

June 2020

ON&T

oceannews.com



OCEAN NEWS & TECHNOLOGY

The Advent of Commercial ASVs pg. 10



Fifty Years of Ocean Science

CSA opened its doors in 1970 with a mission to advance ocean science. For 50 years, from coastal waters to the deep sea, we've proudly partnered with industrial, academic and government organizations to design and implement scientifically robust and progressive environmental programs, all in accordance with the strictest quality assurance and HSSE requirements.

But we're just getting started. Every day of each project pushes us to reach greater depths, discover new frontiers, and develop ever-innovative solutions to sharpen our subject matter expertise and facilitate our clients' understanding of what lies beneath.

Find out how CSA can help you manage the environmental impact of your marine activities as we embark on the next 50 Years of Ocean Science.

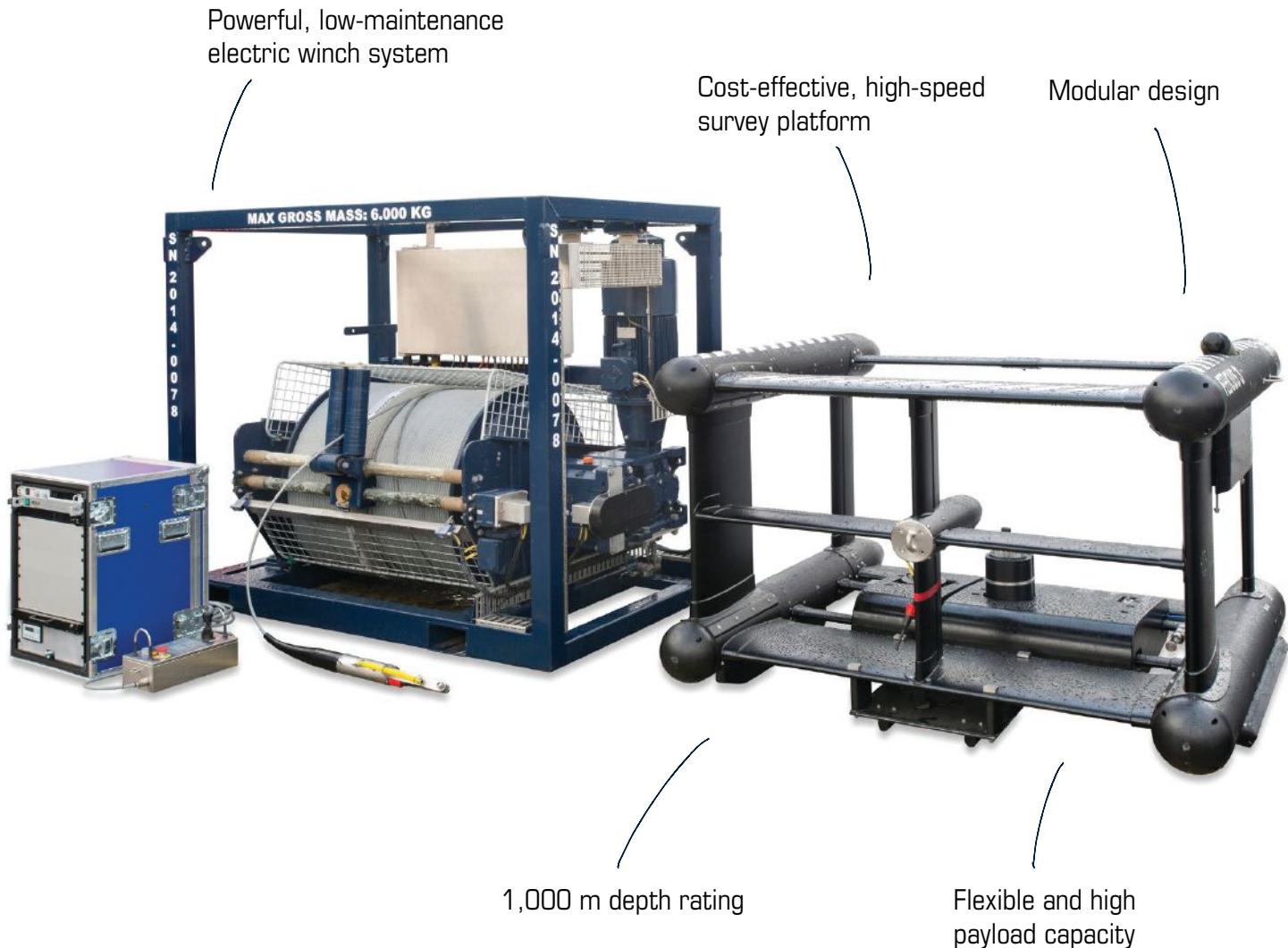
Sea the Difference.



csaocean.com

FOCUS 3

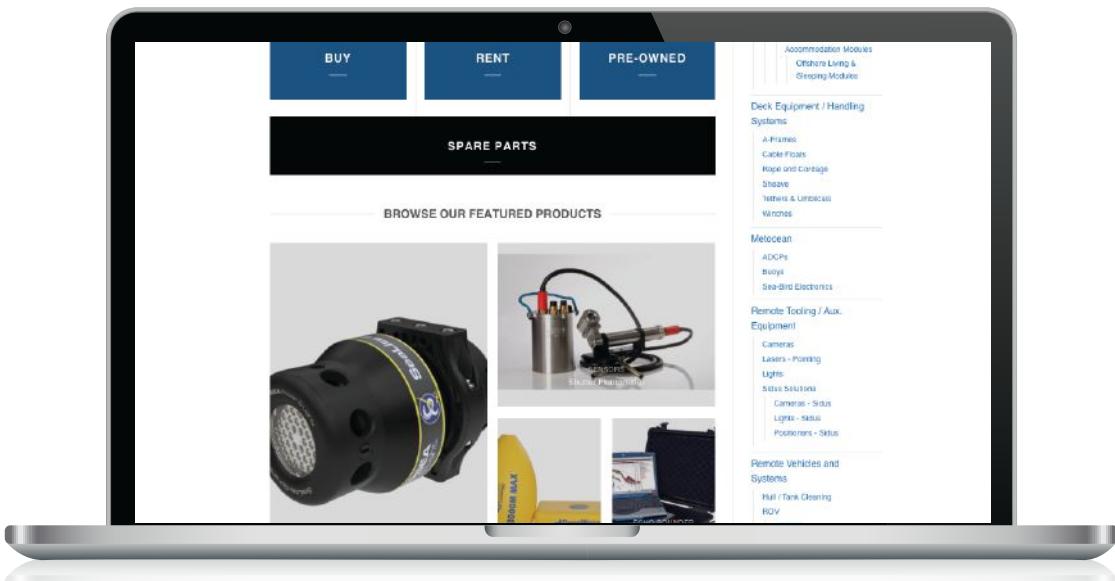
Latest generation FOCUS survey solution



MacArtney global solutions

Denmark | Norway | Sweden | United Kingdom | France
Italy | Germany | Netherlands | USA | Canada | Chile
Brazil | Singapore | China | Australia





The largest single source marketplace for marine professionals

SeaCatalog.com is a centralized marketplace that supports ocean professionals from around the world by sourcing components and parts from multiple vendors through long time relationships with our global partners.

Receive quotes on new and pre-owned equipment from our extensive product line which includes thousands of parts and equipment, including over 10,000 ROV and Subsea spare parts alone.



seacatalog.com

HIGH PERFORMANCE USVs

- Simple One Person Operation
- All Weather Conditions
- Easy Payload Integration
- Sizes: 50 in - 80 in
- Straightforward Autopilot
- Weights: 24 lbs - 145 lbs
- Self-Righting
- Battery or Hybrid Power



HYDRONALIX

www.hydronalix.com
(520) 203-8351



FEATURES

- 10 The Advent of Commercial ASVs**
- 16 Weathering The Storm:** The Ocean Tech Keeping Us One Step Ahead Of Extreme Weather Systems
- 21 SOMAG AG Jena Offers High-Precision Gimbal Systems** for Maritime Applications
- 22 Nexans' Aurora:** Cable Layer Sets New Standards
- 25 SeaRobotics:** Intelligent Unmanned Systems

DEPARTMENTS

- 14 OCEAN SCIENCE & TECHNOLOGY**
- 30 OFFSHORE ENERGY**
- 34 SUBSEA INTERVENTION & SURVEY**
- 40 CABLE TECHNOLOGY**
- 44 DEFENSE**
- IN EVERY ISSUE**
- 08 EDITORIAL**
- 26 PRODUCT FOCUS**
- 48 STATS & DATA**
- 52 EVENTS**
- 54 MILESTONES**
- 59 OCEAN INDUSTRY DIRECTORY**



ON THE COVER:

Teledyne's Z-Boat 1800RP: One of a growing range of remotely operated surface vehicles designed to collect high-resolution hydrographic survey data in shallow and hard-to-navigate waters..



A Teledyne Marine Company

Hydrographic Survey Efficiency

For shallow water coastal or inland hydrographic surveying



Z-Boat 1800T – Trimble Edition – NEW!

Designed with Marine Construction and Dredging in mind, this new Z-Boat 1800T offers all the traditional advantages of the Z-Boat 1800 but adds in the precise heading and positioning/guidance of Trimble's BX992 GNSS heading receiver and dual antennas. Combined with the compact and robust Odom Hydrographic ECHOTRAC E20 singlebeam, the Trimble Edition Z-Boat offers customers a compact, portable, and cost-effective package.

Learn more at http://www.teledynemarine.com/Z-boat1800T_Trimble

Z-Boat 1800RP

Exceptionally rugged and outfitted with an interchangeable sensor bay, the 1800RP gives the surveyor the maximum level of flexibility and autonomy for high-resolution data

Learn more at <http://www.teledynemarine.com/z-boat-1800rp>



Z-Boat 1250

Rugged and light, this one person portable solution is ideal for surveying remote areas with a single beam sonar.

Learn more at <http://www.teledynemarine.com/zboat1250>



+1-858-842-2600

Oceanscience.Sales@teledyne.com



TELEDYNE MARINE
Everywhereyoulook™
www.oceanscience.com

Editorial Team**ED FREEMAN**

KIRA COLEY

JOHN MANOCK

G. ALLEN BROOKS

INGER PETERSON

RHONDA MONIZ

Art Director

EMILLE RODRIGUEZ

Conferences Manager

WHITNEY SCHWERIN

Subscription Management

subscriptions@tscpublishing.com

Editorial Advisory Board

Bios available at:

www.oceannews.com/magazine

DR. PHIL HART

Milton Keynes, United Kingdom

DREW MICHEL

Pierre Part, Louisiana

DR. TOBIAS STAPLETON

Westport, Massachusetts

Partners

Center for International Maritime Security (CIMSEC)

Marine & Oceanographic Technology Network (MOTN)

Published byTechnology Systems Corporation
PATRICK C. LAGRANGE, CEO**ADVERTISING SALES**

LISA CHILIK

Tel: 574-261-4215

lchilik@tscpublishing.com

MIMI KING

Tel: +44 (0) 777 6017 564

mking@tscpublishing.com

TO SUBSCRIBE

www.oceannews.com/subscribe

Ocean News & Technology ISSN# 1082-6106

is published 11 times a year in print and digital by Technology Systems Corporation, 7897 SW Jack James Dr., Suite A, Stuart, FL 34997. Copyright ©2020 Technology Systems Corp. All rights to editorial content are reserved. No article, photograph, or illustration may be reproduced in whole or part without the written permission of the publisher. Unless otherwise stated in writing by the contributor, all images submitted to TSC may be used in other promotional materials belonging to TSC without permission. Subscriptions are free to qualified individuals or companies. For all others, call TSC for subscription information.

PRINTED IN THE USA



This has been a challenging time for the marine technology industry and businesses have had to adapt to new working conditions amid the COVID-19 pandemic. Marine tech conferences, which have always been such an important way for the industry to network and promote products, have been cancelled, leaving business development and sales meetings to be conducted virtually. Product demonstrations have also been ported into the online environment; over the last few weeks we have seen several Marine & Oceanographic Technology Network (MOTN) members live-stream demos to engage customers. Many organizations, MOTN included, are even holding virtual happy hours to provide a way for industry members to stay connected socially.

The direct impact on the blue tech economy is still unfolding but tumbling oil prices have put many investments in offshore technology and research on hold. However, there is also cause for optimism. Not only are we seeing growth in a number of key sectors, such as global defense and offshore wind, there are a number of "blue economy" focused initiatives underway that encourage the development of breakthrough marine technologies and new commercialization opportunities.

Defense spending, particularly the Navy, surges ahead. I have talked to several MOTN members that are busy designing, building and delivering products to the Navy. These firms have all had to adapt to changing working environments and social dis-

THE BLUE ECONOMY: ON AN EVEN KEEL

DR. TOBIAS STAPLETON,

*Dean, Graduate Programs, Salve Regina University, Newport, RI
VP, Marine & Oceanographic Technology Network (MOTN)
Co-Founder of the Blue Innovation Symposium*

tancing practices to ensure the safety of these essential workers.

A sector of growing importance in the Northeast US is offshore wind and expansion plans off Southern New England will undoubtedly lead to new developments within the autonomous vehicle sector, both underwater and surface. As wind developers look for novel and cost-effective methods of monitoring and maintaining offshore assets, they'll likely look to UUVs and ASVs to conduct much of this work. At the Blue Innovation Symposium, held in Newport, RI last January, Orsted, a global leader in offshore wind development announced that they were opening their US Innovation Hub in Providence, RI, at the epicenter of this offshore wind activity. According to Orsted, the purpose of the hub is to catalyze the development of new technologies and enterprises related to offshore wind. The offshore wind farms that are being sited off will serve as both an area to test these technologies and as customers for these new products.

Lastly, we can all be excited about the attention that the blue economy is getting from our local, state, and federal legislators and economic development officials. Throughout the US, in places like the Northeast, Gulfport, MS, San Diego, CA, and Seattle, WA there are a number of active "blue economy" development initiatives that seek to attract and support blue technology firms in numerous ways, such as accelerator programs, incubators, prototyping facilities, and more. These efforts will encourage

the development of innovative technologies designed to address the unique and critical needs of several sectors, such as defense, aquaculture, seafood, research, and even oil and gas.

