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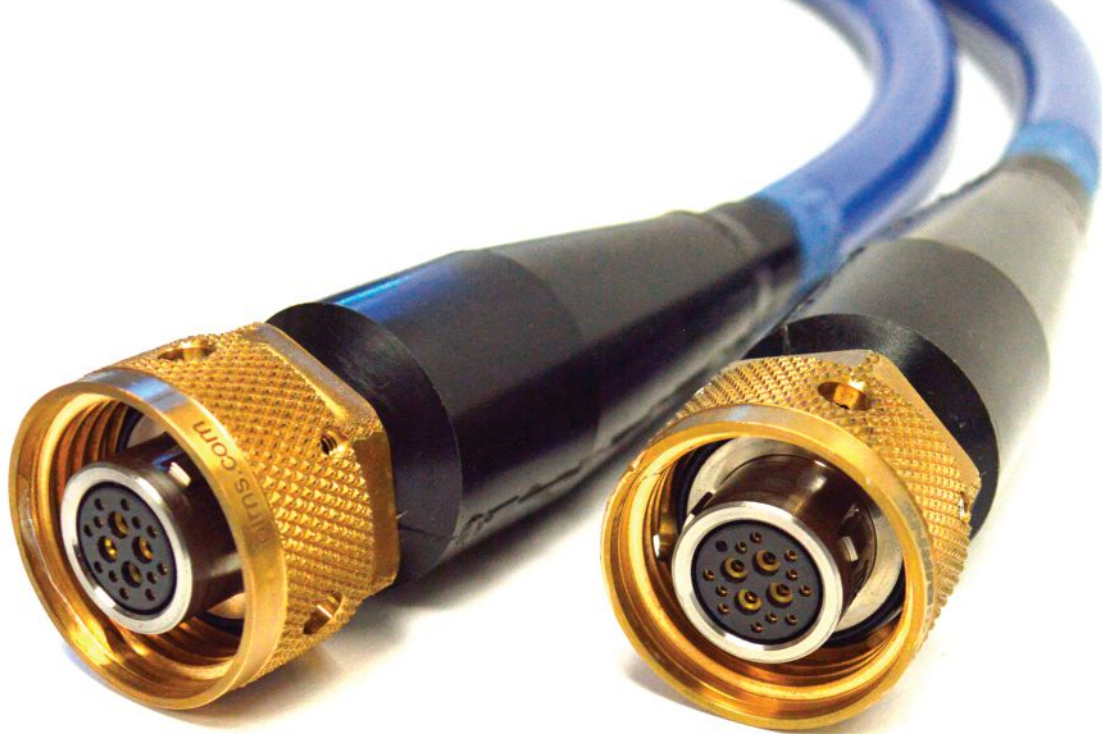


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The National Science Foundation Ocean Observatories Initiative Deep Profiler at Axial Base, docked in its charging station at the bottom of the mooring. The yellow profiler vehicle climbs up and down the mooring wire between the seafloor and the top buoy, collecting oceanographic data on thin layers in the water column. (Credit: NSF-OOI/UW/CSSF, Dive 1742, VISIONS14)

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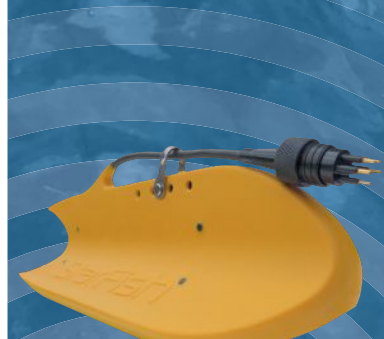
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Ray Mahr, Jr.
KRK Consultants Ltd.
17476 Slipper Shell Way, Ste. 6
Lewes, DE 19958
Tel: (302) 569-0019 (M)
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WESTERN U.S.A. & CANADA

John Sabo
Barbara Sabo
Gregory Sabo
John Sabo Associates
447 Herondo St. #305
Hermosa Beach, CA 90254
Tel: (310) 374-2301
bsabo@jsaboassoc.com

EUROPE

John Gold
John F. Gold & Associates
"Highview"
18a Aultone Way
Sutton, Surrey, SM1 3LE, England
Phone/FAX Nat'l: 020-8641-7717
Int'l: +44-20-8641-7717
johnfgold@gmail.com



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Unlocking a Bright Offshore Wind Future

The horizon looks bright for American offshore wind. Regulatory and technological questions regarding offshore wind are clearing up. Atlantic states are offering to purchase more and more gigawatts of wind-produced energy. Wind producers have demonstrated that they are willing to make substantial financial commitments to the industry.

With all this progress, however, a key piece of the offshore wind puzzle remains—a federal commitment to the wind industry through regular and predictable wind lease auctions.

There is zero doubt that the market for offshore wind is strong; just look at what the Atlantic states are doing. In the past year, Virginia began construction on the first wind farm in federal waters; Connecticut awarded an 804-MW deal for offshore wind; New York signed 1.7 GW of offshore wind contracts and New Jersey greenlit a 1.1-GW offshore wind project.

To ensure they can meet this demand in a timely manner, offshore wind producers have made coordination and alignment among themselves a top priority. Through a collaborative and innovative approach, wind producers are able to offer joint solutions, providing a sensible pathway for all ocean users to co-exist in the Atlantic offshore region.

This leadership is paying dividends. Last November, Ørsted, Equinor, Eversource, Mayflower Wind and Vineyard Wind released a uniformed turbine layout proposal. They provided a common solution to questions regarding navigational safety, fisheries considerations, distinct transit corridors and the facilitation of search and rescue operations. In January, the U.S. Coast Guard issued its updated draft of the Massachusetts and Rhode Island Port Access Route Study (MARIPARS). The wind developers worked hard together and paved the way for the Coast Guard's proposal, which is very consistent to what the lease holders offered.

Likewise, the advance of offshore wind technology has been amazingly unrelenting. The largest floating wind turbine in the world has been installed offshore Portugal. The WindFloat Atlantic wind farm is delivering nearly 8.4 MW of electricity to onshore customers using floating technology that was out of reach just a few years ago.

Nearly 80 percent of wind resources are in waters too deep for traditional anchored wind turbines. Floating wind turbines solve the question of how to tap the stronger winds in deepwater areas. WindFloat Atlantic isn't just leading the way in Portugal; it is showing what is possible in waters offshore California and Maine, too. And the industry continues to advance the efficiency and power-generating capacity of fixed offshore turbines, with the latest-generation turbines providing 45 percent more power.

The wind industry is on the threshold of something great. Close to \$70 billion in capital expenditures by 2030 will be needed, and more than 160,000 direct, indirect or induced jobs could be created by 2050.

Yet even with all this good news, the offshore wind industry is still dependent on the availability of wind leases provided by the federal government.

The last U.S. wind auction, in December 2018, provided a taste of what more is out there. While a whopping \$405 million was generated by three winning bids, eight companies with more than \$286 million in bids were not able to secure offshore wind leases.

Right now, the offshore wind industry is driving down the highway with no exit signs. Companies know more investment opportunities are down the pike, but they don't know what or when. The mystery of future lease auctions can make business development and securing timely financing incredibly challenging. A clear road map of when and how to invest can clear up that uncertainty and help further unlock a new offshore wind industry. **ST**

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)) Consider Cybersecurity in Coronavirus Preparation, Response. Maritime cybersecurity faces a new and highly unpredictable threat as scammers line up to exploit fears surrounding the coronavirus (COVID-19) at the same time that the industry moves to encourage remote working to minimize the spread of the pathogen. For example, phishing email can come into inboxes with an attached Word document that claims to contain advice on how to prevent infection but is in fact a visual basic for applications (VBA) script that drops a payload to steal confidential information. More generally, scammers are setting up websites to sell bogus products and using fake emails, texts and social media posts to seek out personal information or financial reward. Under cover of promoting awareness, offering prevention tips or providing fake information about cases local to the recipient, fraudsters can request donations for “victims” or deliver malicious email attachments to spread malware or steal log-in credentials. GTMaritime recommends that shipping companies review their cyber response plans to ensure they can withstand the fresh threats emerging due to coronavirus.

)) Call for Start-Up Tech to Assist US Coast Guard. The U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T) Silicon Valley Innovation Program (SVIP) is looking for start-ups to develop or adapt a system to more clearly mark and track objects in the water. The U.S. Coast Guard (USCG) needs a more reliable system for clearly marking and accurately monitoring objects in the water for recovery. Tracking solutions must be interoperable with current USCG maritime and aviation assets. USCG also seeks more robust buoy tracking technology that will assist USCG operations and has the ability to be deployed from both air platforms and maritime surface vessels, on patrol or in pursuit. This will strengthen waterway security, drug interdiction, and search and rescue missions while benefiting maritime navigation and marine safety. For more information, visit www.dhs.gov/science-and-technology/svip or contact dhs-silicon-valley@hq.dhs.gov.

)) Digital Innovation for Blue Economy. ClassNK has developed the ClassNK Digital Grand Design 2030, the future vision of the classification society for the digital society of 2030. The concept is: “creating innovation for a blue economy.” ClassNK aims to expand its cultivated technology and knowledge to ocean-related business and to bring innovation to the maritime industry and related industries. It has established three fundamental policies: further improve safety and efficiency by providing advanced and rational classification services through the development of new technical services based on data utilization, such as survey systems in line with condition monitoring and evaluation technologies, and the creation of individual ship charts; diversify certification services and expand their scope, particularly, create new value in ocean-related businesses by providing support with new challenges involving ocean development and integrated onshore and offshore logistics services; and support the realization of social innovation brought by digital technology and new challenges by establishing various rules and flexible environmental aspects. A business plan based on these fundamental policies is being developed as a roadmap.

)) Robert Ballard Embarks on ‘Lois and Clark’ Expedition. Legendary underwater explorer Robert Ballard will embark on a modern-day version of the Lewis and Clark expedition to map a newly enlarged United States of America, AUVSI reported. In the 1980s, President Ronald Reagan extended U.S. jurisdiction out to 200 mi. from all of its territory as part of the Law of the Sea Convention, which lays out rights and responsibilities for nations using the world’s oceans. NOAA is now home to the Office of Ocean Exploration and Research, with a charter related to the emerging blue economy. “We have the next 10 years to map the underwater America,” Ballard said. “It’s pretty exciting, actually.” The oceans could be used to feed an ever-growing population and for the mining of rare earth minerals, critical to modern electronics. While Lewis and Clark had the Corps of Discovery, Ballard’s team is called the Corps of Exploration, and 55 percent of his team comprises women in positions of leadership and authority. The team is nicknamed the Lois and Clark expedition. They began their journey in March, with the exploration vessel *Nautilus*.

)) Communications Industry Sets Targets Aligned with Paris Agreement. A new International Telecommunication Union (ITU) standard highlights that compliance with the Paris Agreement will require the information and communication technology (ICT) industry to reduce greenhouse gas (GHG) emissions by 45 percent from 2020 to 2030. The standard will support ICT companies in reducing GHG emissions at the rate necessary to meet the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement’s goal of limiting global warming to 1.5° C above pre-industrial levels. The new ITU L.1470 standard puts forward emission-reduction trajectories for operators of mobile networks, fixed networks and data centers.

)) Ocean Philanthropist Passes. John Seward Johnson, Jr., a former investor in Compass Publications Inc. and grandson of Robert Wood Johnson, the founder of Johnson & Johnson, passed away in March 2020 at the age of 89. He was a former chairman of the board and CEO of the Harbor Branch Oceanographic Institution, which was founded by his father, J. Seward Johnson, Sr., in 1971. He also had a successful career as a sculptor. **ST**

Subsea Power

Pioneering Offshore Power Distribution, Conversion System

By Svein Vatland

Growing demand for energy in ever-expanding cities and towns is pushing oil and gas companies to find new sources of fossil fuels, which are expected to account for more than two-thirds of global energy consumption until 2050. Even as nations around the world move toward a cleaner and greener energy mix, fossil fuels are still relevant, and major energy producers are keen on tapping uncharted subsea reserves.

Constructing fully functional facilities on the seabed, which will eliminate the need for heavy fixed or floating installations on the water surface, is a highly efficient means of producing oil and gas from reservoirs located far from the shore. With subsea pumping and gas compression, energy resources can be utilized better with higher recovery rates, lower production costs, enhanced

safety and further development of deepwater production. Removing the topside installation will also result in fewer persons on board, decreasing risk and expenses.

ABB's first-of-its-kind subsea power distribution system, which passed a viability test in November 2019, can supply electricity to the seabed via a sleek cable, extending up to 600 km and going as deep as 3,000 m. Supplying power directly to underwater pumps and compressors near the reservoir leads to energy and cost savings, as well as reduced carbon emissions.

The proven subsea power system, designed by ABB and its partners, will enhance safety, drive productivity, ensure reliability, increase efficiency and streamline performance for offshore oil and gas producers as they embrace Industry 4.0 technologies.



ABB proves world-first subsea power technology system, signaling a new era for offshore oil and gas.

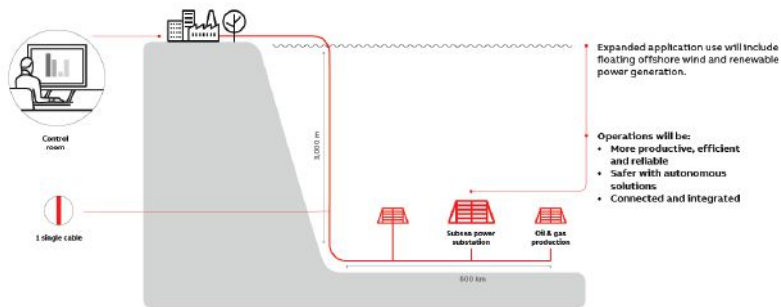
ABB Collaborates To Power the Seabed

In 2013, ABB entered into a five-year joint industry project (JIP) with energy majors Equinor, Total and Chevron to research and develop state-of-the-art subsea power technology. The main focus of the partnership was to design and deliver subsea transmission, distribution and power conversion systems for underwater pumps and gas compressors that could be used for upcoming and existing oil and gas processing fields in the Norwegian Continental Shelf (NCS), the Gulf of Mexico and several other global offshore regions.

