MARINE TECHNOLOGY REPORTER

November/December 2017

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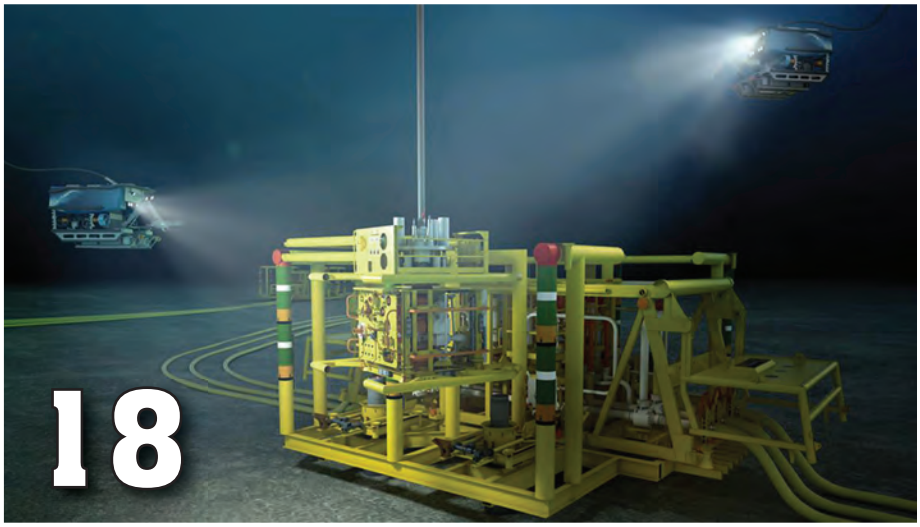

Image: Aker Solutions

Photo: Nortek AS

Photo: AWEA/Deepwater Wind

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Editorial

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The end of the year is the traditional period to review and project, but in today's breakneck paced world I contend that the 'year in review' is a passé from days long gone. I know that many of our colleagues and partners are perpetually consumed by work, seemingly cramming three jobs into one, traversing the globe and playing a never-ending game of catch up. Then, out of the smoke emerges an oasis, in this case it was a recent stop in San Diego for the **Teledyne Marine Technology Workshop**. As a disclaimer, this is not a gratuitous plug for Teledyne Marine, rather it is the first 'user's meeting' that I have had the opportunity to attend in nearly a decade. Nor is it simply the mirage of San Diego, one of my favorite destinations in the country and a stark contrast to my previous three days leading to the workshop, spent in a tent, in the cold, on a mountain.

In reality the Teledyne Marine gathering, which attracted nearly 300 of the company's clients from around the globe, was a refreshing time to stop, look, listen and breathe, to network with colleagues and to learn about emerging technologies and trends that will shape the industry in the coming years. In my experience many companies don't like 'the press' at their user conferences for fear of hearing unvarnished comments on a particular technology from the end users. This was not the case in San Diego, as the cornerstone benefit of this meeting, from my perspective, was the open source approach that Teledyne Marine took to the workshop and unfettered access to colleagues and partners that use its technology globally, daily. The three days was time well-spent to not only refresh and recharge, but to update myself on the cutting edge technologies – from Teledyne Marine and from their partners – that will drive this industry further, faster in 2018 and beyond.

With that I offer all of you a healthy and prosperous end of the year and holiday season, and a sincere 'thank you' from myself and our entire *MTR* crew for your continued interest and support.

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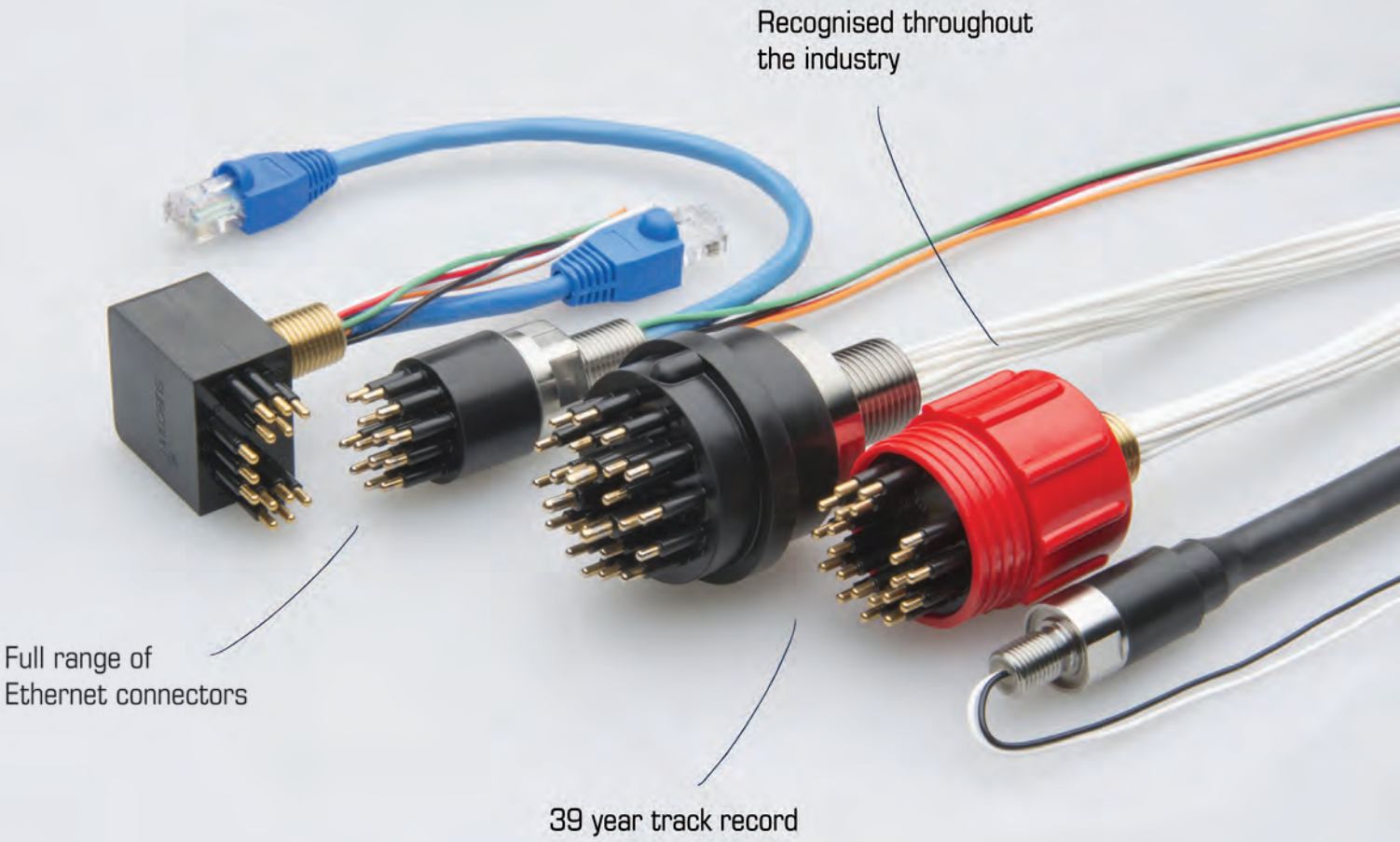

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FRV 7417

Photo: Damen

In November Damen Shipyards Galati launched Baía Farta, a new Fishery Research Vessel (FRV) 7417 for the Angolan Ministry of Fisheries. The vessel's sponsor was Dra. Isabel Cristóvão, director of Gabinete de Estudos, Planeamento e Estatística.

The FRV 7417 is suited to various purposes, including hydrographic operations, acoustics research, pelagic and demersal trawling, plankton, water, environmental and geographical sampling, oil recovery and emergency towing operations. Baía Farta boasts a number of state-of-the-art features, the builder said. The FRV has Silent A/F/R Class notation. Close attention is being paid to the design, construction and outfitting of the vessel in order to minimize noise and vibration both on board and underwater.

Baía Farta features a basic design from Skipsteknisk. Her construction has been an international project, involving input from Damen Shipyards Gorinchem and Damen Schelde Naval Shipbuilding in the Netherlands, with building taking place at Damen Shipyards Galati in Romania.

Photo: Tuco Marine Group

Hydrographic Pair

Tuco Marine Group signed a contract with DALO (The Danish Defense Acquisition and Logistics Organization) to deliver two bespoke hydrographic survey boats to replace two existing survey vessels. The new vessels, based on Tuco's ProZero concept, have been designed to allow full use of the latest technology for hydrographic surveys.

The boats are designed to accommodate two hydrography specialists in addition to a dedicated helmsman. The hull has been specially adapted to address two challenges that are hard to solve at once: on the one hand the low draft capacity to operate in uncharted shallow waters where you face the risk of running aground and on the other hand antiroll and directional stability. The boats are equipped with jet drives and stabilizing features which make them highly agile and seaworthy. According to Tuco, the design enables more efficient surveys under changing weather conditions and the hydrodynamic profile of the hull reduces turbulence and vibration so as not to interfere with the highly sensitive measuring equipment. The efficient design enables extensive operations over large areas, the builder added. The sonar equipment is fixed under the boat and recessed into the structure to protect it against adverse conditions. High performance sensors and processors that are able to capture and process the signals as well as correcting and managing multiform data streams constantly produce and store high quality information that accurately represent the sea floor. The boats are built from composite materials which ensure low weight, high fuel efficiency and low emission of greenhouse gasses, Tuco said. Additionally, the need for maintenance is minimized just as handling of the boat on land is made easier. The boats are capable of reaching speeds in excess of 25 knots under full loading conditions.

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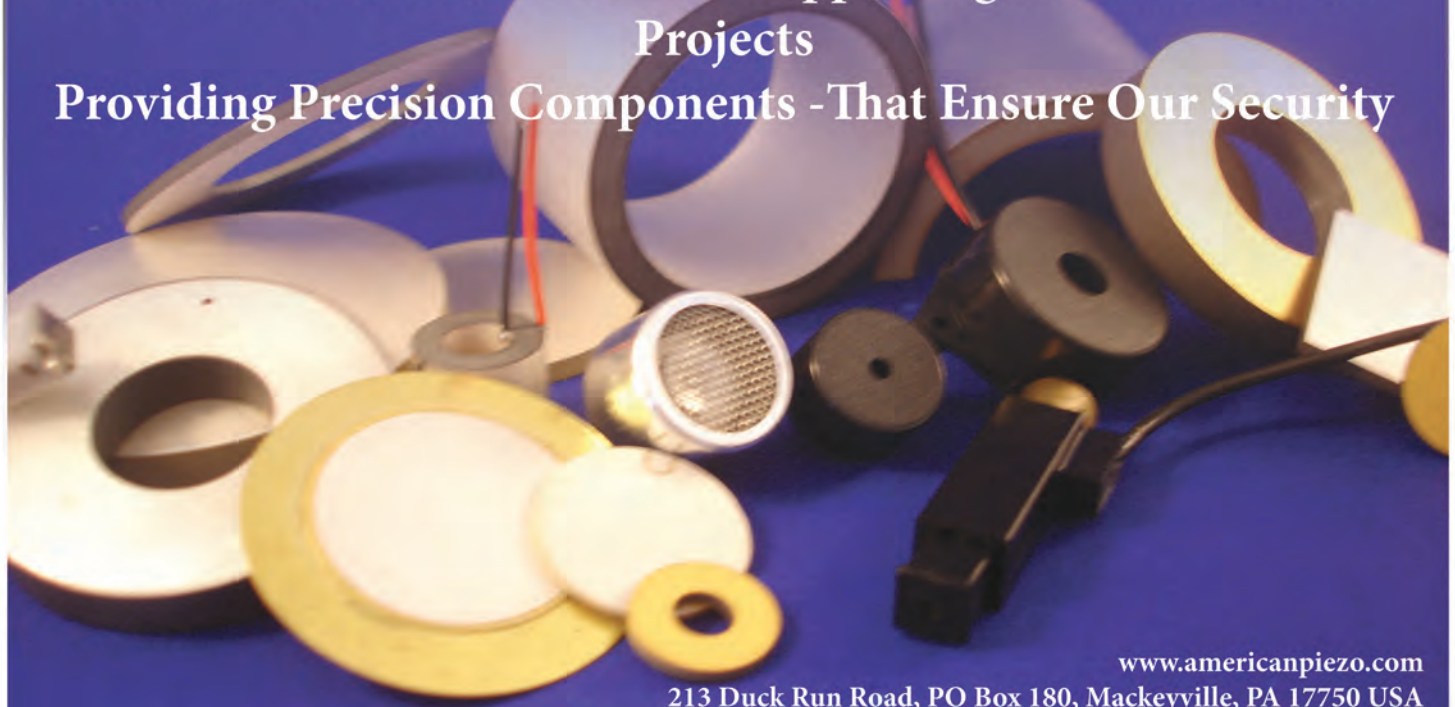

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Hunt for Argentinian Sub

A fleet of four high-tech unmanned underwater vehicles deployed by the U.S. Navy have joined ships and aircraft from more than a half dozen countries in the search for an Argentine Navy submarine missing with 44 submariners on board in the southern Atlantic.

www.marinetechnologynews.com/news/unmanned-vehicles-search-argentine-554493

Official U.S. Navy file photo of a Bluefin-21.

6 x 5,000m+

A fleet of autonomous underwater vehicles launched during recent a survey mission in the North Atlantic have completed the deepest known commercial dive performed by multiple AUVs simultaneously. The team behind the mission, Ocean Infinity, said it plans to descend its AUV fleet even deeper – to 6,000-meter depths – by mid-2018.

Ocean Infinity

https://www.marinetechnologynews.com/news/simultaneously-meter-depths-553744

1 Fish, 2 Fish ...

How many Red Snapper in the GOM?

Photo: NOAA

How many red snapper are in the U.S. waters of the Gulf of Mexico? A team of university and government scientists will lead a two-year, $12 million independent study that aims to produce an estimate.

www.marinetechnologynews.com/news/snapper-mexico-554539

Digitalize Offshore

Kraken Leads the Charge

Under a contract recently awarded to Kraken subsidiary, Kraken Robotic Systems Inc., the company will develop underwater sensors and robotics in order to advance digitalization of integrated operations within Newfoundland and Labrador's offshore oil and gas sector.

www.marinetechnologynews.com/news/kraken-advance-offshore-digitalization-554400

Kraken CEO Karl Kenny

Photo: Eric Haun

World First

Floating Wind Farm

The 30MW Hywind Scotland wind farm – the world's first offshore floating wind farm – operated by Statoil in partnership with Masdar 25 km offshore Peterhead in Aberdeenshire, Scotland, was officially opened October 18.

Photo: Øyvind Gravås / Woldcam - Statoil ASA

www.marinetechnologynews.com/news/world-first-floating-starts-553502

C-DRONE

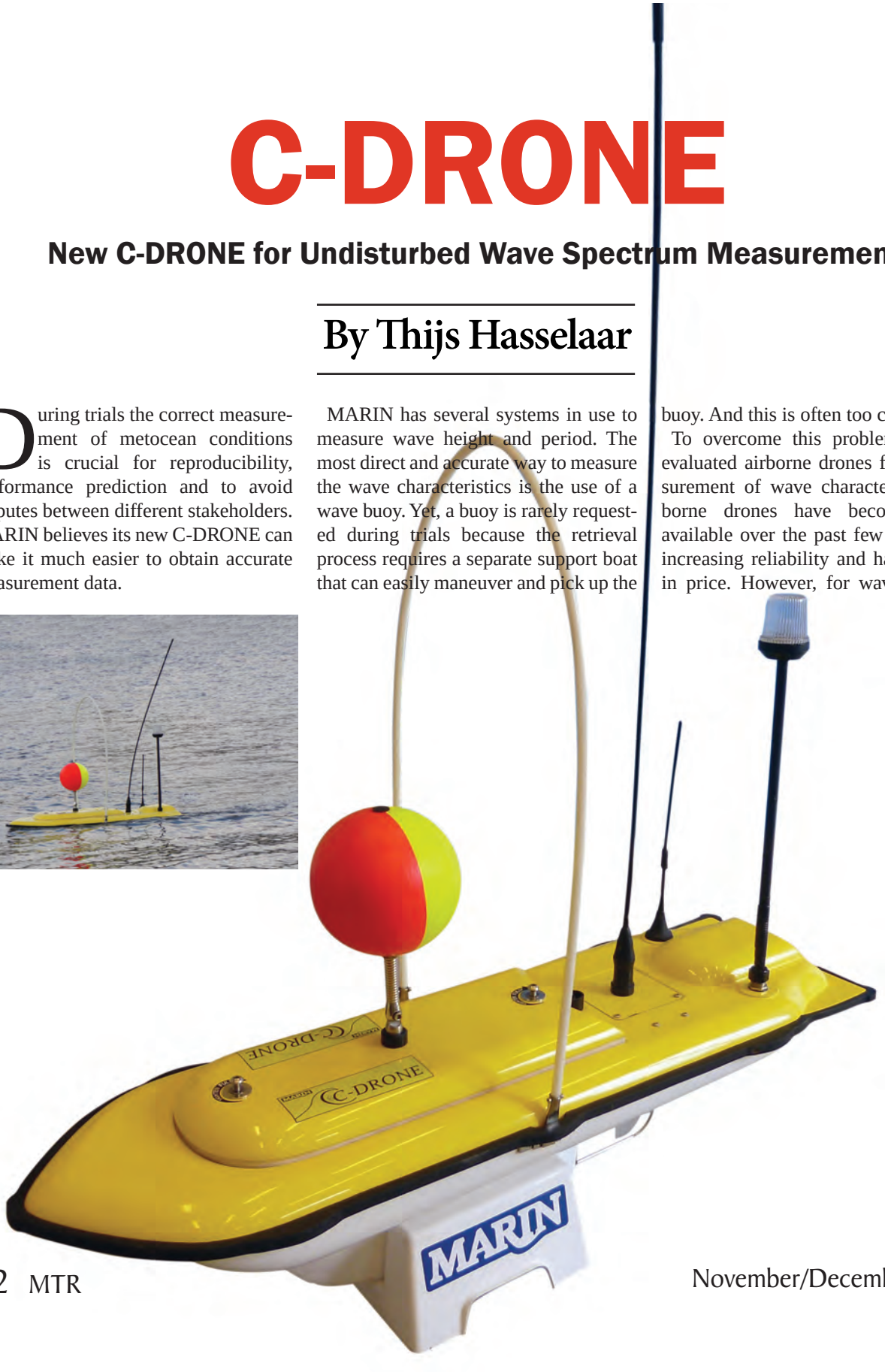
New C-DRONE for Undisturbed Wave Spectrum Measurements

By Thijs Hasselaar

During trials the correct measurement of metocean conditions is crucial for reproducibility, performance prediction and to avoid disputes between different stakeholders. MARIN believes its new C-DRONE can make it much easier to obtain accurate measurement data.