While these are challenging times, it is encouraging to see the significant levels of investments in time, energy, and money, being made by both the public and private sectors to develop and commercialize blue technologies and develop ecosystems that encourage and support this sector.

ON THE EDITORIAL HORIZON

*August: Submersibles**September: Marine Renewables**October: Ocean Science & Technology***NEW!**

SeaState
THE ON&T PODCAST

See page 54, visit:
oceannews.com/seastate

GET IN TOUCH AT:editor@oceannews.com**CONNECT WITH US:**

[linkedin.com/company/
oceannews](https://linkedin.com/company/oceannews)

twitter.com/oceannews

[facebook.com/Ocean
NewsandTechnology](https://facebook.com/OceanNewsandTechnology)

SPECIALIZED OCEAN TECHNOLOGY AND MARINE OPERATIONS

Commercial, Scientific,
and Government
Projects



Ocean Specialists' expertise is in integrating engineering, technology and marine operations. We provide cost effective, rapid deployment and discrete solutions for a wide range of projects.



SUBSEA TELECOM



GOVERNMENT
& DOD



POWERS CABLES



OIL & GAS



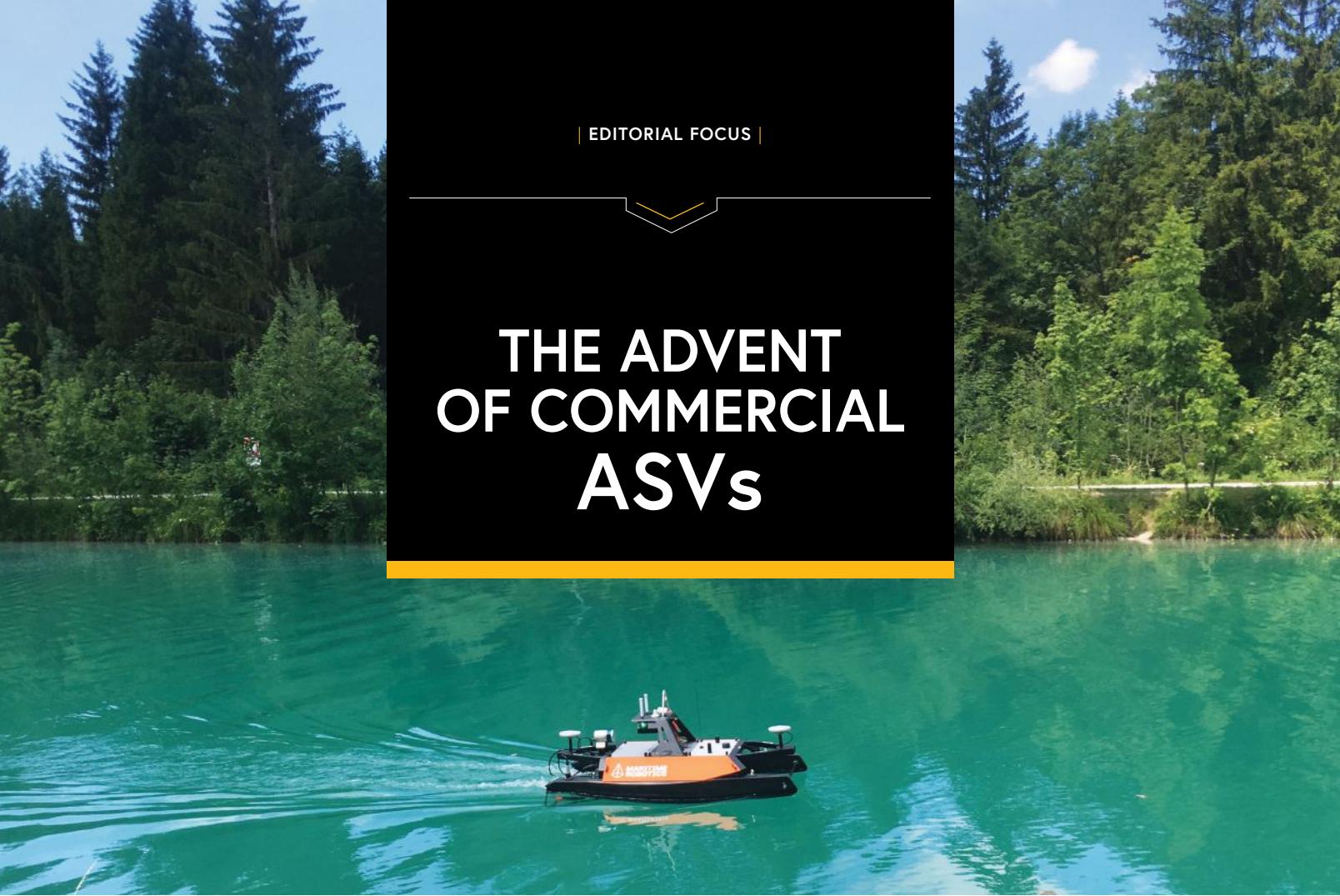
OCEAN SCIENCES
& OBSERVING



SEABED MINING



THE ADVENT OF COMMERCIAL ASVs



» *Maritime Robotics' Otter: A cost-effective turn-key solution for bathymetric surveys in sheltered waters, such as small lakes, canals, rivers, ponds and harbors. (Photo Credit: Maritime Robotics)*

Marine environments are notoriously difficult to study. It's only within the last few decades that technology has enabled any systematic and scientific exploration of what lies beneath. Today, our need for secure, real-time data demands that blue tech manufacturers respond with ever-smarter products, powered by increasingly efficient, integrated and perceptive components. Meanwhile, breakthroughs in automation, machine learning, and control systems have helped to streamline operations and transcend new frontiers. The cross-pollination of these two branches of advanced engineering is the Autonomous Surface Vehicle, or ASV.

However, autonomy is a somewhat subjective notion when it comes to ocean technology, and the term USV (Unmanned Surface Vehicle), although arguably representative of a broader category, is often used interchangeably when referring to such systems. Semantics aside, the benefits are indisputable: to carry out water-based tasks without a crew, in the name of optimized efficiency, flexibility, and security.

ARTEMIS, developed in 1993 as part of the MIT Sea Grant Program, was one of the earliest recognized ASVs and was an important platform for testing innovative navigation and control systems, before running bathymetry studies of the Charles River in Boston, MA. From there, naval architects began to explore with new payloads and hull forms, resulting in a

period of accelerated development in the early 2000s, mostly driven by interest from the US Navy, as well as niche requests from the private sector. Today, ASVs perform an ever-growing range of assignments, from seafloor mapping to tactical warfare. Currently, ASV unit prices range from \$4,500 to \$242 million. Suffice to say, defining a market can be as complicated as defining an ASV.

A MARKET SET FOR LAUNCH

Recent industry reports, one published by TSC Strategic and one by VynZ Research, both predict unprecedented demand for ASVs over the coming five years, with market forecasts exceeding \$3 billion by 2025. Demand will predominantly be driven by defense contracts—Intelligence, Surveillance and Reconnaissance (ISR), Mine Counter Measures (MCM), anti-submarine warfare, logistics, and surface combat—but commercial markets also look to prosper as ASVs for hydrographic survey, oceanographic research, near-shore maritime missions, and offshore exploration become more common.

The potential military applications are numerous, but perhaps Mine Counter Measures is the quickest route to market. Manned mine clearance is labor intensive and dangerous, so leveraging autonomous vehicles—much in the way Explosive Ordnance Disposal (EOD) uses robots—is an attractive

alternative. Furthermore, ASVs can launch and recover complementary technologies, like underwater and aerial drones, so compatibility will remain a priority as developers enhance this operational capacity. Strategic alliances will continue to revolutionize maritime security operations, much like Thales and L3Harris did in 2012 with the launch of Halcyon, a versatile 11-meter USV that set a new benchmark for autonomous operation. The partnership continues to prosper to this day.

ASVs FOR COMMERCIAL MARINE SURVEY

2020 has already been significant for the commercial market. ASVs are not new to coastal and offshore activities, but they are fast becoming the preferred equipment for marine survey companies. The premise is simple: ASVs allow operators to economize time in the field and invest more on interpreting quality, decision-critical data. Or, alternatively, zero time in the field, allowing surveyors the ability to monitor data remotely, in real time. The challenge for ASV developers, therefore, is to achieve the right balance between data optimization, efficiency and function. Aided by ever sophisticated communication systems and intuitive software packages, in recent years the market has responded with a growing range of man-portable, multi-purpose systems, each claiming the ideal configuration in terms of draft, payload, and overall dimensions. This is where design meets function, so from hull form to sensor suites, we can expect to see ongoing diversification as the market develops.

From Maritime Robotics' Otter to SeaRobotics' SR-Surveyor M1.8 to Teledyne Marine's Z-boat, all signs point to the emerging commoditization of tightly integrated units. In particular, the incorporation and development of multibeam sonar and LiDAR technology will broaden the application of portable ASVs. This sensor synergy allows operators to capture a 360-degree view of all data points—in high resolution—making compact ASVs the perfect solution for rapid deployment in hard-to-navigate waters. Not only is this suitable for surveying coastal waters and infrastructure, but for hazard detection (for example, in post-hurricane damage assessment) and search and recovery efforts (for example, law enforcement crime scene investigation).

In fact, Hydronalix, an Arizona-based company, has developed a unique portfolio of unmanned systems designed specifically to support military and first responders in the field, including a mobile command center vehicle for its "Emily" range of automated beach and ocean rescue USVs.

Advances in new technology and economies of scale should, in time, help lower the barriers to purchase for the other market segments, including the broader scientific community.



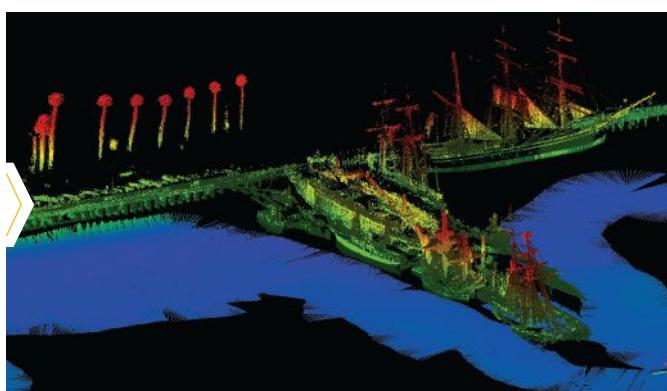
» *Halcyon: The game-changing 11-meter USV that ushered in a new era of autonomous operations for maritime, civil, security and military applications. (Photo credit: L3Harris)*



» *Maritime Robotics' Otter: Unmanned Surface Vehicle (USV) for seabed mapping and monitoring of sheltered waters. (Photo credit: Maritime Robotics)*



» *Teledyne Marine's Z-boat 1800RP: A ruggedized ASV capable of high-resolution shallow-water hydrographic survey with multibeam and LiDAR capabilities for mapping both above and below the waterline (Photo Credit: Teledyne)*



» *Advances in Sensor Technology: Multibeam EchoSonders and LiDAR sensors allow operators to capture a 360-degree view of all data points—in high resolution—making compact ASVs increasingly versatile for hydrographic survey (Photo Credit: Teledyne)*

AN OCEAN TO EXPLORE

That said, there are signs that ASVs will play a central role in some of the more high-profile scientific programs in the coming years, in particular the Nippon Foundation-GEBCO Seabed 2030 Project's public pledge to map the Earth's seafloor by the end of the decade, an ambition that will lean heavily on autonomous systems. Details are still to be unveiled, but ASVs are likely to be deployed from larger research vessels to maximize coverage and reduce time on location, as well as survey near-shore shallows and waters around coastal infrastructure.

The further offshore we venture, the more diverse the ASV catalogue becomes. Industrial-grade systems with workboat capacity promise to transform the way we work at sea. Companies like Sea Machines are redefining what we thought possible in terms of AI-powered situational awareness, new ground that will rewrite maritime history before long. Balancing sustainability and endurance is also a creeping challenge for autonomous marine operations and a number of manufacturers have introduced hybrid diesel-electric propulsion systems, such as 5G International's 9-meter Oscar, or SeaRobotics' 7-meter SR-Endurance 7.0, which can deploy additional assets, such as ROVs and AUVs, owing to the A-frame boom type LARS.

OFFSHORE ENERGY EXPLORATION

ASVs are also making inroads with the offshore energy sector. The most prolific development in this market segment came in February this year, when Ocean Infinity released its plans to launch Armada, a "pioneering marine technology and data company" that will use a fleet of 15 highly custom ASVs to "perform a multiplicity of offshore data acquisition and intervention operations down to a depth of 6,000 meters." Ocean Infinity's supply record shows a strong demand for its marine surveys from offshore oil and gas majors, and the capacity of these ASVs to deploy AUVs and ROVs, in addition to harvesting superior visual and acoustic data, will be decisive. Armada does not plan to use any manned ships

once the fleet is deployable (expected by the end of 2020); instead, the monitoring and controlling of its robotic fleet will take place "via satellite communications from state-of-the-art onshore facilities in both Austin (Texas) and Southampton (England)." While this bellwether move is a firm commitment to ASV technology, the short-term industry response to Armada—especially given the current economic outlook amid the COVID-19 pandemic—should be telling.

Offshore Wind development, in the short-term at least, may prove more fertile ground for ASVs. Notably, Terrasond's 2018 site survey for the Vineyard Wind offshore wind farm—the first commercial-scale offshore wind farm in the US—was carried out by a L3Harris C-Worker. Another recent announcement in this space is ThayerMahan's partnership with iXblue's DriX USV for unmanned survey services in the US and beyond. The news came shortly after ThayerMahan signed a MoU with Ørsted and Eversource in connection with the Revolution Wind offshore wind project. According to Thomas Brostrøm, CEO of Ørsted's US operations, ThayerMahan's "technology will help us reduce any disruption offshore wind might have on North Atlantic marine life and the local fishing fleets."