More than 200 scientists and engineers from ABB and its three JIP partners put in several years of

ABB's pioneering subsea power distribution and conversion technology

Enabling a new era in offshore oil and gas



(From top to bottom) Schematic of the subsea power technology system. Illustration of subsea substation. The latest ABB technology powers offshore oil and gas more efficiently.

difficult and costly to service and maintain assets. The JIP examined the behavior of capacitors and transistors at extreme pressures of up to 300 bar. Engineers redesigned electrical and other system components to ensure the highest leakage requirements, while internal chassis and assemblies

were reconstructed to allow for extended usage with the appropriate thermal properties. The team developed subsea control and protection systems with multiple electronic modules, high-end penetrators, condition-monitoring sensors and high-speed optical communication.

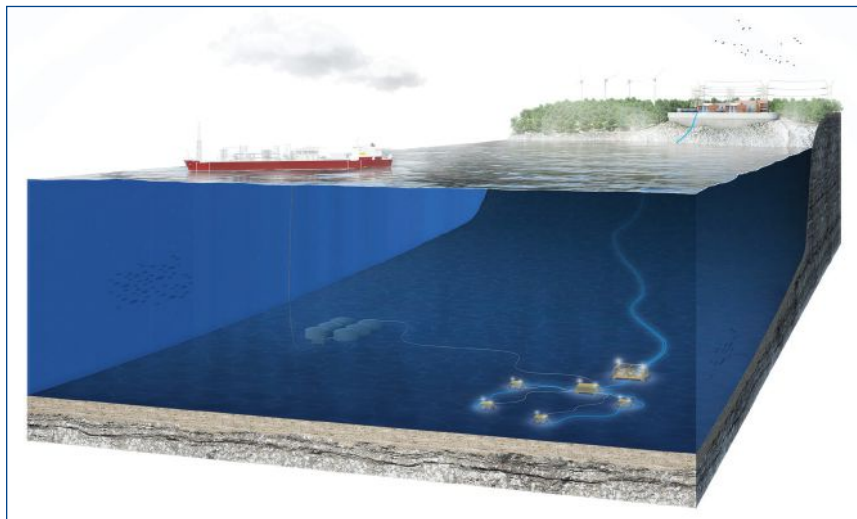
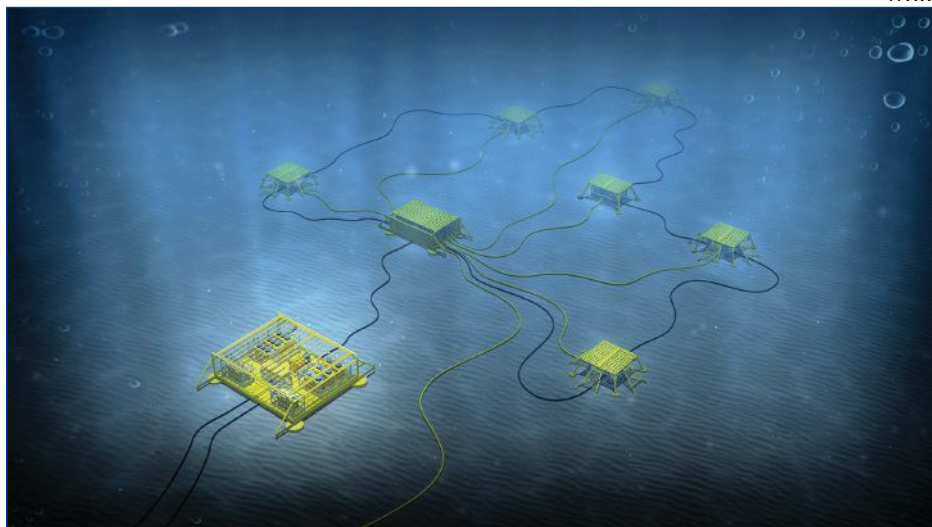
Successful Shallow-Water Test

To ready the new subsea power technology for the extreme pressures and temperatures of the ocean's depths, ABB and its project partners developed thorough testing procedures, scrutinizing every stage of manufacturing to develop resilient, high-quality components for the power system. ABB set up four high-tech subsea labs equipped with pressure vessels to simulate conditions at depths of up to 3,000 m.

Electronic components and printed circuit boards were tested at a lab in Oslo, Norway. A center in Turgi, Switzerland, examined the functionality of the subsea drive power electronics, while power electronic components were tested in Daettwil, Switzerland. Chemical compatibility was studied at a research facility in Västerås, Sweden. The engineering team assembled

a high-resolution digital facsimile of a subsea power grid and combined it with a control system that automates its operations, while detecting and diagnosing problems before they occur.

Power technology experts from ABB and its energy partners certified every component of the electrical system, creating a library for the components that gained approval. New and optimized design guidelines were cataloged for use in future projects. The subsea switch-



hard work and effort to develop the subsea power technology, which will allow oil and gas producers to set up all-electric subsea processing sites as soon as this year. The highly skilled team shared technical know-how and industry experience to design a solution that meets the most stringent international standards and specifications.

One of the major challenges for the R&D team was ensuring reliability of the power solution in harsh and remote subsea conditions, which make it extremely dif-

Lowering Energy Consumption And Making Cost Savings

ABB's subsea power system is poised to become an enabler of energy transition for offshore oil and gas companies that are increasingly setting up subsea processing facilities in a bid to reduce their carbon footprint. Offshore energy producers usually get their electricity supply from gas turbines on fixed floating platforms or ships. Generating power from the shore will drive efficiency and minimize overall energy consumption.

With electrification systems coming so close to the energy reservoir, space and weight on topside platforms are decreased, response time to wellheads is lessened and power demands are reduced. The technology will potentially allow offshore oil and gas operators to eliminate a surface platform altogether, drastically cutting operational costs while boosting productivity, increasing uptime and optimizing energy usage.

The subsea power solution could offer CAPEX savings of more than \$500 million, if eight consumers, such as pumps or compressors,

are linked through a single cable over 200 km from other infrastructure, according to a specific field development case. Having oil and gas processing facilities on the seabed means lesser overall maintenance, with greater cost savings.

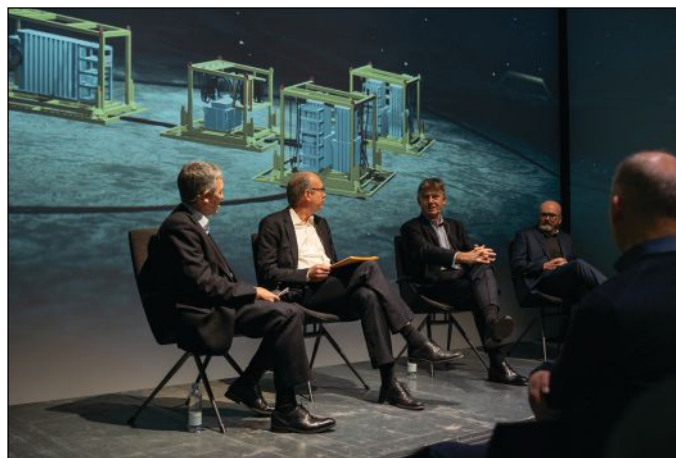
Extraction of oil and gas from deepwater reserves is much simpler when pumps and compressors are moved to the seabed. In 2015, ABB installed its subsea electrical technology for Norway's Åsgard Field, which employed the world's first subsea compression system, enabling operator Statoil (now Equinor) to extend the life of this field up to 2032. Using compression and pumping systems at the seabed results in a reduction in operational costs, promoting the production of more oil and gas from both new and existing fields.

For Chevron-operated Jansz-Io Field, located about 200 km offshore in the northern part of Western Australia, ABB designed and delivered a power solution for a subsea compression system with Aker Solutions and MAN Energy Solutions, driving higher gas recovery with lower energy consumption than semisubmersible compressors.

ABB's proven subsea electrical system can be linked to any source of power, including renewable energies, such as wind and hydropower, which could help oil and



The subsea power technology system was made possible with ABB's Subsea JIP partners.



gear completed two intensive internal tests, one for the primary components and the other for the complete model.

The JIP engineers also ensured that the switchgear fitted in the subsea power system had a solid mechanical structure to withstand the extreme pressures present at the deepest underwater locations. The team employed oil pressure compensation for the switchgear, controlling the dimensions and weight, as well as the costs.

ABB's subsea power technology survived a 3,000-hr., shallow-water test that was performed at a sheltered harbor in Vaasa, Finland, validating the functionality and thermal capability of the advanced system, which has opened up new possibilities for offshore oil and gas producers.

The endurance test and demonstration involved prototypes of a subsea variable-speed drive (VSD), medium-voltage switchgear and a subsea control and protection system. ABB's flagship digital platform, ABB Ability System 800xA, was the topside control system. Passing the test, a world-first, is a remarkable achievement made possible because of the intensive collaborative efforts from ABB and its three JIP partners. The shallow-water test demonstrates the system and prototype functionality, performance and endurance in a realistic environment.

“Operating facilities on the seabed will help oil and gas producers reduce risks and improve safety.”

gas producers to further improve carbon efficiency, and create new possibilities for the future energy transition.

With subsea operations, oil and gas producers could realize about 20 to 30 percent savings on overall expenses over a 30-year operational life, as well as 25 percent faster project execution and completion.

Boosting Safety and Reliability

Operating facilities on the seabed will help oil and gas producers reduce risks and improve safety. With performance and reliability being monitored via remote, onshore control rooms, personnel safety is optimized.

The new electrical system gives oil and gas operators access to a reliable, safe power supply of up to 100 MW to remote distances up to 600 km offshore. Deepwater developments in the Norwegian Continental Shelf, the Gulf of Mexico, Brazil, West Africa and Australia, for example, could employ the technology to enhance efficiency and productivity for existing facilities, as well as upcoming projects.

ABB's highly reliable system has been designed to withstand the extreme subsea environment. The stakes are high for the breakthrough technology, as oil and gas companies expect a stable and effective solution that requires minimal maintenance and upkeep. The shallow-water test and several other internal tests have ensured that the power solution is subsea-ready.

Using the secure ABB Ability industrial control platform, onshore engineers can monitor the real-time functioning of assets on the seabed. The subsea power system is capable of supplying electricity to oil and gas facilities at the deepest underwater locations in a controlled and optimized manner. ABB has decades of experience in electrical technology, deep domain expertise, a well-known record of reliability and exceptional quality control to enable handling and installation of this subsea power technology.

The 800xA system shares data gathered from sensors on various electrical components through firewall-enabled connections that have dedicated servers, ensuring safe transfer of information. Cybersecurity is a key factor for information exchange in the intricately connected Industrial Internet of Things (IIoT). ABB has set up several layers of security throughout its solutions to mitigate cyber threats, ensuring the highest level of data encryption possible.

Autonomous Oil and Gas Operations

As global companies in the energy industries look to run profitable operations in a competitive atmosphere, it is essential to have digital and automation technologies

that boost productivity and efficiencies, enhance on-site safety and reduce risks.

Intelligent, remote and unmanned operations are the ideal combination for offshore energy companies that are facing intense government scrutiny and stringent environmental restrictions. There is tremendous potential for ABB's subsea power solution, especially in areas with long step-out distance and subsea tiebacks for existing oil and gas processing fields.

The fourth industrial revolution is increasing autonomy for offshore energy companies, presenting newer, more efficient methods of oil and gas production. As existing reserves deplete over time, global energy majors know the value of autonomous technologies that permit deeper and farther subsea processing facilities, which are currently costly and difficult to maintain and operate. New-age digital technologies and systems will help extend the life of many offshore oil and gas fields. With two-thirds of the world's surface being underwater, the potential for the development of new fields is also bright.

Decades of experience in offshore operations, a highly skilled pool of well-trained engineers, as well as an arsenal of digital solutions and automation systems will help ABB to drive the energy transition for the world's oil and gas producers. The new subsea electrical infrastructure and equipment will be controlled with ABB's all-in-one 800xA system, which will collect real-time data, permitting condition monitoring and predictive analytics to optimize performance and productivity.

ABB engineers and technicians from oil and gas firms can remotely monitor the health of the electrical components in near real time, conducting comprehensive diagnostics and complex performance analyses. With such advanced processes, energy companies can make well-informed decisions and devise effective project strategies, which will boost efficiency and streamline operations in both existing and new oil and gas fields. **ST**

Svein Vatland is the vice president of ABB's Subsea Technology Program for Energy Industries. He leads ABB's Subsea Power Joint Industry Project (JIP), bringing more than 24 years of experience in the oil, gas and utilities industries to his role. Vatland started his career in ABB in 1995 as a project engineer and has held several positions in the company, including senior scientist at ABB corporate research and senior project manager for oil and gas. He has an M.S. in process automation from the University of South-Eastern Norway and an executive master of management degree from BI Norwegian Business School.



Oceanographic Mooring

Inductive Power Mooring Lines for OOI's Shallow and Deep Profilers

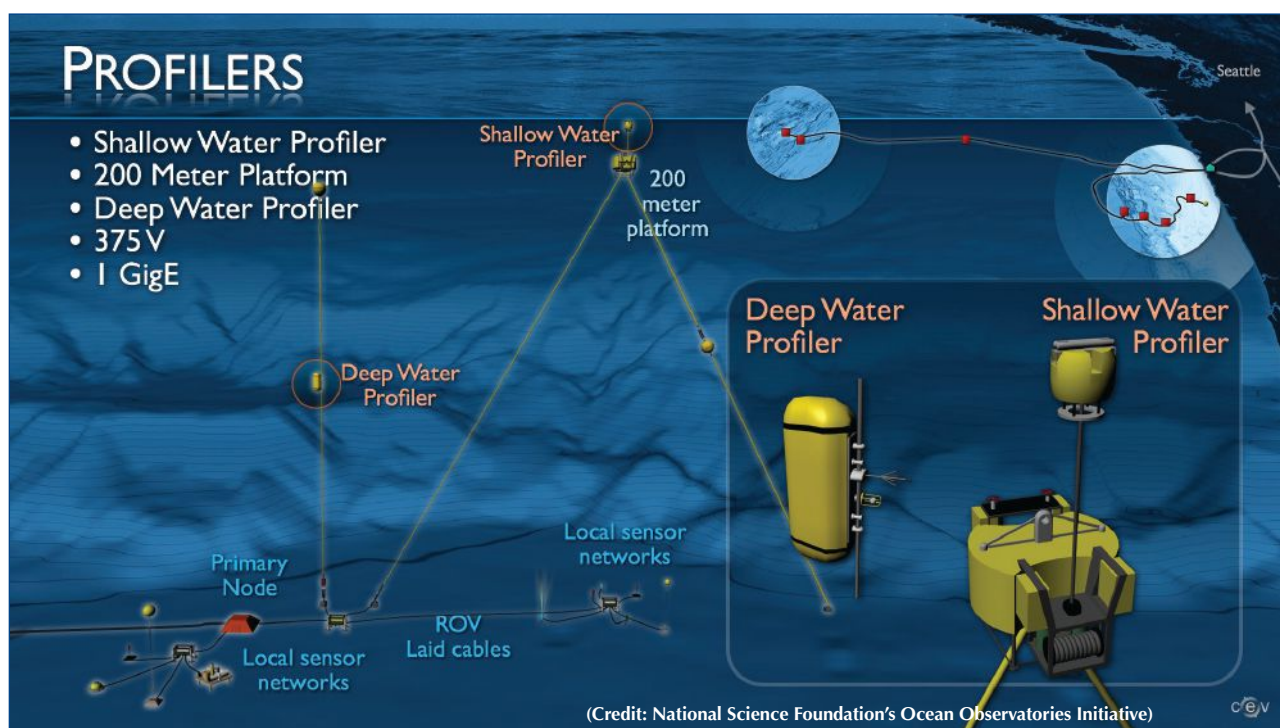
By Tim McGinnis • Geoff Cram • Eric Boget

As oceanographers seek to deploy their field sensors for longer subsea campaigns, advances in mooring line construction and technology are enabling new approaches to moorings. No longer is the mooring line a passive element; instead, the development of the first inductive power mooring line by high-performance fiber-rope maker Phillystran allows it to function as an integral part of an oceanographic monitoring system.