MARIN has several systems in use to measure wave height and period. The most direct and accurate way to measure the wave characteristics is the use of a wave buoy. Yet, a buoy is rarely requested during trials because the retrieval process requires a separate support boat that can easily maneuver and pick up the buoy. And this is often too costly.

To overcome this problem, MARIN evaluated airborne drones for the measurement of wave characteristics. Airborne drones have become widely available over the past few years, have increasing reliability and have lowered in price. However, for wave elevation



Images: MARIN

measurements under strong, gusty wind conditions in a harsh marine environment their applicability and reliability is limited. Moreover, commercial deployment of flying drones requires expensive certification and training. This led us to develop the C-DRONE: an autonomous/remote operated vehicle which can be deployed and retrieved using a rope and hook to measure the undisturbed wave field away from a ship.

The C-DRONE is a small AOV equipped with a 6-DOF motion sensor and GPS. It can navigate autonomously in waves (top speed 3 m/s) at an undisturbed location ahead of the ship, and act as a wave buoy by drifting while measuring the wave spectrum. After a preset time it returns to the deployment location, where an operator on the ship can take over control to maneuver it alongside the ship and pick it up using a grappling hook. The C-DRONE is small enough to be carried as hold luggage in normal commercial airplanes, so that it can be used and deployed at short notice.

In 2016 MARIN tested the Hexapod to evaluate the accuracy of the motion sensors under different combined irregular motions, amplitudes and periods. The accuracy of the extracted global heave motion was comparable to regular wave buoys. In 2017 trials will be performed in the North Sea to evaluate practical issues and performance in seas. After successful trials it will become standard equipment for speed and power trials.

The Author

Thijs Hasselaar is Project Manager at the Business Unit Trials & Monitoring at MARIN, the Maritime Research Institute Netherlands.

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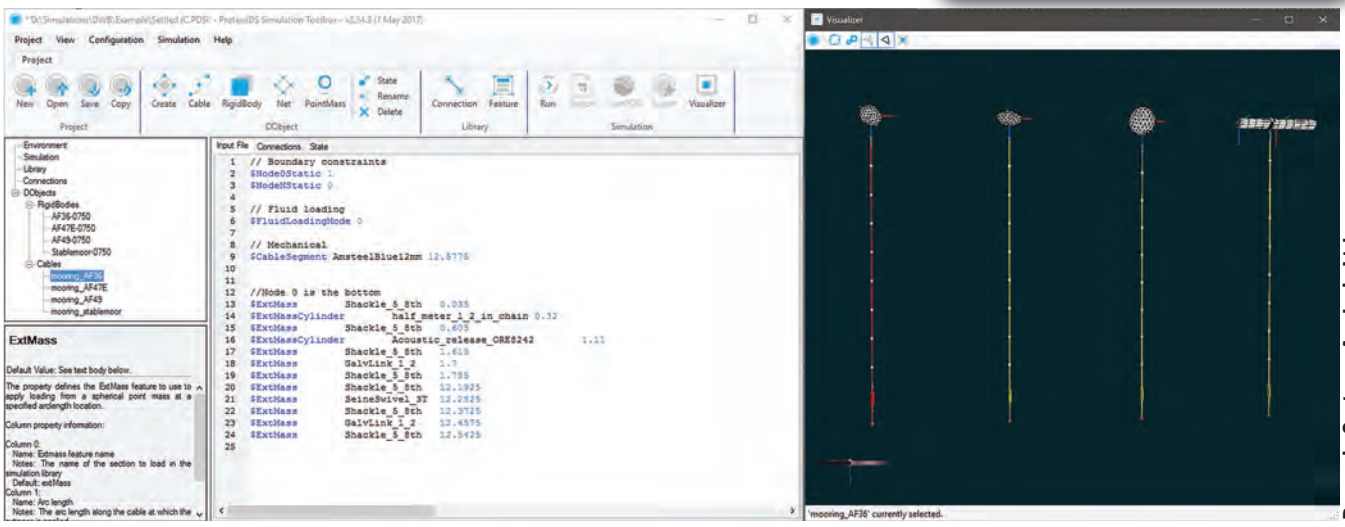
Don't Let the Ocean Knock You Down

Using dynamic analysis software to assess mooring deployment, recovery and performance in current and waves

By Dean Steinke

For many years, moorings have been designed using basic mass-drag-buoyancy calculations, spreadsheets, rules-of-thumb, black magic scripts and a dose of 'salty-sea-dog' experience. With these methods one can frequently estimate a line size to use or an approximate anchor weight. But sometimes this isn't good enough. This article looks at getting more precise with mooring analysis using numerical modeling software designed for ocean engineers.

Numerical modeling software for single point moorings has come a long way in recent years. Finite-element based cable analysis software has been tested and developed by oceanographic institutions and ocean engineers for various purposes (towed bodies, ROVs, moorings, etc). However, its use has been typically limited to a few advanced numerical modeling specialists who had both the expertise and patience to wade through the complex analysis process. In recent years, increasingly refined software has



Dynamic Systems Analysis Ltd.

Figure 1: The ProteusDS software pre-processor is shown. This software allows users to add mooring elements such as shackles and swivels from a central library. Line types such as Amsteel Blue or wire rope can likewise be selected.

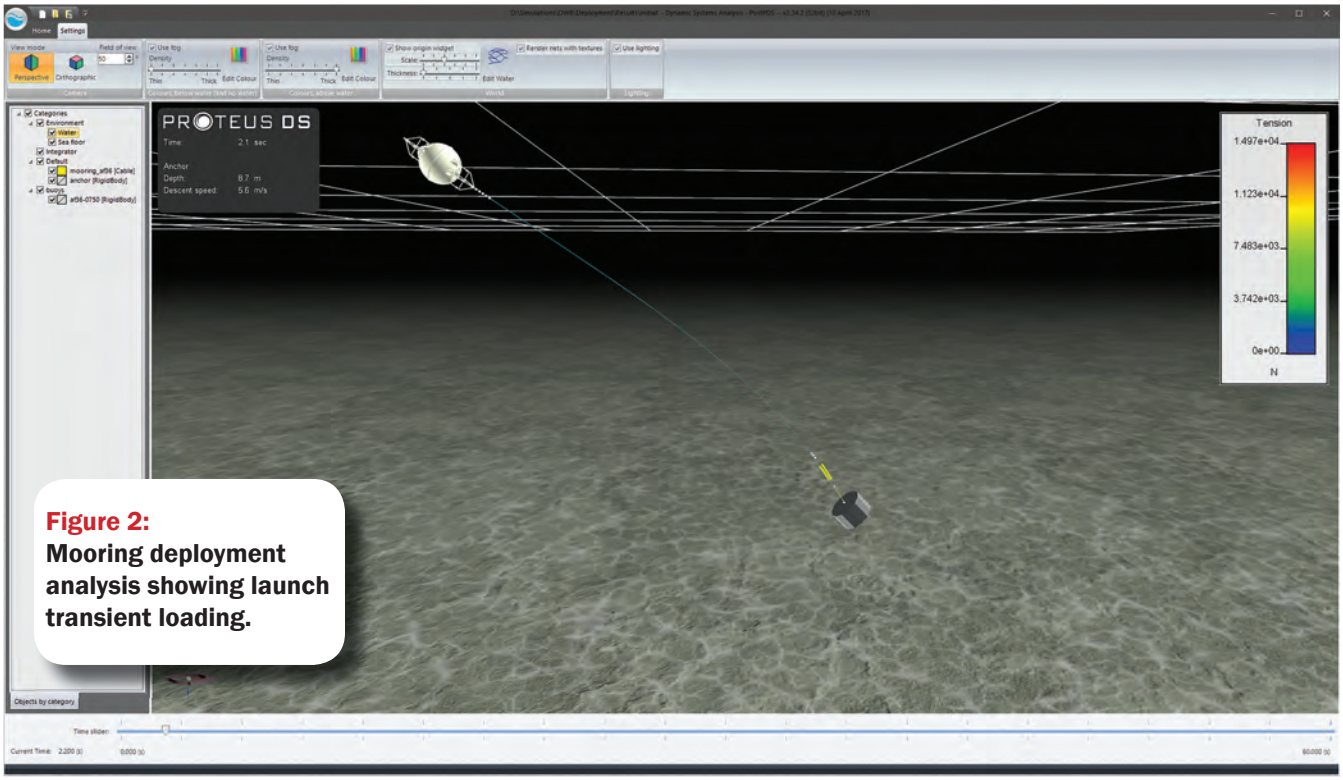


Figure 2:
Mooring deployment analysis showing launch transient loading.

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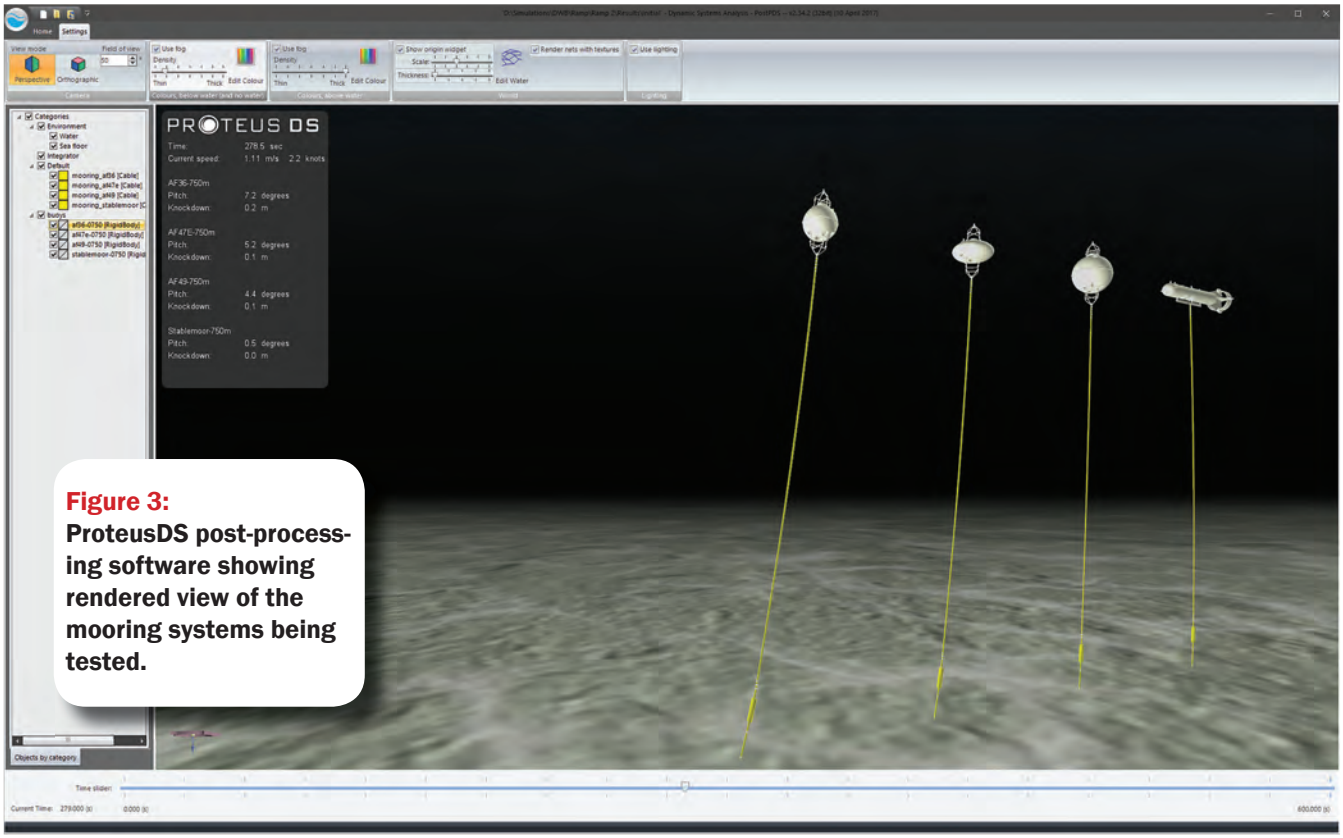


Figure 3:
ProteusDS post-processing software showing rendered view of the mooring systems being tested.

Dynamic Systems Analysis Ltd.

been developed. This software really benefits from increased computational power and advances in 3D graphics. We can now get a much clearer picture as to what is happening with our moorings subsurface.

The article below outlines an analysis carried out by my firm, Dynamic Systems Analysis Ltd, using our ProteusDS software. We're based in Canada and have cut our teeth over the last decade simulating many different types of ocean technologies, including single point moorings.

Analyzing Buoy Pitch and Knockdown in Current

The example shows four buoys of various styles (spherical, ellipsoid and streamlined) being loaded by current. As the current ramps up to 3.6 knots, the knockdown and pitch of the buoys increase. There are two key forces at play: buoyancy and drag. The buoyancy provides a vertical restoring force that keeps the buoy from pitching. Conversely, hydrodynamic drag pitches the buoys about their mooring connection point.

A pitch of greater than 20 degrees is not recommended for as ADCPs, as the inclinometers which allow for compensation of buoy pitch typically only have a range of 20 degrees. Most mooring designers would try to limit ADCP buoy pitch to only a few degrees if possible. Buoy pitch also depends on the length of the mooring, and weight of mooring equipment (chain, shackles, line, etc.) that the buoy is supporting.

The example shows that the buoyancy is effective in preventing knockdown and limiting pitch, as the AF49-750m buoy has the lowest pitch and knockdown of the ellipsoid and spheroid buoys. However, this buoy still pitches significantly. At higher current speeds is where the streamlined Stablemoor buoy with its reduced drag and configurable connection point is effective at maintaining low pitch and knockdown in the 3.6 knot currents tested.

The ProteusDS model uses a 6 degree of freedom for the buoys (heave, sway, surge, roll, pitch, yaw). Although this case is essentially 2D, the solver solves for the position in 3D.

Transient Loading and Acoustic Release Damage

One aspect not often considered by mooring designers is what happens during deployment. As shown in the example, the simulation allows for prediction of launch transients, which ensures that shackles and lines are properly selected to handle the deployment loads.

We've observed that acoustic releases get damaged during deployment when they are placed too close to the anchor. ProteusDS can be used to check that the acoustic release's downward momentum will not cause it to crash into the seabed or anchor.

Mooring Recovery

A few questions I've been asked over the years: How long will it take for the mooring to come to the surface? How far might the mooring drift as it comes to the surface? In the case considered, the AF36-750m mooring rises at about 2.7 m/s. If this mooring was deployed at 750m, it would take between four and five minutes to surface.

Although no current was applied in the example, current can be applied in the simulation to determine how far it might drift in the time it takes to get to the surface. In an offshore environment, typically a mooring won't drift too far.

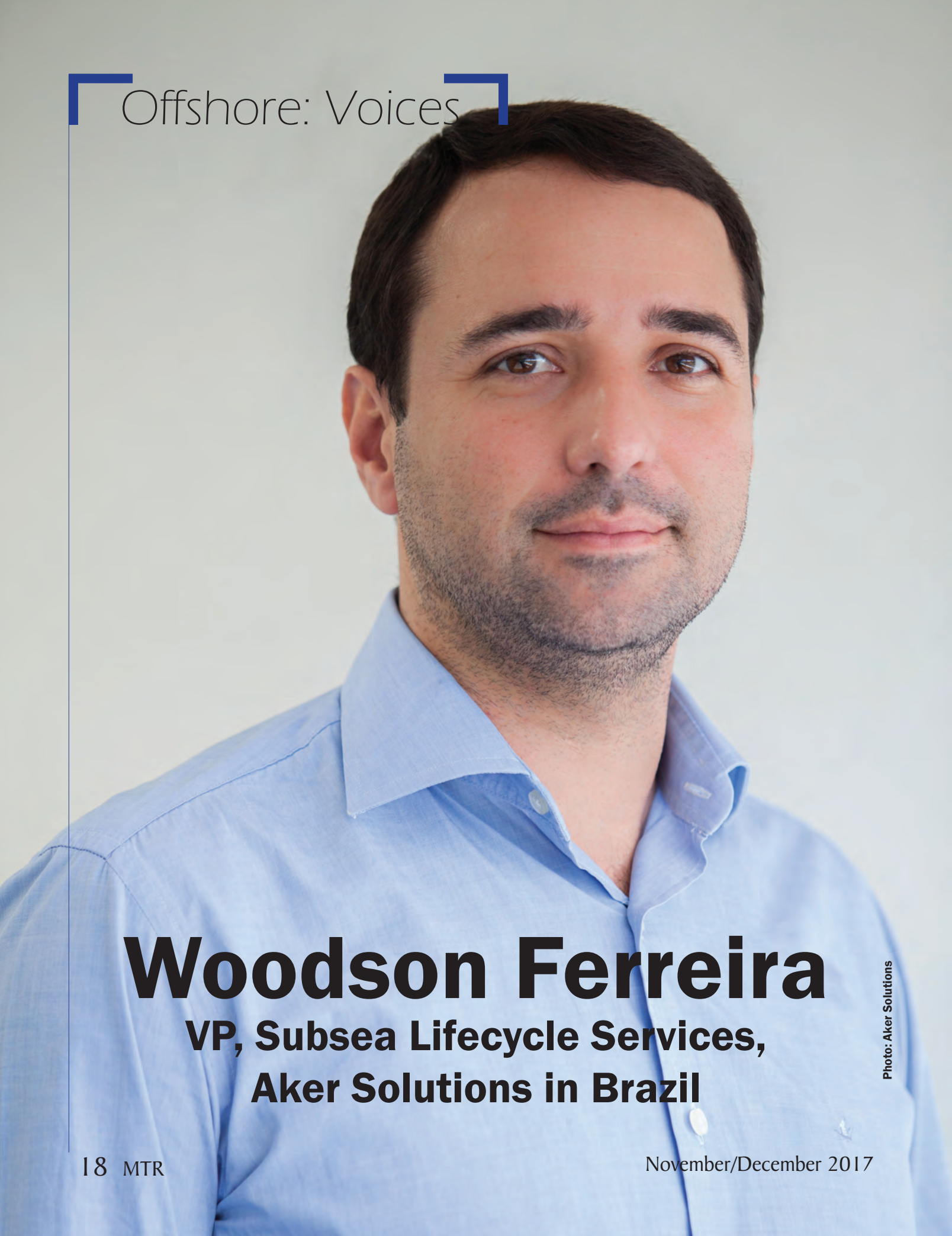
Interaction of Waves with Subsurface Moorings

Much like current, waves can cause an ADCP mooring to pitch and move. This example shows the impact of the subsurface orbital wave motion on the mooring line and buoy. A JONSWAP wave spectrum is simulated to check if the buoy will pitch. Clearly, in this case, a bottom mounted ADCP frame would be preferred, but we don't always have the equipment we need on hand. It's good to have tools to check the impact of waves on our moorings.

