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Ocean Power Technologies**



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**- Chris Coyle,
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JANUARY

Annual Review & Forecast / Buyers Guide/Directory

***Oceanology International Americas*, February 25-27, San Diego, CA

FEBRUARY

Instrumentation: Measurement, Processing & Analysis

***U.S. HYDRO 2019*, March 18-21, Biloxi, MS

***Ocean Business*, April 9-11, Southampton, U.K.

MARCH

Electronic Charting/Vessel Management/Ports & Harbors/Dredging/Homeland Security

***AUVSI XPONENTIAL 2019*, April 29-May 2, Chicago, IL

APRIL

Offshore Technology/Alternative Energy & Ocean Engineering

***Offshore Technology Conference*, May 6-9, Houston, TX

***UDT 2019*, May 13-15, Stockholm, Sweden

MAY

Communications, Telemetry, Data Processing

***BlueTech Expo*, June 4-5, Washington, DC

***Oceans '19 MTS/IEEE Marseille*, June 17-20, Marseille, France

***CLEAN PACIFIC 2019*, June 18-20, Vancouver, Canada

JUNE

Seafloor Mapping/Sonar Systems/Vessels

JULY

Deck Gear, Cable, Connectors, Power Systems & Salvage

AUGUST

Geophysical Exploration/Seafloor Engineering

***SEG 2019*, September 15-20, San Antonio, TX

***OceanObs'19*, September 16-20, Honolulu, HI

SEPTEMBER

Ocean Resources Development & Coastal Zone Management

***Offshore Energy 2019*, October 7-9, Amsterdam, The Netherlands

***CLEAN GULF 2019*, October 28-30, New Orleans, LA

***OCEANS 2019 Seattle*, October 28-31, Seattle, WA

OCTOBER

Environmental Monitoring, Remote Sensing & Pollution Control

***International Water Conference*, November 10-14, Orlando, FL

NOVEMBER

Undersea Defense/Antisubmarine Warfare

DECEMBER

Diving, Underwater Vehicles & Imaging

***Underwater Intervention 2020*, February 4-6, New Orleans, LA

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- *Sea Tech e-News*
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JUNE COVER IMAGE CORRECTION

Due to an oversight, the June 2019 print issue contained an incorrect cover caption. The updated caption is: Teledyne CARIS image of satellite-derived bathymetry of the British Virgin Islands. (Acknowledgements: TCarta, DHI and DigitalGlobe)

JULY COVER IMAGE

PMI's EverGrip Termination and Dam/Blok Splice kit installed on subsea water sampler unit off the coast of California in March 2019.

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Blockchain Isn't Enough— We Also Need Collaboration

Blockchain has had a unique trajectory as a technology over the past year, being touted as a panacea to many of shipping's ills—and, as if by magic, resolving the fragmentation, bureaucracy and opacity that continue to define the sector, while somehow inexplicably netting us all some of that magic internet money. New currencies flourished, initial coin offerings (ICOs) became an exciting new way to raise capital without pesky banks, and blockchains were going to fix everything.

It was an almost overwhelming level of hype—which is, in turn, perhaps why sentiment toward the technology dropped off so quickly in many quarters. As the understanding of blockchain grew, so too did a healthy level of skepticism about its potential applications. Many have quite rightly critiqued the rush to use blockchain for everything—leading to a surprising backlash toward a technology that, two years ago, few had even heard of.

We think blockchain should not be dismissed so quickly. What's necessary is to examine the potential stumbling blocks. A recent report from the Boston Consulting Group does a great job of identifying barriers the technology faces in transport and logistics, markets where, initially, a secure, decentralized store of information seemed to be among the most exciting use cases. "The best blockchain networks," it argues, "are often the hardest to create."

At the crux of the issue is a fundamental element of blockchain: trust. The transformational potential of blockchain networks lies in their potential to create trust between parties without intermediation—but this fundamentally runs counter to many of the business models on which shipping is built. "By increasing transparency, these distributed digital ledgers can mitigate the mistrust that often exists among the industry's transacting parties. Yet this same mistrust makes it hard to bring together the industry's diverse participants into a common blockchain ecosystem." This paradox is at the heart of blockchain, and an important reason why so many applications in transport and logistics have struggled to find their feet.

Instead, we've found the best results come from bringing together industry stakeholders by invitation and aligning interests to address shared friction points across entire value-chains. These stakeholders include suppliers, producers, customers, competitors, regulators and governments, to name a few. The pain points we've identified include: tracing the provenance of a fuel and ensuring that crew documentation can be relied upon.

The pain points are where blockchain can add value by providing efficient, tamper-resistant and auditable chains of custody. The same characteristics that make an effective basis for cryptocurrencies also mean that blockchain can benefit shipping. For example, applied to bunkering, blockchain-based systems can reduce safety risk and create a more trustworthy framework for accurately monitoring emissions from shipping. We've already demonstrated the use of blockchain to verify chains of custody for the bunkering of sustainable biofuel. We continue to build consortia to develop solutions for fuel traceability, as well as crew certification, with stakeholders throughout the industry such as Lloyd's Register, Maersk, Heidmar, GoodFuels and many others.

We regard this collaborative approach of aligning shared interests in a network as akin to the "sport" of conducting business, where every actor may have different roles and self-interests, but by working together they collectively achieve more than by going it alone. This is where the potential for real change lies: creating systems that level the informational playing field with access to trusted information on, for instance, fuel compliance, crew qualifications and emissions reduction.

Bringing together stakeholders with competing objectives and finding common ground is the first, most difficult and most important step. It's only if we as an industry are willing to work more collaboratively that we can realize the value that can come from decentralized digital infrastructure. **ST**

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)) Almost Half of World Heritage Sites Could Lose Glaciers by 2100. Glaciers are set to disappear completely from almost half of World Heritage sites if business-as-usual emissions continue, according to the first-ever global study of World Heritage glaciers, co-authored by scientists from the International Union for Conservation of Nature (IUCN). The study, “Disappearing World Heritage glaciers as a keystone of nature conservation in a changing climate,” combines data from a global glacier inventory, a review of existing literature and sophisticated computer modeling. The authors predict glacier extinction by 2100 under a high-emission scenario in 21 of the 46 natural World Heritage sites where glaciers are currently found. Even under a low-emission scenario, eight of the 46 World Heritage sites will be ice-free by 2100. The study also expects that 33 to 60 percent of the total ice volume present in 2017 will be lost by 2100, depending on the emission scenario. “This study on glacier decline further emphasizes the need for individual and collective actions to achieve the mitigation and adaptation aspirations of the Paris Agreement on climate change,” said Jean-Baptiste Bosson, lead author of the study.

)) SEA-KIT USV Completes First International Commercial Uncrewed Transit. SEA-KIT, a 12-m-long USV designed and built in Essex, U.K., docked in the Belgian port city of Oostende following a successful transit from West Mersea. The voyage, which lasted 22 hr., represents the first commercial crossing of the North Sea by an autonomous vessel and marks a significant breakthrough in uncrewed ocean transit. The SEA-KIT USV was welcomed by Belgian customs officers, who took delivery of a box of oysters caught around Mersea Island. The box weighed around 5 kg—just a fraction of the current model’s maximum payload of 2.5 tonnes. The SEA-KIT USV “Maxlimer” is operated by SEA-KIT International Ltd. and was designed and developed by Hushcraft Ltd. SEA-KIT’s modular design can be configured to a wide range of maritime tasks for various sectors. SEA-KIT was developed for, and used with, the Kongsberg Maritime HUGIN AUV for the GEBCO-Nippon Foundation Alumni Team entry to the Shell Ocean Discovery XPRIZE, a competition to advance deep-sea technologies for autonomous, fast, high-resolution ocean exploration.

)) Success in Saving Derelict Fishing Gear. More than 4 million lb. of derelict fishing gear that would otherwise have become marine debris has been collected, recycled and converted into energy, thanks to Fishing for Energy, a partnership between the U.S. National Fish and Wildlife Foundation (NFWF), the NOAA Marine Debris Program, Covanta and Schnitzer Steel Industries. Over the past decade, the Fishing for Energy partnership has worked directly with 55 U.S. fishing communities in 12 states by offering no-cost solutions to recycle derelict and retired gear. Through the installation of collection bins at strategic ports, local communities have been able to responsibly dispose of fishing traps and nets that are no longer in use, thus preventing them from entering U.S. waterways and coastlines. The partnership has directly engaged more than 1,000 fishermen in recycling.

)) Progress in Washington State’s Blue Economy Strategy. The process to implement Washington state’s Strategy for the Blue Economy is underway. Pursuing Washington State’s vision of being a world-class, thriving and sustainable maritime industry by 2050, WA Maritime Blue, in partnership with DNV GL and Impact Washington, has hosted the inaugural Blue Forum: Uptown Tech Meets the Working Waterfront. This forum is the first in a series of information sharing and networking events designed to strengthen Washington’s maritime sector by fostering its connection with other key sectors within the state. This initial forum targeted the state’s robust information and communications technology sector and convened maritime and tech industry leaders and stakeholders in Seattle to examine and discuss the role and opportunity for data, digitalization and Internet of Things (IoT) solutions, and the challenges for optimization and decarbonization of the state’s maritime industry. The forum provided a unique opportunity for knowledge transfer on challenges and technology readiness for solutions. It also served to connect stakeholders to explore the potential for collaboration through developing joint industry projects (JIPs). As a member of the WA Maritime Blue Cluster organization and a partner for the strategy implementation, DNV GL is leading the effort to convene Blue Forum events, as well as convening JIPs targeting the development of new solutions to solve challenges and break down barriers to implementation. The first WA Maritime Blue JIP workshop was held at DNV GL’s office in Seattle.

)) Boost for Global Seabed Mapping Project. The Nippon Foundation-GEBCO Seabed 2030 Project and the World Ocean Council (WOC) have forged a partnership to advance mapping the world’s ocean floor. WOC will engage the ocean business community to promote the Seabed 2030 vision and the ways in which organizations in the maritime community can collect and contribute bathymetric data to Seabed 2030. Companies interested in participating in providing seabed data are encouraged to contact the WOC at info@oceancouncil.org. Seabed 2030 will take part in the WOC annual Sustainable Ocean Summit that will take place in Paris November 20 to 22, and will collaborate with WOC to conduct an SOS workshop for industry on bathymetric data collection and sharing. The Nippon Foundation-GEBCO Seabed 2030 Project, launched at the UN Ocean Conference in 2017, is a collaborative project to map the entirety of the world’s ocean floor by the year 2030 and to include all bathymetric data in the freely available GEBCO Ocean Map. **ST**

Powering Subsea Operations

Rechargeable Battery Modules Keep AUVs on Task

By Leon Adams • Bob Melvin

Subsea applications are getting smarter and going untethered. Untethered subsea operations that are advancing the industry require batteries that are safer, smarter, smaller, lighter, provide more capacity, deliver more power, and are highly reliable with longer life.

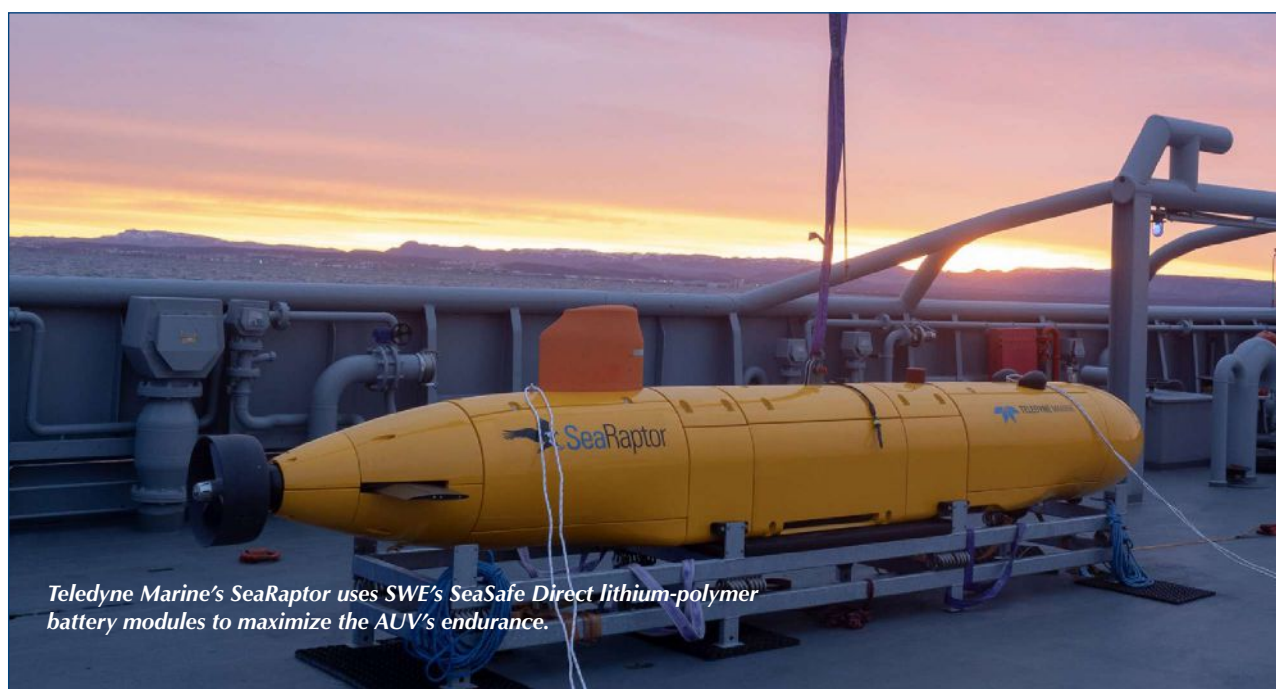
Improvements in batteries to meet these needs is happening, turning battery modules into an enabling technology for keeping AUVs in service and motion for longer missions.

