

## »SENSORS

# Wave the green flag

**Torque sensors based on tidal technology are being used in a simulation system built to test components for an eco-friendly underwater turbine**

Sensors developed by Oxfordshire firm Sensor Technology are playing a key role in the development of commercial-scale in-stream tidal turbines produced by tidal-power company Openhydro.

The Irish company is using non-contact torque sensors, which are based on surface acoustic wave (SAW) technology, to measure rotational speed and frictional forces in a simulator for the turbine bearings.

Openhydro designs and manufactures marine turbines to generate renewable energy from tidal streams — the oscillating movements of water produced by tides. The company aims to deploy farms of tidal turbines under the sea, where they will generate electricity with no cost to the environment.

The tides are completely predictable, which means that the energy output of the turbines is equally as predictable. There are no large seasonal variations and no dependence on the vagaries of the weather, as there are with many other renewable-energy sources.

This method of producing electricity is said to have many benefits. For instance, as the turbines are submerged, they are invisible and produce no noise. Also, since they are submerged at a considerable depth, they present no hazard to shipping.

Reliably and efficiently harvesting energy from the tides, however, requires the use of novel technology and, in the case of Openhydro, this takes the form of open-centre turbines that can be deployed directly on the seabed.

Installation in such an inaccessible location makes reliability a prime consideration in the turbines' design and construction. For this reason, Openhydro evaluates the performance of all of the components it uses.

For the bearings, this evaluation involves the use of a simulator that allows the company's en-



Openhydro's open-centre turbines can be deployed directly on the seabed

**The tides are completely predictable, so the turbines' energy output is equally so**

gineers to determine how frictional forces in the bearings vary with different loads and rotational speeds. Central to the simulator's operation is the measurement of torque in a shaft from the motor that drives the bearing under test.

With conventional sensors, it is hard to carry out this type of torque measurement accurately and reliably, but Openhydro

found that Sensor Technology's Torqsense RWT320 series sensor was suitable.

Like all Torqsense sensors, the RWT320 units depend on SAW transducers. These transducers comprise two thin metal electrodes, in the form of interlocking 'fingers', on a piezoelectric substrate such as quartz.

When a radio-frequency (RF) signal of the correct frequency is

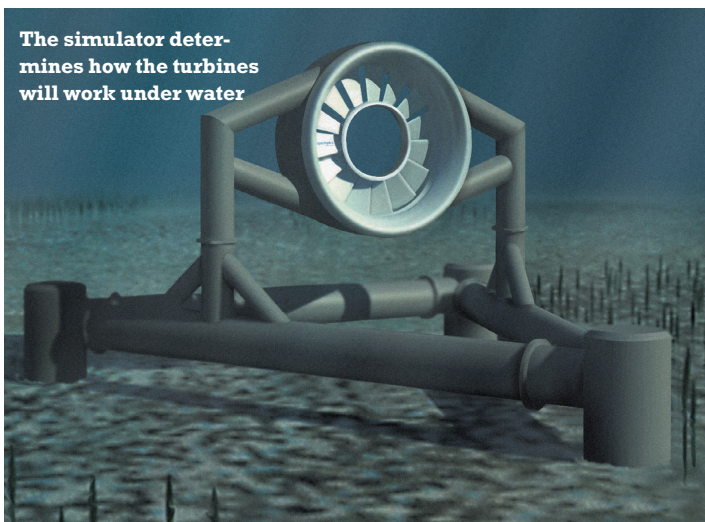
## production essentials

Key facts to take from this article

- » The RWT320 torque sensors depend on SAW transducers
- » These transducers operate as frequency-dependent strain gauges
- » Since they operate at RFs, it is simple to wirelessly couple signals to them
- » The sensors can be used on rotating shafts and can provide continuous data

# production engineering

The simulator determines how the turbines will work under water



« applied to the transducer, SAWs are set up and the transducer behaves as a resonant circuit. If the substrate is deformed, however, the resonant frequency changes.

When the transducer is attached to a driveshaft, the deformation of the substrate and, hence, the change in resonant frequency will be related to the torque applied to the shaft. In other words, the transducer operates as a frequency-dependent strain gauge. Since the

**“The sensor has proved that it is more than able to withstand the tough conditions in our laboratory”**

KEVIN HARNETT, OPENHYDRO

transducers operate at RFs, it is simple to couple signals to them wirelessly, according to Sensor Technology.