DSA has carried out a series of simulations in consultation with DeepWater Buoyancy using our ProteusDS software. The software is designed to help mooring designers and builders to answer practical questions about mooring performance. The software's 3D visualization capabilities are really cool, but I believe that the real value of the software is that we don't have to guess what is happening subsea.

The Author

Dean Steinke is co-founder and Director of Operations, Dynamic Systems Analysis. He combines a mechanical engineering education with hands-on offshore experience.



Woodson Ferreira

VP, Subsea Lifecycle Services, Aker Solutions in Brazil

Photo: Aker Solutions

By Claudio Paschoa

Aker Solutions is a leading subsea equipment and service provider in Brazil, having participated in pre-salt and post-salt subsea field designs, equipment installation, IMR and other life of field services. *Marine Technology Reporter's* correspondent in Brazil, Claudio Paschoa, interviews Woodson Ferreira – Vice President of Subsea Lifecycle Services in Brazil.

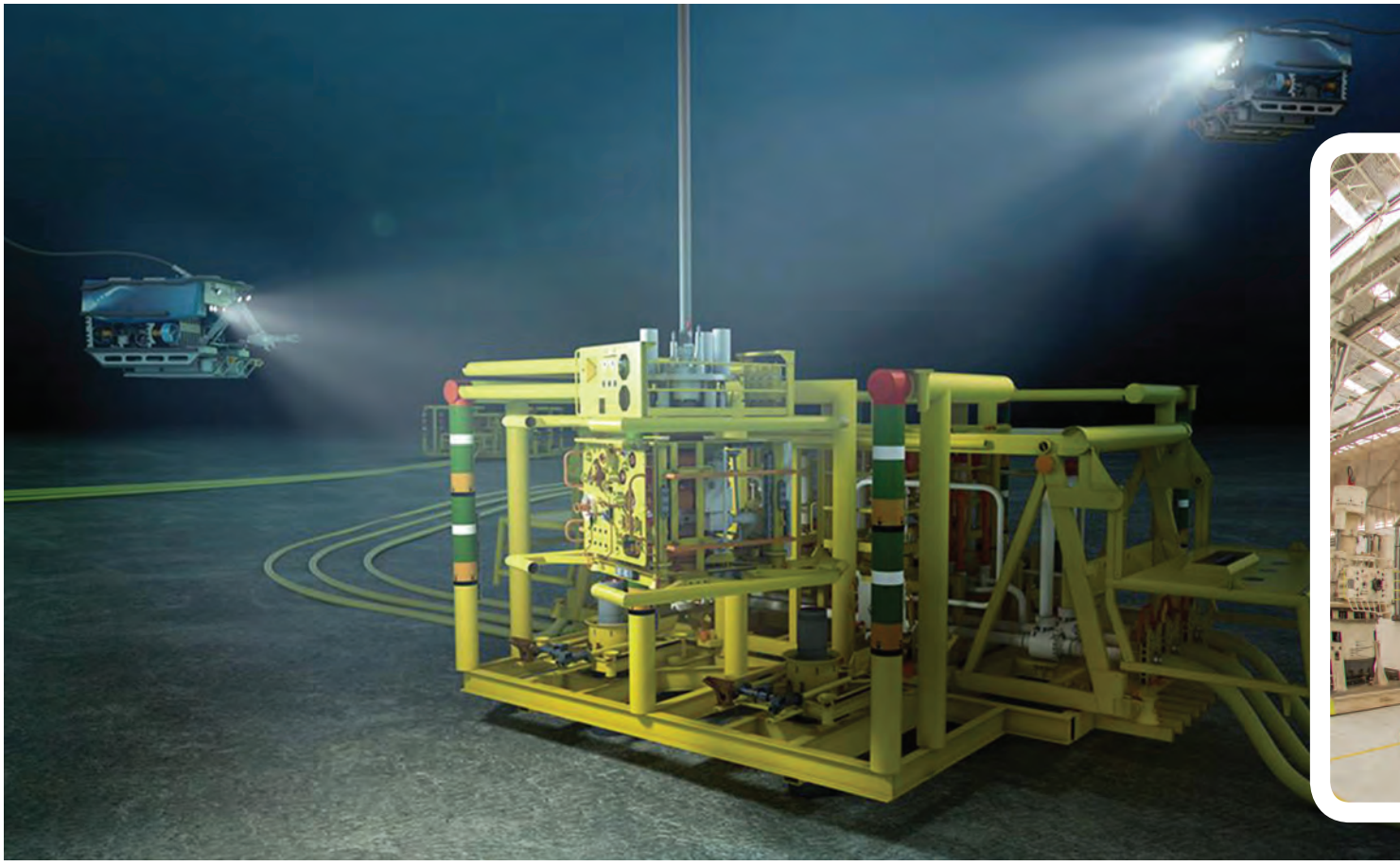
Aker's original expertise in subsea operations came from the challenges of developing the deep waters and complex reservoirs of the North Sea, where Aker Solutions was one of the original companies installing subsea equipment and developing subsea systems. In 2015, it delivered the world's first subsea gas compression system for Statoil's Åsgard field in the Norwegian Sea, about 200 km off the coast. The system, nearly the size of a football field, revolutionized offshore natural gas production by cutting costs and improving safety with fully-fledged oil and gas production and processing systems on the bottom of the ocean. Large subsea systems are the mainstay of Brazil's pre-salt development, where Aker Solutions has also been at the forefront. In Brazil, Aker Solutions operates in two main business areas – Subsea: equipment, systems, lifecycle services and Field Design: offshore engineering, offshore maintenance, modifications and operations (MMO).

Aker Solutions started activities in Brazil in 1995 and boasts a local workforce with more than 10 years experience in the O&G business as a supplier of subsea production systems. Aker's product list includes subsea trees, mani-

folds, control systems, PLEMs, PLETs and Pump stations. The company has achieved success as a supplier of subsea equipment for pre-salt fields being developed in Brazil, such as at the Lula, Lula-Nordeste and Sapinhoá fields for Petrobras and is also present is a number of fields operated by IOCs. The knowledge and technologies developed by the company range from reservoir to production throughout the lifecycle of a field. "Our main products and services are focused on engineering, subsea equipment and offshore maintenance and operation. In Brazil, Aker Solutions has the largest and most technologically advanced factory in the world. In the oil and gas sector's biggest downturn (2015/2016), the company invested around $80 million in a high technology plant, which positioned the Aker Solutions headquarters in Brazil (in São José dos Pinhais, in the State of Paraná) as the largest and the world's most modern, which can become a technology and production hub for Aker Solutions' global projects. The company also has a service unit in Rio das Ostras (Northeast of the city of Rio de Janeiro), as well as bases spread throughout the country to meet service contracts in construction and assembly. The company employs approximately 14,000 people in more than 20 countries, who apply knowledge, create and use technologies to deliver the best solutions to customers. In Brazil, we have approximately 3,300 employees," said Woodson.

Looking at key challenges faced during IMR operations of subsea equipment in general and specifically in deepwater equipment in Brazil, Woodson said that the history of the company operating with equipment installed in the offshore environment spans little more than two decades, which has generated opportunities to work with products and materials from different technologies, from the least to the most complex. "In the scope of inspection services, Aker Solutions operates in the whole range of underwater equipment and in the provision of qualified personnel to work in the offshore units with the client, giving the necessary support for inspection and maintenance activities. In the offshore area, one of the main challenges is the programmed inspections of equipment associated with well production stoppage, requiring agility to avoid production impact. In this period, the actions coordinated with the topside system of the platform occur, taking advantage to

Deepwater IRM operation.



perform preventive or corrective maintenance. Normally in IMR projects, we use subsea resources made available by offshore vessels, for example, remotely operated vehicles (ROVs), cranes and tools operated by ROVs, together with specific equipment and intervention tools provided by Aker Solutions. Another challenge is related to the reduction of OPEX costs, which requires the reduction of the time of service, maintaining the quality and agregate value. In conjunction with the customer it was possible to reduce the subsea inspection time by up to 50% with process planning and optimization," said Woodson.

Aker Solution is also a major player in intervention and workover services in Brazil, especially in deep waters. According to Woodson, "In addition to all equipment installation services, we provide a wide range of equipment intervention services, removal and replacement of modules and equipment, abandonment of wells, inspection, recovery and maintenance of control modules and tie-in connections."

Aker has a significant number of subsea systems already installed in various water depths offshore Brazil, which

Workers assembling subsea equipment at Aker Solutions factory in Brazil.

Images: Aker Solutions

undoubtedly place it in a great position to secure IMR contracts in Brazil's three main production basins: Santos, Campos and Espirito Santo. With ongoing exploration in Brazil's far north (Equatorial Margin) along with recent oil block bidding rounds, including pre-salt blocks and given its track record in Brazil, Aker is in a unique position to capitalize on new subsea equipment orders for deepwater equipment and services. "There are 260 installed systems, among which are 241 wet christmas trees, 14 pump modules and five manifolds. Of the total in activity subsea, the company has 80 multiplexed modules installed on its own equipment and the rest on equipment from other suppliers," said Woodson.

Subsea IMR is highly specialized work, especially in deepwater environments, demanding a highly trained technical workforce. "Aker Solutions currently has a team of approximately 160 people dedicated to offshore services and base support. The technical team is highly qualified and trained, focusing on safety and reliability. The base of operations is in the Special Business Zone (ZEN), in the city of Rio das Ostras, in Rio de Janeiro. The scope of the subsea lifecycle services (SLS) contracts in Brazil involves the provision of regular inspection, maintenance and repair services of the customers' installed assets, and the activities are performed on a monthly basis. In the current scope of its contracts, Aker Solutions provides technical support in the intervention of equipment, being the customer's responsibility to lease the offshore units," said Woodson.

When asked about what may give Aker Solutions an edge in the market, Woodson commented, "Aker Solutions has a solid background in the services provided to the oil and gas industry, pioneering the development and installation of equipment for the deepwater pre-salt fields. All of the accumulated experience combined with the strong culture of continuous improvement have made Aker Solutions one of the most efficient suppliers in the subsea market. In addition, the company invests in research and development (R&D) and interfaces between the operations engineering teams and the new technology center in Paraná."

In October 2016, Aker Solutions announced an agreement to buy the majority (70%) stake in C.S.E, a local offshore service company. The agreement includes an option for Aker Solutions to purchase the remaining 30% of the company in three years. The acquisition gives Aker Solutions access to Brazil's growing market for servicing existing oil and gas fields. C.S.E., which had a revenue of $99.6 million in 2015, provides maintenance, assembly, commissioning and crane operation services for offshore and onshore facilities, with vast experience is topside and subsea IMR projects. "With the acquisition of C.S.E., the Production Asset Services division of Aker Solutions expands its already extensive pool of expertise and resources to provide services to the offshore market and can meet the demands of IMR contracts, and take a position in

Subsea systems at work.

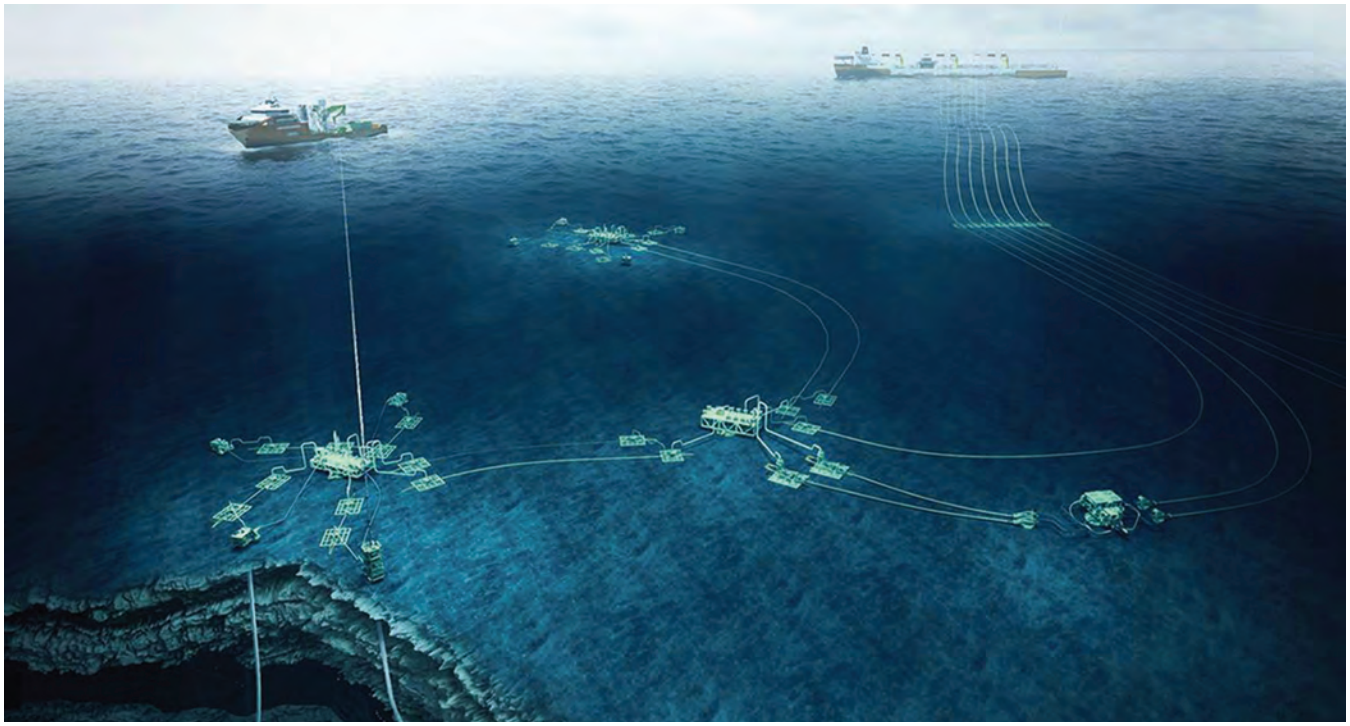


Photo: Aker Solutions

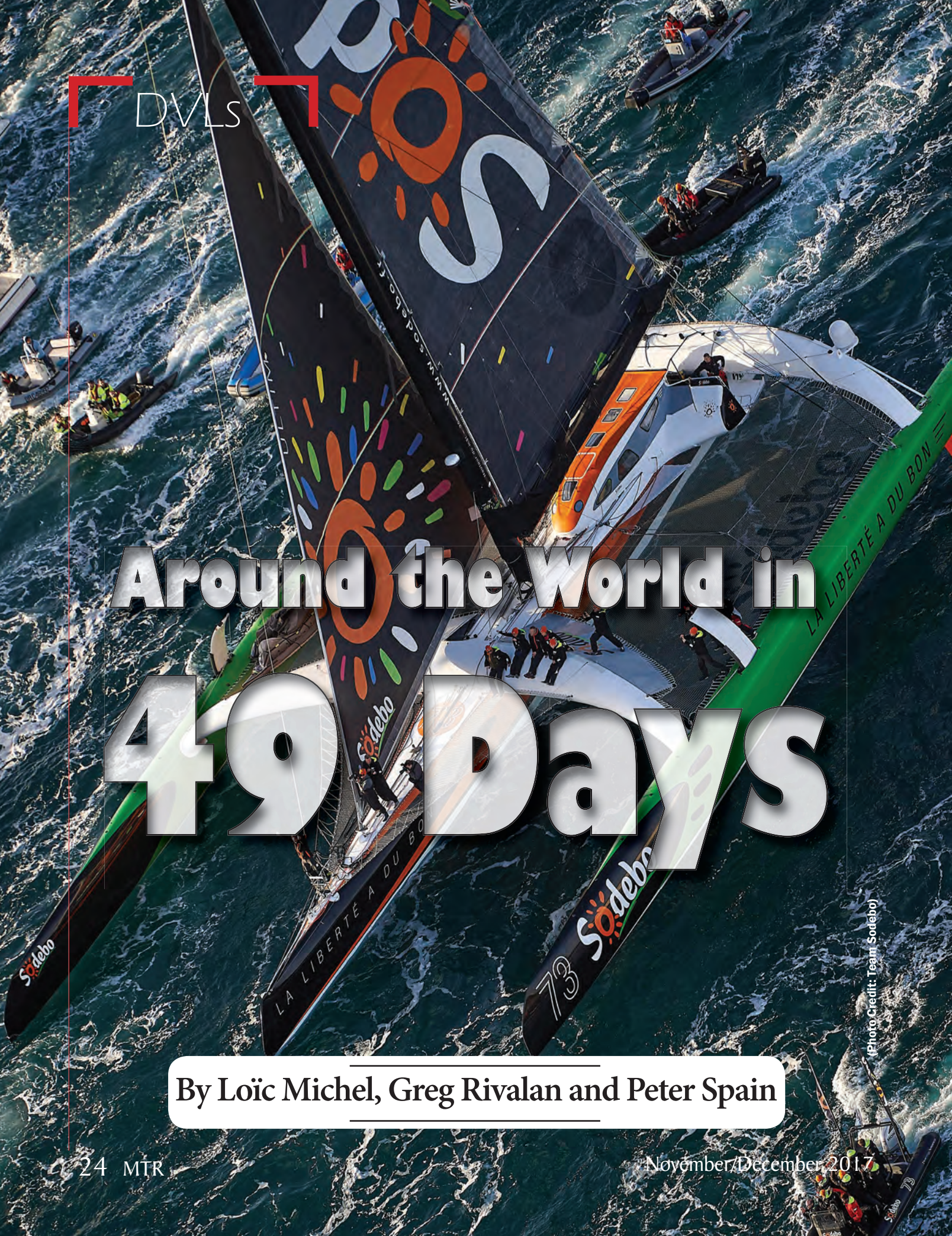
Brazil's brownfield market. The strategic combination of the two companies, Aker Solutions' and CSE's execution capacity, together with the latter's maintenance history, results in a solid company with ambition to establish itself among the leaders in this segment with significant growth opportunities, specifically services for current installations and complex assets that are emerging from the development of deepwater pre-salt plays," said Woodson.

With the gradual but steady revival of Brazil's O&G market, which promises regular offshore oil block auctions and relaxed local content policies, it is interesting to get a glimpse of Aker's view regarding the O&G market in Brazil presently and in future. "Aker Solutions is able to meet global demands from its operation in Brazil. It is part of the company's strategy (for Brazil) to become a competitive international hub for projects with operators such as Statoil, Total, BP, among others. It is still a time of uncertainty and caution, but we are optimistic about the gradual recovery. The Brazilian potential remains one of the largest in the world, we have the technology, capacity and capacity of the market. Public policies and the predictability of auctions are beginning to move forward, but much remains to be done to attract new investments and make projects economically viable. Aker Solutions continues to work to improve its efficiency and bring the best solutions to our customers.

In parallel we are making efforts in the area of maintenance and offshore operations and preparing our company to operate in revitalization and decommissioning projects in Brazil," concludes Woodson.