ASSET INSPECTION AND MAINTENANCE

ASVs also have a vital role in the inspection and maintenance of existing subsea infrastructure, especially assets approaching decommissioning. Inspecting oil rigs, wind turbines and subsea cables is inherently hazardous and mostly conducted in hard-to-predict sea states, so unmanned systems are seen as the future. Again, L3Harris has been at the forefront of development plans and in 2017 launched a project in partnership with the University of Exeter (UK) to run a series of feasibility tests for inspection survey using one of its C-Worker 7 ASVs to deploy a Saab Seaeye inspection class Falcon ROV. The first phase of testing—which was an industry first demonstration of an ASV deploying, operating and recovering an inspection class ROV—yielded some valuable lessons, such as the need to extend the ROV's tether. The dives included testing vertical inspection, getting to a site and



» Beach Emily: Part of Hydronalix's Emily range of USVs designed specifically for beach and ocean rescue (Photo credit: Hydronalix)



hovering, flying the ROV by hand (from shore), putting the ASV on a heading hold and flying the ROV underneath, and testing a docking algorithm. The project continues in phase 2 testing, but clearly this is a prime example of how the disciplines of subsea engineering and ASV technology can work together to promote game changing efficiency for offshore asset integrity management, as well as championing never-before-seen safety standards.

FUTURE IMPLICATIONS

In the near to medium-term future, the lion's share of ASV market development will unquestionably stem from military government contracts that seek to address very specific needs. But much of the technological innovation will, at some point, spill over into the private sector. Regardless, pricing for leading systems will continue to be a barrier, so ASV rentals from companies like Okeanus Science & Technology will be key to trial and adoption in the field. As market forces drive down unit prices, future partnerships between sensor manufacturers and ASV producers will help to further commoditize product offerings. The ongoing shift from custom built engineering to off-the-rack solutions will sustain a new era of marine robotics. Make no mistake, we are now in the advent of commercial ASVs.

Given the rate at which marine technology advances, though, forecasting beyond the next five years would be overly speculative. Other branches of data-reliant technology—such as the IoT, real-time analytics, machine learning, and embedded systems—will inevitably play a role in shaping opportunity; and AI, the great enabler, will result in a surge of regulatory issues and security concerns. Drone-delivered pizzas would have seemed implausible to the early pioneers of unmanned reconnaissance aircraft, so at this stage anything is possible.

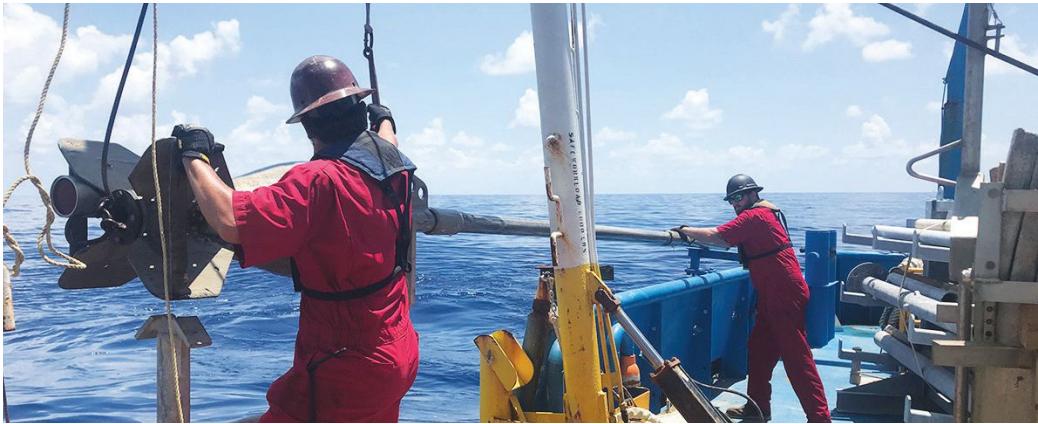
» The SR-Endurance 7.0: SeaRobotics' 7-meter workboat class multi-mission ASV, suitable for a range of coastal and offshore operations. (Photo credit: SeaRobotics)



» L3Harris C-Worker 5: C-Worker 5 is the ideal platform to support hydrographic survey work. (Photo credit: L3Harris)

LIFE IS BUBBLING UP TO SEAFLOOR WITH PETROLEUM FROM DEEP BELOW

By Diana Kenney,
Marine Biological Laboratory



» Recovering sediment cores from the Gulf of Mexico on the TDI-Brooks vessel *R/V Brooks McCall*. Credit: Daniel Brooks

The COVID-19 pandemic is a stark reminder that we move through a world shaped by unseen life. Bacteria, viruses, and other microscopic organisms regulate the Earth's vital functions and resources, from the air we breathe to all our food and most of our energy sources. An estimated one-third of the Earth's microbes are literally hidden, buried in sediments deep below the ocean floor. Now, scientists have shown that these "deep biosphere" microbes aren't staying put but are bubbling up to the ocean floor along with fluids from buried petroleum reservoirs. These hitchhikers in petroleum seeps are diversifying the microbial community that thrives at the seafloor, impacting deep-sea processes, such as carbon cycling, that have global implications.

"This study confirms that petroleum seeps are a conduit for transporting life from the deep biosphere to the seafloor," says co-author Emil Ruff, a scientist at the Marine Biological Laboratory (MBL), Woods Hole. The study, led by Anirban Chakraborty and Casey Hubert of the University of Calgary, was recently published in *Proceedings of the National Academy of Sciences*.

The team analyzed 172 seafloor sediment

samples from the eastern Gulf of Mexico that had been collected as part of a 2011 survey for the oil industry. A fraction of these samples contained migrated gaseous hydrocarbons, the chief components of oil and gas. These petroleum seeps on the ocean floor harbored distinct microbial communities featuring bacteria and archaea that are well-known inhabitants of deep biosphere sediments.

"Whereas sedimentation slowly buries microbial communities into the deep biosphere, these results show that it's more of a two-way street. The microbes coming back up offer a window to life buried deeper below," Hubert says. "These relatively accessible surface sediments give us a glimpse into the vast, subsurface realm."

The study also adds a new dimension to understanding the metabolic diversity of seabed petroleum seep microbial communities. "If it weren't for the microbes living at hydrocarbon seeps, the oceans would be full of gas and oil," Chakraborty says.

Co-authors Bernie Bernard and James Brooks of TDI-Brooks International obtained the 172 Gulf of Mexico sediment cores and performed geochemical testing on them,

setting the stage for microbiology testing at the University of Calgary.

"One of the strengths of this study is the large number of samples analyzed, allowing robust statistical inferences of the microbes present in the petroleum seeps," Ruff says. Because the seafloor is so difficult to access, explorations of deep-sea ecosystems are often limited by the number and quality of samples. The team used metagenomic approaches to determine what microbes were present in the sediment samples, and genome sequencing of particularly interesting organisms to indicate what their activity in the subsurface might be.

The Marine Biological Laboratory (MBL) is dedicated to scientific discovery—exploring fundamental biology, understanding marine biodiversity and the environment, and informing the human condition through research and education. Founded in Woods Hole, Massachusetts in 1888, the MBL is a private, nonprofit institution and an affiliate of the University of Chicago.

Citation: Anirban Chakraborty et al (2020) Hydrocarbon seepage in the deep seabed links subsurface and seafloor biospheres. *Proc. Natl. Acad. Sci.*, DOI: 10.1073/pnas.2002289117

FLYING OVER THE WAVES WITH WORLD'S FIRST FLYING ELECTRICAL BOAT

Together with yachting specialist Denison Yachting, Swedish electric boat firm Candela launches their long-range, high speed electric Candela Seven bowrider in the United States.

The 25 feet Candela Seven is the first electric, foiling boat in serial production. Thanks to a lightweight carbon fiber hull and foils, i.e. wings under the water, the Seven boasts longer range and higher speed than any electric boat before it.

Flying effortlessly above the sea surface at up to 30 knots, the Seven can cruise up to 57 miles on a single charge. That is comparable to gasoline powered boats and 2-3 times better endurance than any other electric boat on the market.

The foils also enable superior seakeeping in moderate seas, since the Seven simply flies over the waves instead of smashing through them.

The ride is smooth and stable even in strong

side winds and waves. The performance is accomplished through an array of sensors that measure wave height, along with a custom designed flight controller with 9,000 lines of code.

The Candela Seven is designed and built by an international engineering team in Stockholm, Sweden. During 2020, serial production is ramping up at the company's 30,000 square feet facility in Stockholm with the goal of making Candela Seven the largest e-boat builder in Europe.

From April 2020, the Seven is for sale in the U.S. through a partnership with Denison Yachting, one of the most well-known American brokerages with 22 brick-and-mortar offices across the States.

"We're happy that Denison Yachting chose to team up with us. They are a dream partner for us. We look forward to getting American customers on the boat. Once you've flown above the waves silently, it's hard to go back



» The Candela Seven is the World's first Hydrofoiling Electric Production Boat.

to planing boats" says Candela CEO and founder Gustav Hasselkog.

"Candela represents a technological leap forward for boating. It's the perfect combination of ecofriendly water transportation, style and a smooth ride. Not only is owning a Candela Hydrofoiling Electric boat fun, it's a statement about embracing innovation and looking to the future. Also, it's the perfect Superyacht accessory," says Tony Smith at Denison Yachting.

© Eric Gevaert/Shutterstock.com

A large, white, cylindrical gyro stabilization mount is shown mounted onto the side of a dark-colored ship's hull. The mount has a circular base with several mechanical components and a prominent vertical axis. A camera or sensor unit is mounted on top of the main body. The background is a bright, slightly overexposed view of the ocean and sky.

**When
it gets
rough
we'll
keep you
balanced**

somag[®]
AG JENA

High-precision gimbal systems for maritime applications

Pitch and roll motions at sea present a constant challenge for surveillance tasks with EO/IR systems and video cameras as well as for mobile mapping and scanning. The solution for a stabilized field of view and high-quality data acquisition are Gyro Stabilization Mounts. With utmost precision SOMAG AG Jena manufactures a range of two axis gimbals, which dynamically balance the movements of ship, boats, USVs or buoys to keep the sensor always in a leveled position.

▲ Meet us at Oceanology International 2020 booth F200



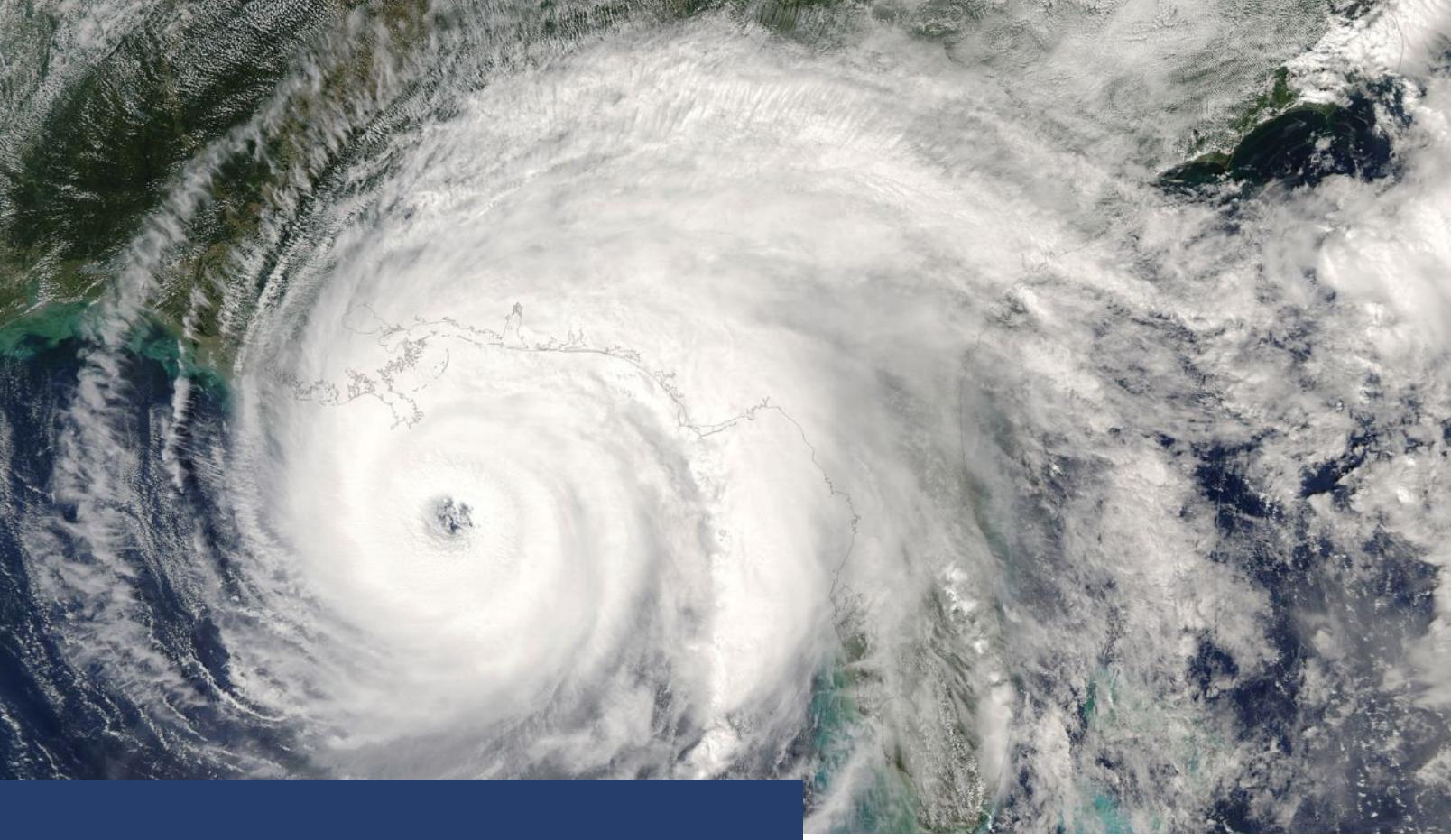
www.somag-ag.de



info@somag-ag.de



+49 3641 633 68 0



| FEATURE |



WEATHERING THE STORM: THE OCEAN TECH KEEPING US ONE STEP AHEAD OF EXTREME WEATHER SYSTEMS

As this year's Atlantic hurricane season begins, ON&T takes a look at the oceanographic technologies helping to forecast extreme weather events and aid coastal recovery efforts

In early April, Colorado State University released its Extended-Range Forecast of Atlantic Hurricane Activity for 2020, anticipating an "above-average probability for major hurricanes making landfall along the continental United States coastline and in the Caribbean." Bleak news for countless communities along the Eastern Seaboard, but not altogether surprising given the havoc caused by Category 5 events in recent years—Dorian (2019), Michael (2018), and Irma and Maria (2017).

