A wave of renewable energy

There's no such thing as bad weather

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Troubled water is full of energy and the North Sea has it in abundance. If wave energy could be captured cost-effectively, it could help meet the ever increasing demands for energy. ABB is playing a major role in a remarkable initiative by Fred Olsen Ltd, to develop a profitable wave energy conversion device.

Ingenuity and energy

When it comes to energy production, the rough waters of the North Sea have more to offer than their vast oil and gas fields. At least, that is the view of the famous Norwegian ship owner and entrepreneur, Fred Olsen. ABB is helping him to realize his dream of producing a financially sustainable system for harvesting wave power.

Increased energy demands have spurred many technology development projects to harness renewable energy from a variety of sources. Wind power technology has already come a long way. Wave power could be next in line.

While watching one of his platforms being erected close to the Scottish coast, Fred Olsen began thinking about how the energy in the waves could be turned into usable power. But it was not until a few years later that he found out exactly how this kinetic energy could be converted into electricity. On a vacation in Spain he observed the behavior of oil barrels floating in the sea. And that was the starting point of an initiative to develop his wave energy converter (WEC) concept, which has been named FO3.

Converting wave energy into electrical power

Many attempts to design wave energy converter (WEC) devices have been made in the past, and many have failed due to the hostile environment the devices have to endure. The challenges involved in WEC cover a range of engineering disciplines, including civil-, electrical-, and control engineering. Projects that fail to consider all of these disciplines will not succeed. The most critical aspect of a WEC development project is the structural design. The device must be extremely robust, while material and manufacturing costs must be kept to a bare minimum. These design objectives are hard to combine, which explains why wave power has not yet been commercialized on a wide scale.

ABB is globally committed to developing environmentally friendly energy solutions based on renewable resources.

ABB receives many inquiries from people wanting to develop WEC devices, but Fred Olsen's initiative was in a class of its own. Thanks to their many years of offshore experience, Olsen's engineers have learned a lot about the perilous challenges of the North Sea.

ABB's contribution

ABB is globally committed to developing environmentally friendly energy solutions based on renewable resources. ABB has been a partner in the wave power project since the initial testing in 2004 and is heavily involved in what could become the next industrial venture along the Norwegian coast.

ABB is a leading supplier to the oil and gas industry, in both on- and offshore systems for automation and safety, for power equipment, such as switchgear and transformers, and for instrumentation. More specifically, for Olsen's FO3 project, ABB has contributed its know-how in the area of power conversion and automation, and has supplied the power and automation components.

The underlying principle of conversion is simple

The WEC device looks like a traditional rig, but one striking difference is the floating, egg-shaped cylinders hanging underneath it 1. Energy is absorbed from the waves as they move the cylinders up and down. This linear, vertical motion is then converted to rotational motion by means of a hydraulic system – a hydraulic motor drives a generator to produce electricity. Another important difference is that the rig structure is built using lightweight composite material instead of steel.

Initially, a 1:20 model of the rig structure was built at the Marintek/Sintef laboratories in Trondheim, Norway. Promising results from these tests led to the building of Buldra – the 1:3-scale research model of Fred Olsen's wave power dream 2. It measures 12 by 12 meters and is 8 meters high. The hydraulic towers are 7 me-

1 WEC platform concept

2 Buldra as a 1:3 scale research platform

ters high. The full-scale version will be 36 by 36 meters.

According to Fred Olsen's power production estimates, the full-scale model will produce 2.52 MW from 6-meter high waves with a period of 9 seconds. This is power enough to supply 600 households, and is approximately the equivalent to the productivity of one wind turbine. The goal is to produce power at a cost of 2.8 EUR/kWh. Each full-scale platform will cost an estimated 3–4 million euros to build.

The current state of the project

The Norwegian authorities have granted Fred Olsen permission to build a wave power plant off the island of Karmøy on the west coast of Norway. The project is currently in its engineering phase and is scheduled to be completed in 2007.

Assuming that Fred Olsen's initiative demonstrates the financial viability of wave power, ABB will be in a favorable position to deliver automation and electrical equipment for the large-scale production of WEC platforms. The required technology is similar to that supplied by ABB to the wind turbine industry. Hence the company's experience and product portfolio match the needs of a potential WEC industry.

3 Fred Olsen, the entrepreneur (far right)

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Fred Olsen 3 has proved that his wave power project is realistic, but he still has some way to go in proving its competitiveness. The keyword is optimization. The considerable margins of the oil and gas industry do not apply to wave power. The construction, operation and maintenance costs must be minimized and the power output maximized to ensure profitable long-term operation.

The multidisciplinary Sustainable, Economically Efficient, Wave Energy Converter (SEEWEC) project is currently assessing every aspect of the FO3 concept to see whether improvements can be made. Testing is being pursued on several different levels, eg, new cylinder shapes, new platform design, and the use of new materials. Testing is also under way to establish whether a linear or rotating generator would be more efficient, how to maximize the power production given a certain wave climate, how to connect several WEC installations together, how to bring the power ashore and so on.

In the SEEWEC project, ABB have a particular interest in power generation efficiency and in the design and manufacturing of second-generation systems and components. ABB's main contribution to SEEWEC is at the corporate research center in Västerås, Sweden. ABB is also involved in field testing and data collection activities.

Future perspective

In Norway, there is a saying – there's no such thing as bad weather – and when it comes to wave power this is true. It is too early to say whether WEC will become a new industry, but if it does, ABB is well position to capture a significant share of the new market and it will be yet another showcase for ABB's state of the art power and automation technologies.

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