The Author

Claudio Paschoa is *Marine Technology Reporter's* long-tenured contributor stationed in Brazil.



Around the World in 49 Days

(Photo Credit: Team Sodebo)

By Loïc Michel, Greg Rivalan and Peter Spain

Global-Race Solo Sailor Is on Track with High Tech

Teledyne RDI's DVL Equips Triumphant French Trimaran

On Christmas Day 2016, Thomas Coville completed a record-breaking trip. He sailed around the world in 49 days aboard Sodebo Ultim — a 32m French trimaran. Averaging 23 knots over the 27,000-mile course, Coville reduced the previous record for solo global circumnavigation by eight days. That record had stood for 12 years. In fact, Coville had previously made three unsuccessful attempts to break it. For two weeks, Coville's route headed south from France down the Atlantic and far into the Southern Ocean. There he picked up strong winds called the Roaring Forties. In less than three weeks, Coville sailed clockwise around Antarctica keeping the Indian Ocean and Pacific Ocean à gauche. After 32 days of sailing, Coville finally turned north into the Atlantic, headed to his homeland and the finish line.

Efficient Sailing

Apart from finding the right winds, a key aspect of global race sailing is maximizing the component of a sailboat's velocity along the direction of the true wind. Sailboats cannot sail directly upwind. As a result, there is inevitably some sideways drift to leeward of the desired course. This drift is called leeway.

The engineering team for Sodebo sought a new approach for measuring speed-through-water and leeway. Existing devices could not accurately report the high speed and acceleration of this custom racing boat. Accounting for high acceleration is critical for accurately measuring winds. To meet these needs, Coville's team selected Teledyne RDI's (TRDI) Doppler Velocity Log (DVL).

As well as supplying the traditional piston DVL design, TRDI provides DVLs in a patented 2D phased array configuration. This technology pushed back the practical, mechanical limits for transducer size and frequency at both ends of the size continuum. At 600 and 300 kHz, phased array technology permits very accurate, precise and robust navigation in smaller configurations. TRDI's phased array product lines also include lower frequencies for longer measurement ranges.

Doppler Velocity Log

A DVL is a sonar system that measure motion underwater. Using sound waves, the DVL works like hand-held radars used by police to catch speeding motorists. The vertical range of this measurement is greater for lower frequency sound waves.

To measure motion, DVLs emit sound bursts along beams angled

Fig. 3: Sodebo Ultim, a 32 m French trimaran, averaged 23 knots over the 27,000-mile course.

downward in different directions. Echoes are returned due to scattering off the seabed. Because the DVL sonar is aboard a moving vehicle, returning echoes carry a change in pitch; this is the Doppler Effect.

Generally, a different frequency shift is heard along each beam. Combining these readings tells how fast the vehicle is moving and in what direction.

Measuring Leeway

Currents and winds can change the path traveled by a vessel. The dead-reckoned track is estimated using only ship speed and heading. This estimate needs to be corrected for the effects of water currents and winds.

Obviously, winds cause a sail boat to move along its track. Yet wind also causes motion across the vessel's heading. This downwind motion is called leeway. It can be seen by a sensor that is looking at the water. The effect of leeway can be seen when the vessel's wake is angled away from straight astern.

To counter leeway, sailboats with multi-hull designs use adjustable daggerboards. These are retractable keels that slide vertically through a slot in the hull. The shape of a daggerboard makes it act like a vertical wing; it converts forward motion into windward lift that opposes leeway drift. This countering effect can be adjusted by varying the immersion of the daggerboard. The tradeoff is that greater immersion also creates more drag to oppose the sailboat's forward motion.

Minimizing sideslip due to winds and currents is a critical advantage in competitive sailing. Measuring leeway can provide key information for winning. A rapid and accurate system to measure leeway gives a navigator direct and immediate feedback after course changes or daggerboard adjustments. This information helps in tuning the boat's use of wind power to move most efficiently to the desired destination.

Teledyne RDI's Phased Array DVL

Sodebo's Engineering team desired more accurate measurements of the high speed and acceleration of Sodebo Ultim. They needed to evaluate design changes made to improve the trimaran's

Fig.2: Sailing solo, Coville circumnavigated the world in 49 days.

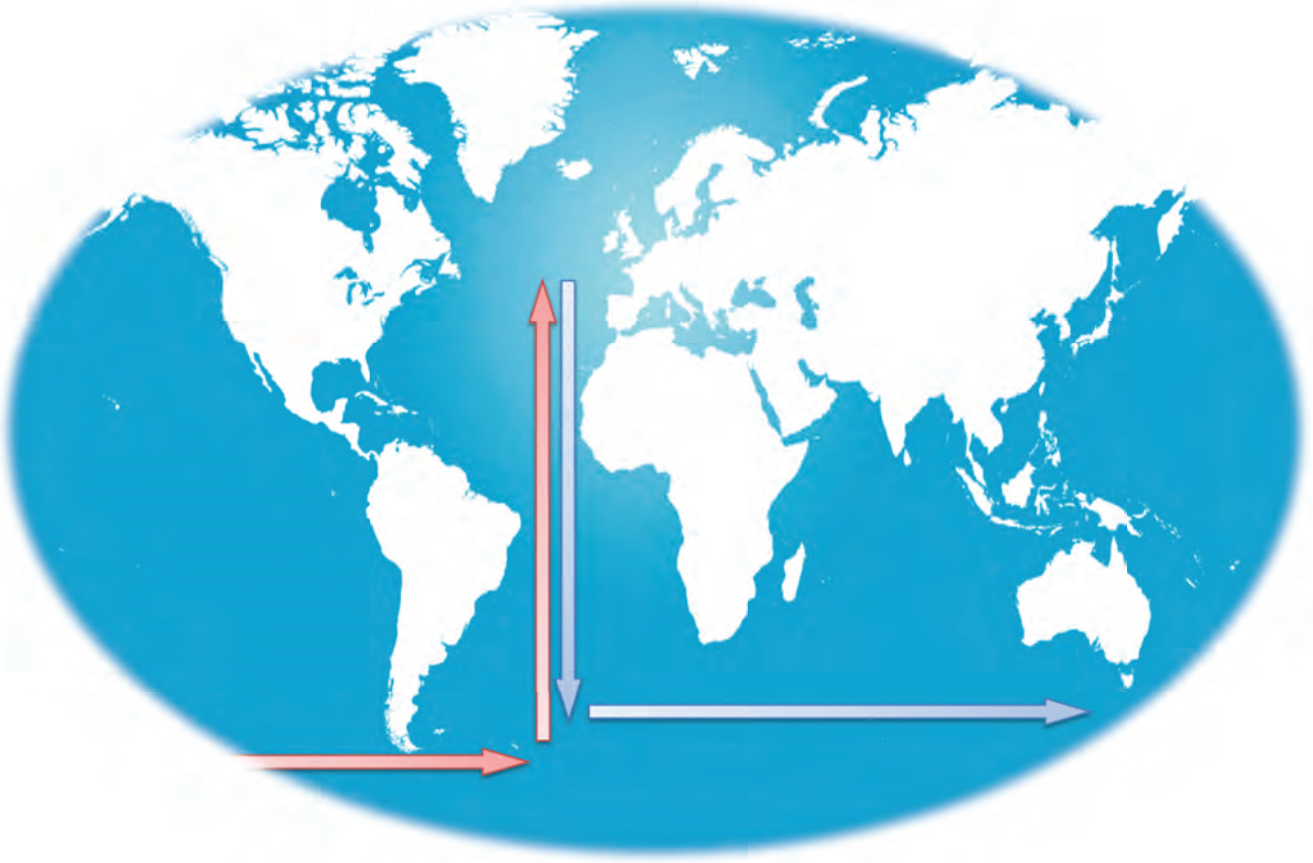


Image Courtesy: Teledyne RDI

performance. Better velocity measurements had several advantages. Not only did they report speed-through-water and leeway but they enabled more accurate values for measured winds. The latter are the vector sum of actual wind and boat velocities.

Sodebo selected Teledyne RDI's Explorer DVL to meet these needs. This device uses a flat-faced phased-array transducer to measure speed-through-water with 0.3 percent accuracy. Moreover, the DVL's BroadBand signaling outputs low-noise velocity measurements. Thus, the sailboat's navigation system can benefit from high quality data at higher update rates than other DVLs supply.

For a boat that sees both warm tropical waters and chilly sub-polar seas, the phased array design of this DVL offers an unusual advantage. The calibration of horizontal speed measurements is insensitive to changes in water temperature (and salinity). Thus additional sensors for measuring water properties are not required.

Unique Installation

In 2014, the Sodebo team equipped its multi-hull racing boat with the Teledyne RDI DVL. At times, the outer hulls will rise above the water so the DVL is in the center hull. A unique aspect of this installation was that the DVL sits inside the carbon fiber hull. The reason for this unusual location was to avoid adding hydrodynamic drag. Such drag is unavoidable with in-water DVL installations. At the same time, having the DVL transmit and receive signals though the hull created other issues. Tests verified the phased array transducer had efficient acoustic coupling. As well, the effect of the hull was checked for causing signal distortion.

Combining the DVL and GPS data observed while underway reveals ocean surface currents. The Teledyne Explorer DVL measures the sailboat's velocity through the water. The GPS outputs the sailboat's velocity over ground. The surface currents emerge continuously as the vector sum of these two data types.

Using DVL Data

For a fast-moving sailboat, calculating

leeway accurately requires knowing the DVL's exact alignment. To this end, the system was calibrated in coastal waters where the DVL's acoustic signals can reach the seabed. The bottom tracking of the DVL measures sailboat velocity relative to the seabed.

Merging these data with heading from a fiber-optic gyrocompass delivers sailboat velocity and trackline in earth coordinates. GPS data can supply similar information. Comparing these two data records reveals the alignment angle between the DVL and the boat's heading.

Once the Teledyne Explorer DVL's performance was validated, its output stream was fully integrated into the navigation system of Sodebo Ultim. Later a new software was developed to display boat velocity and leeway in real time.

Once proven, the Teledyne RDI DVL was used in a couple of ways by Team Sodebo to improve boat performance. As well as directly reporting leeway to the helmsman, the DVL data helped with evaluating refinements to the boat's foils and dagger boards.

Observing Remote Parts of the Oceans

Vessels such as Sodebo Ultim that sail through remote seas can collect new marine information about poorly known regions. The French Ocean Agency IFREMER partnered with Team Sodebo on this project. These researchers plan to analyze water currents observed from Sodebo Ultim. Part of the work will be comparing these direct observations with currents inferred from satellite altimetry. The latter miss wind-driven currents that can be significant in the Southern Ocean.

Shortly after Coville's successful circumglobal trip, the DVL data and boat navigation logs were sent to Teledyne Marine's France office, where a map of water currents was generated and a detailed report was prepared. It validated both the DVL installation and the measurements collected during the trimaran's travels.

Looking Ahead

The Sodebo team intend to integrate two of the new miniature phased array DVLs on the future version of the Sodebo Ultim scheduled to be unveiled in 2018. The team's goal is to beat the around-the-world record again in 2019.

Photo Credit: Loïc Michel

Above:
Fig.4: The flat-faced phased array DVL was seated inside the carbon fiber hull. This location avoided adding hydrodynamic drag.

Photo Credit: Teledyne RDI

Right
Fig.5: Explorer DVL comes in two designs: phased array and piston. Operating at 600 kHz, the DVL has a nominal bottom range to 80 m.

The Author
For two decades, Loïc Michel has worked as technical support, management, and Director for Teledyne RDI, Europe. He has a technical degree in Physical measurements.

The Author
Since 2005, Greg Rivalan has worked in technical support, application engineering, and product management for Teledyne RDI, San Diego.

The Author
During 27 years at Teledyne RDI, Dr. Peter Spain has worked in Sales & Marketing from staff to management with a common theme of Technical Marketing.

Optimizing

As long as the moon continues to orbit the earth, there will be energy in the tides. This reliability is just one of the many advantages of tidal energy, and as sea levels rise, it will become even more relevant as the effect of climate change becomes a reality. In the U.K. alone, the government estimates that wave and tidal combined has the potential to deliver 30 – 50GW equating to around 20 percent of the country's current electricity needs. As investment and innovation begin to surge across the sector, Dutch-based tidal energy leader Tocardo joins with Nortek to help optimize the operational performance of its turbines. Sicco Kamminga, Director of Nortek's Netherlands division, explains how ADCPs are contributing to solving the world's sustainable energy needs.

g the Tides

By Kira Coley

Tocardo International uses the Signature1000 to verify the performance of their turbines. The data from the instrument also helps Tocardo check the correct orientation of the blades.

Image: Nortek AS

Image: Nortek AS

The Signature1000 is mounted on turbines that are installed in three different locations in the Netherlands. The TTC test facility in Den Oever, in the Eastern Scheldt storm surge barrier, and on the BlueTEC floating tidal Energy platform Texel.

Unlike other forms of renewable energy, tidal energy isn't dependent on random weather patterns but offer a uniform, reliable and an inexhaustible source of energy. Furthermore, turbines installed in the water are out of sight; something that has been a controversial issue in connection with both land and offshore wind farms.

As a leading designer and producer of tidal and free-flow water turbines, Tocardo sought to measure water speeds through the rotor of the turbines to further verify and optimize the turbine's production of clean energy. In order to achieve this, they needed to find a ADCP that could cope with the challenging conditions.

Adapting for Tidal Energy

Den Oever is a tidal testing center that operates in the Afsluitdijk tidal barrage, one of the most prestigious civil structures built in the 20th century. The 33-kilometer long dam was built in the 1930s to protect the Netherlands from flooding.

Tocardo engineers wanted to use ADCPs to verify the performance of the turbines and check the 'Cp/Lambda' curve, which is used to determine the rotor power for any combination of water and rotor speed.

Kamminga said, "It was a very challenging environment to work in. We were using the ADCP to measure currents really close to the turbines, and the water flow in these locations are very strong because the performance of the turbine, and energy outcome, is much better there. That's understandable, but when it comes to deploying an instrument, it's not an easy place to work especially while making sure the boat didn't get chopped up. We also had

some unexpected technical challenges that we had to overcome."

Each turbine creates an electronic noise, otherwise known as an Electromagnetic Compatibility (EMC) noise spectrum. This was picked up by the communication and power-line of the ADCP, distorting the instrument's signal and decreasing the measurement range. Nortek analyzed the noise spectrum present at the site and was able to modify the internal filter of the power supply to reduce the EMC noise and enable the 20-meter range.

"There are subtle electronics in the ADCP instrument, and the turbine itself is basically a giant electromagnet. This meant that initially, we couldn't get any useful data so close to the turbines. There is also a lot of fluctuation and turbulence in the water. To measure that properly you need to measure quickly and accurately at the same time, but our old products could only measure currents every 1-2 minutes, so we needed to make some changes."

Turbulence can reduce the efficiency of the turbine's performance and cause fatigue on the structure. For engineers to maintain the system effectively, Nortek also had to find a way to capture turbulence at Tocardo's testing facility.

Kamminga said, "We had to redesign the instruments to better cope with all the challenges we encountered – some challenges no one knew existed until now – and we came up with an improved version of the Signature1000. The Signature1000 is the only instrument which is capable of collecting current profile data with a 16 Hz sampling rate, a big increase compared to the older 4 Hz models."

The turbine blades have a maximum turn rate of two revolutions per second. Nortek's new ADCP makes it possible to collect ample data Tocardo needed – even in these challenging conditions – and help propel tidal energy into the next stages of commercialization.

Getting the best from the tides

A Signature1000 was mounted horizontally on top of a turbine and measured the velocity through the rotor with the fifth beam of this ADCP. A second instrument was mounted in the tail of the turbine, also measuring with the fifth beam of the sensor.

The velocity data provided by the ADCPs help Tocardo determine the performance of the turbine. The validity can be checked with the amplitude and correlation data, but Tocardo also discovered an additional benefit to this previously underutilized information.

The amplitude data contains information about the returned echo of the transmitted acoustic signal. Acting as a strong reflector, the blades can be recognized during the validation of the data. While using a mechanism to control the orientation of the blades, Tocardo discovered that by looking at the profile of the amplitude, they could learn what happens when they change the orientation in specific conditions.

The ADCP data have also contributed to the calibration and further improvements of Tocardo's CFD software model and provided new design improvements relevant for performance and reliability. Furthermore, the instruments have helped to provide accurate energy yield predictions for individual devices and optimize array layouts.

Growing the tidal sector

As well as the test facility in Den Oever, Tocardo successfully uses Signature instruments on two other locations in the Netherlands: The Eastern Scheldt storm surge barrier and on a floating tidal energy platform in the Waddenzee.

The Eastern Scheldt storm surge barrier is part of the famous Dutch Delta Works put in place to protect the Netherlands from flooding from the North Sea. The installation is the largest tidal energy project in the country, as well as the world's largest commercial tidal installation of five turbines in an array.

The site consists of a 1.2 MW array of five turbines, and the special design enables the turbines to generate electricity during ebb and flood, demonstrating how future water defenses also can provide hydroelectric power.

As the world's only turbine manufacturer capable of installing this type of multi-turbine installation, Tocardo can monitor the array in turbulent waters using the ADCPs and see how the turbines interact. The data will back the future upscaling and the commercial rollout of tidal projects across the world.

An example of this is the recent announcement of Tocardo's first offshore tidal array with four one Megawatt Universal Floating Structures (UFS) in Canada's Bay of Fundy, in collaboration with Minas Energy and International Marine Energy Inc (IME).

In late 2017, four 250kW-rated T2 bi-directional turbines were deployed in the Minas Passage within the bay. The turbines will be attached to Tocardo's semi-submersible Universal Floating Platform Structure to form a 1MW system held in place by catenary mooring systems. Canada's new turbine facility will also produce vital data and valuable experience with turbine installations that could set in motion a wave of investment and innovation, helping to catalyze further growth in the sector.

Kamminga said, "Tidal energy is at a really exciting stage, so it's been amazing to contribute towards its development this early on. We're thrilled to support a market that is still discovering itself and to help solve problems that no one has faced before. Tidal energy will one day contribute an important amount of the world's energy needs, but first companies such as Tocardo must work to ensure the installations are able to offer the best performance possible. They are challenging projects, and these structures are massive; no one would even see these tiny ADCP instruments that play such a big role in optimizing the tidal energy outcomes."

Tocardo International chose the Signature1000 since it could measure water speed through the rotor of the turbines. The Signature1000 can be mounted on top of one turbine and measure the velocity through the rotor with the fifth beam of this instrument. Another Signature1000 can be mounted in the tail of the turbine.