Most forecasts center around two essential climatic factors. First, as is the case in 2020, the absence of El Niño. This natural, cyclical warming of the Equatorial Pacific creates deep tropical thunderstorms, which usually trigger sufficient westerly wind shear to keep most systems over the Atlantic Basin. Second, sea surface temperatures, which are notably warmer this year, and earlier than expected, especially across the Gulf of Mexico and the southwest Atlantic. Broadly speaking, the higher the water temperature, the stronger a storm's potential.

There are, of course, a multitude of other elements that make hurricane forecasting a complex task but, reassuringly, models are increasingly accurate. The reason why, notwithstanding the many highly accomplished meteorologists and scientists that make it their lifetime's work to study the troposphere, is the abundance of available data. And this is only possible thanks to ocean technology.

FLOATING SENTINELS OF THE SEA

In many ways, buoys are the guardians of the sea. They allow oceanographers to send instruments deep

beneath the surface for sustained periods of time to measure water properties—such as velocity, salinity, and temperature—in remote places. This ongoing data collection is key to quantifying shifts in oceanic conditions. Moored buoys have proven critical to observing air-sea interactions in the central Pacific that help us understand the critical role that El Niño plays.

The National Data Buoy Center in the US is run by the National Oceanic and Atmospheric Administration (NOAA) and is responsible for the operation and maintenance of an expanding network of buoys and weather stations. Specific Hurricane Buoys are considerably larger and more robust than traditional weather buoys—some up to 12 meters in diameter—and are equipped with an internal back-up system. Real-time data from the buoys is critical to pre, during, and post storm analysis and is used to validate the measurements and predictions made by remote-sensing reconnaissance aircraft and satellites, as well as national weather service advisories.

Drifters, essentially drifting buoys, also collect information on sea surface temperature, wind, and atmospheric pressure, and transmit this data via the Global Telecommunication System

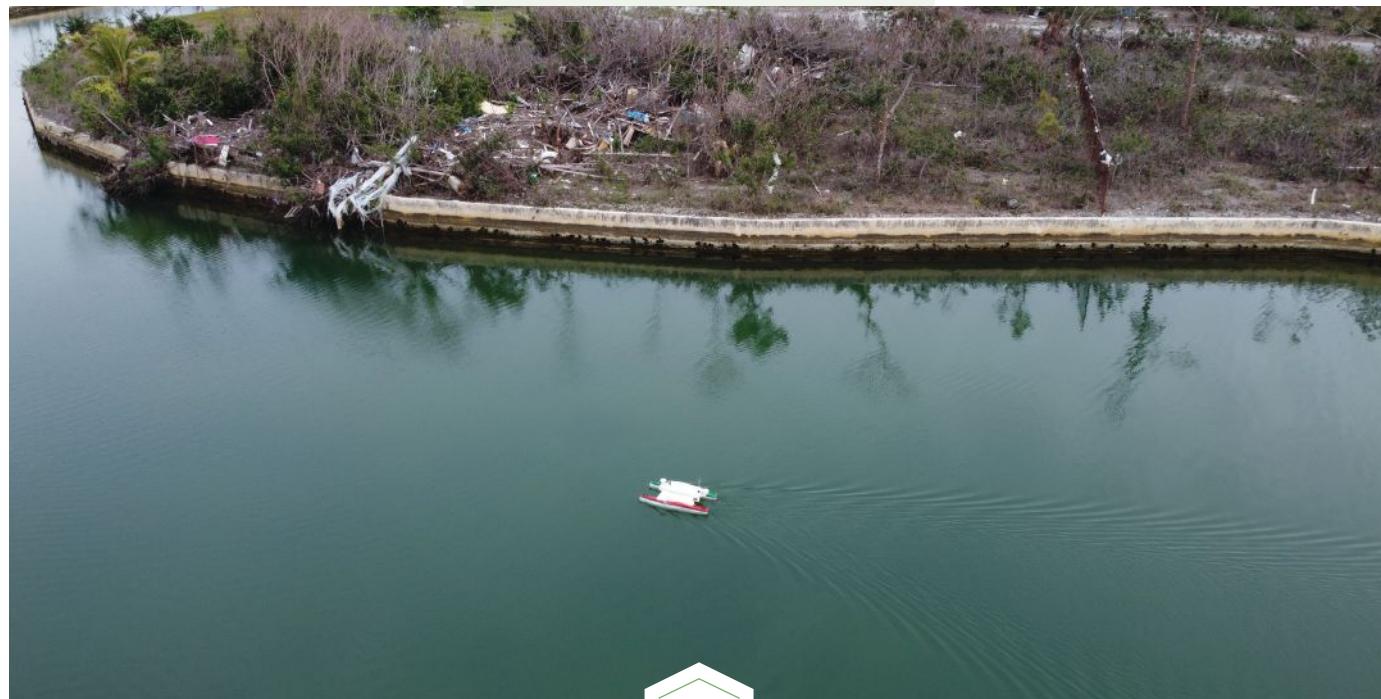
(GTS). The World Meteorological Organization (WMO) describes the GTS as the "coordinated global system of telecommunication facilities and arrangements for the rapid collection, exchange and distribution of observations and processed information within a framework of the World Weather Watch." In short, it allows for the instantaneous exchange of weather information across the entire globe, helping forecasters predict the path and intensity of hurricanes.

The Global Drifter Program (GDP), a joint program between NOAA and Scripps Institution of Oceanography, deploys nearly 1,000 drifters each year to maintain a global array throughout the ocean, with additional support provided by the U.S. Office of Naval Research. The Drifter Data Assembly Center (DACP) applies quality control procedures to drifter data (position and temperature) and interpolates them to 6-hour intervals using an optimum interpolation procedure called kriging, which is commonly used for two and three-dimensional analyses. Data, assembled from over 30,000 drifters and dating back to 1979, is available for public download. Hourly interpolated datasets are also available, introduced in the early 2000s.

MARINE ROBOTICS PROBE OCEAN DEPTHS FOR CLUES

Autonomous platforms, such as Liquid Robotics' Wave Glider, have also proven particularly versatile. The Wave Glider is a glider tethered to a float, which acts as the command center and is powered by lithium rechargeable batteries connected to two solar panels. The float is supported by an Iridium modem and GPS. Ingeniously, propulsion is provided by the conversion of wave energy to thrust; that is, when the float rides a wave, spring-loaded wings on the propulsion unit pivot slightly to convert the up-and-down motion into a horizontal one, which is then controlled by an electric rudder, as programmed. The Wave Glider's open sensor and payload integration architecture makes it a flexible asset for ocean research, and ideally suited for monitoring the meteorological and oceanographic parameters that concern storm trackers, such as salinity, weather conditions, wave data and currents.

Autonomous Underwater Vehicles (AUVs), often referred to as underwater drones, are also used to probe ocean depths in order to record varying water temperatures and salinity levels. Access to critical information from stratified water columns helps meteorologists determine where models need adjustment. In



» The devastated waterways of Grand Bahama following Hurricane Dorian in September 2019. Survey companies like Morgan & Eklund are increasingly making use of ASVs for pre- and post-hurricane assessment. Credit: M&E

particular, gliders are able to identify salt caps that prevent the mixing and upwelling of cool water from below. They can also be equipped to monitor current profiles, bio-optical properties, dissolved oxygen, and turbulent microstructure.

Teledyne Marine's G3 Slocum glider is perhaps one of the more seasoned gliders for hurricane research. Buoyancy driven to enable extended range and endurance, the Slocum glider can be deployed from any size vessel. Once seaworn, it can easily be controlled from anywhere in the world through the use of web-based piloting tools. The glider's modular design allows for sensor reconfiguration as required and the optional thruster provides horizontal speeds of up to 2 knots, making it capable of tracking storm systems, even in the roughest seas.

NOAA have run a glider program since 2014—using Slocum gliders—in partnership, with the U.S. Navy, Rutgers University, University of Miami, and University of Puerto Rico-Mayaguez.

This toolkit—buoys, drifters, and autonomous gliders—clearly has a critical role in helping us better understand the science behind hurricane intensity, but these oceanographic instruments also give us a better picture of how the ocean recovers after a storm. Major weather events often leave a cold wake behind them and researchers are keen to unravel how this influences consequential weather systems.

AUTONOMOUS SURFACE VEHICLES ASSESS DAMAGE

And then there is the devastation. The hallmarks of a major hurricane once it interacts with land are well documented—wrecked buildings, uprooted trees, and downed power lines—but the true extent of damage often lies below the surface. Assessing a storm's impacts on our coastlines is the domain of the hydrographer, and a field that once again relies on state-of-the art ocean technology.

Increasingly, hydrographic surveyors are deploying Autonomous Surface Vehicles (ASVs) to collect year-round bathymetric data to monitor



» Wave gliders are wave-propelled, solar-powered autonomous surfboards tethered to an instrumented underwater glider that controls speed and direction along a programmed or remotely piloted path. They measure wave properties, currents, ocean temperature and salinity, exchanges between the air and water, along with surface weather. (Photo credit NOAA)



» Meter normad type ocean weather research buoy has instruments that measure and record data like: sea surface temperature, air temperature, air pressure, wave height, storm surge, wind speed, rainfall, ocean oscillations, and othe perameters. This type of buoy is also important in studying the effects of El Niño, hurricanes, sea earthquakes and tsunamis and tracking chemical and oil spills.



the lasting effects of powerful storm forces on our coastal ecosystems and infrastructure. The ramifications for planned mitigation practices and storm preparedness are of paramount concern, especially in the age of climate change and rising sea-levels. Thanks to advances in multibeam sonar and LiDAR technology, operators are able to produce detailed 3D representations of the coastal geomorphology over time. One such outfit is Morgan & Eklund (M&E), a Florida-based survey company that has been collecting storm-related data along the US East Coast for over 35 years.

"The deployment of ASVs for storm-related marine survey has transformed the way we approach such projects," explains M&E director Rob Collaro. "We ran detailed studies in Puerto Rico following the destruction left by Hurricane Irma and Maria in 2017 using a Teledyne Z-boat, and more recently a SeaRobotics SR-Surveyor M1.8 to assess the devastation caused to the Bahamas following Hurricane Dorian in late 2019."

M&E's work in the Bahamas proved fundamental to the islands' search and recovery efforts; the brief was to map the underwater environment of Grand Bahama's waterways following the Category 5's 185 mph sustained winds and a 20 ft storm surge. Surveying hurricane-torn environments—inspecting damaged coastal infrastructure and identifying hazardous underwater debris—often means navigating hard-to-access waters, and that is when marine robotics—in this case a man-portable ASV with shallow draft—can ensure that people stay out of harm's reach.

NAVIGATING THIS SEA OF DATA

We know more about hurricanes today than ever before. The more technology we deploy, the more data we harvest. The more data at our disposal, the more we can validate intensity forecasts. Understanding the forces of nature is heavily reliant on data capture and analysis and, as we sit and watch in awe as a reconnaissance aircraft pierces the eye wall of whatever systems threaten our shorelines this year, we are reminded of how imperative this data is in helping shape our scientific understanding of extreme weather events and informing our mitigation strategies against them.

Advances in sensor technology and oceanographic instruments have unquestionably enhanced our research capacity but further advances in robotics—be them marine or otherwise—may help us identify new ways of deepening our in-situ analysis. And more, perhaps the challenge for technologists of the future will stretch beyond analysis to explore the realms of storm intervention, or even energy capture.

In the near term, however, data is the currency we need to negotiate safe passage. How we act on this perpetual swell of information will prove key to the safekeeping of communities up and down coastlines around the world. Ocean technology—past, present and future—will continue to play a frontline role in keeping us one step ahead of extreme weather and help other tracking technologies, such as Geostationary Operational Environmental Satellites, validate their real-time forecasts.

» Buoy intended for weather and oceanographic observations. The buoy is anchored and is floating on sea surface. The image was shot in the Gulf of Trieste on a calm April day.



900% RISE IN DEMAND FOR REMOTE INSPECTION OF OFFSHORE RIGS

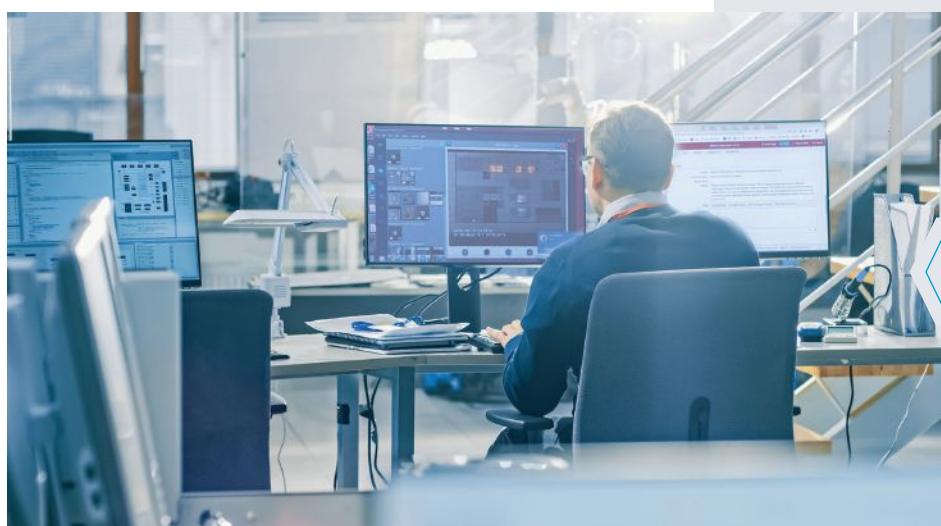
Bureau Veritas, a world leader in testing, inspection and certification services, is reporting a 900% rise in demand for the remote inspection of offshore assets and equipment since the outbreak of the COVID-19 pandemic.