Subsea mooring lines must meet a number of requirements. In addition to strength, elongation and stiffness, physical factors such as construction, diameter and ease of deployment must also be considered in the moor-

ing line selection. Maximizing the mooring line's utility while minimizing the inevitable trade-offs calls for a close working relationship between engineers and the mooring line supplier.

One example of this is the collaboration between the University of Washington and rope maker Phillystran on mooring systems for the Ocean Observatories Initiative (OOI), a National Science Foundation (NSF) Division of Ocean Sciences program that focuses the science, technology, education and outreach of an emerging network of ocean observing systems. OOI is a networked infrastructure of science-driven sensor systems to measure the



OOI Profilers.



(Credit: National Science Foundation's Ocean Observatories Initiative)

(Top) Deep Profiler deployment. (Bottom) Deep Profiler docked on the seabed, showing the mooring line.

physical, chemical, geological and biological variables in the ocean and seafloor, as well as the overlying atmosphere, providing an integrated system collecting data on coastal, regional and global scales.

Five organizations are responsible for OOI's construction and ongoing development: Woods Hole Oceanographic Institution, Scripps Institution of Oceanography; Oregon State University; the University of California, San Diego; Rutgers; and the State University of New Jersey, with its partners University of Maine and Raytheon Mission Operations and Services.

Regional Cabled Array

The Applied Physics Laboratory at the University of Washington (APL-UW) is responsible for OOI's regional seafloor systems and moorings. The Regional Cabled Array (RCA) was designed for 25 years of continuous measurements across the Juan de Fuca plate and in the water column at three sites: the base of the continental slope (slope base 2,900 m); on the Oregon Margin (OR Endurance Offshore 600 m); and at the base of Axial Seamount (Axial Base 2,600 m).

The RCA is very flexible. It has substantial power and bandwidth, making it a highly adaptable network that spans a large area of the seafloor off the central Oregon coast. It currently supports over 140 oceanographic instruments.

At each site, two profilers are deployed. A profiler is a vehicle that moves oceanographic instruments up and down the water column. For research purposes, OOI surveys the upper 200 m—the euphotic (or sunlit) zone—at

each site with the Shallow Profiler, which is a purpose-designed system with capacity for up to 15 instruments on a specialized winched float. The Deep Profiler, a highly modified wire-crawler vehicle, transits the water column between the seabed and approximately 150 m below the surface. The profilers are designed to measure physical oceanographic parameters (e.g., current, temperature and conductivity); ocean chemistry (e.g., pH, CO₂, nutrients); and biological parameters (e.g., zooplankton and chlorophyll distributions).

With the profilers are normally under autonomous control, real-time data are streamed to the UW RCA Operations Center and into the OOI Data Portal. Capabilities include implementation of predefined missions, switching of missions and changing of mission parameters on the fly with commands from the UW Operations Center. The University of Washington worked with Phillystran on the profiler mooring lines for each site.

Deep Profiler. The Deep Profiler is a modified McLane Mooring Profiler. It is a traction-motor-driven, wire-following vehicle weighing approximately 100 kg in air and neutrally buoyant in seawater. It is mounted on a single mooring cable. Attached to a subsurface float positioned 80 m below the sea surface, the Deep Profiler mooring allows measurement of ocean properties from approximately 2,900- to 200-m water depth.

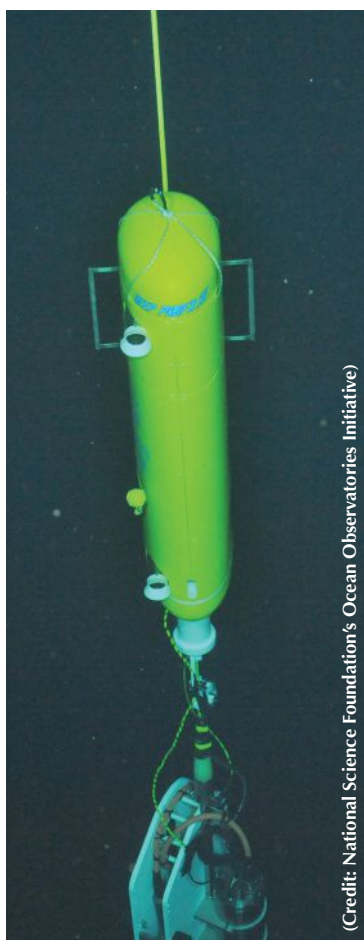
Continuous data communication is provided to the Deep Profiler vehicle via an inductive modem using the single copper conductor in the mooring cable and seawater as the return conductor. The inductive data consist of engineering data: depth, power consumption, battery status, etc.

When the Deep Profiler vehicle is in the dock at the base of the mooring, the science instrument data that have been stored on board during the profiles are transmitted to the dock through Wi-Fi and then to shore over the seafloor fiber-optic network.

While the vehicle is in the dock, the onboard batteries are charged using a wireless inductive charging system.

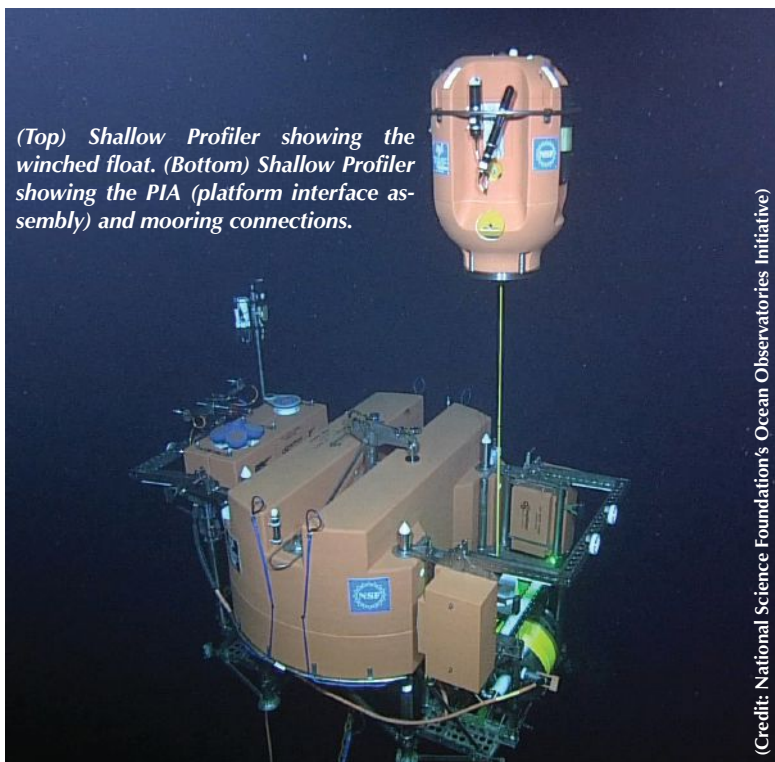
The Deep Profiler vehicle hosts six instruments and moves through the water column along the mooring cable, continuously sampling ocean characteristics over a specified depth interval (150 m below sea surface to near bottom).

Shallow Profiler. Since 2015, Shallow Profilers have executed over 30,000 profiles, providing unprecedented high-resolution data to shore in real time, covering processes in the upper 200 m of the water column. Built



(Credit: National Science Foundation's Ocean Observatories Initiative)

(Top) Shallow Profiler showing the winched float. (Bottom) Shallow Profiler showing the PIA (platform interface assembly) and mooring connections.



(Credit: National Science Foundation's Ocean Observatories Initiative)

Mooring Challenges

In general, the factors influencing the design of subsea mooring lines can be summarized as the length of the rope and anticipated maximum loads in use and during deployment. Other factors include: the maximum allowed diameter, including jacket and choice of jacketing material, together with the degree of permitted creep during the lifetime of the mooring.

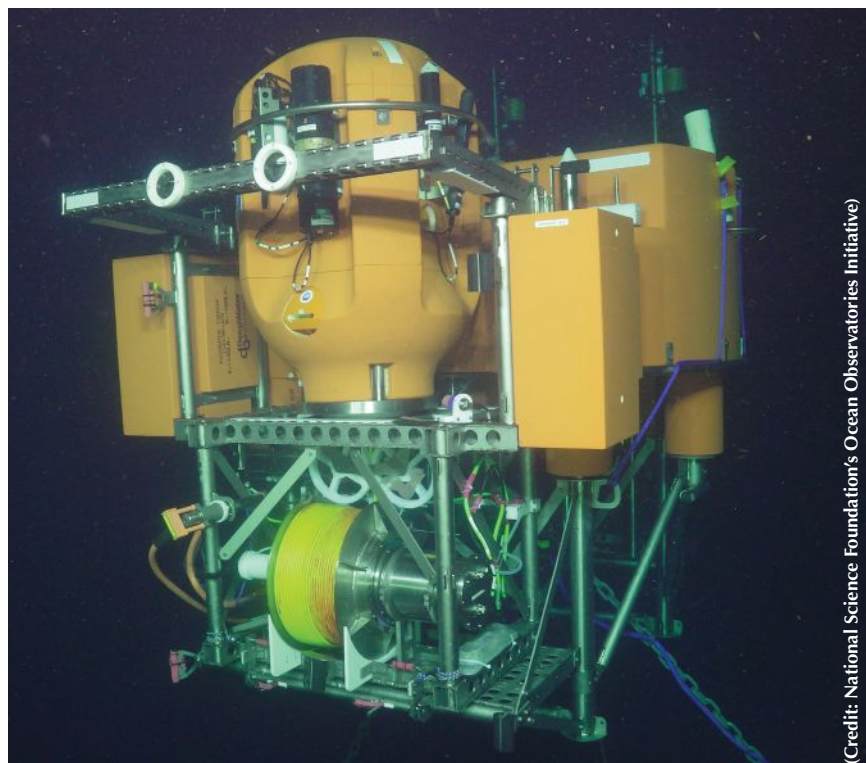
Deep Profiler Mooring. During installation of the Deep Profilers, the mooring cables are used to lower an anchor weighing 4,000 lb. and subject to a tension of 2,200 lb. In addition, to work with the profiler's in-built traction drive mechanism, the mooring line had to be approximately 16 mm in diameter (0.62 in.).

For the Deep Profiler, the most important requirement was that the mooring line must have enough tensile strength with low elongation to protect the copper conductor needed for the inductive communications with the profiler. APL-UW worked with Phillystran to develop a high-performance mooring cable with an Aramid tension member and a copper conductor that allowed the use of inductive communications technology.

The longest Deep Profiler mooring line is 2,900 m from the seabed to a flotation buoy positioned at 80-m water depth. Phillystran designed the mooring line to minimize elongation under load with a Zytel jacket for toughness. Copper yields at around 0.5 percent elongation, and there was a risk that the tension-induced elongation of the cable could cause the copper conductor to fail. Making the cable stronger protected the copper core. Phillystran was able to strike a balance between strength, elongation and flexibility to ensure it had a minimum bend radius, allowing it to be wrapped around the winch during shipping and deployment.

The Deep Profiler cable has titanium terminations designed by the UW team to provide the mechanical connection to the anchor and also an electrical connection between the copper conductor and seawater for the inductive communications. In the dock at the base of the mooring line, power and data transfer are provided to the Deep Profiler via an inductive coupler and underwater Wi-Fi antenna. Data are transmitted through Wi-Fi to the cabled docking station during battery charging.

Shallow Profiler Mooring. The Shallow Profiler has mooring requirements that are different from the Deep



(Credit: National Science Foundation's Ocean Observatories Initiative)

for nine profiles per day and 365-day operation between annual servicing missions, each Shallow Profiler is deployed and recovered by ROV, and so is the Platform Interface Assembly (PIA), which functions as an adjacent power and communications node for the Shallow Profiler.

The Shallow Profiler and PIA are supported by a 14- to 18-kN buoyant titanium and syntactic foam platform moored at a depth of 200 m at each site.

Profiler. It is moored with two mooring lines at each site, anchored roughly one water depth apart and oriented in line with the principal currents to minimize platform blowdown. One leg is a 1-in.-diameter electrical-optical-mechanical (EOM) cable with an Aramid strength member. This leg connects the seafloor network to the Platform Interface Assembly and Shallow Profiler, providing power and real-time data connectivity to shore. Phillystran supplied the second mooring line at each site. Made from Dyneema SK78 with a Dyneema jacket, it provides the strength, low creep and durability needed for a secure multi-year mooring.

Mooring Line Deployment

Two different winches were used for the moorings. For the Shallow Profiler, mooring line deployments involved a purpose-built drum winch with a 13-in.-diameter core and a hanging block with a sheave root diameter of 17 in. UW was particularly concerned about handling these lines under high tension on this winch, which contained up to 30 layers for the deepest site. Prior to deployment, the lines were loaded onto the winch at a tension of 1,000 to 1,500 lb. using a bull-wheel tensioner with two 36-in. diameter sheaves.

At sea, a 4,000-lb. weight was lowered on the end of the line to a depth of approximately 93 percent of the total line length and recovered onto the winch drum to provide additional pre-tension of the mooring line. Finally, the line was used to lower a 12,000-lb. (air weight)

anchor to the seafloor. The winch was designed with ample drum capacity and a level wind capable of triple-spaced line winding. The Shallow Profiler's Dyneema line length is greater than water depth and comes off the winch under relatively low tension after the anchor is on the seafloor.