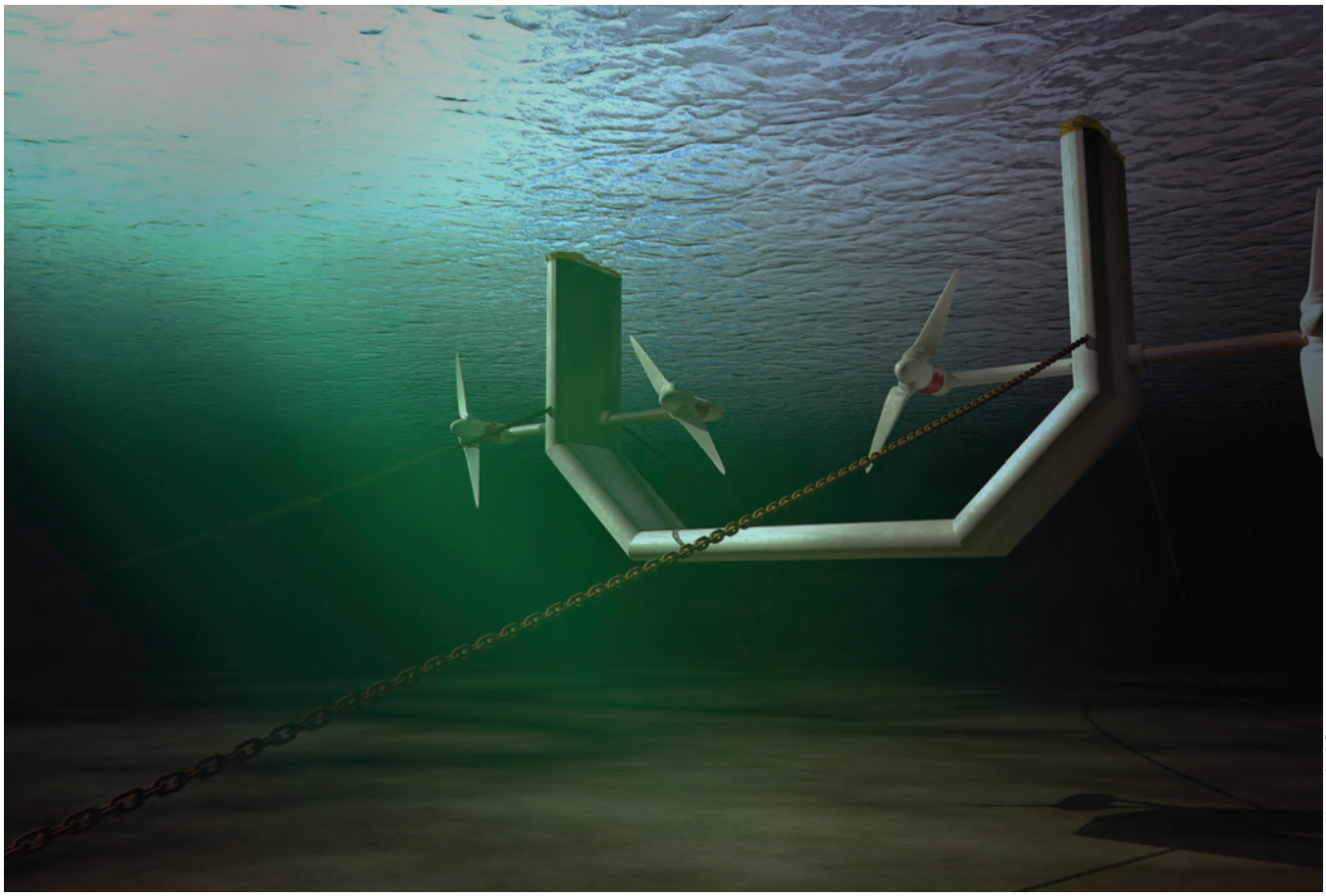
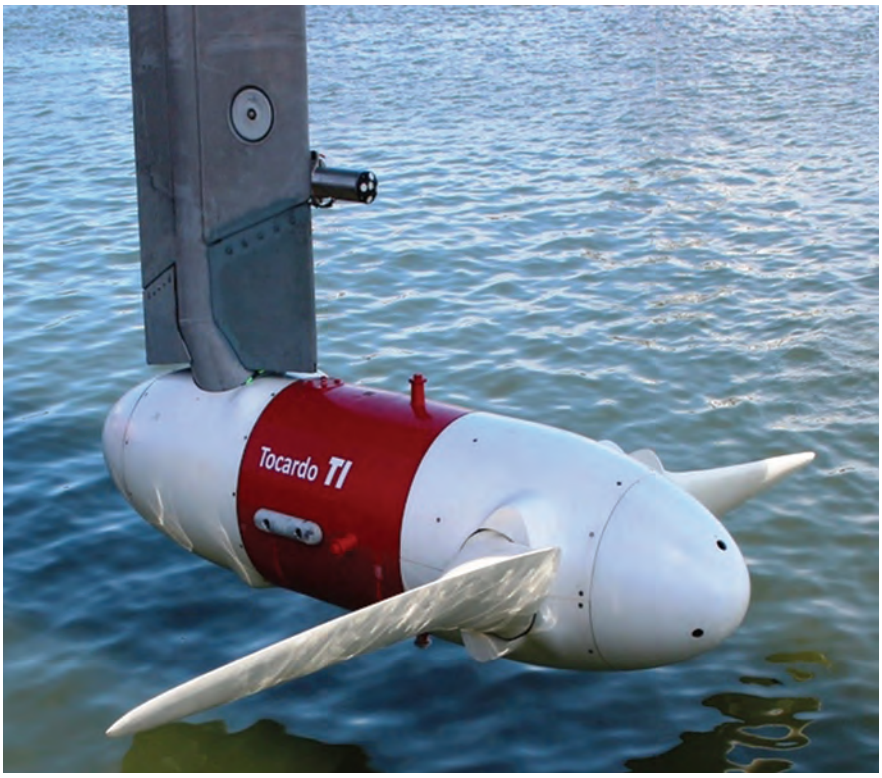


Image: Nortek AS



All Images: Nortek AS

The Author
Kira Coley is a freelance science writer and regular contributor to *Marine Technology Reporter.* She is a lecturer in science communication and a PhD researcher.

Above: Tocardo is on a mission to contribute to clean, sustainable and predictable energy. It does this by designing turbines that can harvest power from tidal flows and rivers.

Left: The Signature1000 is designed for unprecedented performance in high-energy turbulent environments.

Below: Tocardo makes tidal turbines that harvest clean and sustainable tidal energy.

Image courtesy of TechWorks Marine

Finding Monsters on the Ocean Surface

By Frederic Diaz and Darryl Symonds

The study of extreme wave events in the ocean has become a popular area of research in recent years. Aside from seafarers, extreme waves impact coastal communities and are of great interest to marine renewable energy companies. This is particularly prevalent in the face of coastal erosion, rising sea levels and uncertainty in how the wave climate will change in a warming world. However, much of the current research is based on modeling and experiments. Extreme wave events – including storm waves, rogue waves, storm surges and tsunamis – are rare, and as such are difficult to observe and measure. Usually the wave categories are divided into two streams: long waves and short waves. Generally, the ratio of depth to wavelength is used as a parameter to differentiate between long and short waves. Tsunamis and storm surges are typically very long waves, so they are considered shallow water waves. Storm waves and rogue waves are much shorter in wavelength relative to ocean depth.

The west coast of Ireland is a perfect location to observe extreme waves, especially when it comes to storm waves and rogue waves. Indeed, Atlantic swells propagate eastward toward the coastline of Ireland. Depressions from the Atlantic regularly bring very unsettled weather across Ireland. A few weeks ago, post-tropical cyclone Ophelia towered waves to the coast of Ireland, with a number of record breaking wave heights.

Definition of rogue waves: Oceanographers describe the sea state with a statistical measure called the significant wave height. This is the average height of the one-third highest waves. A rogue wave is one that is more than double the significant wave height. Rogue waves are sometimes called freak waves, but this is misleading: although they are rare and extreme, rogue waves are part of the normal behavior of the oceans.

Ocean wave measurement usually uses spectral approaches developed in the 1950s. Surface waves are recorded with a fixed length time series (usually 20

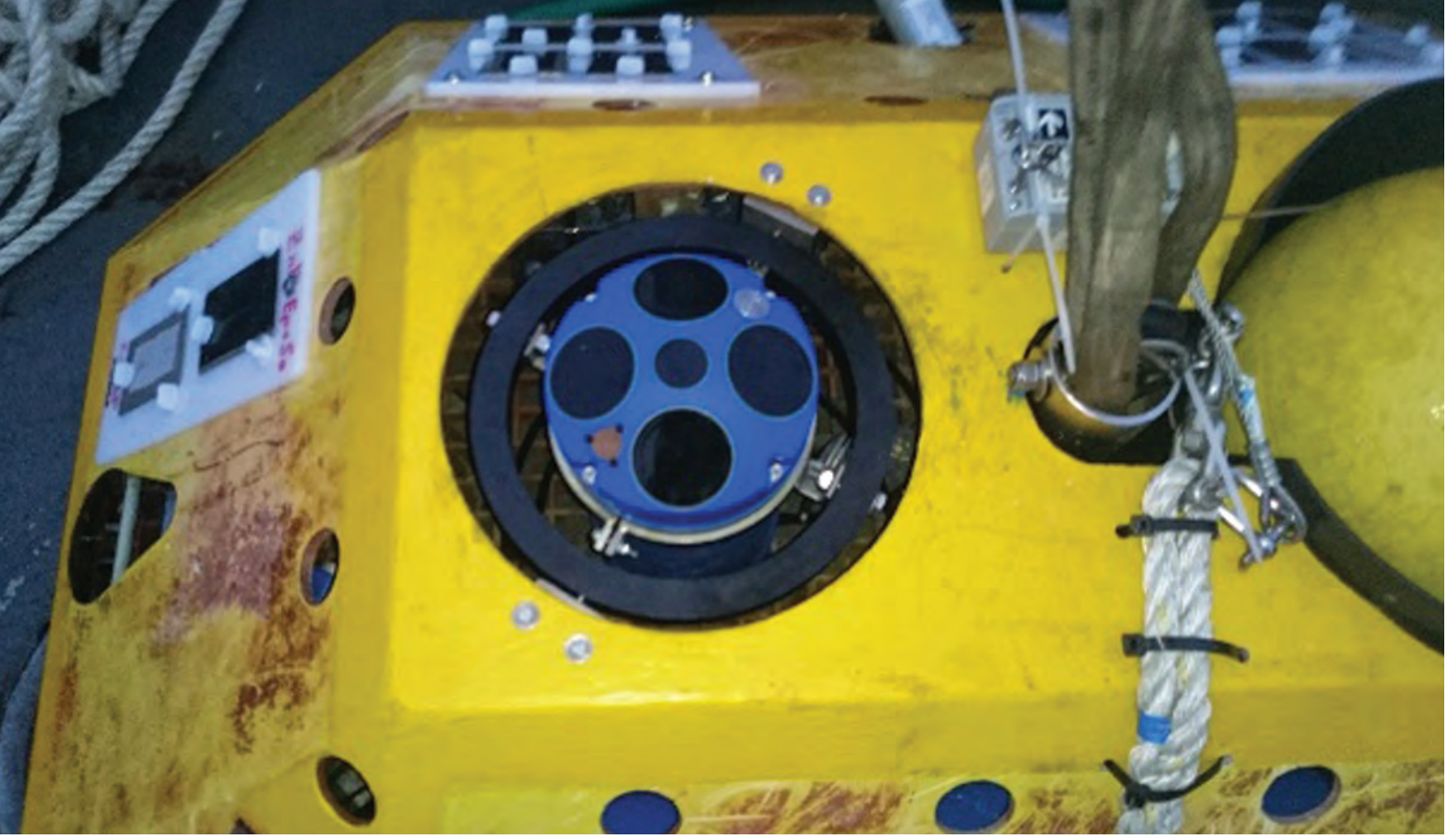
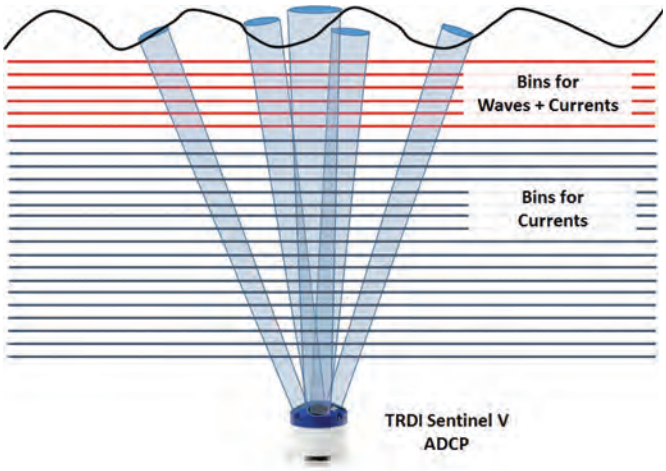


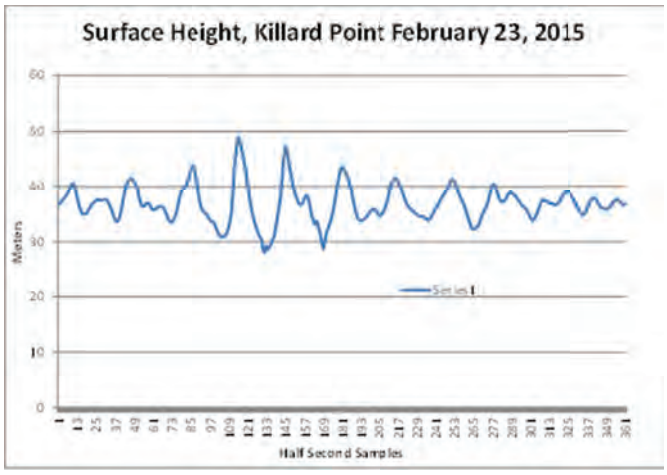
Image courtesy of TechWorks Marine

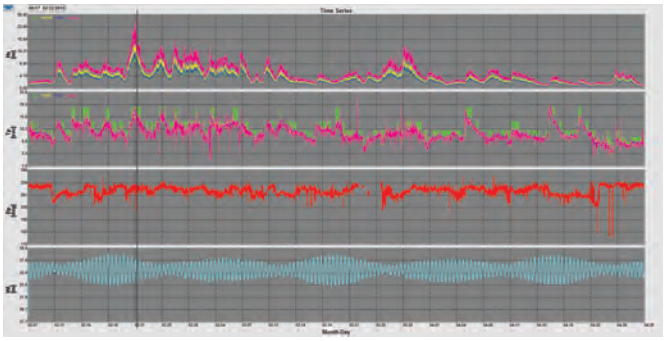
minutes) from which are derived nominal wave spectra. Hardware is based on wave staffs, wire gauges, buoys or underwater acoustic sensors, but device cost means that measurements are made at a single point. These existing techniques have deficiencies: (i) many of the most dangerous wave classes on the ocean either cannot be measured at all or are inaccurately recorded because of sampling deficiencies; (ii) existing wave buoys cannot reliably measure processes such as wave breaking or rogue waves which are all better characterized as instantaneous phenomena and which do not appear in average wave spectra; (iii) sensor cost precludes wide area deployment and inhibits measurement of full spatio-temporal wave evolution dynamics. Buoys only measure accelerations, and a double integration provides displacement. Also, the buoy sensor in the case of a usual Datawell is gimballed in the buoy and can produce spurious large values if the buoy is rotated. Satellite measurements (altimetry) only provide significant wave heights.

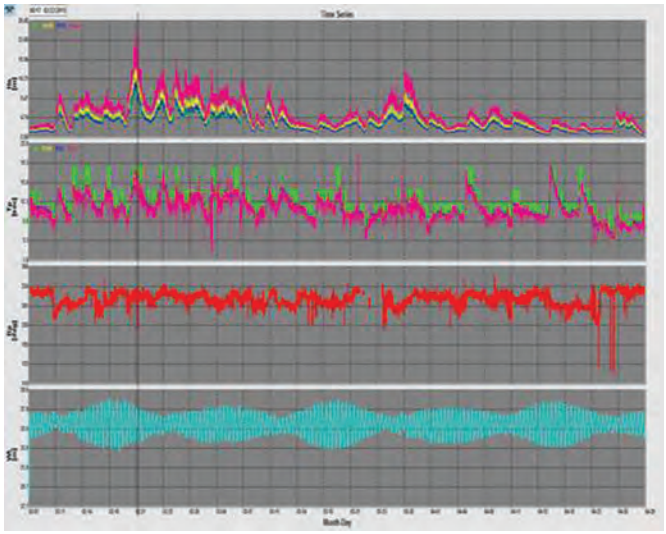
The Irish winter of 2013-2014 was severely affected by many storms due to the atmospheric jet stream extending right over Ireland carrying successive storms. This exceptional weather combined with high tides resulted in serious coastal damage and widespread flooding. An altimeter pass in the Eastern Atlantic detected phenomenal significant wave heights near 19m just west of Ireland.

Prof. Frederic Dias from University College Dublin then decided to organize a measuring campaign for the following winter (2014-2015). He concluded that the best instrument to capture extreme wave events off the west coast of Ireland was an Acoustic Doppler Current Profiler (ADCP). In collaboration with Teledyne RD Instruments (TRDI), a Sentinel V







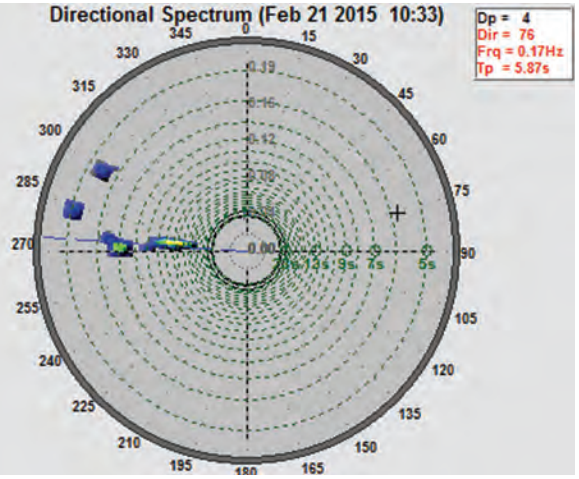


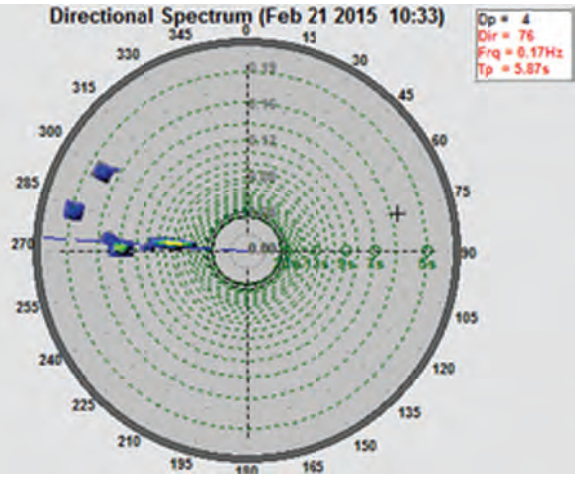
ADCP was deployed in 36m of water at a site off the west coast of Ireland during the winter of 2015 (the experiment was repeated during the winters of 2016 and 2017), with the aim of gathering accurate wave measurements in extreme conditions.