Bureau Veritas says requests for its remote inspection, certification, examination and verification services has escalated from a 'want' to a 'need' this year as businesses seek to keep employees safe from the coronavirus. A number of remote inspection solutions are already in progress for operators and oilfield service companies and there have been in excess of 20 additional requests since the start of this year.

Inspections and verification are vital for offshore companies to comply with legislation and ensure the efficiency and performance of their assets and equipment. Through the use of mobile cameras and the existing personnel, Bureau Veritas employees can carry out these essential services remotely onshore, limiting close contact and reducing the need for travel.

Bureau Veritas has, along with respective clients, risk profiled activities and identified which inspections can be performed remotely and which can't to help operators and oilfield service companies plan for the year ahead, benefiting from direct and indirect savings as well as reducing carbon footprint in the process. Where physical inspection is unavoidable, an up-front technical and safety assessment underpins the reduction and/or elimination of risk at site.

Paul Shrieve, Vice President Offshore & Services, explained: "Previously, the remote inspection of assets and equipment received a limited reception and was thought of as a good idea, something that the industry should get around to."



"Customers have been considering using remote inspection as an alternative way to meet the requirements of the Offshore Safety Directive (OSD) for some time. However, since the start of this year demand has greatly increased. It is no longer a want but a need."

An immediate health and safety benefit of remote inspection is the reduced potential for exposure to the coronavirus for clients and Bureau Veritas staff.

Other advantages include reductions in personnel risk, time and cost by eliminating travel to client premises and helicopter travel to offshore installations, fewer on-site inspections, accommodation requirements, improved green credential and instant accessibility to a broad spectrum of subject matter experts qualified to perform the task.

The company's remote inspection services are the first to have been reviewed by the United Kingdom Accreditation Service (UKAS). This provides an essential assurance for duty holders in meeting the OSD requirements regarding remotely inspected mobile equipment on-board an installation.

Furthermore, the Health and Safety Executive is being regularly informed of progress. Bureau Veritas's remote services have specifically been designed to meet the HSE's requirements and future intervention initiatives with the industry during the pandemic.

Several major international companies from both the operator and service sectors are already using Bureau Veritas's remote inspection services. Shell U.K. explained: "An ongoing pilot with Shell U.K. is working towards establishing an end to end, remote-based verification process which Bureau Veritas will use to give duty holders assured confidence in meeting regulatory requirements."

"COVID-19 is demonstrating that working practices can not only be conducted in a more environmentally friendly manner but also, through technology, businesses can deliver in a much more effective and efficient way to achieve a quick turnaround," said Paul Shrieve.

"The world will never be the same again, nor should it be. At Bureau Veritas we have been very quick to take the learnings from COVID-19 and implement long-term changes that are both responsible and sustainable as everyone looks to adapt to the new normal."

Marine client portal, visit
WWW.VERISTAR.COM



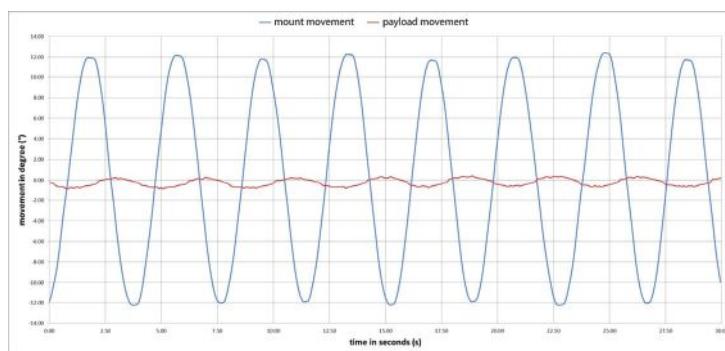
SOMAG AG JENA OFFERS HIGH-PRECISION GIMBAL SYSTEMS FOR MARITIME APPLICATIONS

SOMAG AG Jena is a worldwide operating specialist for high-precision gimbal systems. The company, consisting of hand-picked experts in the fields of electronics and mechanics, has focused since 2004 on the development of Gyro Stabilization Mounts for data acquisition and surveillance applications. All products are assembled and tested with highest precision at the headquarters in Jena, Germany. The gimbal specialist works as an OEM partner of well-known camera and LiDAR manufacturers but has always maintained its status as an independent supplier in the market. The application possibilities are limitless, as the gimbals can be combined with a wide range of antennas and sensor systems. The uniqueness of their clients' projects and the multitude of different usages drives the SOMAG team to develop customized solutions and to improve the performance with every new device.

SOMAG AG Jena introduces the company's latest addition to their range of Gyro Stabilization Mounts for maritime applications: the OSM 4000. With a combination of high-power engines and a hydraulic gimbal system the Gyro Mount stabilizes payloads up to 160 kg. The two-axis gimbal offers a usable mounting space of Ø600 mm providing sufficient space for large sensor systems. In complex maritime environments ships, boats, Unmanned Surface Vessels (USVs) or buoys exhibit rotational movements (pitch, roll and yaw) triggered by the swell. Sensor systems mounted without stabilization on vessels or



» OSM 4000



The graph shows the performance of the OSM 4000 in one axis (roll movement). The Gyro Mount got stimulated by a sinusoidal movement with a peak at about ± 12.00 degree. The stabilization unit reduces the residual movements of the payload to ca. ± 0.45 degree peaks, compensating for more than 95% of the initial motion.

buoys are exposed to these motions, which have the potential to adversely affect the data acquisition of these units. The OSM 4000 actively balances vessel movements which drastically reduces motions of the sensor ensuring perfectly aligned images, less image smearing, a stabilized field of view for video recordings and an increased ranging accuracy for LiDARs.

The OSM 4000 compensates roll up to $\leq \pm 13.0^\circ$ and pitch up to $\leq \pm 10.0^\circ$ with a residual deviation from perpendicular of only $\leq 0.2^\circ$ rms without IMU support at sea state 4. Like all SOMAG devices, the OSM 4000 works automatically and independently due to internal gyros but can also process external IMU data, which improves the residual deviation performance for long

term applications. With high-quality materials, a rugged housing and a weatherproof design that makes the device salt- and splash-water resistant, the OSM 4000 is made to last.

SOMAG AG Jena clients include commercial, governmental and defense organizations as well as research institutions. Gyro Stabilization Mount applications range from coastal surveillance and harbor safety to anti-collision systems on ships and USVs to offshore surveys.

To experience the gimbal systems up close visit SOMAG AG Jena at Oceanology London 2020, booth F200.

In addition to their maritime mounting systems, SOMAG AG Jena offers Gyro Stabilization Mounts for airborne applications, which are the perfect add-ons for bathymetric airborne laser scanners. Please visit www.somag-ag.de to learn more about the whole product range.

Author: Sebastian Schreiber, CTO SOMAG AG Jena
E-mail: s.schreiber@somag-ag.de
Phone: +49 3641/ 633 68 0

Author: Lisa Schönbürg, Marketing Manager SOMAG AG Jena
E-mail: l.schoenborg@somag-ag.de
Phone: +49 3641/ 633 68 14

Location: SOMAG AG Jena, Am Zementwerk 8, 07745 Jena – Germany

The following article has not been submitted or published earlier in any journal and is not being considered for publication elsewhere.

NEXANS' AURORA: CABLE LAYER SETS NEW STANDARDS

The submarine cable market is booming. Every segment of the market, from offshore wind to interconnectors to fiber optics, has experienced strong growth for several years and are seeing some of the strongest levels of deployments in their history.

The scale of submarine cable growth is striking. According to ON&T's sister publication, *SubCableWorld*, subsea fiber optics projects currently under development for installation in the next five years account for approximately 250,000 kilometers of cable. The numbers are equally impressive for offshore wind, although the scale is very different as power cables are much larger and more expensive than fiber optic cables. Installations are also much shorter, primarily in coastal areas versus transoceanic. A 2019 report by RenewableUK forecasts that over 16,000 kilometers of offshore wind cable will be

installed globally between 2020 and 2024, which represents a pace much higher than any previous comparable period in the industry.

In response to the growth of submarine cable installations, Nexans, a leading submarine cable supplier and installer, is adding a new cable-laying vessel (CLV) to its fleet. Scheduled for delivery next year, the CLV *Nexans Aurora* will feature state-of-the-art technology for cable laying.

The *Aurora*'s design is based on the combined experience of Nexans, ship design consultant Skipsteknisk, Ulstein Verft shipyard and marine engineering consultancy MAATS Tech. The ship is being built by Ulstein Verft in Norway, and the hull is currently under completion at the CRISP shipyard in Gdynia, Poland, prior to being towed to Ulstein in Norway where the final outfitting, commissioning and testing will be performed prior to the vessel's delivery in Q2 2021.

The *Aurora* is a technological marvel and sets a high bar for future cable ships. It will be capable of conducting operations worldwide and able to deal with severe weather conditions wherever it is operating. It will be outfitted for power cable laying, including bundle laying, cable jointing and repair and cable system protection and trenching. In addition, it features a 10,000-tonnes load capacity and a split turntable with dual product lay lines. It also can be used for the installation of offshore umbilicals.

Some aspects of the cable laying process have not changed much since the first cables were installed in the 19th Century, others are no longer recognizable. One area where technological advancement is most prominent is in the control of the cable laying ship itself.



» Cable lay vessel *Nexans Aurora* under construction at the CRISP shipyard in Gdynia, Poland.



» Artist's illustration of *Nexans Aurora*, scheduled to be delivered in Q2 2021.

In order to maintain its precise position at sea, the *Aurora* will have a Dynamic Positioning system. Dynamic positioning allows a ship to maintain its position in the face of wind and waves without anchoring. Ships with dynamic positioning systems acquire and process data from a broad range of sources, differential GPS, including radar, sonar, sensors and other detection equipment, to monitor the impact of wind and waves on the ship's course and position and correct for those influences using the ship's thrusters and propellers.

Considering the precision and reliability needed to conduct submarine cable laying, dynamic positioning is critical for modern cable ships. The *Aurora* will have the highest level of Dynamic Positioning: Level 3 (DP3).

Dynamic positioning has three levels, as spelled out by the International Maritime Organization (IMO), DNV GL, LR and other classification agencies. Level 1 is the most basic and generally is used on ships where drifting does not represent a threat to the ship, the crew or the ship's mission. Level 1 does not include redundancy in its systems and loss of position may occur in the event of a single fault.

Level 2 is more sophisticated and used where maintaining course is mission critical. It has built-in redundancy so that no single fault in an active system, such as the power or communications systems, thrusters, etc., will cause the dynamic positioning system to fail.

Dynamic Positioning Level 3 (DP3) is similar to Level 2 but with a full redundancy. DP3 will maintain the ship's course and position even if one of the ship's compartments is flooded or on fire. This requires multiple levels of redundancy in systems such as cables and piping.

The *Aurora* is one of only a handful of cable layers in the world with DP3 capabilities.

Meanwhile, although it will not enter service until next year, *Nexans* already has lined up several jobs for the *Aurora*. It will provide cable-laying services for the Marjan oil and gas field in the Arabian Gulf off Saudi Arabia. This project includes the laying of two, 90 kilometer 230kV HVAC three-core submarine power cables. Cable installation is expected to commence in February 2022.

Nexans also plans to use the *Aurora* in the United States, where it will lay cables for the rapidly growing offshore wind industry produced by the company's new submarine cable factory in Charleston, South Carolina. In December 2019, *Nexans* announced a frame agreement with Eversource and Ørsted to provide up to 1,000 kilometers of export cable for multiple projects through 2027.

For more information, visit
WWW.NEXANS.COM

Nexans
BRINGS ENERGY TO LIFE

UNIVERSITY INVESTS IN MAJOR KONGSBERG SIMULATION UPGRADE



KONGSBERG

» Aaland University of Applied Sciences has signed up for an extensive upgrade to all Kongsberg Digital simulators on its premises.

Kongsberg Digital has been contracted by the Aaland University of Applied Sciences in Aaland, Finland to deliver a comprehensive upgrade of the institution's simulator training capabilities. This large-scale overhaul will update the university's existing K-Sim Engine simulators to the newest technology and models, while the faculty's ship's bridge simulators will in turn be upgraded with new hardware panels and ported over to the latest K-Sim Navigation technology platform.

Additionally, to enable advanced training in LNG handling and bunkering procedures, a new vessel model based on a pioneering Dual Fuel passenger ship will be developed as an integrated Bridge/Engine simulator solution for the K-Sim Engine DEDF 42 model. The entire delivery, scheduled for the autumn 2020, is reinforced with a five-year LTSSP (Long-Term Service Support Program) agreement.

Included in the delivery will be several K-Sim Navigation Full Mission Bridge simulators meeting DNV GL Class A and B certification requirements. One of the simulators will be integrated with KONGSBERG'S Dynamic Positioning system for DP training. Further, the contract also includes K-Sim Navigation DNV GL Class C Desktop Bridge simulators incorporating NAV and GMDSS notations; instructor and debriefing systems; and a K-Sim Engine Full Mission and Desktop simulator upgrade with four additional student stations, instructor training modules, touch-based main and emergency switchboards, and model software simulating operational equipment on a variety of vessels.

The end result will be a state-of-the-art simulator facility with largely unparalleled functionality in an educational establishment, capable of mounting integrated team training exercises for marine engineers and bridge crew on a total of five different simulated vessel models. The integration of K-Sim solutions will instruct students on such crucial disciplines as decision-making and leadership, situational awareness, team interaction and crew/ship-to-shore communications.

"We chose Kongsberg Digital to deliver this contract because the company offered the best solution at the best price," says Bengt Englund, Vice-Rector, Aaland University of Applied Sciences, "and that combination is unequalled, so it was a logical and beneficial choice. This huge upgrade emphasizes our commitment to educate students by using the best and most modern simulation equipment available. It's a substantial investment which means that the university will now have a complete range of simulators for study and research purposes. Our focus is on team training to strengthen both individual and collective competence, and the five simulated vessel models, with their integration flexibility, will address all of our training requirements."

"This highly significant contract continues the long and mutually fruitful relationship we have enjoyed with the University of Applied Sciences in Aaland," adds Tone-Merete Hansen, Senior Vice President, Kongsberg Digital. "We're extremely proud to be providing such high-quality training tools for the university, knowing that by doing so we're helping to produce the best-qualified and skilled crews for the maritime industry in Finland."