When it comes to underwater vehicles, rechargeable battery module systems that can easily be swapped on deck to speed the unit's return to the water and next mission are key. One example is the Teledyne Marine SeaRaptor AUV design that uses Southwest Electronic Energy Corp.'s (SWE) SeaSafe Direct lithium-polymer battery modules to maximize the AUV's endurance, as was re-

cently demonstrated during testing operations with the Icelandic Coast Guard Vessel *Þór* in 2018.

The SeaRaptor, an AUV approximately 5.5 m long, is suitable for applications such as search and recovery, salvage, exploration, deepwater construction, marine archaeology and oceanography. It has a maximum speed over 4 kt. While its endurance depends on speed and the exact configuration of the AUV, the SeaRaptor can typically survey for 24 hr. at 3 kt. with a standard configuration. The standard battery configuration comprises 13- to 16-kWH lithium-ion rechargeable SeaSafe Direct modules from SWE, and the energy can be increased to 20 kWH to meet the extra demands of longer duration missions or additional sensors.

The vehicle's operating criteria require the batteries to power all of the AUV functions, from control to motion



Teledyne Marine's SeaRaptor uses SWE's SeaSafe Direct lithium-polymer battery modules to maximize the AUV's endurance.



The SeaRaptor during trials with the Icelandic Coast Guard. (Right) SWE's SeaSafe II and SeaSafe Direct.

to communication to payload sensors. The ability to change batteries with ease on deck without reconfiguring the SeaRaptor is critical for efficient mission execution. The SeaSafe battery modules can be accessed behind an easy-to-remove panel and replaced with a freshly charged module or recharged relatively quickly. The battery modules are pressure tolerant to 6,000 m, allowing for diving deeper and staying deep longer to support important mission objectives.

During the testing operations on the Icelandic Coast Guard Vessel *Pór*, the SeaRaptor carried out 10 hr. of surveys in shallow and deepwater to validate the sensor performance and navigational accuracy. For continuous surveying, the battery modules can be hot swapped in 20 min. While the AUV is in the water, the battery modules can be recharged over a period of about 4 hr. The SeaRaptor performed flawlessly during the testing operations, locating the wings of a B-24 bomber of the 1940s.

Meeting Subsea Power Needs

Such operations would have been a major challenge without some revolutionary changes in subsea batteries. Many electrical subsea operations are tethered and powered by costly umbilicals. Untethered subsea vehicles previously used sealed lead-acid batteries, which made them heavy and bulky, or batteries contained within 1-atm-pressure vessels, which made them more expensive and heavier as they strived for deeper depth ratings.

In 2013, Southwest Electronic Energy Corp.'s SeaSafe battery brought revolutionary changes to the market. The first commercial pressure-tolerant lithium-ion polymer subsea battery module known as SeaSafe became available after SWE worked on the design in conjunction with Woods Hole Oceanographic Institution. The radically lighter and smaller battery delivered efficiency gains in installation times and vastly improved performance. In 2017, SWE made available the SeaSafe II, which incorporated lessons learned, reliability improvements and American Bureau of Shipping (ABS) certification.

The powerful, pressure-tolerant SeaSafe II battery modules are easy to install in a pressure-balanced oil-filled (PBOF) container, which is smaller, lighter and lower cost than a pressure vessel.

In response to industry demand to eliminate the PBOF container for additional convenience, SWE developed the SeaSafe Direct, which has been available since 2017. It can be placed directly into the water without requiring the PBOF container.

The SeaSafe II and SeaSafe Direct are powered by large lithium-ion polymer cells that are specially engineered into modules managed by the SWE-patented Battery Management System (BMS) to provide 30 V at 28 Ah or other size options. They are able to operate in water depths to 6,000 m. Multiple SeaSafe modules can easily be connected together to meet the voltage and power needs of various applications.

These autonomous battery modules are easy to use and are designed for use in subsea vehicles, oceanographic systems, and deepwater oil and gas infrastructure.

Supplying electric power or running hydraulic power from the surface can be expensive and motion constraining, but single or multiple linked battery modules can economically and safely be placed in water as deep as 6,000 m to store and provide energy locally for operations such as actuating valves on subsea equipment like Christmas trees and blowout preventers.

The batteries have been used in short-duration, high-power-demand applications and long-duration, low-power-demand situations. Applications include

“Single or multiple linked battery modules can economically and safely be placed in water as deep as 6,000 m”

AUV propulsion, control and instrumentation; in remotely located infrastructure equipment for valve control and possible pipe shearing; and in oceanography sensing set-ups, such as those for monitoring the salinity and temperature of ocean water over a period of time.

Compared to lead-acid batteries, SeaSafe battery modules weigh one-quarter, deliver longer mission times, provide up to four times more energy, and can take thousands of charges. SeaSafe battery modules also function for up to eight times the life cycle of traditional sealed lead-acid batteries, which may provide many years of service and eliminate classic and costly battery-failure headaches.

Each module includes the BMS to safeguard the battery. The integrated BMS automatically manages and tracks the safety, reliability, charge and discharge of the

batteries and reports technical information on demand. Immediate feedback on the status of the battery system enables the operator to confidently respond to an emergency requiring battery power.

As subsea needs continue to evolve, safely and economically squeezing more power and lifetime out of battery systems has never been more important. SWE's SeaSafe Battery modules deliver. **ST**

Leon Adams is the vice president of sales in lithium and lithium-ion battery solutions, product definition and technical customer support at SWE. He is a member of the Marine Technology Society, Society for Underwater Technology and Institute of Electrical and Electronics Engineers. Adams holds an M.B.A. and B.S. in engineering physics.



Bob Melvin is the vice president of engineering at Teledyne Marine Systems. He has more than 30 years of experience in both engineering and program management and has responsibility for overseeing the engineering teams for Teledyne's underwater vehicles, including the Slocum Glider, Gavia AUV, Deep Tow and APEX floats.



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Seawater-Activated Battery

Developing Prototype for Underwater Alternative Energy Source

By Arunkumar Balasubramanian • Dr. S. Sakthivel Murugan

Seawater has significant potential to generate electricity at low cost. It is possible to design an efficient system for various applications, for instance, a seawater battery that converts chemical energy into electrical energy via the redox reaction. Such a battery comprises electrodes and an electrolyte. Every electrode has its own standard reduction potential, which determines the overall voltage of the battery system. The standard reduction potential of each half-cell is used to determine the direction of current, and the overall potential must be positive.

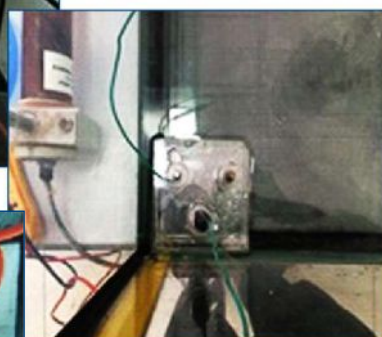
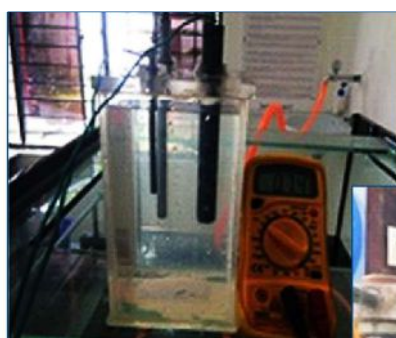
The overall reaction is an addition of the reduction half-reaction and oxidation half-reaction. The electrode participating in the reduction half-reaction is called the cathode, and the electrode participating in the oxidation process is called the anode. This kind of battery employs seawater as the electrolyte, which makes the battery much cheaper and more environmentally friendly compared to conventional battery systems.

The performance of the battery depends on the selection of electrodes and the geometry of each cell.

Experimental Setup

The electrode material, particularly for the cathode, predominantly influences the performance of the seawater battery. The ideal electrode material has good electrical conductivity, low resistance, chemical stability, anti-corrosion properties, large surface area and mechanical strength. Efficiency can be improved by using high surface area and granular materials such as carbon paper, carbon felt, carbon brush, carbon fiber and graphite of various types.

We developed a seawater battery using graphite for the cathode and iron for the anode, and tested the battery with seawater samples collected from the Bay of Bengal off Chennai, India. The open-circuit voltage was mea-



Lab testing of single-cell prototype underwater battery.



sured for 1 hr. with a time interval of 10 min., and 1.1 V of open-circuit voltage was obtained.

Further testing was done on the graphite-and-iron pair of electrodes using more samples of seawater collected from the Bay of Bengal along the coastal regions of Tamil Nadu, covering a distance of 230 km. Specifically, samples were collected from Mahabalipuram, Pondicherry, Chennai and Poompuhar to provide the electrolytes used for the experiment. The samples were filtered to remove soil particles. Lab testing was carried out in the underwater Acoustic Research Laboratory at SSN College of Engineering, Chennai. The seawater samples correspond with the following open-circuit voltages: Mahabalipuram 1.03 V; Pondicherry 0.94 V; Chennai 0.99 V; and Poompuhar 0.98 V.

“Eventually, the seawater-activated battery will power underwater sensors and other devices and could serve additionally as a power source for emergency light and security systems on fishing vessels.”

Single-Cell Prototype Test

We designed a single-cell prototype containing two electrodes, based on the above experimental results. The prototype is 18 cm high, 10 cm long and has the capacity for 1,000 ml of electrolyte. The single-cell prototype was tested using artificial seawater inside a test tank at the Underwater Acoustic Research Laboratory. It was also tested using seawater in a real-time ocean environment.

The lab's underwater test tank has a capacity of 200 liters. The pH value of the artificial seawater was maintained at 8.2 to mimic seawater. The prototype was tested under three conditions: control, floating and immersed. An electrical potential of 0.74 V was obtained from the lab testing.

The single-cell prototype was also tested in a real-time sea environment from August 29 to September 2, 2018 at the following locations: Mahabalipuram - 12°36.066'N, 80°14.326'E; Kalpakkam - 12°36.526'N, 80°16.718'E; and Chennai - 13°05.348'N, 80°21.760'E at depths of 5, 15 and 20 m.

The pair of graphite-iron electrodes is fixed in the prototype, and the open-circuit voltage was measured at various time intervals and analyzed for each location sample. A maximum of 0.95 V was obtained from the Kalpakkam and Mahabalipuram samples.

The potential of the single-cell prototype exceeded 0.69 V at the 30-min. interval due to activation of the battery via seawater; thus, this type of battery is called a seawater-activated battery, or a reserve battery. Single-cell potential reached a constant level after an interval of 120 min. for the samples collected at different depths.

Overall, maximum energy was yielded from natural seawater compared to artificial seawater in the lab. There is a higher potential output from high-pH samples, indicating that the pH level of seawater plays a significant role in electrical potential, due to its ionic concentration.

Seawater Battery Prototype Design

A single cell cannot produce a high voltage, but a series of cells can. We designed a prototype containing 16 individual cells, each one containing respective electrodes (cathode, anode and catalyst). Each cell and the electrodes are cylindrical. An inlet shut-off valve allows for seawater inflow to activate the battery, and an outlet shut-off valve enables water flow from the battery to the outside for cleaning purposes.

The structure of the prototype was designed using open-source Autodesk inventor software, which enables 3D modeling. All 16 cells are covered by an enclosure to separate the electrode connection terminal from seawater. The overall structure is covered by IP67 material to avoid corrosion and water leakage.

Conclusion

We developed a seawater battery using the redox reaction to generate electricity underwater. Initially, a pair of graphite and iron electrodes provided an open-circuit voltage of 1.1 V from a single cell in the lab test environment using artificial seawater. The single cell was also tested in the lab with seawater samples collected from the Bay of Bengal, as well as deployed in the bay.

Maximum energy was produced from natural seawater, compared to artificial seawater in the lab. The pH level of seawater plays an important role in electrical potential, based on its ionic concentration.

From the initial testing, we developed a 16-cell prototype. This prototype was deployed offshore Chennai from May 27 to June 3, 2019. Upcoming work includes improving voltage for two-cell, four-cell, six-cell, eight-cell and 16-cell battery systems. Performance of the multiple-cell systems will be analyzed by studying the corrosion of electrodes, cell life cycle and power density.

Eventually, the seawater-activated battery will power underwater sensors and other devices and could serve additionally as a power source for emergency light and security systems on fishing vessels.

Acknowledgments

This work was carried out in the Underwater Acoustic Research Lab, Department of ECE, SSN College of Engineering. The authors wish to thank D. Rajasekhar, project director, vessel management, NIOT, Chennai, for providing the vessel to collect data for this study. The authors also wish to thank K. Ramasundaram and Mohanraj of VMC, NIOT Chennai, for their kind support during data collection. **ST**

Arunkumar Balasubramanian received a B.E. in electronics and communication engineering from A.V.C. College of Engineering, Mayiladuthurai, India. He is pursuing an M.E. degree in communication systems from SSN College of Engineering, Chennai, India.