The Deep Profiler mooring cable was deployed using a medium-lift winch with a drum diameter of 32 in. and a deployment block with 36-in. sheave diameter. The cable comes on and off the winch under tension and requires grip transfers. The same winch was also used to deploy the 1-in. EOM cable for the Shallow Profiler.

Correct placement of the mooring lines was critical to avoid damaging previously installed seabed equipment. The Deep Profiler typically required about 12 separate grip transfers to remove the top end of the cable from the winch during deployment. This is primarily due to the fact that the cable termination is not designed to pass over the winch drum, level wind and deployment block while under tension. For each transfer, three grips were used; although only one was needed, the other two serve as backups as a safety precaution. For the Deep Profiler, the original line had an HMPE jacket, which was susceptible to damage by the grips, and so Phillystran replaced the jacket with a more robust Zytel nylon jacket for subsequent moorings.

For the Shallow Profiler moorings, the two-leg configuration had significant deployment benefits. Because each catenary leg length is longer than the water depth,

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the team was able to connect the Shallow Profiler mooring lines to the subsea platform while it was still on the vessel. The mooring was deployed by lowering the first anchor to the seafloor on the Phillystran mooring line. The subsea platform is attached to the mooring line and the EOM cable on the ship and then deployed on the surface.

The EOM cable is deployed on the surface and syntactic floats are attached at intervals to offset the cable weight. Once deployed, the EOM cable is attached to the second anchor, which is lowered to the seafloor using the ship's steel wire winch. Deployments of Shallow Profiler moorings are complex operations that can take up to 18 continuous hours.

Conclusion

Resilient and reliable, the Deep and Shallow Profilers' mooring systems have been in operation for over five years. Interestingly, Phillystran's cable jacketing technology has proved its worth in more ways than expected.

Marine growth is common to all long-term oceanographic deployments. For the Deep Profiler, the build-up of growth on the mooring line was impeding its movement. To remove the marine growth during the profiler's annual maintenance, one profiler is replaced with another one, and a scourer fitted to an ROV removes the marine growth on the line with no adverse effect on the jacket and the cable inductive communications. Phillystran continues to demonstrate essential support

for OOI in more ways than one. APL-UW has had a long and successful relationship with Phillystran, which worked closely with APL-UW to meet OOI specifications, provide the required qualification data and supply terminated line assemblies to a tight schedule.

Acknowledgments

The authors would like to thank Brian Hostetter, marine sales manager at Phillystran, a WireCo WorldGroup company based in Philadelphia, for his contributions to this article. **ST**

Tim McGinnis is the Ocean Engineering Department head at the Applied Physics Laboratory at the University of Washington. He has over 35 years' experience designing and operating towed sonar systems, seafloor coring systems, cabled observatories and instrument moorings.

Geoff Cram is a licensed professional engineer at the Applied Physics Lab at the University of Washington. He led mechanical development, procurement and construction of the OOI Cabled Array Shallow Profilers and their moorings, as well as the OOI Cabled Array Secondary Nodes. His current work interests include advancements in hydroacoustic systems, seafloor geodetic instrumentation and undersea cable assemblies.

Eric Boget is a principal engineer at the Applied Physics Laboratory at the University of Washington. His primary focus and expertise is the deployment and recovery of complex oceanographic systems at sea. This includes the design, fabrication and deployment of moored, towed and seafloor systems.

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UDT 2020

Undersea Defence Technology (UDT), as the largest global event dedicated to the underwater defense industry, is a multifaceted exhibition and conference reflecting the community's desire for continuous learning and development.

UDT is designed to equip nations to deal with an increasing diversity of threats and challenges. It brings together researchers, military end-users and professionals spanning the entire supply chain to evaluate developing solutions in one of the harshest environments known to man.

In 2020, the event was initially scheduled to take place May 26 to 28 in Rotterdam Ahoy in the Netherlands. Because of the worldwide coronavirus pandemic, the event has been postponed to December 8 to 10. The show's overarching theme is "Teamworking in the Underwater Domain." Teamwork, between military and government, academic research, and industry development—what the Netherlands calls the "Golden Triangle"—is a concept vital to capability development.

The Netherlands' defense policy makes clear that international cooperation is at the heart of the Netherlands' development of its capabilities and in its future operational employment. This cooperative approach encourages regular and institutionalized collaboration between the government, knowledge institutions and industry. This ensures developments are both informed by the latest research and designed in accordance with the latest operational requirements.

UDT is a platform for the exchange of information and ideas between those working in the development and exploitation of undersea defense technology; it is the Underwater Golden Triangle.

Netherlands Underwater Focus

The latest Netherlands defense policy, published in 2018, highlights the investments the host nation will be making in the underwater domain. These investments are across the spectrum of underwater defense, with major programs in mine countermeasures, anti-submarine war-



fare (ASW) frigates and submarine platforms highlighted in the most recent policy papers.

As a key area of focus within the ASW domain, the Netherlands is funding a Maritime Unmanned Systems program, and interest and focus on torpedo defense is of increasing prominence. These program developments reflect the Netherlands' approach to its defense needs, but many other nations face similar challenges and share the same needs; for example, the need within these programs to be clear on the endurance requirements of platforms and capabilities. Is the deciding factor to be patrol endurance (port to port)? Will it be deployment endurance (homeport to homeport)? Or is to be the matching of individual capabilities to the overall demands of task group endurance?

These considerations have a major bearing on investment and design in all aspects of a capability, from material to personnel. UDT 2020 takes up these questions and aims to investigate them through its comprehensive conference agenda.

Agenda

The main conference agenda covers the following key areas: Operational Drivers and Imperatives, incorporating underwater communications, human-machine interfacing, command information flow and ASW; and Platform Design, including propulsion and energy system developments, signatures, life cycle management and costs, and innovative design. A Sensors and Processing stream will cover acoustic modeling, sonar design, passive sensors, and processing optical and audio signals, while the Unmanned, Remotely Piloted and Autonomous Systems stream will consider mine countermeasures, unmanned ASW, navigation and control of autonomous systems, and applications of extra-large UUVs (XLUUVs).

The full agenda is on the event website, with speakers confirmed from TNO, Royal Norwegian Naval Academy, Norwegian Defence Research Establishment, U.K. MoD Submarine Delivery Agency, Lloyd's Register, Damen Shipyards and Marina Militare Italiana, to name a few.

For more information, visit www.udt-global.com. **ST**

WEC Test Platform

Platform Enables Testing of Wave Energy Converter Hydraulic System

Xiangnan Wang • Qiang Li • Yi Guo

There is a growing interest in renewable energy world-wide. Wave energy can alleviate the pressures of energy shortage, greenhouse gas emissions and air pollution, and it can solve the problem of power supply in remote coastal areas of China.

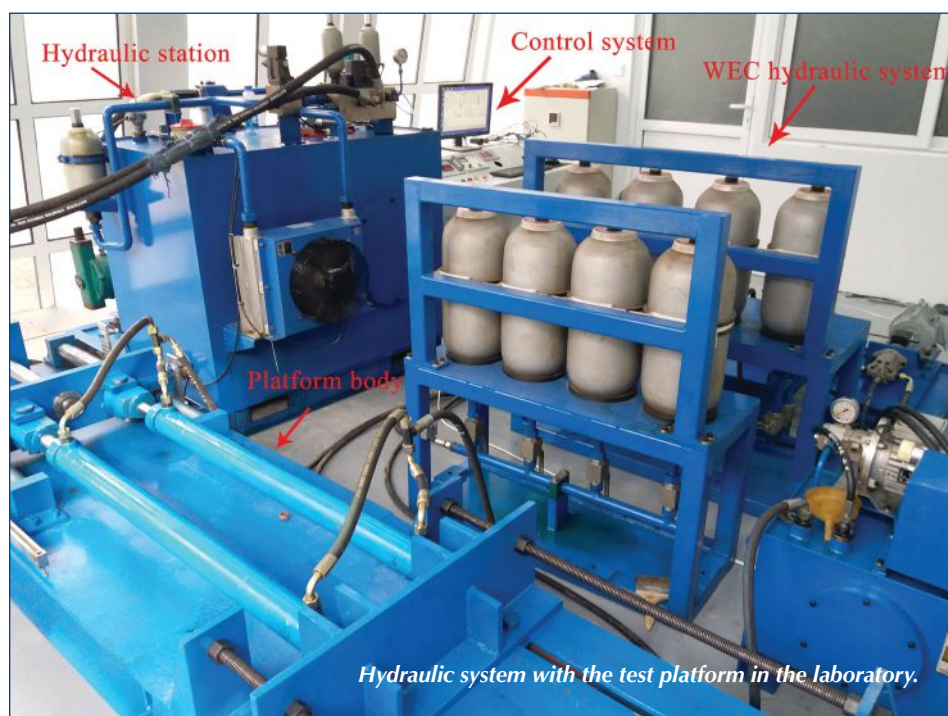
Utilization of wave energy is a complex process that involves energy absorption, transmission and conversion into electricity. There are two primary kinds of energy transmission systems used in wave energy converters (WECs): mechanical and hydraulic. Hydraulic systems can apply to small waves, and they are used in WECs such as the Wavebob, Wavestar and Pontoon Power Converter. The conversion efficiency of a hydraulic system directly affects the WEC's power generation capability.

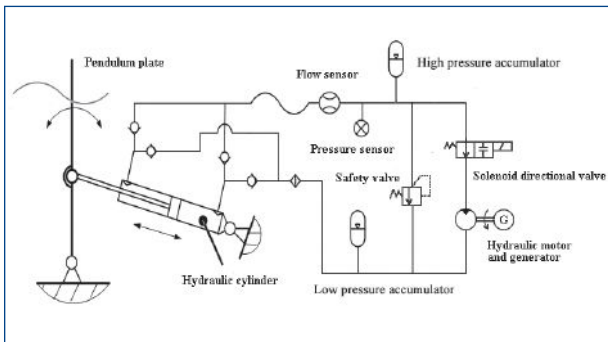
Dr. Jing Yang has designed a centralized hydraulic transmission system for a pendulum WEC and corrected the key parameters of the simulation model through a tank experiment of the scaled model. Professor Yaqun Zhang conducted a series of tank tests on the Sharp Eagle WEC model to obtain the optimal load matching each wave element and measured the primary and secondary energy conversion efficiency of the model under different wave conditions. A hydraulic test platform was also built for the small WEC, and it was tested in the lab in October 2017 and on land in June 2019.

Hydraulic System of Pendulum WEC

The pendulum WEC is composed of a pendulum plate, hydraulic system and control system. Under the movement of a wave, the plate oscillates back and forth to drive the piston of hydraulic cylinders, thus driving the operation of the whole hydraulic system.

The hydraulic system of the pendulum WEC is a closed system including hydraulic cylinders with a direction control valve group, hydraulic motor with solenoid directional valve, high-pressure accumulator, low-pressure accumulator and a 1-kW magneto generator. The hydraulic cylinders produce high-pressure oil by the pendulum plate under wave motion, and the oil is transformed by the direction control valve group into a one-way flow. In order to obtain high pressure and





(Top) The pendulum WEC. (Bottom) Schematic diagram of pendulum WEC hydraulic system.

enough flow to rotate the motor, a solenoid directional valve is set to open only when the pressure reaches 7.5 megapascals. The high-pressure accumulator can store high-pressure oil, reduce flow pulsation and achieve stable power generation. The low-pressure accumulator can store excess oil and supply oil to the hydraulic cylinder.

Test Platform Design

In order to test the performance of the WEC hydraulic system, the test platform needs to have the functions of wave simulation and data acquisition. The platform comprises a hydraulic station, driving hydraulic cylinder, platform body and control system. The hydraulic station provides a power source with a maximum flow of 145 liters/min. and a maximum pressure of 23.2 megapascals. The driving hydraulic cylinder has a diameter of 110 mm and a stroke of 600 mm. The driving hydraulic cylinder can provide reciprocating linear motion for the WEC hydraulic cylinder with a motion cycle of 4 to 12 sec. Its maximum thrust and pull forces are 30 and 22.5 tons, respectively. At the output end, a generator is connected to the motor. It can vary in power, according to the needs of the experiment. The control system consists of a PLC, an extension module and a host computer with corresponding test software. It can automatically control the position and velocity of the driving hydraulic cylinder and store data.

The high-pressure oil is pushed into the WEC hydraulic system by the movement of the driving hydraulic cylinder, and the hydraulic motor drives the generator to rotate. Between the hydraulic motor and the generator is a speed and torque sensor, which can calculate the output power of the WEC hydraulic system. Similarly, there are two pressure sensors and one flow sensor in the hydraulic station to measure the pressure and flow values of the driving hydraulic cylinder for input power calculation. These data are transmitted to the host computer through a data acquisition card. Finally, the input power, output power and conversion efficiency of the WEC hydraulic system are obtained.

In order to obtain the displacement curve of the driving hydraulic cylinder, a simplified hydraulic system model based on the hydraulic station is built with Siemens Simcenter Amesim. The sine wave signal and displacement feedback signal of the hydraulic cylinder are processed with a PID controller to get the input signal of the servo valve, and then the displacement curve of the piston is obtained. The spring damper rating is 10^5 N/(m/s), and the wave amplitude of the sine signal source is 0.3. The sine wave frequency is set to 0.25, 0.2 and 0.125 Hz, respectively, to obtain displacement curves of the piston in different periods. The results show that the displacement errors between the piston and sine wave signal in different periods are within 0.05 m, which meets the experiment's requirement.

Lab Experiment

First, the WEC hydraulic system was connected to the platform. Then, the values of stroke and motion period of the driving hydraulic cylinder were set on the computer. The stroke can be calculated according to the structure of the WEC and wave height, and the motion period is equal to the wave period.

Two groups of typical wave height and period data were selected as input for the test platform. The experiment results show that the maximum value and average value of output power of the hydraulic motor can reach about 850 and 400 W, respectively, which proves that the WEC hydraulic system can output power well.

The conversion efficiency is significantly affected by wave height and wave period. In this experiment, the conversion efficiency reached a value of 21.67 percent when wave height was 0.5 m and wave period was 3.5 sec. The results show that the test platform has the ability to test the WEC hydraulic system and get valuable data.

