wiring redundancy and ensures that the system remains operational even in the event of a broken wire. This design ensures fast configuration, during which only a few low-voltage cables have to be connected. The system controls all moving parts, including the hydraulic system, and communicates with external devices such as variable-speed drives. All monitoring tasks are handled via the TwinCAT HMI tool, which requires no drivers or other communication protocols, and in which the variables are addressed locally in the same software as the programming logic.

Alan Smith, Beckhoff Regional Manager for Scotland, said: "This is a particularly innovative and demanding project. Accordingly, there were stringent requirements for the control components with regard to robustness and availability. For this reason Scotrenewables demanded absolute reliability and high MTBF values.¹ The openness of our highly integrated control solution was an important prerequisite for speeding up the engineering without the risk of interoper-

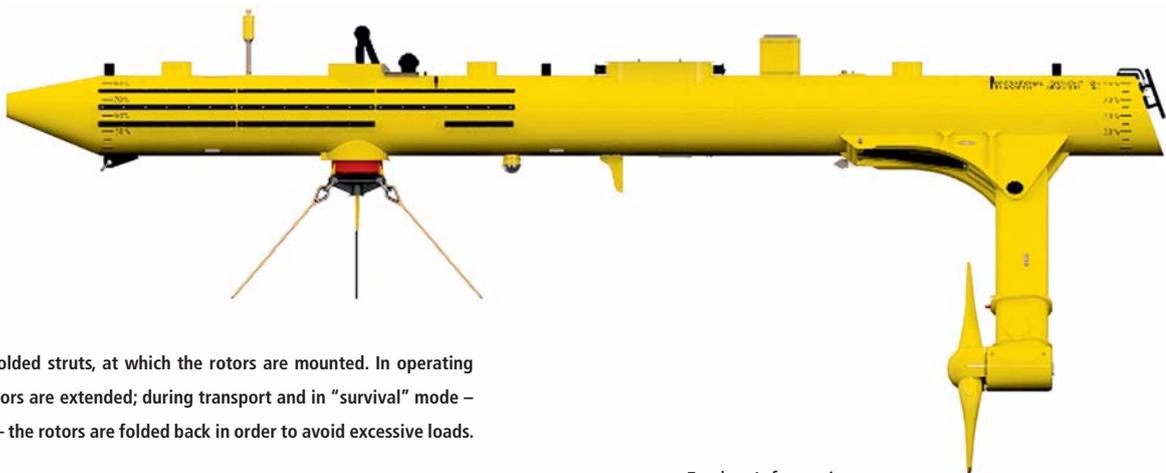


Model of a tidal turbine “farm” for energy generation in the North Sea. The SR2000, which is currently being developed by Scotrenewables, is expected to have a rated capacity of 2 MW at a flow rate of 3 m/s.

ability issues. The EtherCAT platform is ideal for research and development projects such as the SR250, since it enables a modular approach.” Angel Rua, development engineer at Scotrenewables, said: “The design concept of the SR250 enables various tests to be carried out, including towing tests. We can use these tests to simulate tides in a controlled manner and check all on-board systems. The test under full power was very successful and demonstrated that our floating turbine can produce energy reliably and efficiently and achieve its rated output of 250 kW.” The tests relating to in-situ power generation with grid connection were also very successful”, said Mark Hamilton, Technical Director of Scotrenewables.

As for the future, Scotrenewables is on schedule with the development of a next-generation 2 MW turbine for commercial application. The SR2000 is designed to achieve a rated output of 2 MW at a flow rate of 3 m/s, which means it would be one of the most high-powered tidal turbines in the world, perhaps even the most powerful one to date.

¹ MTBF, Mean Time Between Failures, is the expected operating time between two consecutive failures.



The tidal turbine with unfolded struts, at which the rotors are mounted. In operating mode (underwater) the rotors are extended; during transport and in “survival” mode – for example in heavy seas – the rotors are folded back in order to avoid excessive loads.

Further Information:

www.scotrenewables.com

www.beckhoff.co.uk