Dr. S. Sakthivel Murugan is an associate professor in the Department of ECE at SSN College of Engineering (SSNCE), Chennai. He has more than 15 years of experience in academia and research. His areas of research are underwater acoustic signal processing, underwater sensor networks and underground communication. He established the Underwater/Underground Research Laboratory at SSNCE.



OceanObs'19

OceanObs'19, the third installment of the decadal conference series, will open in the Hawaii Convention Center in Honolulu on September 16 and run through September 20. This series produces community-driven conferences that bring people from all over the planet together to communicate the decadal progress of ocean-observing networks and to chart innovative solutions to society's growing needs for ocean information. OceanObs'19 will celebrate progress across national, regional and global ocean observation networks while establishing commitments to execute the collective vision for these systems over the coming decade.

Outcomes and Themes

The conference will examine how ocean observing yields societal benefits and how information products can best be supported.

OceanObs'19 will determine how we meet future user needs (information); improve the delivery of products across the globe (interoperability); advance technology and services (innovation); and balance needs, capabilities and knowledge worldwide (integration). Achieving these outcomes will result in a fit-for-purpose Global Ocean Observing System over the next decade.

The three overarching themes of the conference are: Data and Information Systems; Ocean System Governance; and Observing Technologies and Networks.

Under these larger themes, OceanObs'19 will focus on seven vital areas: Discovery; Ecosystem Health and Biodiversity; Climate Variability and Change; Water, Food

OCEAN OBS'19



and Energy Security; Pollution and Human Health; Hazards and Maritime Safety; and Blue Economy.

Community White Papers

In 2017, abstracts for community white papers (CWPs) were solicited from the ocean-observing and end-user communities. The organizers of OceanObs'19 requested abstracts with the hope they will evolve into overarching CWPs, becoming collectively reflective of community wisdoms and perspectives.

The OceanObs'19 Program Committee has reviewed and consolidated approved abstracts with similar scopes to enhance the overarching vision of the final CWPs. Abstract author teams have been notified of their CWP groups and are nearing the end of their writing process and publication. The full list of approved and consolidated CWPs can be found on

the website at oceanobs19.net/community-white-papers.

The collective vision of the final CWPs will focus on being forward-looking to the next decade, addressing end-user engagement and opportunities for integration, and connecting to conference themes.

Frontiers in Marine Science is publishing CWPs online as the team completes the review process. You can check out the available CWPs at frontiersin.org/research-topics/8224/oceanobs19-an-ocean-of-opportunity#overview.

To learn more about OceanObs'19, visit oceanobs19.net. **ST**



Electric Power for ASVs

Integrated Electric Propulsion System for Wave-Adaptive ASV

By Steve Trkla • Kurt di Sessa

These are exciting times for the ASV community with innovative designs, architectures and capabilities opening new possibilities to meet the burgeoning demand for ASV services for a wide range of missions. An example of creative thinking in this area is the unique Wave Adaptive Modular Vessel (WAM-V) concept developed by Marine Advanced Robotics Inc. (MAR). In this article, we will describe the integration of MAR's WAM-V and an advanced battery-electric propulsion system from Torqeedo. In our view, electric propulsion has proven to be an ideal solution for many ASV missions.

But first, a few words on the background behind our two companies and technologies.

Entrepreneurs at Work

Behind a successful technology company there's often an interesting personal story. That's how it was with

Marine Advanced Robotics and WAM-V technology. It was the brainchild of Dr. Ugo Conti, an engineer and entrepreneur from the San Francisco Bay Area. Having circumnavigated the world with his young family on a sailboat, he found he was particularly sensitive to motion. The boat's rolling and pitching was upsetting, and he asked himself, "Isn't there a better way?" That planted a seed that didn't germinate until years later, when he returned to the subject of reducing motions for surface vessels on the water and founded a company to develop the concept. Thus, MAR was born.

The first WAM-V was Proteus, a 100-ft. manned catamaran with a unique design that included a cabin set high above the water and a patented hull configuration that provided a smooth stable platform even in heavy seas and swells. It traveled more than 3,000 nautical miles in the Pacific and Atlantic Oceans and the Mediter-



100-ft. WAM-V Proteus.



WAM-V for hydrographic survey.

anean Sea and was later put through a battery of tests by the U.S. Navy in Virginia. From the lessons learned with Proteus, it was recognized that the unique wave-adaptive concept had great potential for unmanned operation, and the R&D effort refocused on ASVs. There are now nearly 50 of MAR's WAM-V ASVs working in oceans around the globe. They are in service with research institutions and universities, hydrographic survey companies and navies.

Likewise, Torqeedo had its origins in a personal experience. Dr. Christoph Ballin, Torqeedo's CEO and co-founder, enjoyed boating on Lake Starnberg, a large Alpine lake in south Germany, but the local authorities had placed severe restrictions on operating boats with

combustion engines on the pristine inland waters. This led him to look into the feasibility of an electric-powered boat. What he discovered was that there was no supplier taking a comprehensive integrated approach to electric marine propulsion. The commercially available electric motors and drives for marine applications in 2005 did not reflect the state of the art in electromobility technology. Recognizing a market opportunity, he and his co-founder started Torqeedo to develop integrated electric propulsion systems for the marine market.

Starting with small outboards, the company has since developed a full line of electric and hybrid drives from 0.5 to 100 kW for commercial and recreational vessels,

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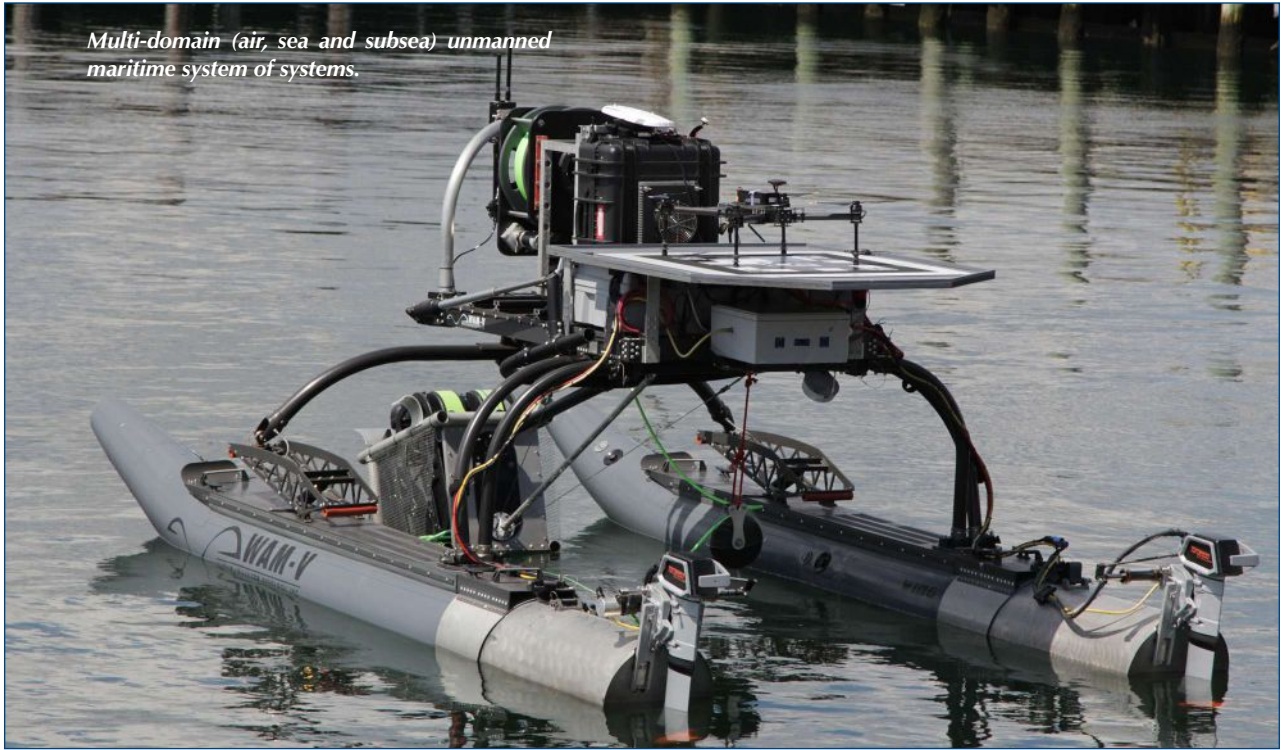
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including complete integrated inboard propulsion systems. Torqeedo is now part of the DEUTZ Group, one of the world's leading independent suppliers of diesel and natural gas engines.

Dancing with the Waves

The WAM-V is a totally unique class of watercraft based on a patented technology that radically improves sea-keeping capabilities. Instead of pushing, slapping or piercing the waves, the flexible hulls of the WAM-V continually adjust to conform to the water's surface. The effect has been described as "dancing with the waves."

The superstructure is connected to specially designed pontoons in a way that allows each pontoon to move in relation to one another. It employs a combination of springs, shock absorbers, ball joints and articulation to minimize structural loading and maximize stability for the boat and its payloads. The inflatable pontoons help dampen wave energy. The engine pods are hinged to the hulls, maintaining constant control by keeping the propellers in the water at all times, resulting in higher efficiency. The boat's 2:1 length-to-beam ratio, light weight and shallow draft make for a stable and versatile platform for multiple missions in open-ocean or sensitive shoal-water environments.

MAR has produced WAM-V vessels in a variety of sizes from 2.5 to 30 m in length to meet customer requirements.

Going Electric

Originally, the MAR USVs used gas engines. The decision to develop an electric power package was initially driven by customer demand, hoping to reduce noise and air pollution that can interfere with certain types of data collection. As a result, the WAM-V 16 was designed from

the beginning to be an all-electric vessel. After looking at the available state of the art in electric motors and drives, Torqeedo was the natural choice, due to its high-tech engineering and extensive system integration capabilities. Torqeedo also had extensive previous experience in working with other ASV builders. The full range of Torqeedo drives, from 0.5 kW up to the high-voltage 50-kW Deep Blue system, has been successfully integrated into ASVs by builders around the world.

Torqeedo and MAR engineers worked closely together to design and build an integrated electric propulsion system tailored to the specific requirements of an unmanned autonomous vessel with the unusual performance characteristics of the WAM-V. As a result, the Torqeedo system is now the standard propulsion package for the WAM-V 16.

The propulsion system on the WAM-V 16 consists of two Torqeedo Cruise 2.0 outboards with high-torque propellers, powered by multiple Torqeedo Power 24-V lithium-ion batteries. Each motor provides equivalent propulsive power to a 5-hp. combustion outboard. Up to six batteries can be installed, depending on the desired operating range and endurance on station. All components are waterproof to IP67 standards.

Electric Benefits

The following observations are derived from our experience with the WAM-V 16s over the last several years.

For an autonomous vessel, it's an absolute requirement for the propulsion and control systems to be fully meshed. With the support of Torqeedo's application engineers, MAR was able to design a proper interface between the control systems and electric motors to provide seamless integration and remote control. Experience has shown that a WAM-V 16 with twin Torqeedo Cruise 2.0

motors and six lithium-ion batteries can do a full-day's work of 8 to 12 hr. It can be recharged overnight and then do the same the next day.

Torqueedo's new higher-capacity Power 24-3500 batteries will extend the endurance times on station by more than 30 percent or allow the same amount of work with fewer batteries.

Another important benefit for AUV operation derives from the direct-drive electric motors. Station-keeping often requires quick cycling back and forth between forward and reverse thrust. Using a computer to rapidly shift gears will chew up a transmission in no time. Torqueedo's electric motors can switch from forward to reverse indefinitely without damage.

In addition, the electric motors are sealed and do not require any regular maintenance. Gas engines require regular oil changes and other time-consuming and costly maintenance procedures. There is also an obvious safety benefit in not having highly flammable fluids on board.

Finally, there is the environmental consideration. Often, ASVs are required to work in environmentally sensitive waters, where the noise and pollution of gas-powered vessels may be undesirable. The Torqueedo systems reduce noise, are emission free and completely eliminate the risk of fuel and oil spills.

Looking Forward

In sum, from our experience, we conclude that the pairing of electric propulsion with ASVs will be a key

enabling technology in the years to come. Electric motors continue to become more efficient, and the energy storage capacity of batteries is improving at a head-spinning pace. When compared to gasoline outboards, the performance gap continues to shrink. Electric drives will open new opportunities for applications in which gasoline is wholly inappropriate. The WAM-V 16 and Torqueedo Cruise 2.0 have proven what an all-electric ASV is capable of and have opened a window into the future of autonomy at sea. **ST**

Steve Trkla is president and general manager of Torqueedo Inc. and manages Torqueedo's operations in the Americas. Before joining Torqueedo, he worked as sales director for a number of Silicon Valley start-ups. He entered the marine industry as a co-founder of Red Oak Marketing, a provider of online marketing strategies. Trkla is a graduate of Macalester College in St. Paul, Minnesota, with a double degree in political science and law and social science.



Kurt di Sessa, in his third year with Marine Advanced Robotics, likes to deliver value—and boats—to customers. As operations manager, he draws from broad experience across multiple industries to anticipate issues and guide day-to-day activity, from the shop floor to the balance sheet.