The Sentinel V was gimbal-mounted and housed within a trawler-resistant frame and secured to the seabed in an upward-looking configuration. The Sentinel V is one of the latest in a line of ADCP developed by TRDI. It utilizes sonar pulses along five beams to gather measurements of both orbital velocity and echo intensity at predetermined distances (bins) along each beam. The five beams are arranged in the so-called Janus configuration, with beam five in the vertical and beams one-four offset at some predefined angle from the vertical. For this deployment, the Janus angle was 25 (degrees) and 34 bins, each separated by 1.2 m from center to center, were selected along each beam.

The nominal vertical distances from the ADCP transducer head to the centers of the first and last bin were approximately 26m and 66m, respectively, giving an effective range of measurement from about 10m below to 30m above the Mean Water Level (MWL). In addition to Doppler readings, pressure was recorded by the Sentinel Vs onboard sensor. The Sentinel V had on board a 16GB memory card. Pitch and Roll readings were recorded by the ADCP's onboard micro electromechanical systems (MEMS) accelerometers.

Velocities and backscatter intensity were recorded along the five beams continuously at 2 Hz for three months. Continuous sampling enabled the capture of details of several giant events with crest-to-trough heights more than 22m. Several theoretical explanations have been proposed for such extreme waves, in particular modulational instability and directional focusing. Typical oceanic wind seas are short-crested, or multidirectional, wave fields and their dynamics is more 'free' than the 1D 'long-wave-guide' counterpart. Indeed, energy can spread directionally and as





The Author

In 1984 Darryl Symonds started his career at Teledyne RD Instruments (TRDI) located in San Diego. During this career he has worked as an assembler, technician, customer service manager and, starting just over 17 years ago, he became the Director of the Marine Measurements Product Lines (MMPL).

The Author

Frederic Dias received a PhD in Civil and Environmental Engineering from the University of Wisconsin in 1986. He started his career in the U.S. before coming back to France to join CNRS in 1990. In 2000, he moved to Ecole Normale Superieure de Cachan and has been a Professor of Applied Mathematics since.

a result nonlinear focusing due to modulational instability is diminished. The recorded extreme wave is 22m peak to trough, but does not show any characteristic nonlinear features such as depleted adjacent waves or unusual steepness. Instead it appears more like a standard wave group produced by superposition. What we saw during this extreme event is a group of waves that is moving and grows in amplitude to reach a maximum before it decays.

A key quantity to understand the formation of extreme waves is the wave directional spectrum. While traditional statistical approaches have been developed to derive wave directional spectra, the array of five direct surface tracking beams provides an opportunity to construct directional estimates for short time scales or even individual events. A successful investigation into the directional properties of groups of large amplitude waves was performed using time-frequency decomposition methods applied to the surface-track and subsurface velocities measured by the Sentinel V.

An independent measure of wave direction was produced through a concept created by Brandon Strong, an engineer at TRDI. This new measure compared well to proven methods.

Time frequency decomposition revealed details in wave direction on short time scales necessary to isolate a wave group. Short time scale directional distribution shows that the 22m wave group had a particular direction but that the directional grouping in and around the peak was not different than the rest of the storm. Measurements also showed that the directional variability of this storm was significant making it unlikely that nonlinear models like modulational instability are responsible for this event because they require a quasi-single direction.

These figures provide an overview of the entire deployment in 2015, where a significant wave height greater than 10m and maximum wave height greater than 22m was measured, and the extreme wave direction.

Wind Energy

The good news in Offshore U.S.

Offshore wind is hot, a burgeoning market with myriad opportunities above and below the water. In step with our Annual Planner, MTR's *energy reporter in Oslo, William Stoichevski, puts on his red, white and blue game face to report on the largest untapped market for offshore wind power in the world.*

By William Stoichevski

Block Island — U.S.-based Deepwater Wind's five-turbine, 30-MW wind park — was the first. It showed what was possible, what might not have been optimal and how long it all takes. Since then, incentives for onshore wind have been curbed, while a tax credit for offshore wind has been extended. Wind parks are in the works. States have power companies buying offshore wind energy, and experienced offshore operators are hiring the new wind-service vessels from elements of their oil-and-gas supply chain. The Jones Act, too, is being overcome by fleet owners and designers joining the U.S. offshore wind build-up.

"The algorithms are built on top of the dynamic-positioning (controls) — accelerate, decelerate, wait, (throttle). Due to the repetition involved (in operating a wind-turbine service vessel's walk-to-work platform, or W2W), you need an auto-stop mechanism. It's too much for one person," a source close to Norwegian tug owner Ostensjo's two wind-service vessel new-builds tells us over coffee in downtown Norway.

A survey confirms the preponderance of Norway's offshore fleet owners are building new or converting vessels to capture wind service market share. So, too, are the Dutch, the Danes and the Brits — and, yes, Americans. Some Northern European ship owners say they're content to serve the world's hitherto largest offshore wind markets: Britain and Germany. "America", for these, is too "wait-and-see".

Some of their peers, however, have secured U.S. partners, builders or design offices to serve what market watchers

Photo: courtesy Fred Olsen Windcarrier

U.S. leader: Fred Olsen Windcarrier's Bold Tern (multiple) and crew transport vessel.

know is the largest undeveloped wind market in the world: at least five U.S. coastal states have held successive, successful offshore lease sales for some of the over 2,000,000 acres in offshore wind concessions under auction. Populace New York and Massachusetts (the latter with mega-project bids due this December 2017) are notable for total acreage offerings of at least 750,000 acres, according to numbers from the Department of the Interior and the Bureau of Ocean Energy Management. New York in 2017 qualified 14 companies for its sixth lease sale, part of a commitment to 2.4 gigawatts of installed offshore wind energy hoped for by 2030. The first is Deepwater Wind's South Fork, although Statoil now also has rights to areas acreage. Ship owners would be wise to get to know the unfamiliar company names winning leases in New Jersey (offering over 345,000 acres), North Carolina (429,000 acres), Rhode Island (Deepwater Wind) or Maryland, where U.S. Wind Inc. plans a 248 MW project for 2020 and Skipjack Offshore Energy LLC's a 120 MW windfarm due 2022.

North Carolina in 2017 qualified nine companies to bid in its seventh offshore lease auction, and in March 2017 an auction for the Kitty Hawk Wind Energy Area, or WEA, for 122,405 acres went to Avangrid Renewables with a winning bid of $9.1 million. Projects now tend to dwarf the pioneering five-turbine, $350 million Block Island project of 2014-2016.

Aligning Fortunes

BOEM checks the legal, financial and technical wherewithal of offshore operators now deep in planning that'll make them U.S. offshore grid owners. Statoil won the wind lease sale for 80,000 acres offshore New York and plans a wind park of up to 600 MW in the New York Wind Energy Area, or WEA, 30 to 60 miles offshore in water 65 to 130 feet deep. "The U.S. is a key emerging market for offshore wind — both bottom-

fixed and floating — with significant potential along both the east and west coasts," the operator says, echoing a DOI report. Like the others, Statoil's an offshore stakeholder elsewhere: at Sherrington Shoal off the U.K. since 2012 and at a just-installed, first-ever floating wind park for its lauded Hywind turbines offshore Scotland.

Foreign Firsts

The largest U.S. wind farm is expected to be U.S. Wind's $2.5 billion installation 12 miles off the coast of Ocean City, MD. U.S. Wind brings international experience via its Italian leadership and will need it to install a planned 187 turbines by 2020. Despite such apparent needs for vessels, our calls to U.S. operators about their future shipping needs produced "reluctance", although there are good reasons for caution: Reason No. 1 is the not-yet assembled offshore wind supply chain.

There's another reason: The Block Island, R.I., project revealed that while jack-up vessels could install wind-turbines with fair ease and security, smaller "support jack-ups" available locally appeared to some to struggle while handling large, unwieldy turbine components while being buffeted by waves. Cells, rotor blades, shafts, flanges and towers require scale or risks appear high. Word of Block Island's "demo" spread via veteran deck hands who had compared small local hires to the large installation vessel, Bold Tern, of Block Island's capable hire, Fred Olsen Windcarrier.

New Designs

"A typical windfarm support vessel," said Vard Design's concepts VP, Kjell Morten Urke, of the Vard 4, a type offered American builders via the company's U.S. offices. "Typical" implied a norm has been established by Europe's veteran offshore wind industry (now over 20 years old), as exemplified by Fred Olsen Windcarrier. Vard, too, is confident of its U.S. clout. "We're ready. We're in Holland right now presenting the (just announced wind-vessel) design. We may not take much market share in install vessels but in cable-layers, hook-up and service. We'll focus on that," Mr. Urke says.

Houston's GustoMSC — a wind pioneer with a hand in "80 percent" of the offshore wind-installation equipment out there, including Bold Tern and Brave Tern — has adapted a new jack-up installation concept to its view of the U.S. wind market as "emerging". GustoMSC offers shipyards and the growing numbers of U.S. wind operators self-propelled and unpropelled jack-ups, the latter for "the more risk-averse".

In October 2017, "the economical, safe and efficient" SEA-3250 LT installation jack-up was unveiled: "Currently there is no equipment available in the U.S. that is capable of installing present and future heavy foundations and turbines, due to insufficient carrying and lifting capability in terms of both capacity and height," the company says, echoing the view in European. The SEA 3250 LT joins the larger, wind-capable self-propelled NG-98000C-US and its NG-3750C feeder unit in solving "this (financial and installation-capacity) bottleneck". The SEA 3250 can carry two of the largest turbines "while underway" to the installation site. Heavy lifts to heights of over 130 meters — new normal for turbines sizes now reaching 12 MW— are possible "in an area where technicians are performing assembly tasks at the same time". Interestingly, this GustoMSC design can "serve as a Jones Act compliant feeder solution to a larger foreign vessel".

From New Orleans, lift-boat maker AK Suda has also joined the fray recently by developing its JG series of wind-turbine installation vessel, or WTIV. The first, JG6000P, "works within all U.S. staging ports" and can carry and install 8 MW turbines. AK Suda and GustoMSC might represent the bulk of U.S. wind-installation vessel offerings.

Europeans Contrasts

Saving enormous sums, the Hamburg-based Fred Olsen Windcarrier's jack-up boat crossed the Atlantic with wind-turbine components aboard, a first for the vessel type and a hard-to-match feat. "Fred Olsen Windcarrier sees the U.S. as an important and potentially world-leading offshore wind market," business-development manager, Stuart Thornton, writes in an email. The company's twin lift-boats can install any of today's turbine sizes to fixed, seabed foundations.

A2Sea is typical of the seasoned, offshore wind European supply chain with links to Statoil, including its 67-turbine Dudgeon park, its just-installed Racebank wind park and a September 2017 contract for the Merkur project in Holland with a Sea Challenger fresh from the Racebank job of summer 2017.

While a DOE report confirms the "lack of a project pipeline" has held up the U.S. market, A2Sea confirms Europe's projects keep the company busy. Like A2Sea, European turbine maker Siemens Gamesa seems too busy for the U.S. market: "No offshore projects for now. It's a market where we see potential in the next few years. It's an important market of the future for us," they write in a letter. Like the U.S. grid operators "to-be", they can only be vague when it comes to vessel needs. "We work with nearly all operators of wind-turbine installation vessels. The challenge in the U.S. is that … If you need a jack-up for a turbine installation, it might be a challenge."

Specialty Vessels

When this writer visited the East of

The Author

After honing the media campaign of Norwegian green group Bellona, William Stoichevski began working for the AP in Oslo. In 2003, he left the AP to oversee and write for a number of energy industry publications in the Norwegian capital. He lives and works in Oslo, and has written for *MTR* since 2014.

England years ago, Britain was seeing its first wind turbines novel designs for crew-transfer vessels. For the uninitiated, there was something worrying about the bump-up against the grouted flanges turbine towers rested on. Grid operators then complained of suppliers' rickety finances.

Today's operator-supplier bonds are robust, as illustrated by Esvagt signing a 15-year contract with MHI Vestas Offshore Wind to deploy SOVs to both near-shore and remote European wind projects in need of accommodation, W2W and the company's deployable safe transfer boats, or STBs, for technicians, tools and turbine spares. In 2010, ESVAGT brought SOVs to the market that offered offshore-style leisure, office, storage and workshops of special interest should floating wind take projects succeed farther out into the U.S. 200-mile limit, as is envisioned.

So, is the U.S. an Esvagt target market? "The short answer is no," says business development manager, Ole Ditlev Nielsen. "ESVAGT aims to follow and assist the expansion of the renewable industry, where SOVs create value. We will therefore be ready to follow our customers out of Europe as well. This requires that the local regulations enable ESVAGT to perform its services there."

Meanwhile, British advocacy Subsea UK now advises its members to seek wind work to wherever it may be to offset lost oil-and-gas opportunity. In August 2017, the organization put world offshore wind spending at over $465 billion through to 2026.

The "Erie Hack" $100K Challenge

The Start to the Smart Lake

By Max Herzog, Project Manage at the Cleveland Water Alliance

Innovation has long been a part of life and work on the Great Lakes. The unique water resources of this region set the stage for technological advancement and continue to drive one of America's most dynamic regional economies. Despite their essential role in our commerce, industry and entrepreneurship, the Lakes are consistently undervalued as an economic asset and catalyst of innovation.

However, the systemic undervaluation of the Great Lakes has not gone unnoticed. The Cleveland Water Alliance (CWA), a collection of forward-thinking research institutions, industry leaders, environmental organizations and public utilities, came together to develop a new way of thinking about regional economic development. This framework focuses on creating a Blue Economy where innovating and monetizing solutions to water challenges replaces continued pollution of our resources as a key driver of prosperity.

DigitalC quickly saw the value of CWA's vision. As a catalyst of Northeast Ohio's civic technology ecosystem, DigitalC sees the Great Lakes as an opportunity to leverage big open data for positive community impact.

By bringing technology leaders together to craft digital solutions for water, DigitalC would help CWA accelerate the growth of a regional sector of data-driven solutions with the potential to ignite creativity and innovation across the nation.

It was this shared vision for community, economic and ecological development through the cultivation of an ecosystem of innovative water technology solutions that created the Erie Hack in early 2017.

Erie Hack was a $100,000 innovation challenge that activated more than 200 techies, creative thinkers, entrepreneurs and environmentalists from six cities around in the U.S. and Canada to tackle Lake Erie's key challenges with creative tech solutions. The competition quickly gained following, engaging more than 100 partner organizations as it put some of the region's best minds to work.

Many of the strongest Erie Hack teams focused on monitoring for nutrient pollution as a means to address harmful algal blooms (HABs), the type of ecological disaster that deprived Toledo residents of public water in 2014. Current research suggests that blooms of this scale will become an annual norm, threatening a regional loss of $1.3 billion over the next 30 years. This looming crisis has prompted the governments of Ohio, Michigan and Ontario to pledge a 40% reduction in nutrient pollution of Lake Erie by 2025.

CWA and DigitalC saw that the Erie Hack teams were onto something; projects funded by these regional governments, like the Sandusky Bay Initiative, are placing Lake Erie at the cutting edge of nutrient pollution mitigation, but there is a key piece missing. Nutrient

Photo: © Gerald Bernard / Adobe Stock

Erie Hack was a $100,000 innovation challenge that activated more than 200 techies, creative thinkers, entrepreneurs and environmentalists from six cities around in the U.S. and Canada to tackle Lake Erie's key challenges with creative tech solutions.

data are not collected with the frequency or granularity required to understand the impact of individual projects or run data analytics to understand trends. Initiatives like Great Lakes Commission's ErieSTAT and USEPA's Nutrient Sensor Action Challenge show that important steps are being taken to address this problem, but an end-to-end monitoring solution has yet to be developed.

Having identified this need, CWA and DigitalC partnered with US Ignite to launch the Internet of H2O Challenge, a competition aimed at bringing next-generation networking, detection and analytics technology to bear on nutrient monitoring in Lake Erie. The partnership worked closely with the best Erie Hack teams and a handful of strategically positioned companies and research groups to populate this smaller challenge with pilot projects with the capacity to monetize and scale.

CWA and DigitalC are working with key local stakeholders at the City of Sandusky, Bowling Green State University, Heidelberg University and Great Lakes Observing System to enable participating teams to deploy their systems at existing research sites. These deployments will last up to a month and enable teams to leverage both their own data and data collected by research partners in their analytics.

Teams will also have access to a Software-Defined Network Infrastructure set up by Embedded Planet and WAN Dynamics to ensure that their data is kept secure and their solution is scalable.

In addition to awarding $50,000 in prizes to the winning teams, CWA and DigitalC plan to continue to accelerate their work by building a coalition dedicated to a "Smart Lake Erie." Groups like IBM, Great Lakes Protection Fund, the US EPA Innovation Team, Ohio Sea Grant, Cisco, Great Lakes Commission and Alliance for Coastal Technologies will continue to work toward a holistic monitoring system for the Lake. Currently, options are being explored for longer-term funding to accelerate, marketize and implement successful teams' technologies at scale so that they can have a concrete economic and ecological impact.

The sheer scale and energy of Erie Hack laid essential groundwork for the CWA and DigitalC vision. By forging transdisciplinary connections across the region and demonstrating the entrepreneurial and sustainability potential of water tech to a broad audience, each of the 42 competing teams played a role in elevating the conversation around the value of Lake Erie as a driver of innovation.

Now the best and brightest of these teams are pushing that vision forward with the Internet of H2O, diving deeper into one of the most challenging issues of our time and putting Lake Erie on the map as a hub of water tech innovation.

People & Companies

InterMoor

Mark Jones

OceanWorks

Harald Grob

Greensea

Karl Lander

InterMoor Appoints Jones CEO

InterMoor named Mark Jones, global chief executive officer. Jones, currently vice-president at Acteon, previously served as managing director for a division of EXPRO, as well as head of strategy and business development for Siemens Subsea. In addition, Blair Wilson will undertake the role of global director of operations, reporting directly to the CEO.

Mæland New DeepOcean CEO

DeepOcean's board of directors announced that company COO Ottar Mæland will take over the responsibilities as acting CEO of DeepOcean, succeeding current CEO Bart Heijermans, who has decided to step down.

Knox Joins Tritech

Mark Knox comes to Tritech from his previous role as Divisional Head of Engineering at Raytheon in Scotland; prior to that, he spent more than 20 years working for Motorola/Freescale. Knox holds a BEng (Hons) in Electronics and Communications Engineering and an MSc in Advanced Electronic Systems, both from Edinburgh's Napier University.