INTELLIGENT UNMANNED SYSTEMS

The word pioneer is often overused, but after twenty years of producing unmanned marine systems, few can wear it like SeaRobotics Corporation. Today, there is a dual focus to company operations: Autonomous Surface Vehicles (ASVs) for hydrographic survey and specialist Remotely Operated Vehicles (ROVs) for hull grooming. While distinct in application, they stem from the same mission: to design, engineer and manufacture real-world, data-driven solutions that prioritize operational efficiency and a sustainable approach to coastal and offshore activities.

AUTONOMOUS SURFACE VEHICLES

SeaRobotics' history of ASV development demands attention. Over the years, they have developed a series of industry firsts and this experience—in partnership with commercial, government, and defense clients around the world—has resulted in a tried-and-tested portfolio of fit-for-purpose ASVs for surveyors and offshore operators.

The SR-Surveyor M1.8 (above), launched in 2019 and upgraded for 2020, is the flagship of the company's Surveyor Class and comes with an EdgeTech MBES and Velodyne Puck LiDAR as standard, making this tightly integrated ASV the complete package for hydrographic survey, habitat mapping, infrastructure inspection and search and rescue efforts. Perhaps most striking, though, is its size; at 1.8 m in length, it is the only man-portable system that captures such a diverse range of simultaneous data sets in real-time: two frequencies of side scan, motion tolerant side scan, wide swath bathymetry, backscatter, LiDAR point cloud data.

"Our unmanned systems are designed to enhance data integrity and safeguard marine operations, and so are supported by industry leading sensor suites and software," according to SeaRobotics president Don Darling.

SeaRobotics' Utility Class and Endurance Class ASVs offer greater customization and payload flexibility, such as the multi-mission SR-Endurance 7.0, which comes with electric hybrid propulsion, tiered autonomy settings, and an A-frame boom type launch and recovery system (LARS).

GOING GREEN: HULL GROOMING

Few can match Darling and the SeaRobotics team for vision, or their track record of bringing innovation to market. Take the SR-HullBUG, a custom ROV for hull grooming. Biofouling—the natural accumulation of microorganisms, plants, algae, or small animals on wetted ship hulls—poses a problem for vessel operators. As new regulations develop, the need to curb the



» The SR-HullBUG is a semi-autonomous cleaning system that uses light brushes to groom a ship's hull and remove biofouling.

introduction of invasive species to ports around the globe is immediate.

Equally pressing is the need to focus on operational efficiencies. Estimates suggest that pristine hulls could lead to a 10% global reduction in fuel consumption; in other words, the more hydrodynamic drag, the more fuel consumption (and subsequent CO₂ emissions). Clearly, clean hulls are a win-win.

There are a number of ROV systems in the field, all of which offer a safer, more systematic alternative to deploying divers. ROV solutions generally fall into two categories: ones that use water jets to remove biofilm and ones that use a brushing mechanism. Research suggests that the latter is more thorough, impeding the rate new fouling develops, and categorically uses less power to operate.

The SR-HullBUG uses nine rotating non-destructive brushes but the real gamechanger is its capacity to filter out offending effluents.

"The SR-HullBUG has a unique compact capture and filtration system that reduces fouling to the micron level and allows us to remove particulate and heavy metals from the water" explains Darling. "From a regulatory and sustainability perspective, this system is designed to meet current and potential future regulations and has already proven effective in the cruise line industry."

To find out more about SeaRobotics, visit www.searobotics.com

CHECK THE TECH

TERRADEPTH'S MISSION TO DEMOCRATIZE OCEAN DATA

Texas-based startup is expanding ocean knowledge through affordable autonomous data collection

The energetic team at Terradepth—a collective of admittedly ocean-obsessed engineers, scientists, subsea roboticists, US Navy veterans, and machine learning experts—shares a vision: To increase ocean knowledge through autonomous data collection on scale, at high resolution, and at a cost customers are happy to pay for.

The company, formed in 2018, has developed a unique means of ocean data collection that takes a refreshingly holistic approach to deep-sea exploration, and leverages the latest advancements in hardware, software, and ocean technology to provide the world's first deep ocean data-as-a-service business.

Instrumental to this democratization of ocean data is the company's groundbreaking "AxV" vehicle, or, more accurately, pair of vehicles. The AxV, named so on account of its dual autonomous surface and subsurface capabilities, is a vehicle system that consists of two (or more) identical unmanned assets (see Figure 1), one operating semi-submerged and the other at depth.

While deployed, the topside AxV provides surface data collection, communications and navigational assistance, while the other AxV conducts its subsea mission. The two AxVs can then substitute roles once the

submerged vehicle resurfaces to recharge its hybrid system of lithium batteries using an air-generated power bank.

"We believe that a deeper understanding of the oceans is achievable through autonomous marine robotics" according to Terradepth co-founder Judson Kauffman. "Terradepth's technology proposes to drastically lower the cost of decision-critical, deep-sea data for a wide range of ocean stakeholders."

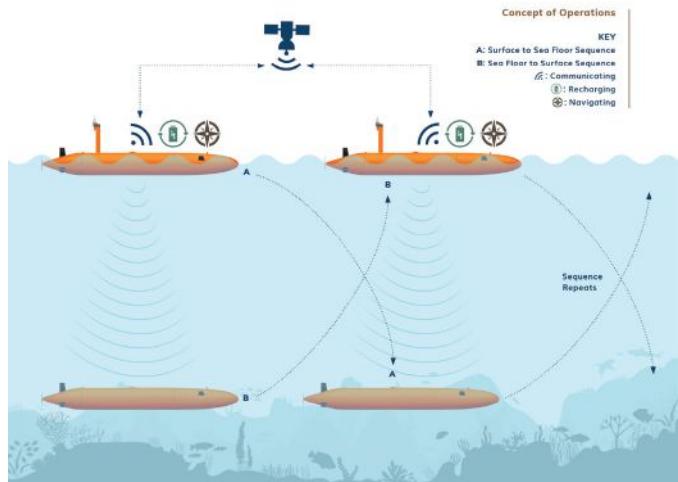


» Co-founders Judson Kauffman (left) and Joe Wolfel

Terradepth's AxV utilizes a cooperative acoustic networked navigation architecture to provide varying grades of absolute positioning accuracies needed for ocean data collection. With multiple sets of vehicles working in unison, units at the surface provide positioning commands and act as a control gateway to those underwater. Our mission



» Figure 2: AxV Hardware



» Figure 1: Terradepth's AxV vehicle system

autonomy computer processes each data collection run and automatically re-tasks itself for additional surveys, as necessary, through the onboard analytics software.

Terradepth's approach is further testament to the advent of unmanned vehicles for marine exploration. The AxV system, which is deep ocean rated, highly modular, and can support a large payload of sensors, is deployable from shore, air, or surface vessel, and missions are controlled from a state-of-the-art operations center in Austin, Texas.

Terradepth is effectively rewriting how oceanic data is harvested, transmitted and processed using state-of-the-art machine learning and sophisticated software. According to Kauffman, assigning manned tasks to highly intelligent machines trained to process ocean data has dramatically reduced the time and margin of error associated with long-established methods.

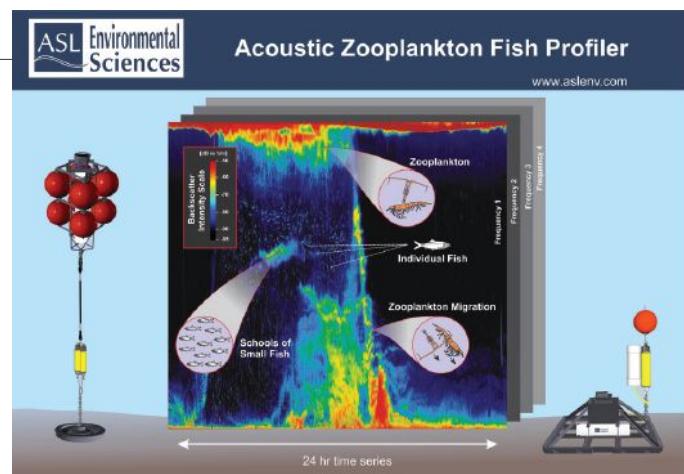
For the end-user, however, Terradepth maintains that data should be easy-to-understand and that's why the company prioritizes high resolution visualization techniques for geophysical survey and offshore infrastructure monitoring services. This, after all, is critical to the democratization of data. www.terradepth.com

- Duration: 30 days
- Max. depth: 1000m (3000m coming soon)
- Range: 1000 nMi per deployment
- Diameter: 1050mm
- Length: 9.2m
- Energy: On board re-charging system, payload power 1 kW
- Weight in air: 3700 kg

ENTER ASL'S 2020 EARLY CAREER SCIENTIST CONTEST

The goal of ASL's early career scientist contest is to support the oceanographic and limnological research community by lending, free of charge, a calibrated battery-powered Acoustic Zooplankton Fish Profiler™ (AZFP™) (either 125/200/455/769 kHz or 38/125/200/455 kHz configuration), plus mooring cage and battery for a three-month maximum deployment period along with the support from ASL's team of experts. This instrument loan program is open to early-career scientists and engineers, graduate students, post-doctoral fellows and others involved in oceanographic or freshwater work.

With the unmatched combination of multiple frequency operation, low power and extended endurance, the ASL AZFP offers a new, economical way of obtaining reliable measurements of marine environmental conditions in the water column. The AZFP can monitor the presence and abundance of zooplankton and fish within the water column by measuring the acoustic backscatter returns at multiple ultrasonic frequencies. Other sonar targets realized from the sonar backscatter data include bubbles and suspended sediments. The AZFP is a powerful tool for scientific research and environmental monitoring in oceans, lakes and rivers. For more details on the AZFP, refer to our product brochure. For a list of past contest winners, go to <https://aslenv.com/assets/files/ASL-Newsletter-Spring-2020.pdf>



» Acoustic Zooplankton Fish Profiler (AZFP) example mooring configurations and field deployment.

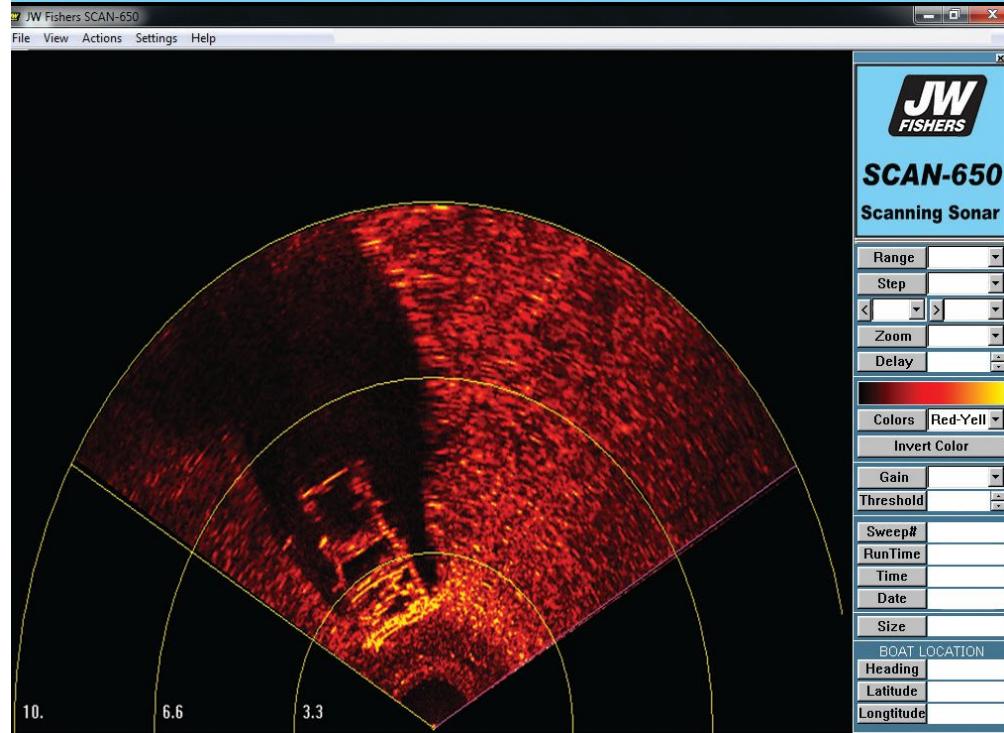
To apply to this program, send a summary proposal (maximum length 4 pages) of your study and description on how it would benefit from the use of the AZFP's capabilities. The selection criteria involve a number of factors including:

- Relevance of the project: the measurements obtained should advance the understanding of physical and/or biological phenomena of importance to the aquatic environment
- Innovation of the project including scientific merit
- The ability of the party to deploy and recover the instrument

Interested applicants may send proposals before June 30, 2020.

In the darkness... comes clarity

with a JW Fishers SCAN650 Sector Scan Sonar



- Target sizing capability
- 360° sweep pattern
- High resolution imagery
- User friendly software
- Commercial construction
- ROV, pole or tripod mountable
- Starting at \$6,995



JW Fishers Mfg., Inc

(800)822-4744

(508)822-7330

Email: info@jwfishers.com

www.jwfishers.com



BOEM AWARDS SENSITIVE HABITAT CONTRACT TO CSA OCEAN SCIENCES

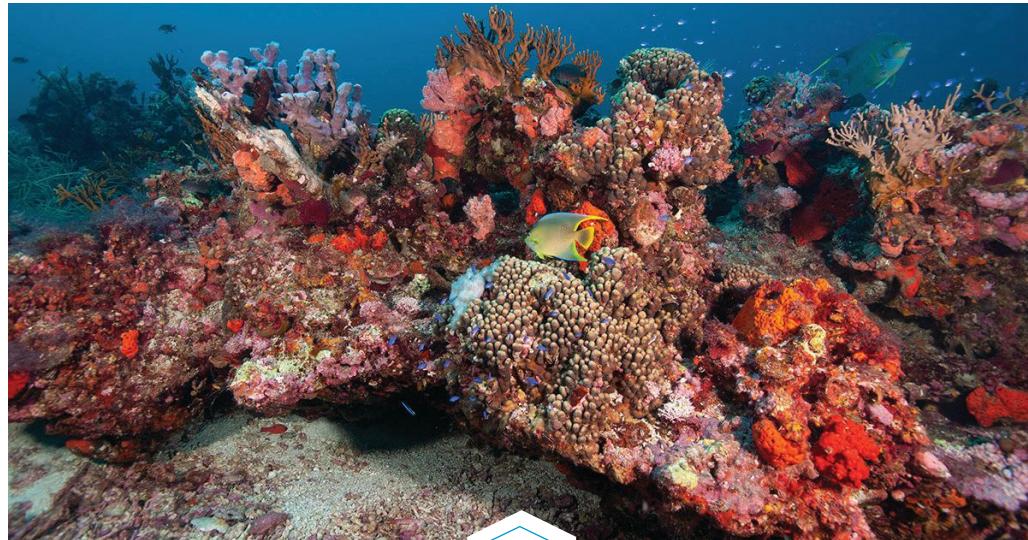
CSA Ocean Sciences Inc. (CSA), a marine environmental consulting firm, has been awarded a contract from the Bureau of Safety and Environmental Enforcement (BSEE), on the behalf of the Bureau of Ocean Energy Management (BOEM), to review existing survey data to identify and describe potential hard-bottom areas in shallow, federal waters of the Gulf of Mexico.