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Advances in Controller Tech

Olis Master Controller Jointly Manages Major Work-Class Manipulators

By Donald Pickering • Tom Boyer

The offshore energy industry utilizes assets that are challenging and expensive to operate and maintain. To perform work subsea, field service companies use fleets of ROVs to install and maintain equipment and expand offshore energy production. Above the water, human resources are used to inspect, service and repair wind turbines and platforms.

The subsea manipulator control devices in use today have changed very little from the systems used three decades ago. The controllers were developed as single-purpose solutions to drive robotic arms and manipulators, and functionality was (and still is) constrained by the high costs and limited capabilities of the controller's electronics to interface with the robot. Control designs were locked in by their firmware architecture with little ability to upgrade functionality. Consequently, although the demands on the intervention team have grown due to increasingly complex subsea systems, there has not been a way to introduce new control tools to make the inter-

vention tasks less risky and overall easier for the teams.

Although more and more information is being channeled to the robotic pilots through the user interfaces and displays, not enough has been done to take advantage of the advancements in display and touchscreen technology that have brought several "ease-of-use" features to market that are now common among consumer devices. Pilots still must rely on a significant amount of training and knowledge to control the subsea ROV systems and conduct critical intervention operations.

While legacy control systems have not been able to maintain pace with the increasing demands placed on subsea intervention teams, they are also woefully inadequate at interfacing with the connected world and all the benefits it has to offer. This includes leveraging the advantages of cloud computing and information technology services to provide cost-effective and more efficient operation plans. As a result, subsea operations have not experienced the decreases in operating costs that are





The Olis master controller is easy to set up in both onshore and offshore control rooms.

starting to appear in other machine-intensive industries such as construction and agriculture.

All of these limitations have either driven—or are a result of—a direct-control mindset where the robotic arm is fully controlled by the human and responds only to human input. These controllers operate with sensors but do not integrate any of the sensor data to make intervention operations more efficient or effective. This approach significantly reduces the potential value of the sensor and the ability to integrate data with sophisticated software algorithms for improved performance of intervention tasks.

At the other end of the spectrum from direct human control, much of the industry is talking about the notion of “fully autonomous” intervention. Although very aspirational, the strategy of transitioning straight from direct control to fully autonomous is very risky. This is best illustrated by the automobile industry’s pursuit of the driverless car, which is an ambition that has far less challenges with respect to modeling and understanding the task space than subsea intervention. An incremental and iterative approach that introduces levels of autonomy in a progressive fashion will build trust and widespread adoption while beginning to reduce pilot stress and error, cut costs, and improve efficiencies today.

Delivering More Precision, Safety And Efficiency at Lower Costs

In the last 10 to 15 years, breakthroughs in processing power, software algorithms and electronic device packaging have enabled delivery of highly advanced, multi-feature capabilities in extremely small containers, such as your cell phone. Olis Robotics has developed the Olis Master Controller (OMC) to leverage these advances to deliver significant increases in remote operation capabilities to the subsea robotics industry.

These increased capabilities enable an intervention team to fully utilize the video and sensor data being gen-

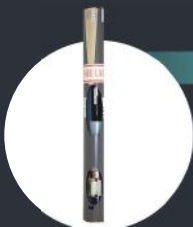
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Remote operations in action using the Olis Master Controller. The Olis operating system works seamlessly with ROV simulators to support transition training for pilots.

Olis Robotics helps reduce offshore human resources and costs by enabling humans to perform offshore tasks from the safety of onshore robotic control centers. Olis's control solution creates an intuitive user experience with software that overcomes latency and bandwidth constraints.

Market Trials Validate Features

The Olis Master Controller underwent market field trials in 2018 by several field service companies off the coast of Africa and in the North Sea. Olis engineering teams worked closely with a variety of customers operating subsea ROVs to conduct maintenance on offshore oil and gas platforms. Based on learnings from the market trials, Olis implemented the following key features that greatly simplify operation of the subsea robotic platforms: GUI with touchscreen, which offers an intuitive and interactive interface that delivers an

experience a user would expect on modern devices; function selection, which enables quickly changing arm or manipulator functions using the gamepad or touchscreen interface; assistive constraints, which allows the pilot to easily lock movement onto selected lines or planes for cutting, torquing or other tasks; preset position settings, which allows the pilot to task the arm or manipulator to go to a preset pose/position while providing the ability to store positions on the fly; and latency/bandwidth tolerance, which allows safe operation in remote locations by being able to withstand communication delays and occasional drop-outs due to link limitations and allows software to toggle between a local (ship-based) and remote (control center) pilot.

erated by the ROV systems in order to make subsea operations safer, more efficient and more effective.

The OMC's design allows field service companies the flexibility to pilot manipulators from either ship- or shore-based control stations. With standard electrical interfaces and software-defined application programming interfaces (APIs), the OMC is able to plug into existing systems right out of the box. With an embedded touchscreen video display and intuitive graphical user interface (GUI), the OMC takes significantly less training time. The controller also combines gamepad features with the traditional master arm controller to enable rapid transition regardless of the type of operations being conducted.

The controller offers one new capability over legacy subsea controllers and several enhanced features that impact safety and efficiency. The primary new capability is the ability to control all the major work-class manipulators over a network. Enhanced safety comes from cell phone motors mounted in the controller that offer unintrusive, intuitive vibration that signals to the pilot when the manipulator is commanded to perform beyond its operational profile. For example, when the manipulator hits a joint limit, the controller will offer a quick "thud," and when the manipulator is commanded beyond a point where it can physically go, the OMC will offer a buzz that grows as the disparity grows.

Unlike other controllers used throughout the offshore robotics field, the OMC offers control solutions driven by system-agnostic software rather than being a fixed component of an integrated hardware product. This enables Olis to provide a suite of possible solutions for each scenario that balance risk with efficiency, improve performance and provide a better overall user experience. The control interface offers integration of additional advanced features that leverage machine learning to greatly reduce pilot burden and increase autonomous functionality.

The OMC, including these advanced features, is now available to customers globally through Olis Robotics' established channel partners who support sales, distribution, training and customer support. This allows offshore customers to confidently and cost-effectively transition from legacy hardware to the more capable OMC technology.

The OMC, including these advanced features, is now available to customers globally through Olis Robotics' established channel partners who support sales, distribution, training and customer support. This allows offshore customers to confidently and cost-effectively transition from legacy hardware to the more capable OMC technology.

Bringing the Innovation Above the Surface

The same control solution being used to improve subsea operations can be immediately utilized to introduce new capabilities for offshore wind and platform maintenance above the water. For example, every blade on every wind turbine will need to have fiberglass repair completed at some point.

Today, this repair is typically accomplished by humans who lower themselves down a blade to the repair location, which is clearly a task with inherent risks. On platforms, the number of human resources could be reduced by enabling pilots from shore to flip switches, turn valves or even make repairs remotely.

Looking Ahead

Planned for release in early 2020, Olis Robotics will begin offering advanced digital models of the workspace updated in real time along with motion compensation. Using standard 2D video hardware installed on ROVs, the software will enable pilots to rotate living “digital twins” of the workspace so they can access multiple views to better facilitate their tasks. Assistive motion compensation features will enable ROV pilots to move the jaws of the manipulator with respect to their intervention target and disregard the shifting position of the free-flying ROV.

Advanced 3D workspace visualization techniques will give the pilot a 3D view of the robot environment using standard 2D optical camera systems. Along with the 3D visualization, the pilot will also be able to overlay other sensor data, such as thermal and sonar sensors to further aid in situational awareness. Target-setting features will allow the pilot to easily identify and classify an object on the screen using the touchpad interface. Quickly being able to set targets will give the pilot an easier method to map a process to each object of interest. The new module will also incorporate motion compensation which, when combined with the target setting, will enable a pilot to identify an object and maintain station on that object through an entire engagement. These features will lower pilot training costs and could reduce the number of vehicles needing to be deployed for operations.

Due to the scalability and extensibility of the OMC, Olis is also able to integrate more intensive data processing that is not available for existing controllers. As a result, Olis is planning additional modules that incorporate machine learning tools to provide dynamic assistance features to enable instant object recognition, collision avoidance and task digitization. As these capabilities mature, they will open up the possibilities of automating operational scenarios and completely integrating operational planning with the control software. Such capabilities

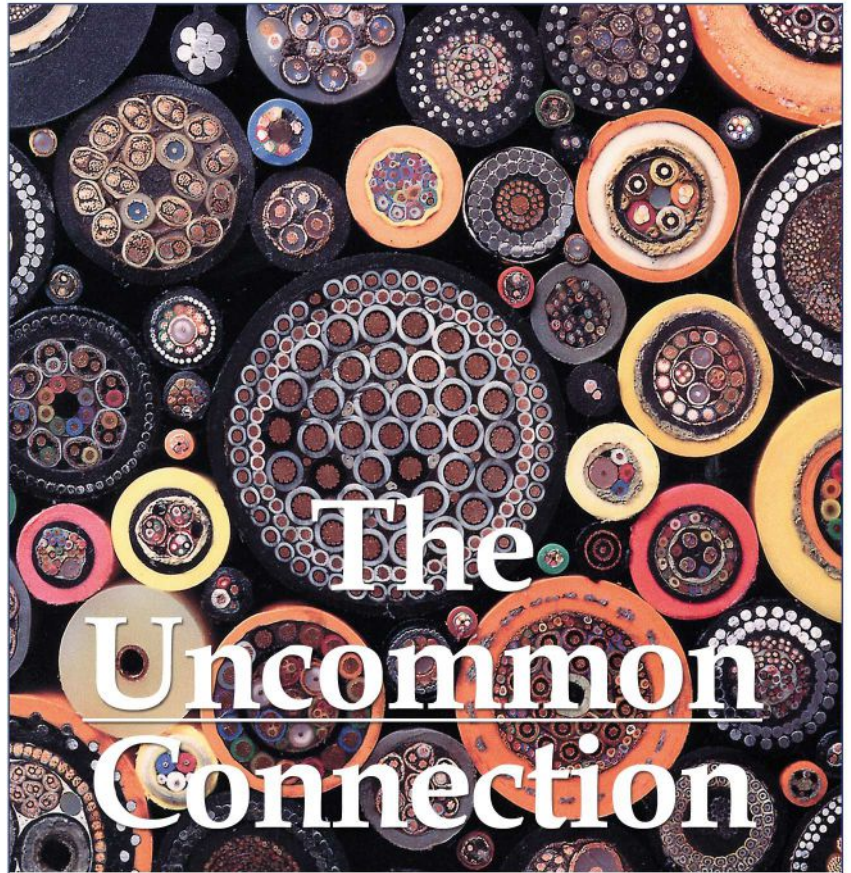
will greatly reduce the cost of inspection operations for undersea pipelines, cables and other infrastructure.

With the OMC, Olis Robotics is advancing its mission to deliver the software platforms that will drive the future of robotics. **ST**

Donald Pickering is CEO of Olis Robotics. An enterprise technology pioneer, Pickering brings extensive experience in software application

development, analytics, geospatial and big data, and unmanned systems for the oil and gas, defense, and software/cloud industries. A former CEO for OneOcean, Pickering has launched and developed five technology start-up companies.

Tom Boyer, chief commercial officer for Olis Robotics, spearheads new business development across core verticals. Boyer brings 20 years of experience launching new products and services, most recently serving as a vice president for Kymeta Corp. He previously held leadership positions with defense companies SAIC, Ravenwing and BAE Systems.



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Ship & Shore Adds New Division

Ship & Shore Environmental Inc. (SSE), an environmental products and services company specializing in air pollution solutions, has launched a new division called Ship & Shore Technologies (SST).

The new group will feature SSE's latest product line expansion of scrubber systems. SST will also engineer, design and supply a full range of pollution, particulate removal and odor control equipment beyond SSE's current scope.

Pushing Boundaries of Deep-Sea Exploration

OceanGate has broken another deep-sea diving record by transporting a crew of four on an abyssal descent of nearly 4,000 m. OceanGate's Titan is the only submersible capable of carrying five people beyond a depth of 3,000 m, according to the company.

The dive, which was validated by a representative from Lloyd's Register, took 2 hr. to reach the ocean floor at approximately 2.34 mi. beneath the surface outside Little Harbor near the Great Abaco Island in the Bahamas. The images, video and data captured will be used as real-world calibration for the *Titanic* Survey Expedition that OceanGate Expeditions has planned for June through August this year.

BIRNS Scholarship Recipient Named

The recipient of BIRNS's annual Debra K. Geist Memorial Scholarship is Jarrod Norton. Norton will be going to Occidental College in the fall. He received a scholarship award of \$500.

The college scholarship program rewards high-school students with strong leadership potential, committed to the pursuit of excellence in a business career.

Industry and Academia Partner To Offer Students Real-World Experience

FarSounder has partnered with the University of Rhode Island ELECOMP Capstone Program. Two students were matched with a local business to work on designing, building, programming and testing solutions to real-world problems.

The two senior-level engineering students working with FarSounder this past school year were Thomas Lott and Cole Boulanger.

Riptide Receives Recognition For Growth in UUV Market

Frost and Sullivan has recognized Riptide as the 2017 North America Product Leader in the UUV market.

As part of its recent UUV market study, Frost & Sullivan recognized Riptide's continuing growth in the UUV market and expanded market presence. The report highlights Riptide's international expansion through new of-

fices and international representatives, along with several key partnerships it has in the marine industry.