Land Experiment

In order to validate the actual output power effect of the hydraulic system, an overall experiment of the pendulum WEC was carried out on land. In the experiment, a large crane was used to pull the pendulum plate back and forth as the input of the WEC hydraulic cylinder. Two groups of different pendulum angles and pendulum cycles were selected. The pendulum angles were 25° and

***“The platform can be improved in the future
to expand the wave simulation range.”***

20° with pendulum cycle of 10 and 9 sec., respectively.

The experiment results show that the maximum output powers are 480 and 489 W, respectively, which validate that the hydraulic system is well matched with the pendulum plate of the WEC to output power effectively.

Conclusion

According to the working principle and characteristics of the pendulum WEC hydraulic system, a test platform was designed that is suitable for testing the conversion efficiency of the hydraulic system of the small WEC model in the laboratory. The results of the laboratory experiment and overall experiment on land show that the test platform has the ability to test the conversion efficiency of the WEC hydraulic system. The design of the WEC hydraulic system can be validated and optimized with the experiment data.

Only two kinds of regular wave motions were simulated in this experiment. In order to get more data, the platform can be improved in the future to expand the wave simulation range. In addition, the testing range and the

function of the test platform can be expanded according to the testing requirements of different hydraulic systems.

Acknowledgments

The authors would like to express gratitude to the team members involved in this experiment for the many valuable discussions and insights that contributed to this article. Zhonghua Zhang and Meng Li, in particular, contributed greatly to the experiment and article revision. **ST**

Xiangnan Wang is a professor whose research focuses on the development and utilization of wave energy technology. He works for China's National Ocean Technology Center.

Qiang Li is an engineer whose research focuses on hydraulic technology of wave energy converters. He works for China's National Ocean Technology Center.

Yi Guo is an engineer whose research focuses on electronic control technology of wave energy converters. He works for China's National Ocean Technology Center.



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**COPENHAGEN
SUBSEA**

Q&A: Scrubber Corrosion

Environmental issues are of worldwide concern, and the shipping industry recognizes that it has a role to play in addressing these issues.

Scrubber systems on ships clean exhaust gases and are essential to minimize the release of harmful particulate matter such as sulphur oxides (SOx) and nitrogen oxides (NOx) into the atmosphere, which can hurt human health and the environment.

The International Maritime Organization (IMO) addresses these polluting elements with Sulphur 2020, effective since January, which limits sulphur in fuel oil for ships operating outside designated emission control areas to 0.50 percent m/m (mass by mass). The objective is to significantly reduce the amount of sulphur oxides emanating from ships for major health and environmental benefits worldwide, particularly for populations living close to ports and coasts.

All ship sizes must now comply with the IMO Sulphur 2020 regulation, and scrubbers are necessary for compliance. Corrosion resistance is key in a high-performance scrubber. Anders M. Sørheim, a chemical engineer at Yara Marine Technologies, discusses the elements of a reliable system.

How important is material quality when selecting a scrubber system?

If the intention of a scrubber installation is to operate the scrubber for the lifetime of the vessel, assuming a minimum of 10 years, then the material quality is imperative.

A study performed by the American stainless-steel manufacturer ATI titled “Evaluation of Alloys for Marine Exhaust Scrubbers – Effect of Welding and a Crevice” confirmed the importance of correct material choice



for scrubbers. The weight loss and corrosion rate of five corrosion-resistant alloys commonly used in marine scrubbers were tested in a simulated scrubber environment. The results revealed that for a severe corrosion case, the alloy 254 SMO had a crevice corrosion rate of approx. 0.7 mm per year, while a corrosion rate close to 0 was found for Alloy 59.

What are the worst-case consequences of choosing poor-quality equipment?

Over the course of 10 years, these crevice corrosion rates could in theory grow up to 7 mm deep, which in some cases is more than the thickness of the scrubber wall. Such weak spots in the scrubber tower structure can lead to cracking or other fatigue issues caused by the constant mechanical vibration and the thermal expansion-contraction cycles on board a vessel, which would result in scrubber leakages.

Hopefully, such corrosion damages would be detected and repaired before any leakage occurs, but such expensive repair work would drastically increase the OPEX of scrubber produced with lower quality materials.

What are the most important factors in building a corrosion-resistant scrubber, in addition to alloy quality?

Welding, welding and welding.

Even if a scrubber was built in pure nickel, it could be susceptible to corrosion damages if the welds were not properly performed by approved welders, following an approved welding procedure using approved welding materials.

A good rule of thumb is that the welding material should be of a higher grade than the material being welded together, also known as ‘overmatching the filler material.’



In addition, the amount of heat applied during welding should be kept to a minimum to avoid hot cracking caused by the formation of carbides and intermetallic compounds in the weld.

Furthermore, the welds should be properly pickled and cleaned and, finally, subject to 100 percent NDT testing to ensure the absence of crevices caused by poor welding, including visual surface examination and ultrasonic testing.

A high focus on quality is as important in the scrubber material selection as in the post-manufacturing inspections.

What is your preferred choice of alloy?

Equipped with a broad base of maritime experience, Yara Marine was very conscious of the corrosion challenges in the extremely corrosive environment inside the scrubber when developing its pilot scrubber back in 2009. For this reason, the company chose the material Hastelloy for the first few scrubbers installed. It has excellent corrosion-resistant properties but is more sensitive to welding and is not very compatible with other materials.

For this reason, Yara Marine Technologies decided to go for a similar nickel-based alloy for our scrubbers. Based on 10 years of operational experience supported by simulations, we know where conditions are worst in-

side the scrubber, especially in the bottom part of the scrubber, and in these areas we design for the use of the material Alloy 59.

In other areas where the temperature is lower, we use the material AL6XN or similar, which, although not as resilient as Alloy 59, has great corrosion-resistant properties matching the corrosive environment in the upper part of the scrubber tower.



How can quality be guaranteed?

The simplest ways to guarantee quality is to purchase the nickel alloys from world-renowned, high-quality steel suppliers and to have the scrubbers manufactured in high-quality weld shops.

Yara's quality department does a thorough job of checking that the quality is ensured at factory acceptance inspection, where 100 percent of the internal welds undergo rigorous NDT testing, and any deviations found are reported, double checked and corrected, if deemed necessary.

Are there any significant developments underway in scrubber materials or construction methods?

Over the last few years, we have seen a shift in our competitors' material choice toward more corrosion-resistant alloys, although not to the extent we would have hoped. We have seen players in the market experiment-

ing with ceramic materials for the scrubber, which is an interesting approach, as ceramics do not corrode, but they are unfortunately susceptible to other types of damages due to their brittle nature.

Various kinds of plastic composites such as GRE have been tested but are not a real option due to their low melting point.

Some manufacturers have even tried different coatings inside the scrubber, but unfortunately the coating does not last long in the extreme environment.

The next developments we see will be about the continued optimizing of the scrubber tower design, as long as it does not increase the risk for corrosion.

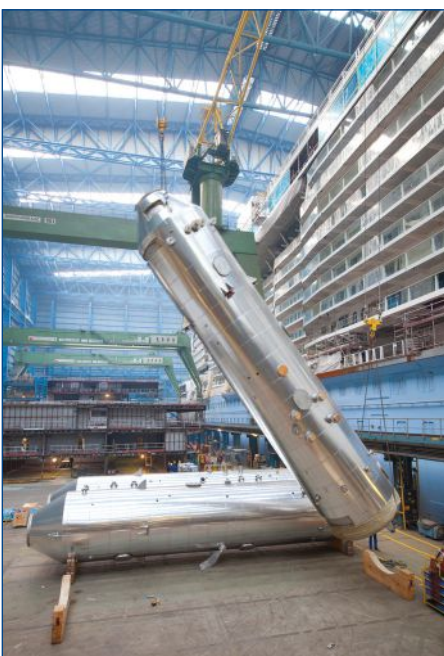
What are some of the most common reasons that ship-owners opt for lesser quality in scrubbers?

Different shipowners have different reasons for opting for lower quality scrubbers, and we cannot know for certain the true reasons behind these decisions. Some shipowners may not realize the extent of the corrosive environment, while others may not believe that it is necessary to use such high-grade nickel alloys. But, then again, dealing with sulfuric acid in a high-temperature environment is a new challenge for most shipowners.

There are also speculations that some shipowners who have high rates of asset flipping do not appreciate the lower OPEX of a more corrosion-resistant scrubber, as the ships will only stay a few years in their fleet before being sold.

In your opinion, are the rules and regulations for scrubber manufacturing strict enough?

In general, the rules set by the class societies such



as DNV GL cover the structural strength, hull integrity, and the safety and availability of the main functions in order to maintain essential services on the ship. Unfortunately, the scrubber system is not considered a main function, and therefore has less stringent rules for manufacturing. When it comes to corrosion protection, DNV GL amended their rules for scrubber systems in 2017 to include the text: "The exhaust gas cleaning unit and exhaust piping exposed to the

cleaning water or treated exhaust shall be suitable for the corrosive properties of the two medias." How well this rule is interpreted and enforced, however, is a different question. Not all corrosion-resistant alloys are sufficiently resistant to corrosion in the scrubber environment. **ST**



pCO₂

General Oceanics, Inc. introduces its **new model 8050 autonomous pCO₂ monitoring system**. Continuous measurement, recording and transmission of sea surface CO₂ levels.

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- **Infrared analysis of CO₂ concentrations.**
- **Automatic calibration.**
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MacArtney Connectors for Mediterranean

MacArtney will supply and test several underwater connectors for INFN, the National Institute for Nuclear Physics. INFN for the IDMAR Research Infrastructure in Sicily supports the KM3NeT (Cubic Kilometre Neutrino Telescope) infrastructure in the Mediterranean Sea. MacArtney will work with INFN to provide junction box mechanical frames and pressure vessels to host optical and power assemblies (OPA) for the connection of neutrino detection units from the seabed. The working depth of the pressure vessel and OPA will be 3,500 m.

Equinor Prioritizes Climate Efforts

Equinor has launched a new climate roadmap to ensure a competitive and resilient business model in the energy transition, fit for long-term value creation and in line with the Paris Agreement.

Equinor aims to: reduce the net carbon intensity, from initial production to final consumption, of energy produced by at least 50 percent by 2050; grow renewable energy capacity tenfold by 2026, developing as a global offshore wind major; and strengthen its industry-leading position on carbon efficient production, aiming to reach carbon neutral global operations by 2030.

Unique Group Expands in APAC

Unique Group has acquired the Australian company Western Advance's Marine Division and appointed Chris Forde as its new regional vice president. Forde has over 20 years' experience in the subsea oil and gas industry. Unique Group has built a strong presence in APAC, offering survey equipment, buoyancy and ballast, diving and life support, and on-site engineering products and services to customers. The acquisition of the marine division of Western Advance provides an established Australian presence.

SBG Moves into Singapore

SBG Systems has a new subsidiary in Singapore to bring sales and technical support to the Asian region.

SBG Systems supplies MEMS-based IMU and inertial navigation systems for land, air and marine applications. The company has been working and developing its sales distribution channels in Asia for many years.

Start-Up Supports Oil, Gas Gig Economy

A new start-up company, set to revolutionize resourcing in the energy industry, has invested £120,000 to open an office in Aberdeen, with plans to recruit an additional 15 employees. Xergy is the company behind Proteus, a cloud-based work management system that allows companies to find the right people for projects as and when needed. It will transform the way the industry sources and uses talent. Xergy believes Proteus has the potential to capture a large share of the oil and gas gig economy, worth £9.6 billion, and a portion of the £3.9 billion oil and gas ERP (enterprise and resource planning) market.

Classification Societies' Evolving Role

The Indian Register of Shipping's (IRClass) Managing Director Suresh Sinha argued that classification societies are looking beyond their traditional roles as regulators and exploring ways to leverage their technical expertise to stay relevant to the industries they serve.

He made the remarks at the Qatar Maritime & Logistics Summit held in Doha. The inaugural summit gathered industry leaders and decision makers from the Middle East and beyond to discuss issues concerning the sustainable development of the maritime and logistics sectors.

In his speech, he said the role of classification in the modern maritime industry is rapidly changing due to technological advancements and tightening regulations on environmental protection and safety, and classification societies must support these changes.

Agreement on Shipboard Data Standard

The Smart Maritime Council, a cross-industry membership group focused on improving technology interoperability in the maritime sector, has announced its intention to support the use of the ISO 19848 data standard for shipboard machinery and equipment.

The Smart Maritime Council is an initiative created by the Smart Maritime Network in 2019, which brings together maritime service and equipment providers, vessel operators and related industry stakeholders to discuss issues of technology compatibility, standardization and harmonization across the global transport chain.

Funding for Diver Resuscitation

Ten subsea companies have pledged £65,000 for a medical research project to determine the best procedure for resuscitation of divers in a diving bell. Led by Philip Bryson, medical director of diving services of Iqarus, the joint industry project will find out how resuscitation techniques should be delivered to a casualty in a diving bell at depth. Divers at depth are exposed to a multitude of hazards that increase the risk of losing consciousness and requiring CPR.

Nanosatellite Design, Build

Space Flight Laboratory (SFL), a developer of microspace missions for over 21 years, is designing and building the first fully operational nanosatellite in Kepler Communications' next-generation constellation of communications satellites. SFL is also helping Kepler set up a manufacturing workflow at a new facility in Toronto, where subsequent nanosatellites will be mass produced based on the design of the first satellite.

AI-Powered Production Optimization

Ambyint has announced a \$15 million Series B funding round led by Cottonwood Venture Partners, with additional investment from Mercury Fund and Ambyint's management team. Building on its successful adoption among oil and gas producers, Ambyint will extend its optimization solutions across all wells and artificial lift systems and grow its Houston and Calgary offices.

StratumFive Acquires FleetWeather

StratumFive, a big-picture data applications company, has finalized the acquisition of U.S.-based weather routing and analytics company FleetWeather Group. With a 50-year history of service to shipping, the integration of FleetWeather Group strengthens StratumFive's current suite of mission-critical solutions with forecasting, routing, monitoring and claims expertise.

ACV Enviro Adds to Fleet

ACV Enviro's maritime team has launched additions to its marine fleet with multi-use deck barges and workboats in various sizes, each custom equipped to respond to growing U.S. East Coast customers' inland and open-water vessel needs.

The team has been servicing major shipping companies, tug and barge operators, port authorities, Department of Defense and Transportation for nearly 50 years, and this expansion reflects the increase in demand from old and new customers.

Polar Star Completes Another Antarctic Journey

The 159 crew members on board the U.S. Coast Guard Cutter *Polar Star* have left McMurdo Station after escorting three refuel and resupply vessels and assisting a five-day inspection of foreign research stations, installations and equipment in Antarctica.