Daly Joins Sea Machines

Boston-based smart ship technology company Sea Machines Robotics has hired Jim Daly as Chief Operating Officer. Daly was previously Chief Operating Officer and an early member of the leadership team at Rethink Robotics, where he scaled operations from technology concept through first and second-generation products. He most recently led the Sawyer robot product development project from conception through design, launch and global customer deployment. He held earlier senior leadership roles at startups Zeemote, Tea Forte and Handspring, and as a Division Manager at Solectron Corporation. Daly earned a BS from Worcester Polytechnic Institute and an MBA from Santa Clara University. He serves on the Advisory Board for Robotics Engineering at WPI.

Grob Rejoins OceanWorks

OceanWorks International welcomed back Harald Grob as Technical Director. Having spent almost half of his 30-plus years of experience with OceanWorks, Grob rejoins the company to lead the technical staff and providing innovative solutions to OceanWorks customers in all markets. During his previous time with OceanWorks Grob played a key role in the development of the U.S. Navy Pressurized Rescue Module System (PRMS) as well as numerous other subsea projects for OceanWorks' scientific, and oil and gas clients.

Lander Joins Greensea

Karl Lander has joined Greensea as Account Executive, responsible for managing accounts associated with the company's military products as well as strengthening its relationships with manufacturing partners and military operational communities. Lander brings more two decades of experience with the U.S. Coast Guard, having most recently served as Executive Officer aboard the USCGC Healy, where he was responsible for the internal operations of an 85-member crew and managed a 137-member cross-functional team during a 64-day scientific expedition to the North Pole. Lander earned a M.S. in Engineering and Technology Management from Portland State University, and a B.S. in Naval Architecture and Marine Engineering from the U.S. Coast Guard Academy.

Rose Joins Global Diving

Eric Rose has joined Global Diving & Salvage, Inc. as Director of Business Development, responsible for the company's long-term revenue generation, and the support of Global's regions and service lines, including marine construction, commercial diving, environmental services and marine casualty response. He will oversee sales and business development, marketing and votpotstr strategy for revenue generation.


Kreuz Subsea

AJ Jain


ASV

Mark Exeter


Aquaterra Energy

Nick Hawkes

New Senior Management at Kreuz Subsea

Singapore registered subsea solutions provider Kreuz Subsea has named AJ Jain chief executive officer and Balaji Bhashyam as chief operating officer.

Jain brings to the CEO role more than 25 years of executive industry experience, having held a number of leadership positions in the oil and gas industry. His previous posts include managing director at Harkand Group where he was responsible for operations in North America and Africa. Bhashyam has been with Kreuz Subsea for the last two years as vice president, business development and corporate strategy. He has more than 25 years' operational experience in subsea project management and engineering. He previously worked in senior operational roles for Technip in Asia Pacific, Global Industries Ltd. and McDermott International.

3D at Depth Expands Senior Team

Subsea LiDAR systems and solutions provider 3D at Depth announced the appointment of Cory Moore as Global Offshore Operations Manager and Ian Roberts as Senior Mechanical Design Engineer. Moore has more than 20 years' experience overseeing subsea survey and mapping projects with Tier #1 energy providers in Africa, Europe and North and South America. Roberts joins 3D at Depth from Tidewater Subsea where he was responsible for remotely operated underwater vehicle (ROV) operations, engineering and tooling design.

Exeter Joins ASV Global

ASV Global has named Mark Exeter as the new Managing Director of its Portchester, U.K. office, while Exeter's predecessor, Dan Hook, moves into a new role as Senior Director – Business Development.

Aquaterra Appoints Hawkes

Offshore engineering solutions provider Aquaterra Energy has appointed Nick Hawkes as Financial Director based at the company's headquarters in Norwich. Hawkes has more than four years' experience in the oil and gas industry and joins Aquaterra having spent nearly 20 years with Babcock International Group where he latterly held the position as Financial Director for 15 years. Hawkes graduated from Bournemouth University in 1987 with a BA (Hons) Business Studies.

People & Companies

Boskalis

DSV Constructor

Briggs Marine

Briggs Marine

Boskalis Expands Subsea

Royal Boskalis Westminster N.V. (Boskalis) is set to expand its market position in the area of subsea services, according to its Corporate Business Plan 2017-2019. "In a persistently challenging market there tend to be interesting opportunities for anti-cyclical investments in companies or equipment that will result in Boskalis being well-positioned when end-markets recover again," it says. In mid-August Boskalis acquired subsea survey specialist Gardline, and the group recently exercised a purchase option on the leased DSV Constructor to acquired the vessel for around $46.7 million. Boskalis said it is also in advanced stages of negotiation for the purchase of an existing modern high-end SAT DSV. Boskalis saw a slight increase in revenue in Q32017 compared to the quarterly average reported for the first half the year.

NSRI: Project Director Sought

The National Subsea Research Initiative (NSRI) says it is recruiting a director to drive market-led research and technology development in the subsea industry. The subsea focused technology research arm of Subsea UK is seeking to replace current project director, Dr. Gordon Drummond, who is returning to Subsea 7 following his three year secondment to NSRI.

Briggs Marine Wins Framework with SSEN

Briggs Marine said it has secured a place on a six-year framework agreement with Scottish and Southern Electricity Networks (SSEN) for the replacement and maintenance of its subsea cable assets. The framework, which was awarded in August 2017 and will run to 2023, sees Briggs support more than 100 submarine electricity cables which provide power to islands and rural communities, from Shetland to the Isle of Wight.

Briggs will provide survey, inspection, repair, removal and installation services for SSEN's submarine electricity cable assets. The work will allow Briggs to further expand its subsea cables specialist workforce based in Burntisland, Fife, and complements a series of frameworks already held with other major cable owners.

NOAA: $9.3m for Aquaculture Research

The National Oceanic and Atmospheric Administration (NOAA) announced 32 research grants totaling $9.3 million for projects around the U.S. to further develop the nation's marine and coastal aquaculture industry.

"This country, with its abundant coastline, should not have to import billions of pounds of seafood each year," said Secretary of Commerce Wilbur Ross. "These grants will promote aquaculture projects that will help us reduce our trade deficit in this key industry."

The grants were awarded through two competitions – Integrated Projects to Increase Aquaculture Production and Addressing Impediments to Aquaculture Opportunities – to help spur the development and growth of shellfish, finfish and seaweed aquaculture businesses. The projects include basic and applied research to improve efficient production of seafood, permitting of new businesses, management of environmental health issues, and economic success of aquaculture businesses. NOAA received 126 proposals requesting nearly $58 million in federal funds.

Sonardyne for Deep BV

Dutch survey company Deep BV has purchased underwater acoustic technology supplied by Sonardyne International, UK, to support its inshore, harbor, coastal and offshore activities. Within days of the order, the two Mini-Ranger 2 Ultra-Short BaseLine (USBL) tracking systems and WSM 6+ mini transponders were delivered to Deep BV's headquarters in Amsterdam and were put straight to work during an operation to search for unexploded ordnance (UXO).

For its first project with Mini-Ranger 2, Deep BV installed one of the systems on board its 15 meter, twin hull research

Christopher Katalinus NOAA Sea Grant

Maine oyster farmers Jeff McKeen and Tyler Hild.

Sonardyne

vessel, Deep Volans, and configured it to track a WSM 6+ transponder mounted on a remotely operated towed vehicle (ROTV) Iron Lady. Accurate positioning is paramount for the Iron Lady's control software in order to 'fly' the 6-meter-wide, gradiometer UXO set-up just two meters above the seabed.

OSIL Delivers Multi Corer for China's XMU

Global seabed sampling experts Ocean Scientific International Ltd (OSIL) said it has delivered a 12 station Multiple Corer to XMU University in China. The hydrostatically damped Multi Corer is capable of collecting up to 12 samples simultaneously, which include a high-quality sediment sample and the overlying supernatant water. The corer is constructed from stainless steel and features detachable core assemblies, which enables the core tubes (or if necessary the entire core tube assembly) to be removed from the corer for analysis or storage. The core tubes are sealed top and bottom once the sample has been taken, allowing rapid retrieval of the corer without jeopardizing sample integrity.

GMG Acquires Fugro's Trenching, Cable Laying Business

Global Marine Holdings LLC (GMG) will acquire Fugro's trenching and cable laying business in exchange for an equity stake of 23.6 percent in Global Marine Holdings LLC (parent company of Global Marine Systems Limited) valued at $65 million, and a one year secured vendor loan of $ 7.5 million. Fugro said it will realize a gain on this transaction, valued at approximately $73 million.

GMG is a supplier of subsea cable installation and maintenance services in the telecoms, offshore renewables, power and oil and gas market segments. The acquisition of Fugro's trenching and cable laying business provides added high-end capabilities that strengthen its service offering. The transaction involves the transfer of the 2011-biuilt vessel Fugro Symphony, two Q1400 trenchers and two work class remotely operated vehicles (ROVs) as well as 23 employees located in Aberdeen.

Subsea Robotic Inspection Initiative

A first-of-its-kind integration of artificial intelligence, autonomous underwater vehicles, laser sensors and 3D imaging aims to advance inspection services for the oil and gas industry.

Kraken Robotics Inc.'s wholly-owned subsidiary, Kraken Robotic Systems Inc., has partnered with GE Venture Avitas Systems to integrate autonomous underwater vehicles (AUVs), acoustic and laser sensor technology and artificial intelligence-based navigation software into unique subsea inspection solutions for the oil and gas, offshore renewable energy and shipping industries.

The partnership expands capabilities for inspections of ship and FPSO hulls, underwater production fields, subsea pipelines and cables and offshore wind farm assets. Kraken's SeaVision sensor, which can flexibly attach to AUVs and remotely operated vehicles (ROVs), combines laser scanning and optical imaging to provide highly detailed data for inspectors and operators. The sensor's colorized laser imagery better detects and characterizes corrosion, cracks, marine growth and other defects.

ESS Scoops Wind Farm Boulder Contract

Ecosse Subsea Systems (ESS) has deployed the offshore supply vessel (OSV) Noordhoek Pathfinder in support of a seabed clearance workscope for a wind farm project offshore northwest England. ESS said it will use boulder grab equipment to remove an estimated 1,700 boulders located over a 135-km route in water depths up to 60 m.

The boulder grab spread will be used for displacing obstacles nearshore and in low density areas and will complement other seabed clearance operations being performed using ESS's SCAR2 Seabed System.

People & Companies

Statoil

Statoil's "Empire Wind"

Lockheed Martin

Lockheed Martin: XL UUV for USN

NY Offshore Wind Project Named 'Empire Wind'

Empire Wind is the project name of Statoil's offshore wind site located off the southern coast of Long Island, N.Y. The 79,350 acre site, secured by Statoil in a federal auction in December 2016, has the potential to generate up to 1GW of offshore wind power for New York City and Long Island, according to Statoil, making it a key part of New York State's plan to deploy renewable energy sources to meet the state's electricity needs. New York's Clean Energy Standard mandates an increase in the share of renewables in its energy mix to 50 percent by 2030. As part of that effort, Governor Andrew Cuomo recently called for the development of up to 2.4 gigawatts of offshore wind power by 2030. Statoil said it is still in the early stages of developing the offshore wind farm; the Empire Wind project team is currently conducting an extensive evaluation process, gathering detailed information about the seabed conditions, grid connection options and wind resources characteristic to the area.

Polarcus Awarded XArray 3D Project

Polarcus Limited has been awarded a XArray 3D seismic acquisition project in South America for an undisclosed client. Polarcus said the project will commence in the fourth quarter of 2017 and run for approximately 10 weeks.
polarcus.com

Lockheed Martin to Design an Extra Large UUV for USN

The U.S. Navy has awarded a $43.2 million contract to Lockheed Martin for the design of its next autonomous underwater vehicle. The Extra Large Unmanned Undersea Vehicle (XLUUV) Orca is a two phase competition, including the currently awarded design phase and a competitive production phase for up to nine vehicles to meet increasing demands for undersea operational awareness and payload delivery.

Lockheed Martin said it will design long-range autonomous vehicle to perform a variety of missions, enabled by a reconfigurable payload bay. Key attributes include extended vehicle range, autonomy and persistence. Orca will have the ability to transit to an area of operation; loiter with the ability to periodically establish communications, deploy payloads and transit home. Navy personnel will launch, recover, operate and communicate with Orca from a home base and are never placed in harm's way.

Lockheed Martin employees in Palm Beach, Fla., will perform the work on Orca, with additional support from employees at the company's locations in Manassas, Va.; Syracuse, N.Y. and Owego, N.Y.

New ASV Delivered to University of Southampton

The first of ASV Global's brand-new class of C-Cat vessels to roll off the production line has been delivered to the University of Southampton. The 3-meter autonomous catamaran, funded by an EPSRC RAS Capital Award, will be used by the university for scientific research and development of autonomous behaviors.

C-Cat 3 Main Particulars

Length:	3.02m
Beam:	1.55m
Draft:	Min 0.39m
Weight, lightship	270kg
Weight, fully loaded	340kg
Propulsion:	2 x DC electric motors
Speed:	Up to 7 knots
Payload Power:	12V or 24V
Control:	ASView for direct, semi-autonomous or autonomous control
Communication:	Radio/satellite

AkerBP Inks DeepOcean Deal

Aker BP ASA won a contract to DeepOcean for subsea inspection, mainte-

Greensea

Marybeth Gilliam

AkerBP

Olav Henriksen, SVP Projects at Aker BP, and Rolf Ivar Sørdal, Commercial Director GNS at DeepOcean.

nance and repair (IMR) activities. The contract, worth $36.8m during the initial three years, with an option to continue the activities for an additional six years (2+2+2) – includes ROV activities related to subsea IMR on Aker BP-operated assets Valhall, Ula, Ivar Aasen, Alvheim and Skarv.

Gilliam Named Greensea COO

Greensea, creator of OPENSEA, the universal marine industry operating platform, announced that Chief Marketing Officer and VP of Sales, Marybeth Gilliam has been appointed Chief Operating Officer, a new position at Greensea. Gilliam joined Greensea in 2015 and has lead the company through an explosive period of sales growth.

Effective immediately, Gilliam will be responsible for operations, services, and sales. Gilliam will be responsible for ensuring continued sales growth while improving efficiencies and profitability.

Gilliam has over 25 years of experience including founding, operating, and leading her own marketing and strategic planning company for 14 years. She has worked with such well-known companies as Lucas Arts, NEC, Micron, Pandora, SoundHound, Eisenhower Medical Center, and TBWA Chiat Day.

Aquabotix Adds US Distributor

UUV Aquabotix Ltd said it has added

Aquabotix

Aquabotix Chief Development Officer Ted Curley; Audrey Darley, Director of Vendor Relations for Darley; and Henry "Ace" Thrift, Director of Business Development, Navy/SOCUM/Federal Team.

W.S. Darley & Co., a 100-year-old designer, manufacturer and distributor of firefighting, defense and emergency services equipment, as a distributor in the U.S.

Through the partnership, Aquabotix will work closely with Darley Defense to provide its underwater vehicles and camera systems to the U.S. Navy.

Fugro, AGI to Supply Seep Data

Fugro teamed with Amplified Geochemical Imaging (AGI) to acquire offshore hydrocarbon seep data in advance of Canada's 2018 east coast bid round. Bathymetry, backscatter and water column anomaly data will be collected to pull together a comprehensive picture of surficial geological features. These data will be used to identify and precisely target the best locations for geochemical sampling, enabling clients to improve and de-risk their exploration programs. The information may also be used in a variety of further investigations such as establishing environmental baselines, evaluating seafloor geohazards and preliminary planning for field development. The seafloor mapping will be performed by Fugro using its geophysical vessel, Fugro Discovery, and includes acquisition of 10,500 sq. km of multibeam echo sounder data and sub-bottom profiler data.

All images: IEASM Excavations Photo: Christoph Gerigk / © Franck Goddio/Hilti Foundation

Sunken Cities

Long-lost Egyptian Artifacts Are Coming to the U.S.

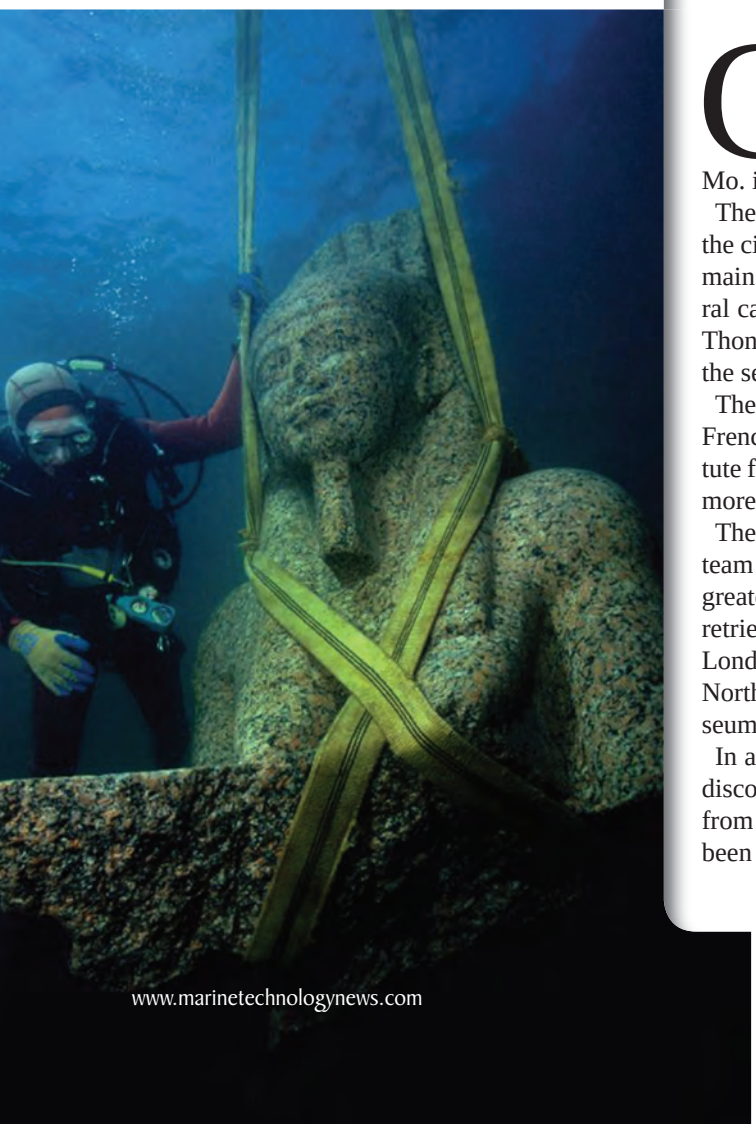
Colossal, 16-foot-tall sculptures and precious artifacts recently excavated from ancient submerged cities will be among the underwater treasures on display as part of the Sunken Cities: Egypt's Lost Worlds exhibit in St. Louis, Mo. in 2018.