Iver4 Demonstrates Endurance During California Mission

L3 Technologies' Iver4 UUV completed a mission lasting more than 14 hr. in San Diego Bay, California. It was successfully completed with a standard nickel-metal hydride (NiMH) battery configuration, demonstrating the battery's power endurance, system efficiency and predictability of the Iver4 platform.

During the transit route of more than 35 nautical miles, the Iver4 UUV collected high-quality side scan sonar and bathymetry data.

New Office for Canadian ROV Company in Chile

Deep Trekker Inc., a Canadian-based global provider and manufacturer of portable and durable submersible ROVs, has opened a new company office in Puerto Montt, Chile. The new office will manage the distribution of Deep Trekker products and services to the Latin American market. Deep Trekker SpA will offer the company's full range of submersible products, technical support, training services and customer service.

Norwegian Hyperbaric Facility Buys Pressure Chambers

NUI, the Bergen-based Norwegian independent hyperbaric research and test facility, has agreed to purchase two very large hyperbaric pressure chamber systems from Optime, with a working pressure of 700 and 1,000 bar (equivalent to 7- and 10-km water depth).

Both systems will be delivered with Optime's advanced control system, enabling NUI's customers to test, monitor and document different environments and scenarios.

New Fast Response Cutter for USCG

The U.S. Coast Guard (USCG) has taken delivery of its newest fast response cutter (FRC), USCGC *Joseph Doyle*. Built by Bollinger Shipyards in South Louisiana, the 154-ft. *Sentinel*-class FRC is the 33rd such vessel in service, and the latest of 58 planned FRCs to be delivered.

At the heart of the vessel's command, control and communications equipment lies a full suite of Furuno marine electronics.

Clean Shipping Award for COMPAC Tech

Thordon Bearings' COMPAC seawater-lubricated propeller shaft bearing system has won the coveted 2019 Seatrade Award for Clean Shipping, in recognition of the technology's capacity to completely eradicate operational oil pollution from ships' stern tubes. The COMPAC bearing system prevents leakage of millions of liters of oil into the world's oceans and reduces ship operating costs.

KVH Sells Videotel And Shifts Focus

KVH Industries Inc. has sold its maritime training business, the Videotel group of companies, to an affiliate of

Oakley Capital for a base purchase price of \$90 million. KVH will use the net proceeds of the sale to invest in three key growth initiatives: the development and commercialization of photonic integrated chip technology for use in autonomous vehicles and other commercial and military platforms; supporting further acceleration of the AgilePlans (Connectivity as a Service) program; and finalizing development and launch of an IoT connectivity solution.

Canada Chooses SEAMOR To Receive Government Funding

Nanaimo-based SEAMOR Marine Ltd. is receiving an investment of up to \$100,000 from the Women Entrepreneurship Fund offered by the government of Canada. Among only three companies on Vancouver Island, SEAMOR Marine joins approximately 200 other women-led businesses across Canada to receive this funding.

Autonomous Vessel Control For Search and Rescue

Boston-based Sea Machines Robotics has a new partnership with Hike Metal of Ontario, Canada, to integrate Sea Machines' SM300 autonomous vessel control system aboard commercial vessels tasked with search-and-rescue (SAR) missions.

Phase I demonstrations will begin this summer, near Hike Metal's headquarters on Lake Erie.

Phoenix Sponsors Engineering Project For Catholic University Seniors

Phoenix International Holdings Inc. and the Catholic University of America announced Phoenix as a sponsor to the School of Engineering for a senior design project at the university.

The \$2,000-dollar sponsorship will go toward a mechanical engineering project that entails designing, building and testing a buoyancy engine that can work up to 6,000 m deep. The funds will provide a highly engaging, hands-on learning experience for the seniors that will promote strong problem solving and teamwork to help them prepare for their future careers.

Auditor for Scrubber Tech

Pacific Green Technologies Inc. (PGTK), owner of the ENVI-Marine and ENVI-Clean exhaust gas scrubbing systems, has announced the appointment of KPMG LLP as its auditor.

In support of the world's need for cleaner and more sustainable energy, Pacific Green Technologies has developed a portfolio of patented, emission control technologies that remove pollutants from marine engine, power plant and waste incinerator exhaust streams in order to meet increasingly stringent environmental standards.

Pacific Green solutions utilize the company's patented Turbo Head Technology, which enables a more thorough mixing of exhaust gases and a chosen reagent solution that delivers more effective contaminant removal in a system that is both smaller and more efficient to build and operate. **ST**

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NAPA, ChartWorld Voyage Planning Solution

NAPA and ChartWorld have partnered to provide revolutionary artificial intelligence-driven voyage planning and optimization.

Past voyages are automatically evaluated via data sets collected from ChartWorld's route network to find improved routes the vessel could have taken. These voyages are also automatically analyzed by NAPA's algorithms for operational efficiency.

SubConn Adds Production Facility

The MacArtney Group and SubConn Inc. have worked together to find a production solution for the SubConn connector range. MacArtney's sale successes have long put pressure on the production of SubConn connectors, but now SubConn has invested in a 2,300 m² new location that is set to double its existing production facilities.

The first connectors are expected to come out of the new facility by October 1, 2019.

UK Regulator Authorizes QuietSea Marine Mammal Monitoring System in UK Waters

Sercel's successful deployment of its QuietSea passive acoustic monitoring (PAM) system has been extended to the U.K., following approval by the U.K. Department for Business, Energy and Industrial Strategy (BEIS) and Joint Nature Conservation Committee (JNCC) of its use for a seismic survey operated by CGG in waters off the Shetland Islands.

Sercel's QuietSea sensors are designed to fully integrate with seismic acquisition or navigation systems, and are incorporated with the hydrophones in the Sentinel streamer.

OSIL Buoy for EU-funded Coastal Erosion Project

Ocean Scientific International Ltd. (OSIL) has supplied a 1.2-m data buoy platform to the ORION joint research and development center for use as a real-time monitoring station on an EU-funded project managing coastal erosion.

The Harmonized Coastal Corrosion Management Framework for Enhancing the Implementation of the Integrated Coastal Zone Management Protocol (HERMES) project required a platform with the ability to record a full profile of water column currents, tidal variations, wave parameters (significant wave height, wave period and propagation direction), and estimated suspended particular matter concentrations, with the data transmitted to a base station on land in real time, complete with software to analyze and process the data with a graphical display.

Expro Increases Offerings

Expro has introduced two new well-access solutions.

The Intervention Riser System (IRS) will safely estab-

lish and maintain well access throughout riser-to-surface operations, replicating the functionality of the blow-out preventer. The Riserless Well Intervention (RWI) system provides a reliable wire through-water integrated solution for intervention and/or abandonment operations.

Partnership to Deliver RMS To Norwegian Spar Platform

BMT has partnered with Sonardyne to deliver to Subsea 7 its riser monitoring system (RMS).

The RMS has been adopted by the world's largest spar platform, Aasta Hansteen, operated and owned by Equinor ASA.

Ashtead Technology's Global Expansion Continues

Ashtead Technology has completed its \$2 million investment in a new Houston facility as part of ongoing international growth plans.

Ashtead Technology also recently completed the expansion of its Singapore base following increased market demand in the Asia-Pacific region.

Oceaneering Chooses Sonardyne Nav Systems

Oceaneering International Inc. has ordered hybrid navigation systems from Sonardyne Inc. for its subsea resident vehicles Freedom and E-ROV.

The two resident vehicle systems are to be fitted with Sonardyne's SPRINT-Nav, which combines a SPRINT INS sensor, Syrinx 600-kHz DVL and a high-accuracy intelligent pressure sensor in a single unit.

Belgium Government Selects Chelsea Technologies for Ballast Water Benchmarking

The Federal Public Service (FPS) Mobility and Transport, the arm of the Belgium government responsible for shipping, has selected Chelsea Technologies to provide benchmark portable testing for compliance with ballast water standards.

Belgium is one of the first European nations to enforce the IMO's Ballast Water Management Convention.

Sabertooth for Modus

Modus has placed an order with Saab Seaeye for the next vehicle in its hybrid AUV (HAUV) fleet. The 3,000-m-rated Saab Sabertooth will be delivered in the third quarter of 2019.

The new system will be equipped with extended autonomous endurance and increased thrust for high-speed survey and will be prepared for the integration of advanced and high-resolution sensors.

Evac Ballast Water Solution Backed by IMO

The Evac Evolution Ballast Water Management System (BWMS) has been granted IMO Type Approval. The system has been designed and manufactured by Cathelco, which has been part of Evac Group since May 2018.

The system has been tested to the latest IMO requirements and the recent Ballast Water Management Code.

WOC Joins World Benchmarking Alliance

The World Ocean Council (WOC) has become an official "Ally" of the World Benchmarking Alliance (WBA). The WOC will work with the WBA and its network of Allies to develop criteria and benchmarks for sustainable development relevant to the ocean business community.

FLAGSHIPS Project to Deploy Two Hydrogen Vessels

The European innovation project FLAGSHIPS has been awarded €5 million from the EU to support deploying two commercially operated zero-emission hydrogen fuel cell vessels in France and Norway.

The FLAGSHIPS project will help create two new-build vessels, one in Lyon, France, and one in Stavanger, Norway. The project started in January, and the hydrogen ships will start operation during 2021.

Collaboration to Support Advances in 3D Printing

DNV GL and Nanyang Technological University, Singapore (NTU Singapore) are supporting academic advances in additive manufacturing—the process of 3D printing—for the maritime, oil and gas, and other industries through a four-year research collaboration agreement.

Two new doctoral student (Ph.D.) positions are being created through the Industrial Postgraduate Programme, supported by the Singapore Economic Development Board (EDB) and DNV GL. A further full-time research fellow post is also being created at NTU's Singapore Centre for 3D Printing.

The research agreement will focus on developing industry standards, quality assurance processes, certification and supply chain tracking for the additive manufacturing sector.

3D printing is expected to become a \$450 million market in the oil and gas industry by 2021, rising to \$1.4 billion by 2025.

Cargotec Cooperates to Solve Maritime Industry Inefficiencies

Cargotec will continue joint projects with several start-ups as an outcome of the Rainmaking Trade & Transport Impact Programme, a maritime start-up collaboration platform to address the largest challenges in maritime, cargo transport and logistics.

Kalmar is collaborating with Arundo Analytics, Cogniac and Predictrics. MacGregor will partner with Arundo Analytics, Geollect, Intelligent Cargo Systems and NauticAI. Navis is cooperating with Loginno, a logistics IoT visionary.

Growth Ambitions for Aberdeen Tech Firm

Viewport3 has moved to larger premises in Dyce, following an exceptional year of growth that saw its turnover jump 34-fold. Viewport3 provides underwater 3D scanning and reverse engineering services using ROV or diver-mounted cameras to obtain technical-grade point-cloud data for operators and marine contractors. **ST**



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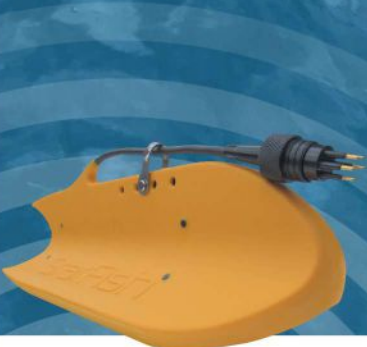
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Side Scan Sonar Software

SonarWiz 7.4 includes more than 80 new features and fixes. Key enhancements include: automated post-processing for side scan data, sub-bottom data aggregation function and improved batch contact import system. Chesapeake Technology Inc.

USV for Chinese Market

Nortek China has introduced an open, low-cost platform to measure water current and direction, with integrated Doppler instrumentation for ocean surveying. The USV has an industrial personal computer as the main operating platform and uses Remote Desktop to communicate with all instruments. Nortek Group.

Maritime Surveillance

The TORNADO-ER, a panoramic IR scanning and automatic maritime target detection and tracking system, was designed for coastal and maritime wide-area surveillance, coastal protection and maritime traffic control, especially in crowded maritime areas. It can track a large number of targets simultaneously in real time. CONTROP Precision Technologies Ltd.

Digital Video Solution

Eagle Portable enhances the live feed from a camera in any existing SDI video system and suits poor-visibility conditions. It connects between the camera and a monitor or VCR for simple installation and can be controlled remotely through

a standard RS232 serial interface with simple text commands. The Eagle Integration kit contains all the necessary parts for simple plug-and-play integration. LYNN AB.

Dynamic Laser Scanner



ULS-500 Pro 6K is rated to 6,000-m depth. This version was released in partnership with Oceaneering International, whose Freedom ROV resident system makes use of the new dynamic laser scanner. 2G Robotics Inc.

Acoustic Modem Location

There is a new GPS option for the UTS-9000 series Universal Topside Units used to command a line of acoustic modems and releases. Customers can upgrade existing UTS-9400 units, or order this option on new systems. The new feature allows them to survey in, and record, precisely where their acoustic releases and/or modems are deployed using only the topside unit and a dunking transducer. Teledyne Benthos.

Future-Proof Antenna

v150NX is a 1.5-m Ku to Ka convertible VSAT supporting 2.5-GHz wide Ka-band networks and geostationary, medium and low Earth orbit constellations. Intellian Technologies Inc.

Subsea Drilling Winch

The Passive Heave Compensation Winch system is a set of winches that safely provide constant tension through the rated range of motion. It is applicable to any environment where a load experiences resistance to movement due to hydrodynamic drag. Logan Industries International Corp.

