Oceanic insights

As commercial maritime activity moves further offshore into more challenging environments, secure and accurate operational current data is essential to safely optimise vessel operations. The Nortek VM Operations Series is an important and timely innovation, providing real-time oceanographic data for the offshore market.

The Nortek VM Operations Series helps map the sub-seabed for a new offshore wind farm development.

The challenge

Offshore wind farms represent a significant investment, requiring meticulous planning to mitigate risks. One risk of these, during construction and installation is the presence of hazards beneath the seabed, the most significant of which is unexploded ordnance (pUXO). Finding such devices quickly and accurately is a challenge that must be overcome before construction commences.

The solution

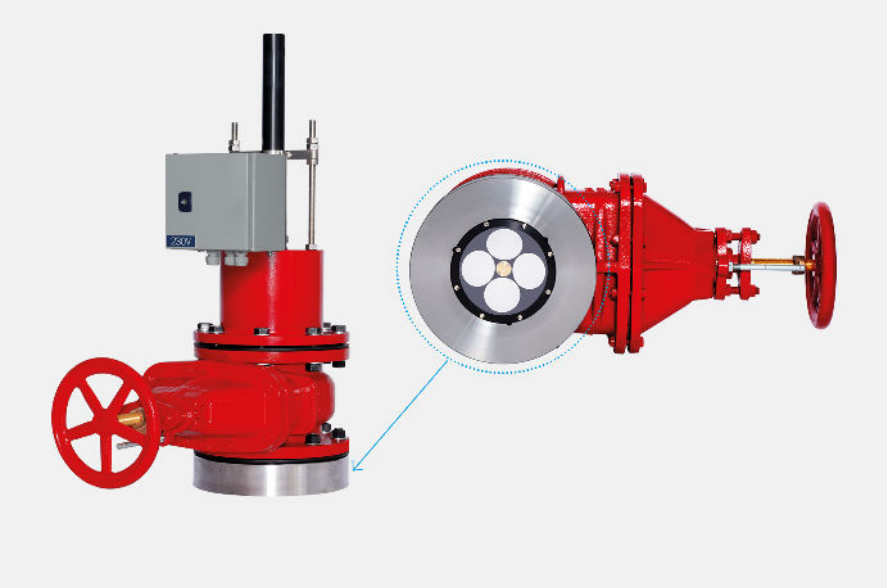
A fast and accurate survey of the sub-seabed can locate all hazards that might be met during offshore construction before detailed planning even begins. Nortek's VM Operations Acoustic Doppler Current Profiler (ADCP) supports these high-resolution, accurate subsea surveys with real-time oceanographic data for the current and tidal flow.

The benefit

The ultimate advantage is a risk mitigation that could save millions of dollars and thousands of lost work hours, by avoiding the need for crisis management of issues like unexploded, buried ordnance.

High-resolution subsea surveys of the East Anglia Hub

Scottish Power Renewables has been developing its East Anglia Hub with the



Impression of the in-water serviceable ADCP fitted inside the sea valve

ultimate goal of delivering a capacity of over 3 GW of electricity from more than 250 wind turbine generators, installed across hundreds of square kilometres of the southern North Sea. Fugro was contracted to provide the geophysical surveys, a multidisciplinary investigation that included sub-seabed mapping to support foundation design, cable routing and engineering.

Kraken Robotics was the offshore operator selected by Fugro to perform a Remotely Operated Towed Vehicle (ROTV) survey. 'Kraken Robotics Services provide a range of acoustic tools and vehicles for imaging and surveying objects and structures below the sea floor,' explains Ian Rouse, an offshore manager for the company and the person in charge of the survey. 'This includes pipe and cable depth of burial surveys, UXO and debris identification as well as boulder identification and seafloor structure analysis. This survey was completed to identify pUXO and other buried objects on the East Anglia Hub corridor.'

The Geo Ranger, a 41 m vessel owned by the company Geo Plus, was selected for the survey. This is a new shallow-water survey and ROV support vessel, launched in mid-2020. It carries multiple sensors, with plug-and-play facilities for survey-specific equipment. 'The Geo Ranger is an ideal size for deploying and running the SeaKite and accommodating the team,' comments Rouse.

Kraken Robotics SeaKite Sub-Bottom Imager

For this survey, Kraken Robotics installed its SeaKite, a Sub-Bottom Imager (SBI), aboard the Geo Ranger. It is based on an XL version of the EIVA ScanFish ROTV designed to cope with the 300 kg payload of the SBI equipment.

The SeaKite has been developed for wide-area site investigation and anomaly mapping using advanced acoustic technology to provide a real-time 3D image of the sub-seabed. It can survey 5 m strips of territory at a time and penetrate up to 8 m below the seabed to identify anything from magnetic pUXO to other non-ferrous geohazards at a 10 cm resolution. It can operate in water depths from 7 to 250 m and work at speeds of up to four knots, six times quicker than comparable ROV surveys, operating on autopilot to control its flight position and height, based on data transmitted from the survey system.

Flying the kite

The SeaKite needs to be towed at some distance from the vessel to stop the engine and motion noise influencing the data. 'The SeaKite vehicle is towed with between three and four times the water depth of cable deployed, and about 3 to 4 m above the seafloor. And it's deployed behind the Geo Ranger at a speed of four to five knots,' explains Rouse. 'So knowing the vessel's speed through water plus the tidal current is absolutely key to being able to accurately tow the vehicle. The Nortek vessel-mounted ADCP and software provided this on board the Geo Ranger.'

Acoustic Doppler Current Profiler

The Acoustic Doppler Current Profiler (ADCP) uses sound waves to measure the rate and direction of water flow. It does this by transmitting a series of high-frequency audio pulses that bounce off particles in the water and reflect back to the sensor. If the particle is moving away from the device the frequency of the return is lower, and if it is moving toward the device the frequency of the return is higher.