The Nile delta city Thonis-Heracleion (a modern arrangement of the city's Egyptian and Greek names) reached its pinnacle as Egypt's main Mediterranean port from 664–332 BC, but by 800 AD, natural catastrophes such as earthquake and soil liquefaction had caused Thonis-Heracleion and nearby community Canopus to submerge into the sea.

The ruins remained undiscovered for more than 1,000 years until French archeologist Franck Goddio, president of the European Institute for Underwater Archaeology, found the long-lost underwater city more than four miles off the Egyptian coast.

The discoveries made by Goddio and his underwater excavation team at Thonis-Heracleion and Canopus are considered some the greatest finds in the history of underwater archaeology. The artifacts retrieved from these historic sites have already been shown in Zurich, London and Paris, and will next be displayed for the first time in North America during a six-month run at the Saint Louis Art Museum starting March 25.

In addition to more than 250 underwater treasures and works of art discovered by Goddio's team, the exhibit will also include artifacts from museums in Cairo and Alexandria, some of which never have been shown outside of Egypt.



New 4K UHD Subsea Camera

Sidus Solutions' new subsea camera, the SS490, is a 4K UHD camera that provides superior video image quality at four times the resolution of 1080 full HD images. The camera uses of HDR (high dynamic range) and features 20x zoom and combined optical and digital zoom of 144x. The camera features fully integrated automatic image processing that corrects distortion, shading and chromatic aberration, and it has adaptive noise reduction and visibility enhancement. Constructed with titanium, stainless steel or aluminum housings paired with sapphire or acrylic windows, the SS490 is rated for operating depths of 6,000 m or 3,000 m.

www.sidus-solutions.com

New Underwater Imaging System

A 3-D optical model of a schooner that sank on Lake Michigan in 1912. A new multifunction, underwater imaging system capable of generating ultra-high definition television (UHDTV) video, 2-D mosaic imaging and 3-D optical models of seafloor objects and environments has been developed by the Advanced Imaging and Visualization Laboratory (AIVL) at the Woods Hole Oceanographic Institution (WHOI) working with Marine Imaging Technologies. The new state-of-the-art technology was field-tested on several submerged shipwreck sites in both the U.S. and Europe. "These new imaging systems can visualize wide areas of the seafloor and shipwreck sites at optical resolutions not previously obtainable and represent a real paradigm change in our ability to image and interpret objects and features on the seafloor," said AVIL director, William Lange.

www.whoi.edu

SeaLife Unveils New Tech

SeaLife has introduced its new pocket-sized ReefMaster RM-4K Ultra Compact Underwater Camera offering 14 megapixel Panasonic CMOS image sensor and ultra-high definition 4K 30fps video. In addition, SeaLife recently unveiled the new Sea Dragon 4500 Photo-Video light, which delivers 4,500 lumens in 120° wide beam; as well as its news Sea Dragon Mini Fluoro and Sea Dragon Mini 900 lights.

www.sealife-cameras.com

New Sonar for Navigator

Shark Marine Technologies' Navigator series is now available with three different Forward Looking Sonar solutions. Teledyne Blueview's Proviewer line sonars – the standard available on the Navigator since its early models – will continue to be offered, along with the newly added Tritech's Gemini and Sound Metrics' Aris. Integration with Shark Marine's DiveLog software adds full geo referencing to these sonars, as well as many other advanced features such as target management, coverage mapping, report generation and mosaicking.

www.sharkmarine.com

Sidus Solutions

Sidus Solutions

WHOI

(Photo by Advanced Imaging and Visualization Laboratory, Woods Hole Oceanographic Institution)

SeaLife

Sealife

Shark Marine Technologies

Shark Marine Technologies

AXSUB, Darkwater Vision Partner

AXSUB and Darkwater Vision have agreed to partner on research and development activities for an underwater vision product line developed using UVAS Technology (underwater vision augmentation system), a patented technology. AXSUB will also act as a manufacturing agent for products dedicated to the commercial diving sector, and the agreement provides for the sharing of distribution channels.

www.darkwatervision.com
www.axsub.com

SubC Upgrades DVRO

SubC Imaging announced a newly upgraded version 6 of its all-in-one video processing system, the DVRO. The system is user-friendly with the overlay software having a graphical user interface and savable templates, cloud-based internet streaming, dive logging for quick review using multiple video inputs, and more. Compatible with both 4K and Ethernet, all six inputs can be recorded and overlaid simultaneously and each channel can be output over HDMI to monitors.

www.subcimaging.com

Mini LED Flasher for AUVs, Gliders

Arctic Rays, LLC has released its robust miniature self-contained deep-sea LED flasher designed to aid in vehicle recovery. Anglerfish, available in depth ratings of 1,000 or 2,500 meters, is a 380 lumen LED with 360 degree collimating optic can be seen from a distance as far away as 5 nautical miles.

www.arcticrays.com

Subsea LED Indicator

Blue Robotics' new, small subsea LED lights fit into a cable penetrator form factor for easy installation on the manufacturer's watertight enclosures and they come in white, red, green and blue. A built-in resistor makes them ready to connect to any 3-20v power supply to act as an indicator light, status light, or on/off light.

www.bluerobotics.com

OEM Acoustic Release Components

EdgeTech introduced a group of new OEM acoustic release components for customizable underwater release packages. With the ability to select individual components, users can purchase the electronics, transducers and release mechanisms found in the commercial-off-the-shelf EdgeTech Acoustic Release products on an OEM part basis for a customized underwater release package. All electronics and transducers are compatible with the EdgeTech surface deck boxes such as the 8011 and the PACS.

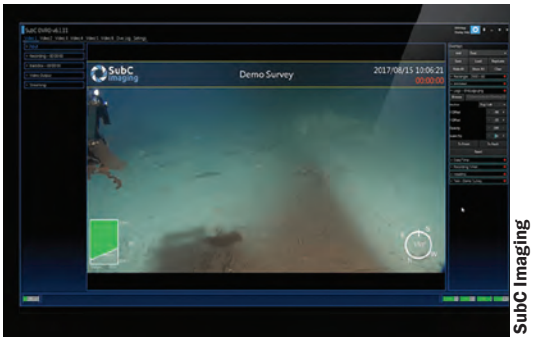
www.edgetech.com

Axsub

Axsub

Andrew Aurigema, Eric Gaudreau, Bradley Scott Jones and Tim Ratcliffe.

SubC



SubC Imaging

Arctic Rays

Arctic Rays

Blue Robotics

Blue Robotics

Oceanology International

Oi '18

Diversity is Key for Oceanology International 2018

Oceanology International 2018 (Oi18) at London's ExCeL in March is billed as the world's premier event for ocean technology and marine science, as well as a leading forum where industry, academia and government share knowledge and connect. The event brings together the latest technologies and thought leaders worldwide.

Exhibition

With more than 500 exhibitors and seven country pavilions for Canada, France, Germany, Ireland, The Netherlands, U.S.A. and Norway, the show floor is the most diverse of any global event covering ocean technology. David Ince, Oceanology International Event Manager, Reed Exhibitions, explained, "With 59% of exhibitors and 46% of visitors coming from abroad, from more than 80 countries, covering Asia, North and South America, Africa and the Middle East, there is an incredibly wide range of new products and services for visitors to explore at Oi18."

The international flavor of Oi18, which runs from March 13-15, 2018, is the foundation for a rich mix of new and innovative technology that crosses industry divides both below and above the surface. Reed Exhibitions is introducing new showcases, features and benefits for exhibitors and other attendees. This will be the 24th edition of the biennial event.

"The sheer diversity of technology buyers and different sectors involved, including aquaculture, marine research, oil and gas, maritime security, ports/harbors and marine renewables makes it an exciting place to discover what is new and network with other visitors and exhibitors," said Ince.

The Conference

The Oi18 conference, taking place over three days offers the same levels of diversity that visitors will find on the show floor. Highly regarded for the quality of its speakers and content, next year's lineup is shaping to be one of the strongest yet.

On Tuesday, March 13, the Hydrography, Geophysics and Geotechnics track, chaired by Andy Hill - Marine Geohazard Technical Authority at BP Exploration, and Richard Salisbury - Senior Consultant at Fugro GeoConsulting, will focus on offshore site investigation and the data collection,

processing and analysis techniques used in mapping and pre-engineering studies of the offshore environment.

The Aquaculture track, chaired by Lawrie Stove - Managing Director at AquaMoor; David Kelly - CEO and CTO, InnovaSea; and Keith Jeffery - Aquaculture Development Officer, Cefas will explore the technologies being used to support the design, monitoring and maintenance of marine aquaculture facilities and marine life support systems, in addition to the emerging challenges and developments for offshore aquaculture.

The Ocean Observation and Sensing track, chaired by Carl Gouldman - Director of U.S. Integrated Ocean Observing System (IOOS), NOAA; Matt Mowlem - Head of the Ocean Technology and Engineering Group at the NOC; and and Justin Manley - Founder of Just Innovation, looks at the latest developments in measurement techniques and instrumentation for the monitoring of ocean physics, chemistry and biology.

On Wednesday, March 14, the new Delivering Efficiencies Across the Offshore Oil and Gas Life Cycle track, chaired by Christopher Curran - Senior Consultant at CJC Enterprises and Steve Barrett - Senior Vice President - Business Development at Oceaneering, showcases examples of techniques and technologies which contribute to reduced operating costs across all stages in the life cycle of offshore developments.

The Ocean Information and Communications Technology track, chaired by Nick Lambert - Maritime Domain Expert at the Satellite Applications Catapult; Dr. Clare Postlethwaite - Coordinator of the Marine Environmental Data and Information Network (MEDIN); and Dr. Helen Wells - Business Group Leader of Meteorology and Science at the Met Office, looks at the latest connected technologies for acquiring,

transmitting and communicating ever increasing amounts of marine data and the software and techniques required for enhanced data analysis, visualization and management.

The first part of the Unmanned Vehicles and Vessels track, chaired by Steve Hall - CEO of SUT; Dan Hook - Managing Director of ASV Global; and Prof Russell Wynn - Chief Scientist of NOC's Marine Autonomous and Robotic Systems, will focus on the latest innovative developments and novel applications in marine autonomous systems. Part two follows on Thursday, covering the same themes.

Another new conference track, Underwater Imaging and Metrology, chaired by Simon Waterfield - Head of Survey Support Group at Sonardyne ,and Blair Cunningham - President of Technology and Divisional CEO of Coda Octopus Products, emphasizes emerging techniques and technologies for marine imaging and metrology, including using real time imaging for significant cost reduction and operational efficiency in offshore and construction activities.

A key focus on Thursday, March 15 is the Marine Renewables track, chaired by Dr. Zoe Roberts - Senior Metocean Analyst at Vattenfall Wind Power (UK) ,and Dr. Stephen Wyatt - Research and Disruptive Innovation Director at the Offshore Renewable Energy Catapult. It will the technology required to safely develop, install and maintain offshore renewable infrastructure and the difficulties associated with taking marine renewable energy systems into increasingly challenging environments.

Also on Thursday is the Navigation and Positioning track. Chaired by Xavier Montazel - Vice President, Director of Navigation Systems Business Unit at iXblue, and Walter Jardine - Upstream Survey and Positioning Authority, BP. This forum will look at the latest techniques and technologies for navigation and positioning in a marine science, research and operational context.

What's New?

There are a number of new aspects in the pipeline for Oi18. The Ocean ICT Expo, is a new parallel event

focusing on the IT, communications and data solutions that form the technical foundation for modern ocean space research and industry. It will highlight the most innovative enabling technologies, including the latest satellite communication, data and networking solutions that facilitate safe, high speed transfer, visualization and analysis of data from the ocean.

"Oceanology International is primarily about the technology, instrumentation, sensor and support platforms required for observing, measuring and operating in the world's oceans. Ocean ICT Expo is a new platform for the industry to connect with the makers of the IT and communication solutions that enable effective delivery, storage and analysis of the ever increasing amounts of data acquired from the ocean," said Ince.

Additional new features have been introduced within the main exhibition to help visitors discover and identify the latest technological developments, such as autonomous systems, advanced sensor technology and robotics. For instance, the new FutureTech Hub will make it easier for visitors to locate the latest development and will feature dedicated content to showcase innovative technologies.

Oceanology International 2018 is exclusively home to the new Ocean Futures Forum, a half-day content and networking event on March 13 concentrating on long-term energy trends, ocean growth and diversification, and sustainability. The fifth edition of the future-looking Catch the Next Wave conference also takes place on March 15. Taking a longer term view of the ability to explore, understand, exploit and protect the oceans, Catch the Next Wave conference will be run in association with The Explorers Club and focus on the theme of technology innovation for exploration.

There are also plans to expand the dockside activity at ExCeL London. Oi18 will have more live technology demonstrations on-board participating exhibitor vessels and from a covered dockside cabin, with a program of in- and on-water product demonstrations taking place throughout the week.

www.oceanologyinternational.com

Underwater Intervention

Underwater Intervention '18

Underwater Intervention 2018 is a consummate event for those working in the commercial diving and underwater ROV industry. Set to take place at the Morial Convention Center in New Orleans, from February 6-8, 2018, UI has something for everybody. The event features educational tracks and sessions from the industry's preeminent thought leaders, as well as opportunities for networking and hands-on evaluation of many of the latest and greatest products, services and innovations serving the underwater space.

Underwater Intervention, which is co-hosted by the Association of Diving Contractors International and the ROV Committee of the Marine Technology Society, is an international event that will draw the industry's leaders from across the country and around the globe. Attendees of last year's event had this to say about UI: "Business is always about relationships, and we get to have those relationships by coming here."

"It's a thrill because there are so many things to do. But it's more than business here, it's a common-share of values."

"The social part of it is huge. I come back to see a lot of good friends, people who I have worked with throughout the years."

ADCI Executive Director, Phil Newsum, said, "We need to keep our finger on the pulse of what are the most current industry challenges and be prepared to answer the hard questions." This year's UI Advisory Board has developed a compelling and thought-provoking educational agenda with presentations spanning the gamut of the industry, including:

Commercial Diving

The Commercial Diving Track helps keep the industry updated by discussing topics including lessons learned from challenging projects, panel discussions by leading authorities in hyperbaric medicine, presentations discussing the combination of technology, training and advancements in assisting divers of today, educational and safety topics, and workshops that assist with equipment maintenance and training. For divers to meet or exceed expectations on the job site, they must draw upon their skill set, knowledge and tools to perform their tasks. These workshops will provide some insight to preparing your divers to do just that and can help your company stand out and succeed during these challenging economic times.

Remotely Operated Vehicles

Historically, the ROV Track at UI has focused on swimming tethered robotics for usage in oil and gas as well as scientific and military applications. This year's technical track is expanding to cover both unmanned ground vehicles as well as unmanned aerial vehicles for usage in various commercial and scientific applications. Topics covered within the purview of this year's technical track include all aspects of equipment and application for tele-operated robotics. From the human machine interface, to power, to deployment methods/equipment, to the sensors, to the end-effector, the latest topics of interest by leading industry experts will be covered in a lively and dynamic forum.

Instruments and Sensors

The Underwater Instruments and Sensors Track features new and innovative technologies made available to the Mmarine community. Without these tools, installing, servicing and decommissioning the underwater structures and facilities we all rely upon in our technological world would be impossible. The new technologies introduced at Underwater Intervention help us all be more efficient and effective in our underwater pursuits, pushing the boundaries of our capabilities. Explore what new and fascinating instruments and sensors are being introduced for our collective use.

Unmanned Maritime Vehicles

UMVs are broadly understood to include unmanned undersea vehicles (UUVs) and unmanned surface vehicles (USVs). Both of these vehicle classes have an important role to play in supporting underwater intervention applications. Seafloor and pipeline route survey, meteorology and oceanography (METOC) and structure inspection are some common examples. In this session recent field results and new technology concepts will be presented. Just as the technology focus is broad so too will the market sectors be wide ranging. Presentations from defense, science, exploration and, of course, offshore energy will be included. This track is the one-stop update on all things UMV in the underwater intervention community.

Manned Submersibles

Each year, the MUV Track builds presentation themes in following areas: emerging design and engineering innovations; advances in material science and fabrication; operations and procedures; commercial and research applications and regulatory updates. In each of the presentations the focus is on manned submersible vehicles but many of the discussion presented in our track directly impact other areas of deep water intervention. This year, the presentations will feature developments from MUV operations including the ALVIN at Woods Hole USA, the Shinkai6500 from JAMSTEC in Japan, Ictineu 3 from Spain, Idabel from Honduras, Deepflight from the Maldives and SEAmagine presenting on their pilot training program in Argentina.

Oceaneering will present a special historical review of the deepest pipeline repair ever performed using the MANTIS MUV – a retrospect from an operations perspective. Technology presentations will feature developments on new hazard mitigation strategies for in-hull Lithium battery fires, new design studies for acrylic windows and deep ocean wide field camera systems.

Marine Education

The 2018 Marine Education track will highlight innovative education and training programs that are helping to prepare students of all ages for the marine industry. From formal degree and certificate programs to entrepreneurial opportunities where students are at the forefront, these programs represent best practices in marine technology education.

Both the faculty and educators who worked with industry leaders to develop these programs as well as the students who benefit from them, including students working at the SeaMATE social enterprise, will be a part of UI. Informal education programs, such as those in place at the Dauphin Island Sea Lab, will also be represented within the track.

www.underwaterintervention.com

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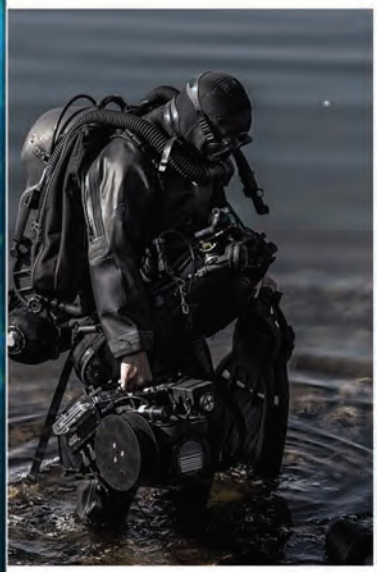

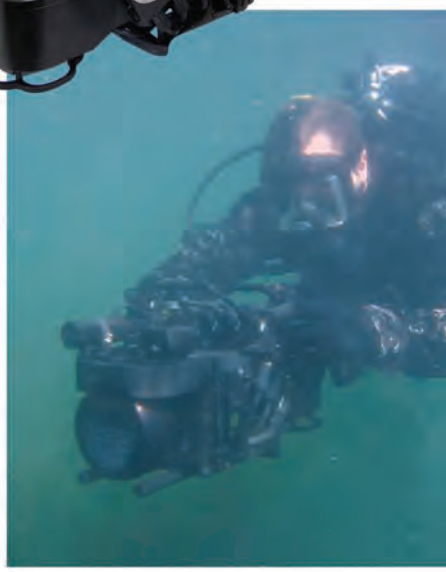

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