Torqsense sensors can be used on rotating shafts and can provide data continuously without the need for the inherently unreliable and inconvenient brushes and slip rings often found in traditional torque-measurement systems.

Kevin Harnett, mechanical engineer at Openhydro, said: ‘We chose the RWT320 because of its convenient wireless operation and because it was easy for us to fix in line with an existing shaft in our experimental set-up. This model of sensor has integral

electronics and a serial output, which means that we can link it directly to a laptop computer in our test laboratory,’ he added.

Openhydro uses the RWT320 sensor in conjunction with Sensor Technology’s Torqview software. This offers a choice of dial, digital-bar and chart-graph format display for torque, revolutions per minute, temperature and power. It also provides facilities for real-time plotting and data recording, and can output stored results as files that are compatible with Matlab and Excel.

‘The sensor has proved itself to be well able to withstand the tough operating conditions in our laboratory,’ said Harnett.

In late 2009, Openhydro successfully deployed the first commercial-scale in-stream tidal turbine in the Bay of Fundy, Canada, on behalf of Nova Scotia Power. This 1MW unit arrived on site on 11 November and was operational, rotating with the tides, collecting data and producing energy six days later.

Last month Openhydro was awarded a grant of up to £1.85m from Scotland’s WATERS fund (Wave and Tidal Energy: Research, Development and Demonstration Support) to help develop energy technologies and improve the operation of marine renewable devices.

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### » SINK OR SWIM

Michell Instruments’ WM33 and WM261 relative humidity sensors have been developed to keep swimming pools dry. Without effective dehumidification and ventilation systems to keep the air dry, air ‘sucks’ vapour from the surface of the pool to create the humid atmosphere that produces humidity-related problems such as mould and corrosion. Michell’s sensors work as an integral part of a dehumidification system to help ensure that the surface temperature of the water remains lower than the air temperature and the relative humidity is kept at a constant 50 to 60 per cent. Both instruments work effectively with long-term exposure to the aggressive atmosphere created by the pool chemicals. [www.michell.com/uk](http://www.michell.com/uk)

### » UPPING THE HEAT

Many of RDP Electronics’ standard LVDTs can now be factory modified for higher temperature operation than normal. Most LVDTs with a range of +/-100mm or less can be ordered modified during production to operate at temperatures of up to 200C. Where significantly higher temperatures are encountered, RDP offers the LIN and PY ranges suitable for reliable and accurate operation at up to 600C. [www.rdpe.com](http://www.rdpe.com)

### » GOOD VIBRATIONS

Monitoring vibration on critical rotating plant equipment can play a key role in meeting the protection requirements of the latest machinery directives. To help operators meet these latest protection requirements and to minimise the risks, Sonosonics has developed vibration-protection systems for many industrial sectors. For example, its DN2611 SIL-rated dual-channel vibration monitor is ideal for machine-casing and bearing vibration-monitoring applications. [www.sonosonics.co.uk](http://www.sonosonics.co.uk)

### » PICKING UP VIBES

The HS-620 portable vibration meter from Hansford Sensors has been designed for use as a simple vibration-level meter or for maintenance engineers across a range of industries. The kit consists of an internal battery-operated meter, a hand-held probe, magnetic mount, a carrying case and battery chargers for mains and in-car use. Microprocessor based, the meter can be set up to monitor acceleration levels, velocity, displacement and bearing condition. [www.techni-measure.co.uk](http://www.techni-measure.co.uk)

### » ON HOSTILE GROUND

Balluff has developed an inductive proximity block sensor with Factor 1 technology that is suitable for use in hostile welding environments and packaging applications. The Q40 sensor delivers maximum sensing ranges in a small housing, with weld-field immunity and the ability to sense aluminium and steel at the same distance. Each sensor has a visible corner light-emitting diode (LED), plus a sensor head that can be mounted in five positions. The connector outlet is adjustable within a 270° arc. Ideal for hostile welding applications thanks to its Teflon-coated sensing face and immunity to magnetic fields, the Factor 1 sensor is also suitable for use with a range of metal target materials. [www.balluff.com/Balluff](http://www.balluff.com/Balluff)