The shift in frequency between the pulses sent out and those returning allows the sensor to calculate the speed and direction of motion of the particles, and hence the velocity of the water flow that is carrying them. By monitoring the time between the sending of the pulse and the receipt of the reflection, the sensor can also determine how far the pulse has travelled before it was reflected back, thus calculating the depth of water of the current speed and direction data measurement. The vessel-mounted ADCP can also measure

The Nortek VM Operations provides real-time oceanographic data, as seen here in the monitor top left, to the bridge and survey rooms, where it is most needed offshore

There are many industries that will benefit from knowing real-time current speed and direction data, including the offshore wind and oil and gas industries, ROV operators, pipe and cable layers, rock dumpers, towed instrument surveys, and the evolving offshore USV sector.

speed through water and speed over ground, by using an extra pulse transmitted specifically to detect the vessel speed relative to the seabed.

The VM operations

While ADCPs are a well-established technology, until now their development has focused on scientific and research use by oceanographers and biologists. The devices have been rarely and only temporarily installed to acquire real-time, operational current data by commercial vessels offshore. This is mainly because ADCPs have traditionally been designed to provide large quantities of oceanographic data that will be analysed on completion of a research voyage.

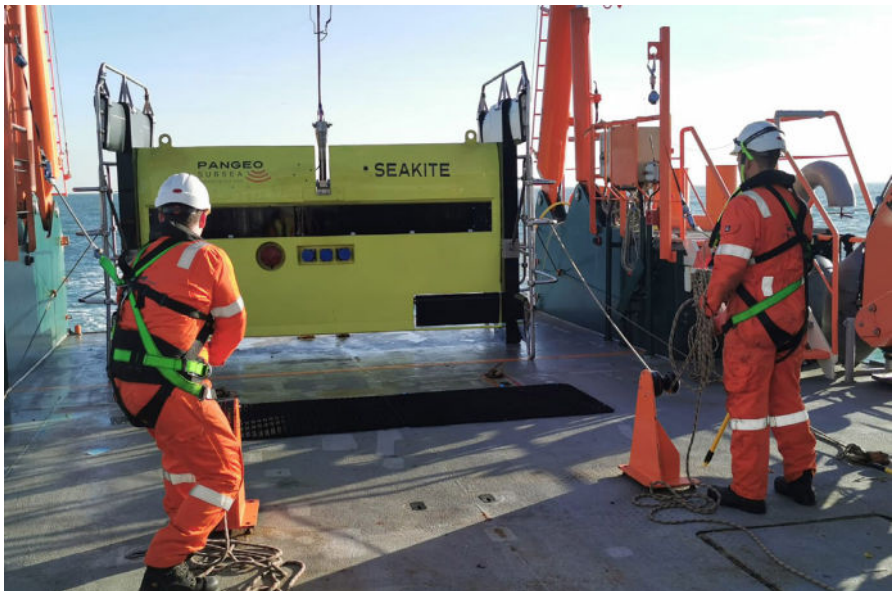
The sensors were not catering to the needs of industry, which requires real-time oceanographic data delivered in a straightforward format to the bridge, the survey or operations room. The VM Operations is the first ADCP developed for this industrial use.

'What we did is make it as simple as possible. The VM Operations helps offshore engineers and project managers on vessels make informed decisions during subsea operations in areas affected by underwater currents. It is designed to give offshore operators clear and detailed information on current speed and direction from the vessel to the seafloor,' says Herman Huitema, Business Development Manager for Nortek's vessel-mounted series.

'The Nortek VM Operations 333 kHz is the result: a brand-new concave ADCP design that can be deployed in combination with a sea valve to create an in-water serviceable and flush hull-mounted solution. During subsea operations, teams rely on ADCP data to make informed decisions. We developed software to fit this application, allowing the data to be shared with other systems,' continues Huitema.

Supporting the subsea survey

'In this case, the survey requires the precise sailing of a grid,' explains Huitema.



The Kraken Robotics SeaKite Sub-Bottom Imager was towed behind the Geo Ranger to perform the sub-seabed survey

'The survey team defines the gridlines and then they must sail along them continuously. The whole idea is not that the vessel is on the gridline, but that the SeaKite is being towed along the survey line. So if there is any current then there has to be an offset for the SeaKite, to maintain its position accurately. To calculate the offset it's essential to have very accurate data on the current profile down to the depth of the SeaKite.'

The Nortek VM Operations provided this information for Rouse's survey team aboard the Geo Ranger. 'The Nortek data is used to maintain a set survey speed through the water and also to provide speed and direction of surface and subsurface currents,' explains Rouse. 'This allows the correct offset from the vessel to the SeaKite to be applied and reduces the corrections to the survey track that the SeaKite has to do. So both the direct reading of the vessel speed through water and the bins of current versus depth data are important for the towed SeaKite survey operation.'

'Geo Plus has a close cooperation with Nortek and they provided valuable feedback to help design the ADCP software for these kinds of operational applications,' adds Huitema.

'We were lucky to have the Nortek VM Operations fitted to the Geo Ranger,' concludes Rouse. 'The sensor was very easy to use. The Nortek display was visible both on the bridge and also in the survey room. It was an essential part of the survey to enable the correct line to be run and also to maintain the correct survey speed.'

A vital innovation

There are many industries that will benefit from knowing real-time current speed and direction data, including the offshore wind and oil and gas industries, ROV operators, pipe and cable layers, rock dumpers, towed instrument surveys, and the evolving offshore USV sector. For all these industries and more, the Nortek VM Operations is a timely and important innovation for offshore engineers and project managers.

www.nortekgroup.com