Mini Optical Gauge

Part of the FiberLine Intervention (FLI) system, the miniature optical pressure-temperature gauge widens the well surveillance application envelope for FLI, both on and offshore, and offers operators a low-cost and disposable alternative to permanent downhole sensors and more traditional electronic logging devices. Well-SENSE Technology Ltd.

Monitoring, Data Transfer Solution



Seatooth PipeLogger is an integrated pipeline, umbilical, risers and flowlines temperature-monitoring and data transfer tool that provides real-time monitoring for offshore and subsea assets. WFS Technologies.

Fiber-Rope Offshore Crane

FibreTrac is able to exploit its full lifting capacity because fiber rope weighs virtually nothing in water, so no additional load is experienced by the crane, regardless of the length of rope, in contrast to steel wire-rope cranes. FibreTrac has a 150-t safe working load capacity and features an advanced

rope monitoring and management system. MacGregor.

Next-Gen DVL



The 600/300-kHz Tasman DVL, with its reduced size and weight and increased range, has increased accuracy and a field-replaceable phased-array transducer design. It has increased bottom tracking ranges from 0.15 to 420 m, in up to 6,000-m water depth. Teledyne RD Instruments.

Camera Housing

FA6500 V2 housing is intended for the Sony a6500 and a6300 mirrorless cameras. V2 features the Fantasea Hybrid Vacuum Safety System, which includes both a pre-dive vacuum check and an on-dive leak detector. Fantasea Line.

Underwater Defense Sonar

PointShield is a portable diver detection sonar for the protection of surface vessels from underwater intrusion and sabotage. AquaShield diver detection sonar provides permanent underwater security for all types of underwater threats. DSIT Solutions Ltd.

GPS Antenna

Connected wirelessly to the Zig-Boat system, the ZB211 delivers push notifications on fleet tracking, geofencing, weather forecasts and anchor watch. Glomex Marine Antennas USA Corp.

Marine Nav App

iNavX now provides access to Delius Klasing's detailed digital charts for European inland waterways and sea charts. iNavX.

Wave-Actuated Profiler

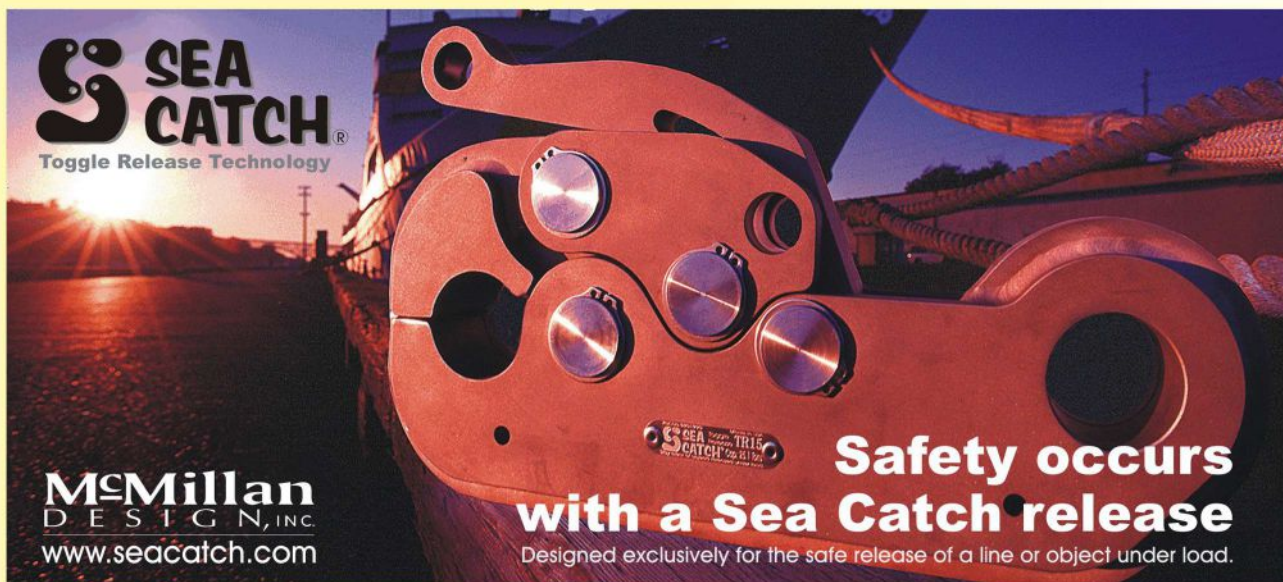
Prawler spans the surface to 500 m and is suitable for the energetic open ocean to low-wave freshwater lakes and reservoirs. It is a low-cost, lightweight alternative to distributed sensors. Deployments of 20 profiles per day for 12 months are possible. McLane Research Laboratories Inc.

Subsea Connectivity

The Hydro Rubber Moulded (HRM) series of subsea connectors come in a range of combinations, sizes and voltages. There are five variants on offer: from bulkheads, attachables and inlines to overmolds and dummy plugs. Hydro Group plc.

Pressure Loggers

The RBRquartz³ Q and RBRquartz³ BPR use the Paros Digiquartz pressure sensor to provide long-term pressure measurements with high stability and resolution. RBR Ltd. **ST**

An advertisement for Sea Catch Toggle Release Technology. It features a large, orange, mechanical release device in the foreground, with a ship's anchor and rope visible in the background. The text 'SEA CATCH® Toggle Release Technology' is in the top left. The bottom left has 'McMillan DESIGN, INC.' and 'www.seacatch.com'. The bottom right has the slogan 'Safety occurs with a Sea Catch release' and 'Designed exclusively for the safe release of a line or object under load.'

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**Safety occurs
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capitalreport

New US Interior Secretary

David Bernhardt was confirmed by the U.S. Senate as the 53rd secretary of the U.S. Department of the Interior, replacing Ryan Zinke. Bernhardt leads an agency with more than 70,000 employees who are stewards for 20 percent of the nation's lands.

Bernhardt is an avid hunter and angler and recently served on the Board of Game and Inland Fisheries for the Commonwealth of Virginia. He also led the International Boundary Commission between the U.S. and Canada. He has years of legal experience in both the government and the private sector. He previously held several positions within the Department of the Interior.

AAPA Testifies on US Maritime Trade, Ports And Advocates for USMCA

In testimony before the U.S. House of Representatives Ways and Means Subcommittee on Trade, the American Association of Port Authorities (AAPA) highlighted a new report showing significant increases over the past five years in U.S. maritime trade and port-related jobs.

AAPA also urged Congressional approval of the United States-Mexico-Canada Agreement (USMCA), which the Trump Administration negotiated to replace the North American Free Trade Agreement (NAFTA).

In her remarks to the Subcommittee on Trade, AAPA Vice President of Government Relations Susan Monteverde cited statistics from a new Martin Associates report on the economic impacts of the U.S. coastal ports system. The report notes that, from the beginning of 2014 to the end of 2018: the total number of jobs supported by cargo moving through U.S. deep-draft ports increased by one-third, from 23.1 million to nearly 31 million U.S. jobs; average annual salaries estimated for these jobs rose more than 17 percent, from \$53,723 to \$62,800, which was 27 percent higher than the average overall U.S. mean salary of \$50,620 in 2017; and personal wages and local consumption related to the port sector increased by more than a quarter, from \$1.1 trillion to \$1.4 trillion.

New Online Tool Enables Public Access to Ocean Data

A new web-based interactive tool for ocean mapping and planning created by the Department of the Interior's Bureau of Ocean Energy Management (BOEM) and the Department of Commerce's NOAA will give everyone from ocean industries to coastal managers, students and the general public the opportunity to be an ocean explorer right from their own computer.

The new OceanReports web tool at marinecadastre.gov/oceanreports provides users specialized "ocean neighborhood analyses," including maps and graphics, by analyzing more than 100 ocean data sets instantly.

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neously. OceanReports builds on more than a decade of data collection to transform how seemingly disparate ocean information can be delivered to the nation's ocean and coastal industries, which add \$320 billion in gross domestic product to the nation's economy.

MARAD Grants for Three Marine Highway Projects

The U.S. Department of Transportation's Maritime Administration (MARAD) announced \$6,790,000 in grants to three Marine Highway projects. The funding, provided by MARAD's Marine Highway Program, will go toward enhancing existing services in Louisiana and Virginia, as well as supporting the development of a new project in New York.

Projects receiving funding are: Harbor Harvest Long Island Sound Service (awarded \$1,812,285); Baton Rouge – New Orleans Shuttle on the M-55 (awarded \$3,155,622); and James River Expansion Project on the M-64 (awarded \$1,822,093).

US Coast Guard Releases Arctic Outlook Early

The U.S. Coast Guard (USCG) has released the Arctic Strategic Outlook four years early in recognition of the accelerated security, economic and environmental trends in the region, and the resulting demand for U.S. Coast Guard leadership.

Presently, the U.S. Coast Guard maintains two icebreakers: the Coast Guard Cutter *Healy*, which is a medium icebreaker, and the *Polar Star*, the United States' only heavy icebreaker. If a catastrophic event, such as getting stuck in the ice, were to happen to the *Healy* in the Arctic or to the *Polar Star* near Antarctica, the U.S. Coast Guard is left without a self-rescue capability.

The Coast Guard has been the sole provider of the nation's polar icebreaking capability since 1965 and is seeking to increase its icebreaking fleet with six new polar security cutters in order to ensure continued national presence and access to the polar regions.

USCG and the U.S. Navy have awarded VT Halter Marine Inc. of Pascagoula, Mississippi, a contract for the design and construction of the Coast Guard's lead polar security cutter.

Last December, in conjunction with the Department of Homeland Security Science and Technology Directorate, the Coast Guard ventured into space with the Polar Scout project, launching two shoe-box sized cube satellites into a low-Earth polar orbit.

The satellites send data to two ground control stations: one at the U.S. Coast Guard Academy in New London, Connecticut, and the other at the University of Alaska in Fairbanks, Alaska. Named Yukon and Kodiak, the miniature satellites are specifically tailored to detect 406-MHz emergency distress beacons.

This Polar Scout initiative should provide valuable insight on the process, cost and feasibility of acquiring and using organic satellites for Coast Guard missions.

The use of such satellites may improve communications in the Arctic and assist in monitoring large areas for illegal activity and helping mariners in distress. **ST**



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European Shipbuilders Collaborate on Connectivity

The biggest European shipbuilders have announced a new cooperative initiative to develop and demonstrate a connected vessel platform. This project is named Code Kilo.

EUROYARDS members—Chantiers de l'Atlantique, Damen Shipyards Group, Fincantieri, Lürssen, Meyer Werft, Naval Group and Navantia—have joined forces to harmonize data management solutions and standards. This ambitious project will seek the full cooperation and engagement of all maritime stakeholders, including shipowners, shipbuilders, suppliers and classification societies, and it is supported by SEA Europe, the Shipyards' and Maritime Equipment Association.

European shipbuilders are committed to applying their knowledge of physical system integration to

improve digital integration, aiming to establish the base for future business opportunities with IoT, big data and AI.

Dialog Platform to Meet Growing Bandwidth Demand

Telenor Satellite aims to satisfy rising demand for higher throughput maritime services on its THOR 7 Ka-band high-throughput satellite (HTS) with a new collaboration with Newtec on Newtec's Dialog platform. Telenor Satellite will use the platform for ferry, cruise and off-shore support vessels.

Newtec Dialog also opens up the possibility of using THOR 7 in verticals not yet using hub-based technology for service delivery.

Quadrans Nav Tech to Equip SailGP Catamarans

iXblue's Quadrans gyrocompasses have been selected to pro-

vide extreme high-precision navigation to the six revolutionary F50 catamarans competing in the new SailGP global sports championship. The F50 catamarans fly above the water on wave-piercing hydrofoils at speeds exceeding 50 knots (60 mph).

The Quadrans gyrocompass is a solid-state and strap-down system. Once in situ, its open architecture guarantees seamless interfacing with all major GPS systems and third-party navigation software packages. Working in tandem with the race boat's GPS system, the Quadrans provides highly accurate and reliable heading and attitude data for precise control of the aerohydrodynamic performance of the craft.

SailGP will culminate in a \$1 million winner-takes-all race in Marseille, France, in September.

Collaboration Creates USV Sounder System

A collaboration between Kongsberg and the VIKING Norsafe boats



Surface Navy Association's

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and davits division has resulted in the Souder USV, a multipurpose platform designed for military and commercial maritime uses, including survey and fishery duties.

The Souder USV deploys maximum stability with minimal vibration on the water and is optimized for low air disturbance under the hull.

A Brief History of SSS

JW Fishers Mfg. has been producing side scan sonars (SSS) since 1992, when the first thermal printer SSS was introduced. The original SSS came standard with a 17-in. thermal printer that allowed the operator to display the ocean floor on thin thermal imaging paper. JW Fishers expanded the technology and moved toward software-driven solutions in the mid-2000s, allowing customers to discard the heavy paper-based printer in favor of a computer-based graphical user interface. Today, Fishers' Sonar View software provides the operator with complete control over the system's operating parameters. Users can choose between 10 different scan ranges and eight color schemes. With a GPS unit connected, position coordinates are automatically captured with the side scan data. Operators simply hover the computer mouse over a target, and the GPS position coordinates are displayed on the screen.

Customers include the Beadle County Emergency Management office in South Dakota, which purchased JW Fishers' dual-frequency 600k/1200k SSS system.

