Versatile Drives Chosen for Wave Energy Project

A project for the testing and development of wave energy for the generation of electricity features AC drives from Control Techniques. The drives are a key feature in the development of wave-power breakwater projects around Europe.

Inverness based Wavegen, part of Voith Siemens Hydro Power Generation, is a wave energy company dedicated to the development of marine renewable energy technology. In 2000, Wavegen became the first company to connect a commercial scale wave energy plant to the grid. On the Isle of Islay, off the west coast of Scotland, Wavegen has an inclined oscillating water column (OWC) generating facility that is used both for generating power and for testing new designs of Wells turbine generators.

Two 250 kW counter-rotating turbines have been generating power for several years at this 'Limpet' (land installed marine powered energy transformer) unit, which utilises the power of a surge-dominated wave field adjacent to the shore. The water depth at the entrance to the OWC is typically seven metres and the air chamber is designed to maximise the capture of wave energy to maximise power output.

Now, one of the turbines has been removed to provide Wavegen with a test-bed for a new design of small turbo-generator that can be incorporated into breakwaters, coastal defences, land reclamation, port walls and community power schemes. These are a fifth generation of Wells generators and incorporate all of the learning and cost-reduction gained from development and practical operation of the Limpet plant.

"It was crucial that we selected the right drive system to accommodate both our changing needs during the development process and the requirements of future customers of these breakwater generators," explained Dr. Tom Heath, Engineering Manager at Wavegen. "We considered five drives suppliers and Control Techniques proved to be a clear choice for several reasons," he says. "The over-riding factor was the facility to program the drives in a high level language, rather than an inflexible block diagram system. It proved to be very easy to adapt the SyptPro control language used by Control Techniques – and their willingness to give us total access to the drive functions proved crucial. I had experience of dealing with Control Techniques previously and again received exceptional support and service throughout this project."

This was reiterated by Wavegen engineer, Janet Lees, who is responsible for running the project and developing a SCADA front-end for the end-users. "We access the drive remotely via Ethernet from our Inverness office and are developing a SCADA package using the SM Ethernet option module within the drive," she says. "We frequently adjust the programming to accommodate specific test routines – to monitor noise and efficiency under different conditions, for example, changing speeds, butterfly valve modulation and so on. We simply couldn't have done this with another make of drive."

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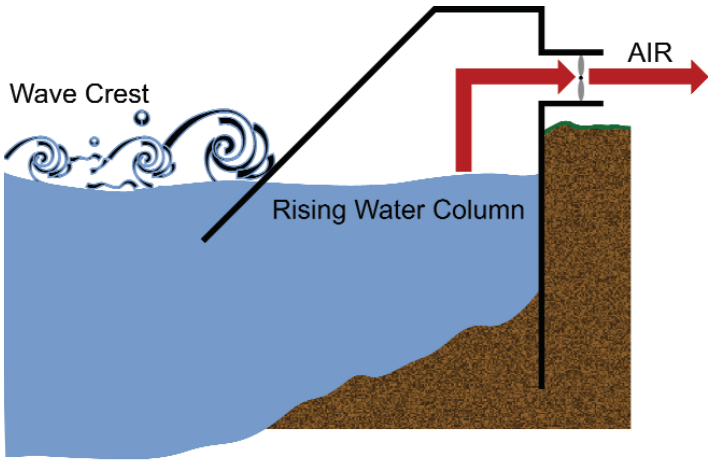


Two 32 kW Unidrive SP drives are fitted; one to control the turbine speed, the second running in regenerative mode to feed AC power to the grid. Both are fitted with SM-Applications modules to provide powerful on-board programming of the system and the first, additionally, has an Ethernet communications module. Because of the high-level of I/O required, as this is a development project, with more intensive monitoring than an operational turbine generator installation – some 20 channels, monitoring temperature, speed, chamber pressure and pressure drop across the butterfly valve etc – additional I/O is provided locally with a Beckhoff unit.

As waves roll into the collector, air is driven up the inclined water column, this can be seen in diagrams 1 and 2. In turn this drives the bi-directional flow, uni-directional Wells turbine that runs at up to 4,000 rpm and which is connected to an induction generator.

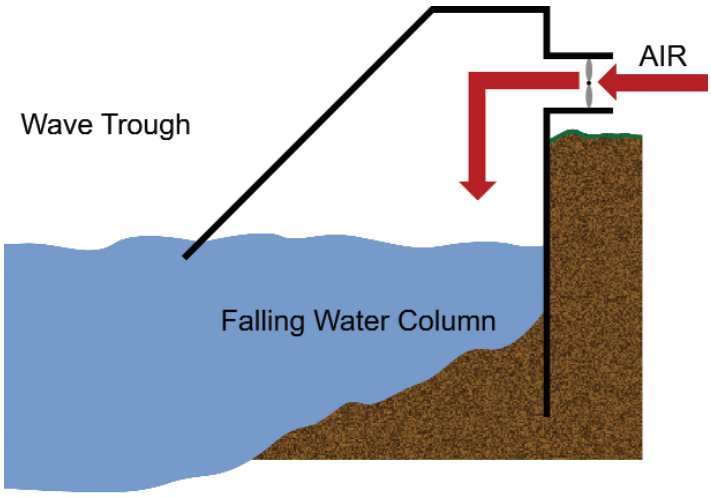
Pressure transducers in the chamber feed the RMS pressure back to a SM-Applications module via the Beckhoff unit. The program calculates the optimum speed for the turbine and the unit can be started. The Unidrive SP motors up the turbine to the optimum speed and switches from motoring to generating mode, allowing the low-inertia turbine to drive free, with the air pressure, but limiting its maximum speed. Then, using a five-minute moving average of the chamber air-pressure, the maximum turbine speed is adjusted every 30 seconds to give an optimum output from the Wells turbine installation.

Normally, the Wells turbine runs 24 hours a day in fully automatic mode, except when very high sea states require throttling back by using the butterfly valve.

"We are up with the most advanced wave generating companies in the world," concludes Dr Tom Heath. "Nevertheless, we have a lot more to learn about getting the best out of different sea states. The Unidrive SP AC drives, with their Ethernet connectivity, have proved ideal during our development phase. In the future, this will be equally important so that we can provide our clients with technical support via the internet.

"We've received tremendous support throughout, both from Control Techniques and Tom Donohue of Dalepark Motion Controls who has been involved with the installation and programming."

Wavegen, formed in 1990 is based in Inverness in the highlands of Scotland. Now part of Voith Siemens Hydro Power Generation (a group division of Voith) is developing Wells turbine technology for use in shoreline, breakwater / coastal defence, near-shore and offshore situations. In breakwater locations, installation can be achieved using a small mobile crane and have a number of advantages, including easy access and maintenance, shared civil costs and simplified planning and consents compared with other schemes.



KEY BENEFITS

- HIGH LEVEL PROGRAMMABILITY
- REMOTE ACCESS VIA ETHERNET
- ZERO HARMONICS ENERGY EFFICIENT REGENERATIVE SYSTEM

CONTROL TECHNIQUES

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