This was the *Polar Star's* 23rd journey to Antarctica in support of Operation Deep Freeze, an annual joint military service mission to resupply the U.S. Antarctic stations.

Kraken Makes TSX Top 50

The Toronto Venture Stock Exchange has recognized Kraken Robotics as a 2020 Top 50 Company. The TSX Venture 50 is a ranking of the strongest companies on TSX Venture Exchange by share price appreciation, trading volume amount and market capitalization growth.

This marks the second year in a row that Kraken has been recognized as a TSX Top 50 company.

Navis, Streamline Partnership

Octopi by Navis, a provider of terminal operation solutions for the maritime shipping industry, and Streamline, a software-as-a-service (SaaS) enterprise resource planning (ERP) logistics and supply chain management company, have partnered to offer small- to mid-size terminals and shipping companies a comprehensive, transparent solution for their logistic tracking needs. The first use of the product of this partnership will be Florida's Port Manatee, the closest U.S. deepwater seaport to the expanded Panama Canal.

OceanGate Relies on NASA for New Hull Design

NASA's Marshall Space Flight Center in Huntsville, Alabama, will serve as the facility for the development and manufacturing of a new aerospace-grade hull for OceanGate's latest Cyclops-class submersible. The sub is intended to dive to 6,000 m with five crew members on board. **ST**

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Digital Hydrophone



Hydraq QQ1000 is a ground-breaking combination of acoustic and auxiliary sensors suitable for seabed, rising cable or suspended cable deployment. It has applications for ports and harbors, including environmental legislation compliance, marine mammal and generic noise pollution recording, and vessel sound signature identification. Seiche Ltd. and QinetiQ.

Vessel Insight Update

Shipowners and operators using Vessel Insight can now improve performance and reporting and reduce fuel and energy consumption through the new Vessel Performance application. Users will also be able to achieve increased transparency and awareness about vessel emissions. KONGSBERG.

Quality Control Module

Version 4.1, which is called Navy, has been introduced to the 7Cs Analyzer. The module enables the validation of AML data. The AML product specifications, AML 2.x and 3.0, are supported by Navy. SevenCs GmbH.

Design Support Software

PrimeShip-HULL (HCSR) Ver.7.0.0 has been developed in response to the IACS Common Structural Rules for Bulk Carriers and Oil Tankers (CSR BC & OT). In addition to the incorporation of the latest rule amendments, various functions were added or improved in the PrimeShip-HULL (HCSR) prescriptive calculation software and direct strength assessment software. ClassNK.

LED Torch Light

Dragonfish II is a dual-channel, high-quality LED torch light for professional HOW/ROV/AUV imaging applications. It features independently dimmable LED arrays, allowing for white or color blending and independent bi-color operation. Arctic Rays LLC.

Multiparameter Sensor

VLux MiniSonde provides robust data collection for UV or visible fluorescence monitoring. It makes integrated corrections for multiple environmental parameters, with models suitable for monitoring BTEX, PAH, tryptophan and algae. Chelsea Technologies Ltd.

AI for Sonar Noise



HIPS and SIPS 11.3 is a software upgrade that will introduce the first-ever commercial-off-the-shelf release of an AI solution for classifying and cleaning sonar noise. The Sonar Noise Classifier automatically identifies the vast majority of sonar noise, resulting in a reduction of manual cleaning effort by a factor of up to 10x at an accuracy of 95 percent. Teledyne CARIS.

Automation Products

The Dynautics range includes: SPECTRE 2 navigation and control electronics; E-Boat SPECTRE for faster, simpler data collection; and SPECTRE MK4 for converting a boat from manned to unmanned operation. Dynautics Ltd.

Acoustic Recorders

SYLENCE-LP is a development of two off-the-shelf, low-power acoustic recorders: SYLENCE-LP 220 (22 cm high, 35 days of autonomy)

with one fixed hydrophone, and SYLENCE-LP 440 (44 cm high, up to 180 days of nonstop recording) with one fixed or loose hydrophone. RTSYS.

Doppler Speed Log



Intelligent data processing ensures that accurate measurements of vessel speeds are available even in challenging sea conditions. The logger has achieved accuracy of around 0.5 percent consistently, even in the open ocean with varying wave and weather conditions. Nortek AS.

Fuel Reporting

The 5720 NMEA2000 Flow Adapter Module reports fuel flow and usage over the NMEA2000 network using positive-displacement flow meters. These sensors connect directly to the 5720 using IP68-rated standard Deutsch connectors. Oceanic Systems (UK) Ltd.

Imaging Sonars

5-D and 6-D Echoscope PIPE (Parallel Intelligent Processing Engine) sonars embed an advance signal processing engine that enables parallel signal processing of every sonar ping value in the sonar viewing volume. This represents processing and availability of up to 40 million 3D backscatter data points per sonar ping in real time in the field of view. Coda Octopus Group Inc.

Regional Connectivity

AgilePlans Connectivity as a Service is now a regional offering with the 37-cm TracPhone V3-HTS antenna. With data speeds as fast as 5 Mbps down/2 Mbps up, the TracPhone V3-HTS suits fishing vessels, workboats and smaller commercial vessels. KVH Industries Inc.

Digital Condition Monitoring

Ability Condition Monitoring for measurement devices will keep

continuous gas analyzers under control to ensure clean air operations. The new digital solution keeps track of the health of ABB measurement devices. ABB Ltd.

Underwater Drones

The Sibiu Nano weighs only 5.15 kg and can conduct inspection procedures down to 100-m depth, with live images from its 1080p camera. The 16-kg Sibiu Pro can carry several payloads for applications such as cleaning of subsea assets, measuring cathodic protection, gauging metal thickness or collating environmental data. Nido Robotics.

Radar Updates

NXT Solid-State options for FAR2xx8 Radar and FAR3000 Chart Radar series are available in X-Band and S-Band configurations. X-Band radar generally provides better target resolution. S-Band radar, operating at a lower frequency, is less affected by rain and fog and can detect targets at greater distances. Furuno USA Inc.

Marine Snow Catchers

Large-volume water samplers have separable top and bottom sections for collecting and characterizing suspended and sinking particles in the water column. These samplers aid research in the export processes of the oceanic organic carbon and nutrient cycles. OSIL.

Ultradeepwater Composite Foam

The Eccofloat materials range includes the TG11500 developed for the Triton 36000/2 Full Ocean Depth (FOD) Submersible, a manned vehicle depth-rated to 11,500 MSW. Eccofloat uses the highest-specification hollow glass microspheres, called Eccospheres. Trelleborg AB.

Clean Water on Board

The FlowSafe DCD 2000 uses commercial-level pre-filtration in front of specially selected ultrafiltration to provide unlimited drinking water and disinfectant on vessels, with environmental and health benefits. Flow Water Technologies Ltd. **ST**

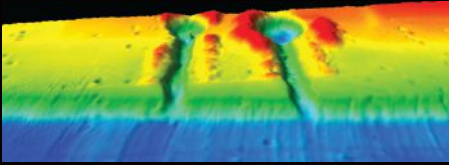
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Data Award for Hurricane Maria Response

Woolpert and Optimal GEO received the MAPPS Award for Data Acquisition & Processing and the MAPPS Grand Award for their "Hurricane Maria: Rapid-Response Lidar Collection" project at the 13th annual Geospatial Excellence Awards in Honolulu.

The project was performed by WMR-532, the joint venture of Woolpert and Optimal GEO, in support of the U.S. Army Corps of Engineers (USACE) and the Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX).

WMR-532 collected topographic and bathymetric lidar, digital imagery and hyperspectral imagery data along the Puerto Rico coastline after Hurricane Maria hit the island in September 2017. The perishable data and imagery helped local, state and federal decision makers assess

immediate post-storm damage to aid in response, recovery and resilience efforts and help the island better prepare for and mitigate the impact of future storms.

Ammonia Fuel Guide

Korean Register (KR) has published technical information on the use of ammonia as an alternative marine fuel, comparing it to other types of carbon-neutral alternative fuels (www.krs.co.kr/eng). The free guide covers the fuel's key features, industry trends and relevant technologies, and the future outlook for ammonia.

The International Maritime Organization (IMO) aims to reduce carbon dioxide emissions by 40 percent by 2030, and by 70 percent by 2050, which reduces the viability of fossil fuels as compliance solutions in the long term. LNG is widely viewed as a next-generation clean fuel, but it derives from a fossil fuel

and still emits carbon dioxide when burned.

KR anticipates that in order to stay ahead of regulations on carbon dioxide emissions and to reduce greenhouse gas emissions, there will be an increasing industry shift to zero-carbon or decarbonized alternative fuels such as biodiesel, methane, hydrogen, methanol and ammonia.

Dive Shops Utilize Underwater Metal Detector

The Pulse 8X is the handheld underwater metal detector sold by JW Fishers Mfg. The unit has been rated #1 by U.S. Homeland Security and continues to be the go-to product for many people looking to own a commercial-grade detector. Sales to military, police, search and rescue dive teams, public safety dive teams, commercial businesses, and recreational divers constitute the majority of sales year after year.

JW Fishers is proud to support local dive shops across the globe, and they are a key part of JW Fishers'

NEW class of ROV Propulsion



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success. For example, Sail Fish Scuba of Key Largo, Florida, purchased a Pulse 8X to locate lost treasures.

Diving Supervisor App

The International Marine Contractors Association (IMCA) has successfully completed trials of its Diving Supervisor CPD App.

IMCA launched a pilot continuing professional development (CPD) scheme for diving supervisors in September 2019. The development of an app-based scheme incorporates the very latest in training techniques to support diving supervisors in keeping up to date with information and guidelines from IMCA.

Website Facilitates Fuel, Lubricant Sourcing

A new online platform has been developed to help ship operators source marine fuels and lubricants in ports across the world: bulugo.com. The platform provides fast and transparent pricing globally.

Bulugo enables ship operators to reduce the time and cost involved in sourcing fuel and lubricants by searching an online database of potential suppliers across several criteria, including fuel type, port, date of availability and compliance with IMO sulphur regulations. Fuel suppliers will benefit by tapping into a wider pool of customers.

Energy Apprenticeships

Energy logistics provider Peterson is actively recruiting individuals looking to enter the energy sector with modern apprenticeships available in business administration, warehousing and logistics. The program offers apprentices the opportunity to develop their skills and knowledge by gaining valuable industry experience from qualified professionals and mentors.

Several apprenticeship graduates have secured full-time positions with Peterson, a company that will turn 100 later this year.

Chile Vessel Tracking Data Now Public

The Chilean government has made its vessel tracking data publicly available through Global Fish-

ing Watch (GFW), which tracks the movements of commercial fishing vessels in near real time. Anyone can now remotely monitor more of Chile's commercial fishing vessels via GFW's map platform in near real time, for free. This demonstrates Chile's commitment to greater transparency in fishing and is the result of Oceana's collaboration with the government to increase transparency of commercial fishing in Chile.

Bio-Fuel Oil Trial

UECC and GoodFuels have launched a joint trial of GoodFuels Bio-Fuel Oil (MR1-100 or BFO) on UECC's ro-ro vessel MV *Autosky*.

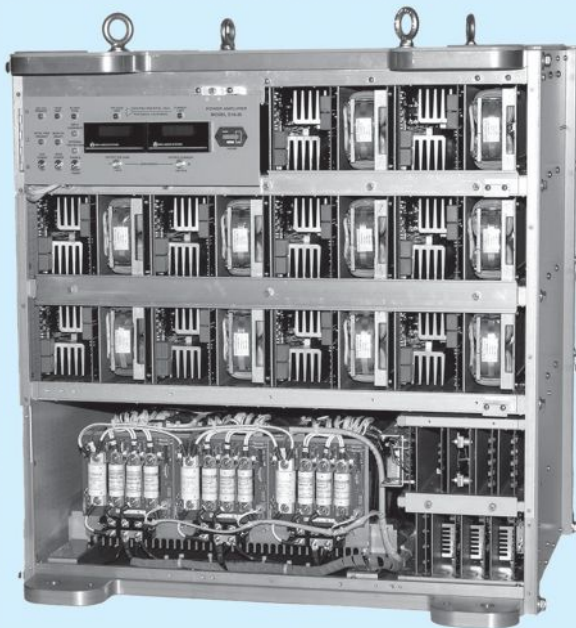
The three-month trial will test 3,000 metric tonnes of sustainable biofuel on the 140-m, 2,080 vehicle carrier.

This will be a significant step in advancing marine biofuel for the ro-ro segment. **ST**

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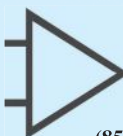
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SPOT Trace to Track North Atlantic Sargassum

Globalstar Europe Satellite Services Ltd., a wholly owned subsidiary of Globalstar Inc., has announced that researchers from the NIOZ Royal Netherlands Institute for Sea Research, the University of Amsterdam (UvA) and Utrecht University are using drifter buoys fitted with SPOT Trace satellite trackers to understand the dramatic increase of Sargassum seaweed across the North Atlantic.

Sargassum has started washing up in areas including the Caribbean and the Southeast U.S. in such huge quantities that it is killing coral, impacting fishing and forcing the closure of beaches. By analyzing the GPS data transmitted from SPOT Trace trackers, the biologists aim to understand where the free-floating, kelp-like algae originates and how its environment is changing, so that action can be taken.

Study Reveals Hidden Benefits of Mesopelagic

A natural carbon sink—even bigger than the Amazon rainforest—helps regulate Earth's climate by sucking up to 6 billion tons of carbon from the air each year, according to a new report from researchers at Woods Hole Oceanographic Institution (WHOI), which reveals for the first time the unseen benefits that people receive from the ocean's twilight zone. Also known as the mesopelagic, this is the ocean layer just beyond the sunlit surface.

The ocean twilight zone is a mysterious place filled with alien-looking creatures. The nightly massive migration of animals from the zone to the surface waters to find food helps to cycle carbon through the ocean's depths, down into the deep ocean and even to the seabed, where it can remain sequestered indefinitely.

The ocean twilight zone comprises a carbon regulating service worth \$300 to \$900 billion each year. Without the nightly animal migrations that help shuttle carbon

to the deep ocean, atmospheric carbon dioxide levels could be as much as one-third more than they are today, which translates to an average temperature increase of about 6° C or 10.8° F.

Commercial interests are considering the harvest of twilight zone organisms as a source of proteins and lipids for expanding aquaculture and nutraceutical operations, which are expected to grow by 37 percent from 2016 to 2030.