While much of the Gulf of Mexico seafloor is comprised of soft sediments, habitats with hard substrate are scattered across the shelf. These hardbottom habitats attract corals and encrusting organisms, provide shelter to invertebrates and fish, are often high in biodiversity and biomass, and are sensitive to disturbance. BOEM is continuously making efforts to improve their understanding of the location of hardbottom habitats in the Gulf of Mexico in order to avoid or mitigate potential impacts to these benthic resources from BOEM-regulated activities. To improve this understanding, CSA's team of geophysical experts will be working in close coordination with the BOEM project team to review survey data to identify and describe

potential hardbottom areas. The resulting inventory of potential hardbottom habitat locations will be used to improve and update maps used by BOEM for decision-making and will ultimately be shared with BOEM's partners and the public.

CSA has worked with BSEE and BOEM since the 1980s to provide a range of services for projects involving energy and mineral resources on the U.S. Outer Continental Shelf. Specific to this project, CSA's team members have extensive experience designing and collecting survey data using side-scan sonar, sub-bottom profilers, multibeam echosounders, and 2D and 3D seismic technologies; reviewing geophysical survey products, maps, and reports based on bathymetry, backscatter, and amplitude data; and interpretation of survey products to extract information on seafloor characteristics, including sediment texture and the presence of hard-bottom habitat, other sensitive habitats such as seagrasses and oysters, and archaeological features.

CSA Ocean Sciences Inc. brings nearly five decades of experience in marine environmental consulting, preparing environmental assessments worldwide through offices in the United States, the Eastern Mediterranean, Qatar, Trinidad, Brazil, and Australia. CSA's expertise in coastal, marine, and deep ocean surveys is built on the integration of science, operations, and an understanding of environmental data collection, management, and analysis within geospatial domains. For more information on CSA's range of marine environmental consulting services, please visit www.csaocean.com



SONARDYNE SUPPORTS SAFER SHIPPING WITH VIGILANT FORWARD-LOOKING SONAR



Maritime technology specialist Sonardyne International Ltd. has introduced a collision avoidance capability for naval, commercial, passenger and private vessels with its new Vigilant Forward-Looking Sonar (FLS).

Providing live and past vessel track, detailed 3D bathymetry out to 600 m and automated warnings of unseen collision hazards on and beneath the waterline out to 1.5 km, Vigilant FLS offers mariners with unprecedented subsurface situational awareness.

Compact in size and with mounting options for both new build and retro-fit, Vigilant is suitable for vessels of all sizes and types; expedition cruise, research and exploration, coastguard, private yachts, merchant and naval shipping. When underway, it provides crew with an early warning of hazards, from rocks and wrecks to sand banks and otherwise hidden, below-the-surface obstacles, over a 90-degree field of view. This makes Vigilant ideal for both day-to-day operations in busy commercial waters as well as more remote off-chart excursions or operations in dynamic environments, for example, approaching a harbor following a natural disaster.

Vigilant is also unmanned surface vessel (USV)-ready, with its output able to be utilized by autopilots for remote control and autonomous over-the-horizon operations.

Vigilant provides two operational modes: 3D and Sonar, which helmsman and vehicle pilots can seamlessly toggle between. Sonar mode detects obstacles in the water out to more than 1,500 meters giving large vessels in particular, valuable time to react. The system's configurable alarms ensure hazards are not overlooked during periods of high operator workload.

In 3D mode, users are able to view an easy to interpret, real-time generated three-dimensional color map of the bathymetry out to 600 m, clearly identifying between safe and unsafe areas, while

sonar mode continues in the background, at the selected range. Users are also able to view a profile display, showing the depth of any obstacles on the vessel's heading or a specific bearing.

Vigilant offers multiple mounting and integration options including permanent, through-hull deployment and interfacing with third-party command and control systems or electronic charting displays and is suitable for both new builds and already commissioned vessels.

Derek Lynch, Sonardyne's Global Business Manager for Marine Vessel Systems, says, "Every day, we hear of ships of all types and all over the world running aground or colliding with unseen submerged objects, sadly including endangered mammals and ecosystems. The costs and consequences in all respects can be enormous. These incidents occur for many different reasons, some human, some technical, but in every case, there is a lack of subsurface situational awareness. Vigilant is the most capable (longest range, highest area coverage, highest resolution) commercially-available forward-looking sonar on the market and it is an invaluable tool to help mariners avoid these situations."

Ocean Engineering

OceanPack™



pCO₂ Underway
Modular, easy to use and reliable monitoring systems



Li-Ion Batteries
Highly reliable, efficient and safe underwater power solutions



COTS

Vehicle

Subsea

SubCtech GmbH
www.subCtech.com
info@subCtech.com

UNI-SAFETY Certified ISO 9001

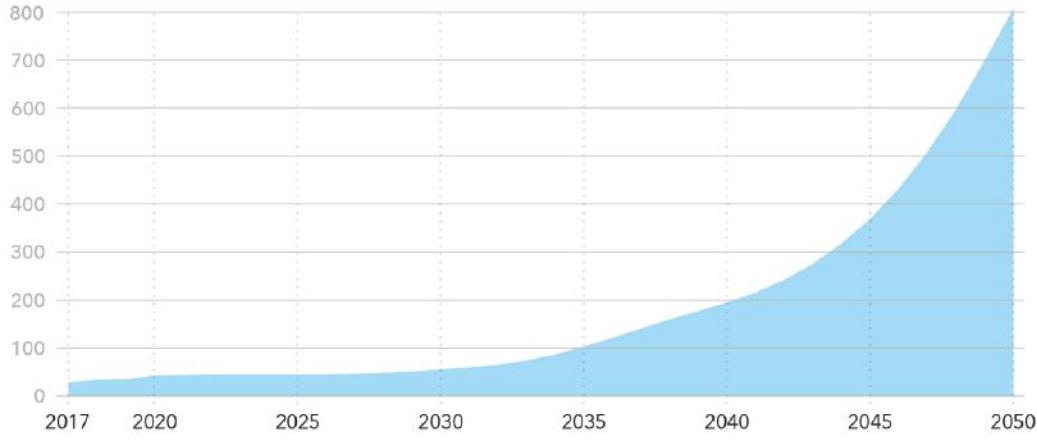
SubCtech Subsea Technologies

DNV GL RESEARCH:

HYDROGEN CENTRAL TO OIL & GAS INDUSTRY DECARBONIZATION

Carbon emissions captured globally

Units: MtCO₂/yr



Source: Energy Transition Outlook 2019, DNV GL

A new report reveals that hydrogen has surged up the priority list of many oil and gas organizations, taking a primary position in the sector's decarbonization efforts.

A fifth (21%) of senior oil and gas industry professionals say their organization is already actively entering the hydrogen market, according to a new report published by DNV GL, the technical advisor to the sector. The proportion intending to invest in the hydrogen economy doubled from 20% to 42% in the year leading up to the Coronavirus-induced oil price crash.

Heading for Hydrogen draws on a survey of more than 1,000 senior oil and gas professionals and in-depth interviews with industry executives. The report suggests that recent shifts in the industry's investment priorities are unlikely to affect the sector's long-term efforts to reduce carbon emissions.

DNV GL found a significant rise in those reporting that their organization is actively adapting to a less carbon-intensive energy mix – up from 44% for 2018 to 60% for 2020. Carbon-free hydrogen production, transmission and distribution is now widely recognized as a central component to the oil and gas industry's decarbonization efforts.

"Hydrogen is in the spotlight as the energy transition moves at pace – and rightly so. But to realize its potential, both governments and industry will need to make bold decisions," said Liv A. Hovem, CEO, DNV GL – Oil & Gas. "The challenge now is not in the ambition, but in changing the timeline: from hydrogen on the horizon, to hydrogen in our homes, businesses, and transport systems."

More than half of respondents to DNV GL's research in Asia-Pacific (56%), the Middle East & North Africa (54%) and Europe (53%) agree that hydrogen will be a significant part of the energy mix within 10 years. North America (40%) and Latin America (37%) are only a little behind.

The success of a hydrogen energy economy is closely aligned with the future of natural gas, renewable energy, and carbon capture and storage (CCS) technology, according to *Heading for Hydrogen*.

While hydrogen gas produced from renewable energy (green hydrogen) is the industry's ultimate destination, analysis shows that the sector can only realistically scale up to large volumes and infrastructure with carbon-free hydrogen produced from fossil fuels combined with CCS technology (blue hydrogen).

DNV GL's 2019 Energy Transition Outlook, a forecast of world energy demand and supply, predicts that natural gas will become the world's largest energy source in the mid-2020s, accounting for nearly 30% of the global energy supply in 2050. Natural gas and hydrogen can play similar roles within the global energy system, and the synergies between them – in application and infrastructure – will drive the hydrogen economy.

However, *Heading for Hydrogen* points to political, economic, and technical complexity in scaling the hydrogen economy.

"To progress to the stage where societies and industry can enjoy the benefits of hydrogen at scale, all stakeholders will need immediate focus on proving safety, enabling infrastructure, scaling carbon capture and storage technology and incentivizing value chains through policy," said Hovem.

DNV GL is involved in projects spanning all four of these enabling factors, including:

- The Hy4Heat program in the UK, which aims to establish whether it is technically possible, safe, and convenient to replace methane with hydrogen in residential and commercial areas. Tests on three specially constructed houses are proving the safety case for a switch from natural gas to hydrogen in a domestic setting at DNV GL's Spadeadam Testing and Research site – the world's first comprehensive hydrogen testing facility.
- A project run by Dutch gas and power networks operator Stedin demonstrating that zero-carbon hydrogen could help to decarbonize heating in a residential apartment block near Rotterdam, the Netherlands.
- A full-scale demonstration project, initiated by Gassnova, in which DNV GL qualified carbon capture technology developed by Aker Solutions, at Norcem's cement plant in Brevik, Norway. DNV GL qualifies and verifies CCS technology and projects in accordance with DNV GL recommended practices and international standards.
- DNV GL supports governments with technical and market analysis to provide a knowledge base for decisions regarding national strategy and policy measures.

Download *Heading for Hydrogen* at:
dnvgl.com/headingforhydrogen



HISTORIC INVESTMENT DECISION FOR TRANSPORT AND STORAGE OF CO₂

Equinor, Shell and Total have decided to invest in the Northern Lights project in Norway's first exploitation license for CO₂ storage on the Norwegian Continental Shelf. Plans for development and operation have been handed over to the Ministry of Petroleum and Energy.

"The Northern Lights project could become the first step to develop a value chain for Carbon Capture and Storage (CCS), which is vital to reach the global climate goals of the Paris Agreement. Development of CCS projects will also represent new activities and industrial opportunities for Norwegian and European industries, says Anders Opedal, executive vice president for Technology, Projects & Drilling at Equinor.

The investment decision is subject to final investment decision by Norwegian authorities and approval from the EFTA Surveillance Authority (ESA).

"This unique project opens for decarbonization of industries with limited opportunities for CO₂-reductions. It can be the first CO₂ storage for Norwegian and European industries and can support goals to reduce net greenhouse gas emissions to zero by 2050," says Opedal.

The investment decision concludes the study phase during which the Equinor, Shell and Total worked closely with Norwegian authorities to conduct engineering studies and project planning, drill a confirmation well and develop the necessary agreements. Following the investment decision, the partners intend to establish a joint venture company.

The initial investments will total almost NOK 6.9 billion. The project will generate much needed jobs for Norwegian industry, with an estimated 57 percent of the investment going to Norwegian contractors.

"CCS is a crucial technology to help society and economies thrive through the energy transition. Shell is active in all parts of the CCS value chain and Northern Lights further strengthens our global CCS portfolio. We appreciate the leadership shown by the Norwegian Government to accelerate the development of CCS value chains and believe that the Northern Lights CO₂ transport and storage solution has the potential to unlock investment in capture projects across Europe," says Syrie Crouch, vice president for CCUS in Shell.

"Total is proud to be part of this first commercial-scale carbon transportation & storage project in Europe. Together with our industrial partners, under the leadership of Norway, we've managed to conclude successfully the technical studies and we have achieved an important step towards the realization of the project. Today, more than ever, we are willing to maintain our efforts on the development of the CCS technology which is needed to reach the EU carbon neutrality goals and is fully part of Total's new Climate Ambition to get to Net Zero by 2050," says Philippe Sauquet, president Gas Renewables & Power at Total.

SIEMENS GAMESA LAUNCHES NEW OFFSHORE DIRECT DRIVE WIND TURBINE



The winds of change have never been stronger, especially when it comes to meeting the world's needs for clean, renewable energy. Siemens Gamesa's new SG 14-222 DD offshore Direct Drive wind turbine now sees the light of day as a part of the solution.

With an unprecedented 14-megawatt (MW) capacity, reaching up to 15 MW using the company's Power Boost function, a 222-meter diameter rotor, 108-meter long blades, and an astounding 39,000 m² swept area, the newest Siemens Gamesa wind turbine stands tall in a world currently undergoing enormous upheaval.