STR Relies on MacArtney For Multiplexer Tech

Subsea Technology & Rentals (STR) has requested MacArtney to design and custom build a new NEXUS MK C to complement the NEXUS MK IV and MK VI systems purchased by STR last year.

The multiplexer systems include full real-time diagnostics for link status, temperature, optical power and voltages, via a 7-in. touchscreen for configuration and operation, an advanced diagnostics graphic user interface, software configurable

multi-protocol ports, micro-second latency data, and full-bandwidth real-time video with no compression.

Survey of Historic Aircraft

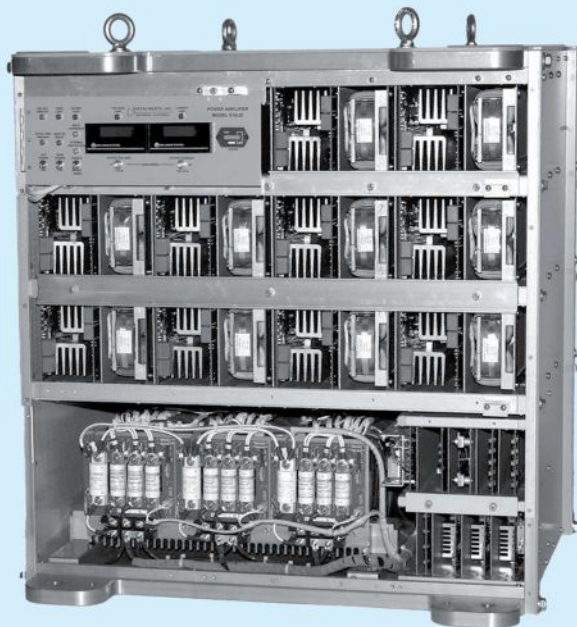
3D at Depth Inc. has used an innovative underwater survey technique integrating photogrammetry with subsea laser LiDAR technology to create accurate, precise, reverse-engineered 3D models. The technique was developed in an

October 2018 expedition with the Air/Sea Heritage Foundation to document the wreck of the U.S. Navy Douglas TBD-1 Devastator aircraft resting at the bottom of Jaluit Lagoon in the Republic of the Marshall Islands. The wreck is located at 130-ft. depth.

Optical imagery from photogrammetry, 360° VR and stills were integrated to render an exact 3D model of the Devastator. **ST**

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RTsys Improves Detection Capacities Of Older-Generation French Frigate Sonars

Since summer 2017, four vessels equipped with analog sonars have been upgraded using RTsys AS3i (Analog Surface Ship Sonar Improvement) technology, which will digitize and improve the processing of signals available to the sensors. The analog sonars used on the French Navy frigates were upgraded in accordance with the ACORES (revAlorisation Capacitaire des sOnaRs des frégatES) frigate sonar capacity upgrade public procurement program.

For this upgrade, RTsys proposed a solution based on its SDA (Synchronous Data Acquisition) technological core to digitize and process the signals received without the need to modify the existing transmitters and transducers. It has been installed on three anti-submarine warfare frigates in Brest and on an anti-aircraft frigate based in Toulon by the Mediterranean French coast, thereby providing them with effective digital tools without requiring the costly replacement of the entire sonar system.

Hydramec Provides AHC LARS for New Zealand Navy ROV

Hydramec Offshore has completed the supply, integration and operational testing of a fully active heave compensated (AHC) launch and recovery system (LARS)

for a Saab Seaeye Cougar XT ROV to the New Zealand Navy.

The New Zealand Navy acquired Ostensjo's *Edda Fonn* multipurpose vessel for conversion to a diving support vessel and required an ROV to assist with diving support and other operations.

Progress in JFD Acceptance Trials For Indian Navy

JFD, part of James Fisher and Sons plc, has successfully completed critical subsea mating exercises, marking a key milestone in the sea acceptance trials of the various assets comprising the second of the two third-generation submarine rescue flyaway systems delivered to the Indian Navy.

Through the course of the trials, and in close partnership with the Indian Navy, JFD carried out multiple dives, including underwater mating operations with a bottomed submarine and conducting a safe transfer of personnel from the submarine to the Deep Search and Rescue Vehicle (DSRV), ensuring there is a robust and effective submarine rescue capability in place.

Israeli Navy Deploys HELRAS-Equipped Seagull in ASW Exercise

In an anti-submarine warfare (ASW) exercise conducted recently together with the Hellenic Navy, the Israeli Navy deployed its Seagull multi-mission surface vessel in an ASW configuration that included an onboard helicopter long-range active sonar (HELRAS).

A deployment in this configuration took place approximately three months after the Israeli Navy completed a sea acceptance test for a HELRAS dipping sonar that was successfully converted for operation on board its Seagull.

The Seagull's performance in the exercise demonstrated that operating a dipping sonar on board such a vessel significantly increases the operational working time while substantially enhancing detection capabilities and the effectiveness of ASW.

Australian Navy Expands Training Capability With Addition of Bridge Simulators

Kongsberg Digital has signed a contract for delivery of two new K-Sim Full Mission Bridge simulators at the Royal Australian Navy's (RAN) HMAS Watson Bridge Simulator Facility in Sydney.

The project adds to Kongsberg's service delivery contracts with RAN, which include multiple ship-handling and engine room simulators delivered at training facilities across Australia.

Naval Group Pools Resources To Stay on Tech's Cutting Edge

Naval Group has just joined b<>com, a European innovation center based in France, to help accelerate technological advances in the field of digital and communication technologies for naval defense.

The global naval defense market is growing steadily by about 4 percent annually.

Naval Group seeks to stay competitive by maintaining a technological edge. **ST**



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environmental monitoring

Turbidity Monitoring In Monterey Canyon

Turbidity currents deliver sediment from the continental slopes to the deep ocean and threaten infrastructure such as submarine fiber-optic cables. The Coordinated Canyon Experiment (CCE), led by the Monterey Bay Aquarium Research Institute and U.S. Geological Survey, used RBR turbidity sensors to continuously monitor the seafloor along the Monterey Canyon for 18 months. The RBR turbidity sensors allowed the researchers to calibrate ADCP backscatter data and measure with new detail the profile of these energetic currents.

Canadian Integrated Ocean Observing System Funding

Fisheries and Oceans Canada announced an investment of \$1.5 million per year to support the Canadian Integrated Ocean Observing System (CIOOS). An additional \$2 million over four years will be provided by the Marine Environmental Observation, Prediction and Response Network (MEOPAR).

Over the next two years, the organizations will partner with groups and universities from across Canada, including Ocean Networks Canada and the University of Victoria, to implement the first phase of CIOOS.

PIES to Monitor US Gulf's Loop Current System

Oceanographic equipment developed by Sonardyne International Ltd. will be used as part of a major \$2 million scientific study of disruptive ocean currents in the U.S. Gulf of Mexico.

The multi-year deployment, led by the University of Rhode Island's (URI) Graduate School of Oceanography, will monitor the Loop Current System (LCS) using Sonardyne's pressure inverted echosounders (PIES). The long-term objective is to improve forecasts of the LCS in order to increase the safety of operations in the Gulf. The LCS is the dominant ocean circulation feature

in the Gulf of Mexico. It influences all ocean processes in the Gulf and has implications for a wide range of human and natural activities, from oil exploration to coastal ecosystems, but knowledge of its underlying dynamics is limited. URI's initial study aims to improve the understanding and prediction of the LCS by deploying a seabed network of PIES plus near-bottom current meters to monitor the central Gulf's deep waters.

A total of 25 of Sonardyne's and URI's own PIES and current meters will be deployed this summer, in waters down to 3,500-m depth, with an initial data retrieval using acoustic through-water communications to a surface vessel planned for autumn 2019. Instrument recovery is scheduled for autumn 2020. The results of this study will be used to inform how best to deploy a larger array for a planned 10-year-long research campaign.

Fisheries Monitoring Studies Aid Offshore Wind Industry

Vineyard Wind will implement recommendations from the University of Massachusetts Dartmouth's School for Marine Science and Technology (SMAST) to guide the project's fisheries monitoring studies during construction, as well as to initiate longer-term studies as part of a regional approach to fisheries studies. SMAST's recommendations were based on its expertise as a leading fisheries research center, as well as input from active fishermen, government agencies and academia.

SMAST's studies will begin later this spring.

In 2017, Vineyard Wind entered into an agreement with SMAST through which the wind developer asked SMAST to design a broad-based approach to research capable of supporting long-term, regional studies in addition to monitoring of construction impacts.

The SMAST studies seek to further public understanding about the effects of offshore wind develop-

ment and inform future permitting and public policy decisions regarding wind energy facility siting.

Port Data Sharing

Trelleborg and OceanWise have collaborated to allow pilots to view important real-time tide and weather data on their Safe Pilot PPUs, further improving the safety and efficiency of operations at ABP Southampton.

The data are drawn from ABP's environmental monitoring system Port-Log, which is supplied by OceanWise and allows easy publishing and sharing of environmental data across the port.

The system supports not only the VTS team but also pilots and dredgers who need reliable access to this key information.

Statistical Techniques for Computer Flood Model

Researchers at Oregon State University have developed a new methodology for building computer models that paves the way to better understanding the flood risks faced by coastal communities.

Estuaries occur where rivers flow into the ocean, meaning the rivers are influenced by tidal flooding and also experience frequent, periodic changes in salinity, sunlight and oxygen.

The study site for this research was Washington state's Grays Harbor, but the methodology can be applied to any area subject to estuarine flooding.

In the short term—i.e., flooding from a particular storm—predictions can inform decisions about actions like evacuations and road closures. They're also critical to understand how flooding occurs across longer time scales—for example, so planners can have more information when deciding whether or not to develop a low-lying parcel of land.

The new computer model involves "emulation" and uses statistical techniques, as opposed to traditional models that try to directly reproduce the wide collection of physical processes at play when estuaries flood. **ST**

offshore oil & ocean engineering

Winch for Alcatel Submarine Networks Subsea Ops

MacArtney's MERMAC R40 AHC winch, aboard the ASN *Ile de Class* vessel, will be facilitating the effective laying of seismic cables on the seabed of the Johan Castberg oil field in the Barents Sea for Equinor's new permanent reservoir monitoring system.

The winch is supplied with a Moog Focal combined electro-optical slip ring. It will be used aboard the vessel in the laying of seismic cabling and sensors that will be permanently deployed on the Barents' seabed to enable more frequent and improved 4D seismic interpretation of the subsurface.

The active heave compensation reduces the influence of wave movement on the touchdown monitoring system and enables it to lay the seismic cables and sensors in the correct position on the seabed.

OTC Award for SES Maintenance Tech

Stress Engineering Services Inc. (SES) has received an OTC Spotlight on New Technology Award for its condition-based maintenance (CBM) of drilling riser systems.

SES developed a new process for collecting critical riser data using a life cycle condition-based monitoring, maintenance and inspection system that can be deployed on the mobile operating drilling unit. It enables resources to be deployed only when necessary.

The CBM system reliably determines the condition of drilling riser joints, consistently predicts when vital components will require service and accurately assesses remaining component life.

Acteon Expands

Acteon has agreed to acquire Houston-based Benthic, which

adds deepwater and ultra-deepwater surveying capabilities to Acteon through Benthic's proprietary portable remotely operated drill (PROD) technology.

The PROD system can conduct in-situ penetration testing and collect samples and cores in extremely challenging conditions, including seabed slopes greater than 20° and water depths exceeding 3,000 m.

Acteon plans to continue its program of capital expenditure to ensure it can service growing worldwide customer demand.

Interventek to Develop Subsea Landing String Control System

Development work has commenced on an innovative control system for a new subsea in-riser landing string, designed to reduce the size, weight, complexity and cost of this critical well intervention equipment for oil and gas operators.

Interventek Subsea Engineering has secured funding from the Oil and Gas Technology Centre (OGTC) toward development. As part of the

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agreement, Interventek has also secured the support of a leading international oil company as project sponsor to provide end-user expertise and design-criteria feedback. Interventek aims to complete the project and deliver a function-tested prototype by the end of 2019.

UK Oil, Gas Industry Maps Vision of Future

Industry leaders have come together to develop the roadmap to steer the U.K.'s offshore oil and gas sector toward achieving Vision 2035 (energyvision2035.com). This national vision is a shared intent by the industry and stakeholders, including government, to ensure industry can deliver as much as possible to meet the U.K.'s oil and gas needs; expand supply chain opportunities at home, abroad and in other sectors; and support the accelerating transition to a lower carbon future up to 2035 and beyond.

A task force of senior industry figures has been formed to help develop a roadmap of what needs to

be done and by when to deliver Vision 2035. The task force members will pull together specific and measurable deliverables under the key areas of skills, technology, exports, diversification and culture.

Design Concept Approval

DNV GL has presented China Merchants Heavy Industry (CMHI) with approval in principle (AiP) certificates for two new offshore units: an Arctic single-column drilling unit and a wind turbine shuttle.

The certificates confirm that DNV GL has assessed each of the two designs according to class rules and found that no significant obstacles exist to prevent the concept from being realized.

The Arctic single-column drilling unit (SCDU) consists of a round floater with an upper and a lower hull, an enclosed deckhouse, and a round footing. It is designed for well work-over, exploration and development drilling operations in water depths up to 700 m in moderate environments, including Arctic and

sub-Arctic areas (open water and up to 1.5-m ice thickness), moored by a 16-point mooring system. The round conical shape of the strengthened hull structure is designed to deflect and break the ice, protecting the drilling riser and other equipment in the moonpool against level ice.