The loss of the carbon sequestration service as a consequence of a changing climate or the overfishing of twilight zone animals could amount to significant mitigation and adaptation costs (estimated in the hundreds of billions to trillions of dollars) by the end of the century.

Fast Storms, Shallow Water Can Increase Flood Damage

Fast-moving storms can cause catastrophic coastal flood hazards on the U.K.'s East Coast, according to new research by scientists at the National Oceanography Centre (NOC). This research used computer programs to analyze the traveling speed of storm Xaver, which was responsible for generating the highest storm surge in the North Sea in the last 60 years. The study found the fast traveling speed of Xaver was an important factor in the consequent coastal flood.

Lead author Dr. Xiaoyan Wei from the NOC said, "We tend to think slower storms should cause greater flood hazards because they act on the sea surface for a longer period of time, and as a result set up a higher surge. But our research shows that fast-moving storms can actually cause much higher water levels if resonance takes place."

The rise in sea level due to wind whipping up the sea was the main contributor to storm surges on the U.K.'s East Coast during Xaver. This effect is strongly dependent on water depth, fetch (the area of sea that wind can blow over) and wind duration. Storm surge, when coinciding with strong tides, can result

in catastrophic coastal flood hazard. But, at coasts with a large tidal range, the storm surge and tide can interact in a way that decreases the maximum water level, reducing the potential flood hazard.

The U.K. southeast coast is particularly vulnerable because of a low tidal range and a long stretch of shallow sea, over which the wind can whip up the sea level.

Workboat for Autonomous Shipping Research

UiT, the Arctic University of Norway, has received a new ProZero Workboat for its Autonomous Ships Navigation research program after successful sea trials at the ProZero building yard of Tuco Marine in Denmark.

In addition to the spacious driver and control cabin, the boat has room for the full research crew. It is equipped with well-organized working decks. The mast can hold all the sensor and camera equipment during research missions.

Making Scientific Knowledge More Useful to Society

In several new studies, University of Miami Rosenstiel School of Marine and Atmospheric Science researcher Katharine Mach and colleagues explore the importance of learning and knowledge in environmental decision making and the different ways in which scientific knowledge can become more relevant and useful for societies.

In a new paper, Mach and coauthor Noah W. Feinstein, an associate professor at University of Wisconsin-Madison, argue that educational tools—including schools, simulations and on-the-job training—can substantially accelerate the adaptation process.

In another paper, researchers point out that the co-production of knowledge, in which researchers, practitioners, stakeholders and decision makers interact for climate change adaptation, requires that different approaches match the types of decisions and decision-making contexts at hand. Researchers and practitioners should work together in ongoing and meaningful ways. **ST**

Web Company Looks to 3D Printing of Spare Parts

ShipParts.com, an online e-procurement portal for marine spares and equipment, is taking part in a project to investigate how additive manufacturing, more commonly known as 3D printing, could revolutionize the way spare parts are procured and delivered.

ShipParts.com has been operating for about five years and has built up a client base of more than 1,800 buyers and more than 17,000 sellers actively trading on the platform.

The company says that digitalizing procurement processes can cut order processing time for spare parts by 80 percent, a key consideration for the marine industry, where reducing off-hire time for ships is critical.

Promoting European Battery Tech

The BMZ Group and VDE Renewables GmbH have formed a strategic partnership to promote a European network platform dealing with battery technology.

The Battery Experts Forum, organized by the BMZ Group, will serve as a platform for jointly advancing the issues surrounding electrification in the future.

VDE Renewables is a 100 percent subsidiary of the VDE technology association, which is concerned with issues relating to renewable energy generation and storage.

Ship Simulation Center Expands in Australia

The expanded facilities of HR Wallingford's state-of-the-art Australia Ship Simulation Centre have opened. HR Wallingford has added two new purpose-built simulators to its center in Fremantle, bringing the total number of simulators that it owns and operates there to six.

This makes it one of the largest ship simulation centers in Australia and allows a full maneuvering team (including pilots, tug masters and vessel traffic service operators) to conduct integrated and immersive

full port scenarios. All of the simulators can be linked together to represent a single virtual port environment, or run separately to allow for a number of scenarios at one time.

Inmarsat Saudi Agreements

Inmarsat will bring its maritime, aviation and enterprise connectivity solutions to customers based in Saudi Arabia through new partner agreements. The company has also secured new spectrum licenses to deliver both its narrow-band (L-band) and high-capacity broadband (Ka-band) Global Xpress (GX) services in Saudi Arabia, enabling Saudi-based businesses to deploy these services for the first time.

Fixed and mobile satellite telecommunications distributor Sada Al Ammah and Global Beam Telecom are Inmarsat's first distribution partners in Saudi Arabia and the region, and they will work closely with Inmarsat's Maritime, Aviation and Enterprise businesses to roll out services in the region.

Cloud Powers Drones

Two Connecticut drone companies are joining forces by automating operations in security, environmental and military fronts globally with airborne and amphibious drones. Aquiline Drones (AD), a cloud and drone solutions company, will power GuardBot's spherical and amphibious robotic vehicles via the AD Cloud (ADC).

GuardBot's circular drones range from 6.5 in. to 7 ft. in diameter and move using a patented drive mechanism for forward and backward motion and 360° turns. They can operate continuously for up to 25 hr. on one charge and reach speeds of up to 3 mph in water. Pods contain interchangeable sensors, such as video cameras, thermal, infrared, microphones, GPS and audio for continuous data gathering, transmission and communications.

Hybrid PowerBuoy Prototype

The prototype for Ocean Power Technologies Inc.'s hybrid Power-

Buoy is in production at its New Jersey facility. The PowerBuoy will provide remote power for subsea and topside applications, reliable data communications and a nominal 1.5-megawatt hours of energy storage. Solar charging of onboard battery power with a clean-fueled Stirling engine backup makes the hybrid PowerBuoy a low- to zero-carbon power solution.

Applications include monitoring, surveillance, subsea charging and connectivity for offshore industries, including oil and gas, science and research, aquaculture, and telecommunications.

BV Survey via Drone

Bureau Veritas Marine & Offshore (BV) has completed its first survey by drone, carried out in the holds of a bulk carrier in an Italian port. The scope was an intermediate survey on a bulk carrier comprising closeup inspections and ultrasonic thickness measurements (UTM) conducted by the drone in two cargo hold spaces. The required prior agreement from the flag authority was confirmed. The ship is subject to the IMO Code for the Enhanced Survey Programme.

Remote inspection techniques (RIT) were reflected in BV's rules in 2019. The drone operator involved in this survey is certified by Bureau Veritas for RIT and UTM.

A Cybersecurity First

In a milestone for the marine industry, ABB's solutions on board a large passenger ship have been awarded cybersecurity verification from classification society DNV GL. This vessel became the industry's first to achieve system compliance under DNV GL's framework for integrated cybersecurity.

Cybersecurity management processes will continue during the ship's operations, with the system's resilience maintained throughout the lifetime of the vessel.

DNV GL's Integrated Cyber Security Dependent Systems verification establishes a framework to address cybersecurity levels for the main functions of a vessel, both during construction and in operation. **ST**

Fugro Investigates Wind Farm In Netherlands

Following last year's geotechnical contract for the Hollandse Kust (west) Offshore Wind Farm Zone, Fugro was awarded a geotechnical site investigation contract for the Ten noorden van de Waddeneilanden Wind Farm Zone (TNWWFZ). The final deliverable for the Netherlands Enterprise Agency will be a data package that can be used to prepare a detailed integrated geological and geotechnical soil model, on which wind farm developers will base future tenders.

The fieldwork is taking place February to May. The project has two phases: a shallow subsurface investigation, followed by a borehole drilling program and standard and advanced laboratory testing.

Guide to Offshore Wind in US

As momentum to build large-scale U.S. offshore wind farms con-

tinues, the new Offshore Wind Public Participation Guide, produced by the American Wind Energy Association (AWEA) and the University of Delaware's Special Initiative on Offshore Wind (SIOW), details the process and opportunities for public stakeholders and interested parties wishing to have their opinion heard.

All infrastructure development has unintended impacts, and members of ocean industries and coastal communities have made it clear they want a say in the offshore wind development process. The new guide highlights public participation opportunities in the federal Bureau of Ocean Energy Management regulatory process that governs leasing of areas on the Outer Continental Shelf for renewable energy development.

Seabed Survey by USV

A vessel remotely controlled from shore took to the sea off Suf-

folk to undertake survey work for the Greater Gabbard Offshore Wind Farm, a joint venture between SSE Renewables and innogy. The XO-450 USV, owned and operated by XOCEAN, carried out seabed surveys on seven of the turbines at the 140-turbine wind farm, located 23 km off the U.K. coast.

Throughout the survey, the data collected were monitored from shore in real time by experts located in the U.K. to validate data collection before the vessel departed the work locations.

Testing Program for Wave Energy Park Tech

Seabased Group has signed an agreement with the European Marine Energy Centre (EMEC) to design and implement a testing program supporting Seabased's certification goal for its latest generation wave-to-grid wave energy park technology. Certification will pave the way for quality controlled manufacture. A certified process will enable a reduction in manufacturing costs,

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logistics and transport, a faster track to local permitting and insurance, and an opportunity for Seabased to generate local jobs and training for future maintenance of their systems.

The collaboration is partly funded by the Interreg North Sea Region Ocean Energy Scale-up Alliance accelerator program for deployment of large-scale marine energy pilots.

Offshore WEC Contract

Malin Renewables has secured a contract to supply a 50-tonne wave energy converter (WEC). Malin has been appointed by AWS Ocean Energy Ltd. to build the half-scale Archimedes Waveswing power generation device, designed for offshore wave energy production.

The development of the Archimedes Waveswing is funded by Wave Energy Scotland.

Renewable Tool Concept, Prototype Tested

After a successful site acceptance test at the test center Østerild, the new SG 11.0-193 DD Horizontal

Single Blade Mounting tool is ready for market and is pre-approved for a German wind farm project.

Working with Siemens Gamesa, MacArtney has established its position as a trusted adviser and solution provider for essential wind turbine development projects through a rigorous design cycle, including concept development, 3D modeling, destructive testing, optimizing and future-proofing for equipment and application.

Jumbo to Conduct Monopile Transportation

Jumbo has been awarded a contract to support DEME Offshore in its scope of work on Ørsted's Hornsea Two offshore wind farm. Jumbo will provide transportation for 165 monopiles from Rostock to Eemshaven and 135 transition pieces from Aalborg to Eemshaven with a K3000 class vessel. Jumbo will also undertake project management for the transport scope, including the engineering and design of transportation and cradles.

Surveillance for South Korea Offshore Wind Farm

Cambridge Pixel has supplied its RadarWatch coastal surveillance software, target tracking and radar recording technology to Klein Marine Systems, a subsidiary of Miticham Industries Inc., as part of a project to protect an offshore wind farm and its associated submarine transmission line off the coast of South Korea.

Cambridge Pixel's radar display, tracking and recording technology has been integrated with the radar, daylight/thermal cameras, an AIS receiver and long-range acoustic device (LRAD) as part of Klein's HarborGuard maritime security and surveillance solution. The local integrator is Seoul-based company iSENTECK.

The surveillance system monitors vessel traffic around the wind farm and along a 10-km submarine transmission line carrying power from an offshore platform transmission station to the onshore distribution facility. **ST**

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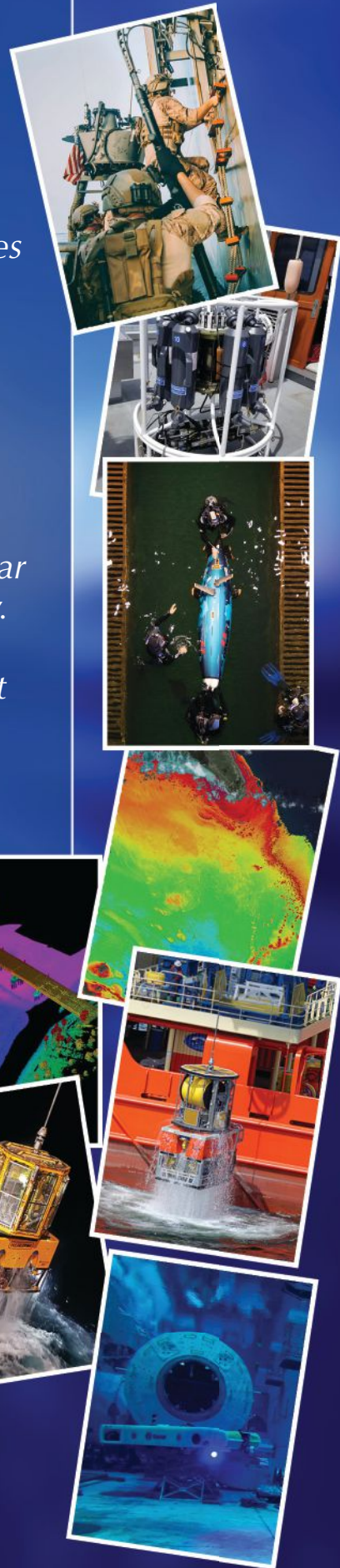
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people

The Harbor Branch Oceanographic Institute Foundation (HBOIF) Board of Directors has announced the retirement of HBOIF President and CEO **Katha Kissman**. She joined HBOIF full time in July 2014. During her tenure, she has worked with the board to increase the foundation's endowment from \$60 million to over \$79 million and has overseen the management of \$31 million in grants. She established strong financial controls and a sound structure for managing grant making and other processes. Kissman will remain as CEO through June. Barbra Kavanaugh will become interim CEO this summer.



Stacey Duff has become president of Turner Designs. She joins from Papco Industries, where she started as a driver 23 years ago, worked her way up to president, and recently sold the company. Former Turner Designs President **Jim Crawford** has known Duff for five years and was impressed with how she

handled difficult business challenges while maintaining a positive culture at Papco. Duff is taking over day-to-day management of Turner Designs. Crawford retains his role as vice president of engineering and remains the sole owner of Turner Designs and chairman of the board.

Blackbuck Resources LLC, specializing in water infrastructure for oil and gas, has expanded its executive management team. **Barry Portman** is now chief operating officer, with more than 20 years of oilfield experience in operations, drilling, completions, facilities, maintenance and integrated service management. **Jamie Liang** is now chief financial officer, with over 17 years of experience in finance, investment banking and E&P management.

Oceaneering International Inc. has appointed **Earl Childress** to succeed **Steve Barrett** as senior vice president of business development. Childress will have worldwide business development responsibility for Oceaneering's energy-related segments.

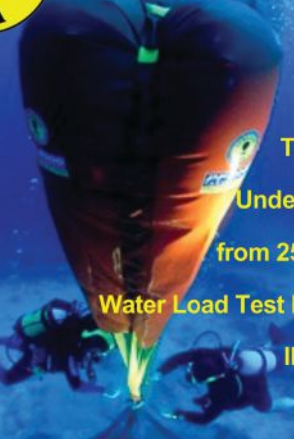
Seiche Environmental has announced three appointments. **Amanda Hyam** joins as associate director to enhance the team's expertise operating in the oil and gas, marine construction and engineering, offshore renewables, and marine science sectors. **Nicky Harris** is being promoted to associate director. **Michelle Roffe** has been promoted to business development executive for Africa.

Tyler McKinney is now Desert Star's sales manager, transitioning from production manager. He has extensive experience with Desert Star's products. **ST**



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meetings

Note: The coronavirus (COVID-19) could affect event dates. Check event websites for the latest updates.

MAY

May 6-7—Remote Hydrography Conference, Southampton, England. helen@ths.org.uk or www.ths.org.uk/content.asp?page=99.

May 18-19—Maritime Transport Efficiency Conference, Geneva, Switzerland. bernard.schopfer@maxcomm.ch.

May 19-21—Aquaculture UK, Aviemore, Scotland. cholm@divcom.co.uk or <https://aquacultureuk.com>.

May 19-21—International Conference on Ocean Energy (ICOE), Washington, D.C. www.icoe2020.org.

May 19-21—MegaRust, San Diego, California. 703-836-6727, asnehq@navalengineers.org or www.navalengineers.org/Symposia/MegaRust-2020.

May 19-21—OceanTech Program, Zhoushan, China. +852 2881 5889 or katherinelee@together-expo.com.

May 19-21—Waterpower Week, Washington, D.C. 202-682-1700 or <https://waterpowerweek.com>.

JUNE

June 3-4—BlueTech Expo, Washington, D.C. 703-850-1448, rich.lawson@iostia.org or www.BlueTechExpo.org.

June 3-4—LNG Latin America 2020 International Congress, Buenos Aires, Argentina. <http://lnlatinamerica.com>.

June 9-11—Capitol Hill Ocean Week, Washington, D.C. info@marinesanctuary.org or capitolhilloceanweek.org.

June 9-11—CLEAN PACIFIC, Seattle, Washington. <https://2020.cleanpacific.org>.

June 9-11—Seawork, Southampton, England. www.seawork.com.

June 10-11—BlueTech Expo, Washington, D.C. rich.lawson@iostia.org or www.BlueTechExpo.org.

June 16-18—Technology, Systems & Ships, Washington, D.C. www.navalengineers.org/Symposia/Technology-Systems-and-Ships-2020.

June 17-19—International Workshop of Marine Technology - MAR-TECH, Vigo, Spain. www.mar-tech-workshop.org.

June 29-30—Navy Contracting Summit, Norfolk, Virginia. tinyurl.com/su69spo.

JULY

July 1-2—Scottish Fishing Conference 2020: From Innovation to Action, St. Andrews, Scotland. paul@mindfullywired.org or tinyurl.com/thlwnkx.

July 14—Restoring Estuarine and Coastal Habitats in the North East Atlantic, London, England. roger.proudfoot@environment-agency.gov.uk.

July 15-16—American Society of Naval Engineers Multi-Agency Craft Conference, Baltimore, Maryland. 703-836-6727, asnehq@navalengineers.org or www.navalengineers.org/Symposia/MACC-2020.

AUGUST

August 10-12—AUVSI XPONENTIAL, Boston, Massachusetts. meetings@auvsi.org or www.xponential.org.

August 11-14—Oceans 2020 Singapore, Singapore. info@oceans2020singapore.org or <https://singapore20.oceansconference.org>.

August 18-21—International Partnering Forum on Offshore Wind, Providence, Rhode Island. www.offshorewindus.org/2020ipf.

SEPTEMBER

September 7-9—Oceanology International Middle East, Abu Dhabi, United Arab Emirates. +971 2 491 7615, firas.abultaif@reedexpo.ae or www.oceanologyinternationalmiddleeast.com/en-gb.html.

September 8-11—SMM (Shipbuilding, Machinery & Marine Technology), Hamburg, Germany. +49 40 3569 2445, nora.hirschfeld@hamburg-messe.de or www.smm-hamburg.com.

September 14-17—Fleet Maintenance and Modernization Symposium, Virginia Beach, Virginia. www.navalengineers.org/Symposia/Fleet-Maintenance-and-Modernization-Symposium-2020.

September 21-25—NMEA/RTCM Conference & Expo, Orlando, Florida. 410-975-9425 or www.nmea.org.

September 23-24—Oil Spill India, Mumbai, India. +011 43013474, priyal@itenmedia.in or <http://oilspillindia.org/pdf/2020/OSI2020-Brochure.pdf>.

September 28-October 2—SNAME Maritime Convention, Houston, Texas. 703-997-6701 or www.sname.org.

September 29-30—Teledyne Marine Canadian Users Conference, Halifax, Canada. www.teledyne-marine.com/events/Teledyne-Marine-Users-Conference-Canada.

OCTOBER

October 6-8—World Conference on Floating Solutions, Rotterdam, Netherlands. admin@pavingthewaves.blue or www.pavingthewaves.org.

October 11-16—SEG, Houston, Texas. exhibits@seg.org or <https://seg.org/AM/2020>.

October 12-14—Climate Risk Summit, London, England. +44 (0)20 7576 8118, events@economist.com or <https://events.economist.com>.

omist.com/events-conferences/emea/climate-risk-summit-2020.

October 14-15—World Ocean Tech and Innovation Summit, Halifax, Canada. oceanspeakers@economist.com.

October 19-22—OCEANS 2020 Gulf Coast, Biloxi, Mississippi. www.oceansconference.org/gulf-coast-2020.

October 20-23—EURONAVAL, Paris Le Bourget, France. www.euronaval.fr.

NOVEMBER

November 2-4—MAST Asia, Tokyo, Japan. https://mastconfex.com/asia2020.

November 3-5—Marine Renewables Canada Conference, Halifax, Canada. amanda@marinerenewables.ca.

November 16-20—BlueTech Week, San Diego, California. www.ttabluetech.org/bluetech-week.

DECEMBER

December 1-3—Oceanology International London, London, England. +44 (0)1202 669244, j.riegal@saltwater-stone.com or www.oceanologyinternational.com.

December 8-10—UDT, Rotterdam, Netherlands. www.udt-global.com.

December 16-17—West Coast Defense Contracting Summit, San Diego, California. 202-552-0179 or marketing@defenseleadershipforum.org.

2021

January 19-20—Floating Wind Solutions Conference & Exhibition, Houston, Texas. 832-862-3390 or https://floatingwindsolutions.com.

September 6-10—London International Shipping Week, London, England. +44 1296 682104, ljacobs@elabor8.co.uk or https://londoninternationalshippingweek.com.

November 2-5—Aquatech Amster-

dam, Amsterdam, Netherlands. +31 (0)6 51815306 or a.koomen@rai.nl.

For more industry meetings, visit sea-technology.com/meetings. **ST**

contracts

Forum Energy Technologies, Houston, Texas, has secured an order to supply a light work-class ROV to be installed on the Canadian research icebreaker CCGS *Amundsen* to support the exploration of Arctic and sub-Arctic seafloor ecosystems. Amundsen Science.

Miros, Oslo, Norway, has a new distribution agreement to introduce its range of radar-based solutions to a global rental pool for real-time insights about local sea state and marine conditions without the need for submerged equipment. Seatronics.

Optimarin, Sjøveien, Norway, has signed a fleet agreement for the installation of 16 Optimarin ballast systems (OBS), with an option to extend the contract to 50 vessels in total. The OBS will be installed across a range of advanced PSV, subsea and AHTS vessels. DOF.

Damen Shipyards, Gorinchem, Netherlands, has signed a contract to supply five inshore ferries to carry tourists visiting Pemba Island and others nearby in the Zanzibar Archipelago. Ministry of Infrastructure, Communications & Transport of the Revolutionary Government of Zanzibar.

i-Tech 7, Aberdeen, Scotland, Subsea 7's Life of Field business unit, has entered into a collaborative technology agreement to accelerate subsea digitalization, initially for a period of five years. Shell International Exploration & Production Inc.

Ashtead Technology, Aberdeen, Scotland, has secured a contract to provide its Deflection Monitoring

System (DMS) and field engineers to install six integrated template structures in the Barents Sea offshore Norway. The DMS is a suite of structural monitoring systems to assist offshore construction. Ocean Installer AS.

Kongsberg Maritime, Kongsberg Norway, has sold a HUGIN AUV system rated to 6,000-m depth, with a HISAS 1032 synthetic aperture sonar and EM2040 multibeam echosounder. Indian National Institute of Ocean Technology.

Høglund Marine Solutions, Barkåker, Norway, will supply fuel gas supply systems for Tallink Grupp's newest LNG powered ferry, *MySTAR*. Høglund will work with Finnish tank manufacturer West Welding on their design and supply. Rauma Marine Constructions.

OSM Maritime Group, Limassol, Cyprus, has extended a partnership for fleet management software. OSM vessels with planned maintenance systems will be standardized on TM Master. Tero Marine.

The International Cargo Handling Coordination Association, London, England, has signed a memorandum of understanding for the coordination of efforts to promote improved safety across the maritime industry. Association of Bulk Terminal Operators.

MacGregor, part of Cargotec, Helsinki, Finland, has received an order to supply deck machinery and cargo handling equipment to the U.S. Coast Guard Polar Security Cutter program. VT Halter Marine Inc.

Alumarine Shipyard, Couëron, France, has delivered a new hydrographic survey boat powered by a Torqeedo dual electric/diesel propulsion system. Port of La Rochelle.

ThayerMahan Inc., Groton, Connecticut, has teamed up to provide unmanned maritime and survey services using the DriX USV in North America and other parts of the world. iXblue. **ST**

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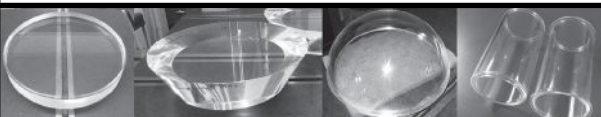
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Europe Needs More Collaboration on Research Vessels—Dr. Paula Kellett

Dr. Paula Kellett is a science officer at the European Marine Board (EMB), an independent think-tank operating at the marine science-policy interface that is based in Belgium. She holds a master's degree in naval architecture, and her Ph.D. focused on commercial-ship underwater noise prediction. She earned both of those degrees from University of Strathclyde, which is located in Glasgow, U.K.



Marine data are crucial for understanding how ocean environments function and, increasingly, how that functioning is being affected by climate and other global change. In coastal regions, it is possible to gather data through direct observations and sampling by scientists and even the public (e.g., via citizen science), but in the open ocean, one of the most reliable means of study today is using research vessels and their equipment.

For this reason, the European Marine Board (EMB) and the European Research Vessel Operators (ERVO) network explored the status of research vessels in Europe. In November 2019, EMB published a position paper on “Next-generation European research vessels: Current status and foreseeable evolution” (tinyurl.com/ts84k2j). A working group of 17 experts from 11 European countries wrote this peer-reviewed document reviewing the status and capabilities of the current European fleet, assessing its ability to support scientific research now and into the future.

At present, 99 European research vessels are publicly owned, openly available to research and operate on at least a regional scale. They all have the minimum capability to measure the conductivity, temperature and depth of water using a CTD rosette; deploy (at least) a small sediment sampler and a small plankton

net or trawl; and have at least one acoustic sensing system. Smaller, less capable vessels, which operate on a local scale, were not included in this study, but should be investigated separately to understand their status, trends and needs.

The fleet of 99 vessels breaks down into around one-third coastal-class vessels, with an average length of 27 m; one-third regional-class vessels with an average length of 46 m; and one-third ocean- and global-class vessels with an average length of 84 m. The fleet is highly capable and well-equipped for current scientific needs but will need to keep pace with changing demand and technological development. The fleet is also aging, with an average age of 25 years and more than one-third of the vessels exceeding their expected functional lifetime of 30 years. A strategic look at the fleet and its capabilities is urgently needed to ensure an appropriate program of renewal, replacement and refits for the continued provision of excellent support to marine research and monitoring into the future.

Research vessel capacity is not equally spread across Europe. While 23 countries operate at least one research vessel, over half of the fleet is owned by only six countries (France, Germany, Norway, U.K., Spain and Portugal). The management approaches also vary significantly: The European fleet is managed by 62 different operators. Only a few countries (e.g., France) manage their fleets centrally. The picture is similar for large items of equipment such as ROVs, AUVs, gliders, drill rigs, etc. While there is no “correct” approach to fleet and equipment management, and appreciating that a number of factors influence the different approaches taken, it is clear that a more efficient use of available resources could benefit operators at local, regional, national and even interna-

tional levels. Pooling or sharing of equipment, crew and data could be beneficial and should be explored. Links with industry in this respect may also be appropriate.

It is also important, given the uneven spread of capabilities, to ensure that researchers are able to access required ship time regardless of the infrastructures available in their country. Excellence in science should be the criteria on which access is decided, and, therefore, transnational access mechanisms are strongly encouraged, coupled with appropriate funding. This is particularly important for ensuring access to specialized vessels such as polar and deep-sea vessels. Nine European research vessels have ice-breaking capability, and eight are capable of deploying a full set of deep-sea equipment, meaning that capacity is limited to a few vessels owned by a few countries. Polar research capacity is further limited by the dual role of most ice-breaking research vessels to also serve as logistics support to Antarctic research stations. While logistics support can be provided by other vessels, research cannot, so alternative approaches should be considered.

With scientific demand and technological development both driving forward, research cruises and vessel operation are becoming more complex, placing additional demand on vessel crews, marine technicians, vessel operators, etc. There is a current lack of dedicated training opportunities, meaning that most operators will rely on in-house training and transfer of expertise. This can lead to problems when key staff leave or are unavailable. Dedicated training for research vessel roles is needed, and, again, links with industry should be explored.

We will need a strategic view and closer collaboration to ensure that research vessels continue to support our study of the ocean into the future. **ST**

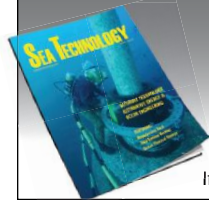
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