The wind turbine shuttle (WTS) was developed to install offshore wind turbines at wind farms. Unlike other installation vessels, the WTS has a small waterplane area twin hull (SWATH) design. This results in very low resistance at the design draft (16 m) and excellent sea-keeping performance, good motion behavior characteristics, and high transit speed of 14 kt. Capable of transporting and installing two fully assembled wind turbines or two wind turbine foundations, the vessel has a highly redundant dynamic positioning system installed, and the wind turbine hoist tackles are equipped with an active system to compensate for the heave motion of the vessel. **ST**



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contracts

KNUD E. HANSEN, Helsingør, Denmark, has signed a contract for developing the basic design of three large RoRo vessels, based on the Finnlines/Grimaldi/KNUD E. HANSEN design. Nanjing Jinling Shipyard.

Oceaneering International Inc., Houston, Texas, has entered into an industry-first, five-year digital services package agreement to provide customers with better reliability and improved throughput enabling streaming video and real-time data. This will allow the provision of emerging services such as remote ROV piloting, surveying and automation aboard a drillship fleet. Pacific Drilling.

The government of the United States, Washington, D.C., has entered into the U.S.-Peru Aeronautical and Maritime Search and Rescue (SAR) Agreement. This is the first binding SAR agreement between the United States and a South American country. Republic of Peru.

Ampelmann, Delft, Netherlands, has secured a contract to perform maintenance work at an oil and gas platform in the Gulf of Mexico. An A-type system has been mobilized on a vessel and will operate for 120 days. Harvey Gulf.

Canyon Offshore Inc., Houston, Texas, the Robotics division of Helix Energy Solutions Group Inc., has entered into an agreement for the charter of the Jones Act-compliant inspection, maintenance and repair (IMR) vessel *Ross Candies*. The charter will commence in July 2019. Otto Candies LLC.

Damen Shipyards Group, Gorinchem, Netherlands, signed a memorandum of understanding for collaboration in the production of marine platforms. ASFAT.

Craig International, Aberdeen, Scotland, will provide third-party procurement services including

equipment for maintenance, repair and operations to all of an operator's assets in the U.K. Continental Shelf (UKCS). BP.

Exceed, Aberdeen, Scotland, has secured a two-year contract to support future well operations. Initial operations will be concentrated on the Columbus Development Well, which is planned to be drilled in 2020, with additional work to drive maximum production from recently acquired assets also planned. Serica Energy (UK) Ltd.

WindServe Marine LLC, Boston, Massachusetts, has awarded a contract for classification of one purpose-built offshore crew transfer vessel for Ørsted North America. The contract covers the construction of the BMT-designed vessel, which will be the first offshore wind vessel built in the U.S. to class requirements. DNV GL.

ORBCOMM Inc., Rochelle Park, New Jersey, has a contract that will be extended for another year through ORBCOMM's partner Kordia. ORBCOMM and Kordia will provide satellite AIS data used for ship tracking and other maritime navigational and safety efforts for designated regions and specific maritime projects. Australian Maritime Safety Authority.

Incat, Hobart, Australia, has secured a contract to build the world's largest aluminum ship. Incat Tasmania Pty Ltd. will build the 130-m-long ship to operate between Argentina and Uruguay. Buquebus.

SVANEHØJ, Aalborg, Denmark, has secured an order for 42 pumps for three new very large ethane carriers. The ships have been ordered by Zhejiang Satellite Petrochemical and will be used to carry liquid ethane from Texas to the company's petrochemical terminal in Lianyungang, China. The order will be manufactured and delivered in 2020. Samsung Heavy Industries. **ST**

meetings

AUGUST

August 20-21—AUVSI Unmanned Systems, Washington, D.C. 571-858-4364 or ehallberg@auvsi.org.

SEPTEMBER

September 1-6—European Wave and Tidal Energy Conference, Naples, Italy. ewtec2019@ewtec.org or <https://ewtec.org>.

September 3-6—SPE Offshore Europe, Aberdeen, Scotland. www.offshore-europe.co.uk.

September 8-11—SMM Hamburg, Hamburg, Germany. +49-(0)40 3569-2445 or nora.ebbinghaus@hamburg-messe.de.

September 9-13—London International Shipping Week, London, England. +44 1295 814455, sales@shippinginnovation.com or <http://londoninternationalshippingweek.com>.

September 10-13—Defence & Security Equipment International, London, England. +44 20 7384 7770, enquiries@dsei.co.uk or www.dsei.co.uk.

September 15-20—SEG 2019, San Antonio, Texas. 918-497-4644, registration@seg.org or www.seg.org/am.

September 16-20—NMEA and RTCM Marine Electronics Conference and Expo, Portsmouth/Norfolk, Virginia. 410-975-9425, mreedenaer@nmea.org or www.expo.nmea.org.

September 16-20—OceanObs'19, Honolulu, Hawaii. 202-448-1245, cyanoff@oceanleadership.org or www.oceanobs19.net.

September 19—NOIA-OMSA Offshore Wind Summit, New Orleans, Louisiana. nnye@noia.org.

OCTOBER

October 2-3—OilComm, Houston, Texas. 484-869-2378, dmuirhead@

accessintel.com or www.oilcomm.com.

October 3-5—INMEX SMM India, Mumbai, India. nora.ebbinghaus@hamburg-messe.de or www.inmex-smm-india.com.

October 6-9—Teledyne Marine Technology Workshop, San Diego, California. 508-563-1639, Margo.newcombe@teledyne.com or www.teledynemarine.com/tmtw2019.

October 7-9—Offshore Energy Exhibition & Conference, Amsterdam, Netherlands. +31 10 209 2600, marketing@offshore-energy.biz or www.offshore-energy.biz.

October 8-10—PACIFIC 2019, Sydney, Australia. +61 (0)3 5282 0500, expo@amda.com.au or www.pacificexpo.com.au.

October 27-31—OCEANS 2019 Seattle, Seattle, Washington. info@oceans19mtsieeseattle.org or <https://seattle19.oceansconference.org>.

October 28-30—CLEAN GULF Conference & Exhibition, New Orleans, Louisiana. CBuchholtz@accessintel.com or www.cleangulf.org.

October 30-November 1—SNAME Maritime Convention, Tacoma, Washington. 703-997-6701, events@sname.org or <https://snameconvention.com>.

NOVEMBER

November 5-7—International Conference on Marine Engineering and Technology Oman, Muscat, Oman. +44 (0)20 7382 2656, marketing@imarest.org or www.icmetoman.com.

November 6-7—ASNE Design Sciences Series Workshop: Digital Engineering: Digital Twin, Washington, D.C. 703-836-6727, asnehq@navalengineers.org or www.navalengineers.org/Symposia/Digital-Engineering-Series-Digital-Engineering-Digital-Twin-2019.

November 10-14—International Water Conference, Orlando, Florida. 412-261-0710 ext. 13, t.bombalski@eswp.com or www.eswp.com/water.

November 18-22—BlueTech Week, San Diego, California. mbjones@themaritimealliance.org or <https://www.bluetechweek.org>.

November 20-21—Combat Systems Symposium, Arlington, Virginia. 703-836-6727, asnehq@navalengineers.org or www.navalengineers.org/Symposia/Combat-Systems-Symposium-2019.

November 20-22—Sustainable Ocean Summit, Paris, France. info@oceancouncil.org or www.oceancouncil.org.

November 21-23—Pacific Marine Expo, Seattle, Washington. 207-842-5666, cdimmerling@divcom.com or www.pacificmarineexpo.com.

2020

JANUARY

January 14-16—Blue Innovation Symposium, Newport, Rhode Island. 401-847-6650, tobias.stapleton@salve.edu or <https://salve.edu/blue-innovation-symposium>.

FEBRUARY

February 4-6—EUROMARITIME, Marseille, France. www.euromaritime.fr.

February 4-6—Underwater Intervention, New Orleans, Louisiana. ui@naylor.com or www.underwaterintervention.com.

APRIL

April 13-16—MTS Buoy Workshop, Wilmington, North Carolina. rickcole@rdsea.com.

MAY

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

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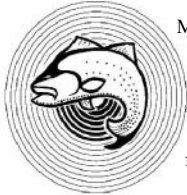
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Increasing the Number of Women in Maritime Search and Rescue—Theresa Crossley

Theresa Crossley was appointed CEO of the International Maritime Rescue Federation in October 2017. She was previously the head of shipping policy and chair of the U.K. Search and Rescue Strategic Policy Committee in the U.K. Department for Transport for six years, and she served for five years as a deputy director of the European Maritime Safety Agency based in Lisbon, Portugal.



The International Maritime Rescue Federation (IMRF) is the nongovernmental organization working to develop and improve maritime search and rescue (SAR) capacity around the world, preventing loss of life in the world's waters.

Since its establishment as the International Lifeboat Federation in 1924, there have been a number of female lifeboat crew members and several all-female lifeboat crews, but women in these roles are still not the norm. The U.K.'s Royal National Lifeboat Institution (RNLI) is still mostly men. Only 8 percent of lifeboat crew members are female.

But times are changing, reflected in the fact that the IMRF secretariat itself is predominantly female, including me, its CEO.

Women's roles can be limited by a public perception of what's appropriate or not, but the IMRF, working with our members all around the world, can see that over and over again women can change perceptions and really make a difference—wherever and whenever they are given a chance.

"The sea does not care if you are a man or a woman, nor does the casualty who you are rescuing," said IMRF Secretariat staff member Rebecca Sweeney, an ex-seafarer and RNLI volunteer crew member. "All lifeboat crew members experience times when they need to be strong, brave and fearless. They should not,

however, have to be any of those things simply to 'compensate' for their gender."

Today, several national SAR organizations are headed by women. Sjöräddningssällskapet, the Swedish Sea Rescue Society, is led by CEO Cia Sjöstedt. She manages 2,300 volunteer crew members, and the society is responsible for 80 percent of all sea rescues in Sweden. The organization has set itself the goal of achieving crew diversity—both gender and ethnic—promoting inclusion at all levels.

"Making room for more women in maritime SAR is part of a larger question: How can we create diversity in every working group?" said Sjöstedt. "If we think inclusively from different perspectives, the end result will always be better, and this is important in SAR, where we, by tradition, have had a male-dominant culture. Changing this is all about leadership, in our organizations as well as at rescue stations and on board our vessels."

In Greece, "Women are strongly represented in the HRT [Hellenic Rescue Team], and they are active in mountain rescue, sea rescue and urban search and rescue; in fact 35 to 40 percent of our volunteers are women aged between 16 and 60 years old," said HRT President Giorgos Kalogeropoulos. "Two of our past presidents have been women, and more recently, when our headquarters in Thessaloniki recruited 63 new volunteers, 30 of them were women. We are delighted that women's participation is growing year on year. We actively promote women's involvement."

Rikke Lind is an IMRF trustee and the secretary general of Redningsselskapet (RS), the Norwegian Society for Sea Rescue. "There is no doubt that diversity in organizations improves results," she said. "We need people with different backgrounds, ages and cultures—and we need both men and wom-

en. At Redningsselskapet, we have worked determinedly towards recruiting more women in maritime positions and in SAR, both as employees and volunteers. We have recently recruited two experienced female leaders in key positions and will continue our focus on increasing the number of women in the maritime sector."

Redningsselskapet has 25 stations around the coast of Norway, run by 1,200 volunteers, and women are represented throughout. For example, of 12 new volunteers in Oslo, four of them are women, and of the 25 heads of stations employed by RS, six are women. They've also just recruited a new female captain.

As part of its work to build global maritime SAR capability, the IMRF is planning maritime SAR training sessions specifically for women in developing countries to increase their expertise and qualifications, enabling them to share their knowledge and skills.

Diversity in search and rescue was discussed at the IMRF's World Maritime Rescue Congress 2019 in June in Vancouver, Canada. The event marked the launch of a new Women in SAR network, an IMRF initiative to provide women around the world the opportunity to share their experiences and challenges.

"Irrespective of gender, everyone in the SAR community is united in our common aim of preventing loss of life in the world's waters, and women are proving that they bring special qualities and skills to this important sector," said Dave Jardine Smith of IMRF. "In SAR, we speak of 'casualties,' 'persons in the water,' 'survivors.' We are not gender-specific about the people we save. It should not matter if the rescuers are men or women. It's what they do that matters."

To find out more about the Women in SAR network, email: info@imrf.org.uk or visit international-maritime-rescue.org. **ST**

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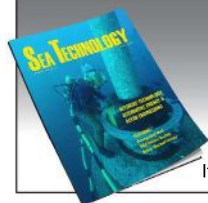
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USBL POSITIONING SYSTEMS

simultaneous positioning and communication - no need to switch between positioning mode and modem mode

- flexible SiNAPS positioning software
- reliable data transmissions
- range: up to 8000 m
- accuracy: up to 0.04 degrees

LBL POSITIONING SYSTEMS

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- reliable data transmissions
- range: up to 8000 m
- accuracy: better than 0.01 m

UNDERWATER ACOUSTIC MODEMS

reliable data transmissions even in adverse conditions, customizable R-series modems, light and compact M-series "mini" modems, the HS high-speed modems, special editions for developers, S2C communication and positioning emulator - remote access or standalone device

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- data rate: up to 62.5 kbps

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