"We've gone bigger for the better," states Markus Tacke, CEO of Siemens Gamesa Renewable Energy, who continues: "Safely and sustainably providing clean energy for our customers and society-at-large is at the core of all we do. The new SG 14-222 DD is a global product which allows all of us take giant steps towards protecting and preserving our planet. We ourselves became carbon neutral in late 2019 and are on track towards meeting our long-term ambition of net-zero CO₂ emissions by 2050. Our installed fleet of over 100 GW both offshore and onshore abates more than 260 million tons of CO₂ emissions annually."

"Offshore is in our DNA," states Andreas Nauen, CEO of the Siemens Gamesa Offshore Business Unit. "Since we helped create the offshore wind industry in 1991, we've been determined to safely increase operational performance, minimize technology risks, and create a consistently lower Levelized Cost of Energy. The SG 14-222 DD demonstrates our drive to lead the way in a world powered by clean energy. In fact, just one unit will avoid approx. 1.4 million tons of CO₂ emissions compared to coal-fired power generation over the course of its projected 25-year lifetime," he adds.

The 14 MW capacity allows one SG 14-222 DD machine able to provide enough energy to power approximately 18,000 average European households every year. Approximately 30 SG 14-222 DD offshore wind turbines could furthermore cover the annual electricity consumption of Bilbao, Spain.

The 222-meter diameter rotor uses the new Siemens Gamesa B108 blades. As long as almost three Space Shuttles placed end-to-end, each 108-meter long IntegralBlade® is cast in one piece using patented Siemens Gamesa blade technologies. Additionally, the turbine's massive 39,000 m² swept area is equivalent to approximately 5.5 standard football pitches. It allows the SG

14-222 DD to provide an increase of more than 25% in Annual Energy Production compared to the SG 11.0-200 DD offshore wind turbine.

Furthermore, the new offshore giant features a low nacelle weight at 500 metric tons. This light weight enables Siemens Gamesa to safely utilize an optimized tower and foundation substructure compared to a heavier nacelle. Benefits thus arise in the form of lower costs per turbine by minimizing sourced materials and reducing transportation needs.

Extending on the proven offshore direct drive track record, the SG 14-222 DD is based on Siemens Gamesa's deep understanding and expertise gained over five product generations since the platform was launched in 2011. Key components such as safety systems, hub and tower concepts, operations and maintenance solutions, along with a strong, qualified supply chain form the basis of the new offshore wind turbine.

Over 1,000 Siemens Gamesa Direct Drive offshore wind turbines have been installed in all major offshore wind markets globally. They include the UK, Germany, Denmark, The Netherlands, Belgium, and Taiwan, among others. Furthermore, confirmed orders for an additional 1,000 Offshore Direct Drive turbines have been received, with installations planned for the markets mentioned above and new offshore markets including the USA and France.

SIEMENS Gamesa
RENEWABLE ENERGY

NEW JV TO EXPLORE DEVELOPMENT OF OFFSHORE WIND IN SOUTH AFRICA

Swedish floating windfarm developer Hexicon AB announced it has agreed to join forces with the leading South African wind developer Genesis Eco-Energy Developments in order to explore the development of offshore wind. The development program will be driven via a joint venture company in South Africa that will be named GenesisHexicon (Pty) Ltd.

The purpose is to jointly develop large scale floating wind projects, contribute to the Oceans Economy and clean energy targets for South Africa, and transfer the Hexicon IP for deep water deployment to the South African market.

"This is the winning formula for large scale energy production in South Africa, one of the top ten long term markets on the planet for deep water deployment. We are proud to have teamed up with Genesis Eco-Energy Developments that since 2002 has a proven track record developing onshore wind and solar projects and also collaborating with the government stakeholders in shaping the renewable energy policies in South Africa," says Henrik



» Hexicon floating windfarm. Photo credit: Hexicon AB

Baltscheffsky, CEO of Hexicon.

"As one of South Africa's pioneering wind energy development companies, the logical progression for Genesis will be to focus off-shore along South Africa's coastline which has abundant unexplored resources. This is an ideal opportunity to explore the deployment of this innovative floating wind technology from Hexicon. Now is the right time to start to develop the South African offshore wind energy market and contribute to Operation Phakisa, the Oceans Economy program," says Davin Chown, MD of Genesis Eco-Energy Developments.



NEXANS AURORA: CABLE LAYER SETS NEW STANDARDS

THE NEXT GENERATION CABLE LAYING VESSELS

In response to the growth of subsea cable installations, Nexans, a leading subsea cable supplier and installer, is adding a new cable-laying vessel (CLV) to its fleet. Scheduled for delivery next year, the CLV Nexans Aurora represents the state-of-the-art for cable laying technology and will play a key role in the rapidly growing offshore wind industry in the US.

For more information about CLV Nexans Aurora, visit www.nexans.com/aurora



Nexans
BRINGS ENERGY TO LIFE

VIDEORAY USES COVID-19 LIMITATIONS TO ENHANCE CUSTOMER DELIVERY EXPERIENCE



» Elvis Lopez, a VideoRay technician, inspects the exterior of a Defender as part of the virtual Factory Acceptance Test conducted for customers.

VideoRay is no stranger to remote collaborative meeting technology. Since a major expansion in 2013, all functions except Engineering moved to a larger office building in Pottstown, leaving Engineering a 15-minute drive away in Phoenixville. Since then, weekly meetings have been by teleconference, with many employees participating from remote locations while traveling. VideoRay's virtual meetings routinely have 12 to 15 people from 6 or more locations in several time zones throughout the world.

With recent government-imposed "work at home" orders in Pennsylvania due to the COVID-19 pandemic, the number of people in meetings has stayed the same, but the number of locations has increased, including those people who are working from home. While other aspects of social interaction are a bit constrained, meeting protocol and technology has not been impacted.

However, VideoRay now is handling complex tasks remotely that have never been attempted. When VideoRay defense systems are ordered by foreign military customers through the U.S. Foreign Military sales program, traditionally a team of experts from the customer and the U.S. Navy travel to VideoRay headquarters to confirm proper operation and conformance to specifications in a "Factory Acceptance Test" (FAT). This also allows the customer to become familiar with the operation of the systems and meet key Point of Contact (POC) representatives from VideoRay and vice

versa. Despite the cost in time and expense for this operation, all involved have planned and budgeted for it during decades of government contracting.

During the COVID-19 pandemic, this process cannot take place. Recently a foreign Navy customer that had placed an order for multiple VideoRay Defender systems was prohibited from traveling, and U.S. Government representatives, key to the FAT process, were similarly restricted to their installations or their homes across the U.S.

To accommodate these travel restrictions, VideoRay updated the traditional FAT plan and made it virtual. In total, there were 14 representatives in 14 separate locations, in three time zones, participating in the virtual FAT process. There were several documents that required review and signature, and several tests that each individual component and system had to pass. Coordination between all parties was required. Each needed to "meet" and engage others at different junctures during the process. Historically there had to be a face-to-face forum where issues and questions could be raised and resolved.

In general, this task seems to be extremely difficult to accomplish with teleconferencing. Two issues come to mind:

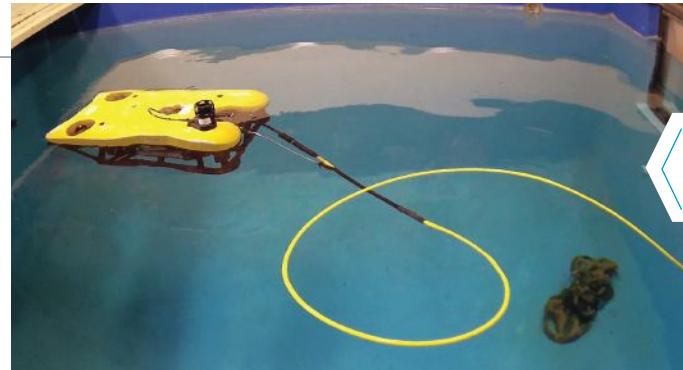
- System performance verification generally requires the person

"signing off" to witness various tests and procedures. Testing typically takes place on the factory floor, in a test tank and in open water.

- Many questions and concerns are typically brought up in "side conversations" rather than with the whole group's focus. It can be challenging to bring up something to the entire group when you only want to privately ask the one person who can most easily provide an answer.

During the week of April 21st, VideoRay, the foreign Navy customer and the U.S. Navy completed this process successfully. Our "lessons learned" include:

- Overall, the process went smoothly. While there is an element of trust involved, careful preparation, documentation, and collaboration meant that the outcome was very similar to unconstrained, in-person meetings.
- Preparation was key, with agendas sent and agreed to in advance, and a friendly but no-nonsense, no-chit-chat vibe during the meetings. The process went smoothly using Microsoft Teams.
- Documents before, during, and after the meetings were carefully managed and organized on a website, where navigation and presentation were very clean and intuitive. No special software or training was required to view or comment on them.
- All tests whether on the factory floor, in the test tank or in the field were video recorded, and these videos were integrated with other data and test results into the online reports.



» A Defender in action in the test pool at VideoRay's headquarters in Pottstown.

- More people were able to participate at a lower cost. Typically, the customer and the U.S. Government spend thousands of dollars to attend FAT meetings. And they typically involve days away from the office. With the virtual FAT, the only expenditure was time spent participating in the meetings.

One of the exciting results of this process is that we expect to continue many aspects of these technologies and techniques after the COVID-19 restrictions are lifted. The process, in many ways, was much more efficient and an effective use of time than the in-person process. However, some in-person interaction – such as when training in the use of the technology in the field – seems like it will always be necessary. But, VideoRay is working on an approach to that too.

WWW.VIDEORAY.COM

Surface to Seafloor

Our suite of sensors sets the standard for performance and durability



**200WX-IPX7
WeatherStation® Instrument**
Proven, reliable weather multisensor for stationary or dynamic platforms.



EchoRange™ 200 kHz Smart™ Sensor
Portable hydrographic survey, Autonomous surface drones, Hydrodrones



200m Mini Altimeter Kit
Ultra compact design for AUV's and ROV's.
Low power consumption.

AIRMAR.COM

For more information, visit airmar.com/offshoremonitoring
or contact Susan Bennett at 603-249-7199 or sbennett@airmar.com

 **AIRMAR®**
TECHNOLOGY CORPORATION

JW FISHERS' METAL DETECTORS: ZERO VISIBILITY SEARCH CAPABILITIES

JW Fishers' signature underwear metal detector is the Pulse 8X. It has provided operators with the right tool for the job for over 25 years and is still the leading underwater metal detector in use worldwide by law enforcement, military, fire and rescue departments, public safety dive teams, commercial divers, and wreck hunters. The recent addition of the SAR-1 underwater metal detector has proven to be an outstanding compliment to the Pulse 8X when zero-visibility conditions make the SAR-1's vibration feature and ultra-bright LED display a necessity. The SAR-1 boasts much of the P8X's technology, but it is contained in a wireless, "snareless", vibrating casing that is second to none when mission requirements dictate safe and efficient operations in the most unforgiving conditions.

The Royal Canadian Mountain Police (RCMP) are avid users of the Pulse 8X detector. The RCMP have been Canada's national police service for nearly 150 years. The team has national, federal, provincial, and municipal policing mandates. From coast to coast to coast, at the community, provincial/territorial and federal levels they strive to prevent crime, investigate crimes, enforce federal, provincial/territorial, and municipal law, and most importantly keep Canadian citizens safe. According to Cpl. T.N. Kaufmann "the Pulse 8x is being used at the RCMP National Underwater Recovery Training Centre (NURTC) in Nanaimo, BC. The RCMP Dive teams across Canada utilize the Pulse 8x when searching for small pieces of evidence at underwater crime scenes."



» With a 200-foot depth rated housing and a 6-foot maximum detection range, the Pulse 8X is Fishers top of the line detector.



» Diver enters the water with SAR-1 Search and Recovery Metal Detector.

The Thurston County Sheriff's Office, in Olympia Washington, is a proud owner of JW Fishers' SAR-1 underwater metal detector. The county dive team consists of 13 members. According to their website "the team specializes in drowning, submerged vehicles, underwater crime scenes, flood rescue, swift water rescue, and rope rescues." The dive team is trained in zero visibility diving, ice diving, evidence recovery, ship hull search, and high/low angle rescue. Sergeant Casebolt, a member of the patrol division, recently shared a story about their experience with the SAR-1 detector. "An armed robbery occurred in the county and it was believed the handgun used was tossed into a local waterway. The firearm was actually not located at this location, thanks to the SAR-1 and its capabilities of searching an area quickly. When our Detective Division explained to the suspect that divers had searched the area and did not locate the firearm, she admitted to lying about throwing it into the pond and directed them to a secondary location and body of water where the gun was located. We just used it again last week for a secondary search in a neighboring County where the suspect claimed to have thrown fifteen stolen firearms taken in a burglary. The SAR-1 located numerous items in the water, to include live shotgun shells, but no firearms. Once again, it was determined that the suspect had also lied in this case and the firearms had not been thrown in the water."

For more information, visit
WWW.JWFISHERS.COM

OCEANEERING WINS SIGNIFICANT ASSET INTEGRITY SCOPE IN THE MIDDLE EAST

Oceaneering International, Inc. (Oceaneering) has been awarded a considerable asset integrity contract from a major operator based in Dubai, UAE. The award includes the provision of general and advanced non-destructive testing (NDT) and fabric maintenance inspection services across the operator's onshore and offshore facilities in the Middle East.

The competitively tendered contract includes integrity and inspection services for around 85 offshore platforms spread across five producing fields, as well as call-off onshore inspection management and NDT work for one of the operator's gas plants, gas control station, LNG jetty, and an onshore supply base. The three-year contract (with two, one-year options) encompasses onshore and offshore NDT, inspection, and onshore and offshore fabric maintenance.

Oceaneering has provided the client with efficient inspection and integrity support

for the past five years. The original scope included the up-man and mobilization of 40 personnel, with the team currently sitting at around 100.

Oceaneering has made significant improvements to inspection enactment throughout the contract, including the introduction of more efficient and effective NDT methodologies. Additionally, the company has ensured all technicians are rope access trained at Oceaneering's accredited facility, which has helped to reduce scheduling and costs for the operator.

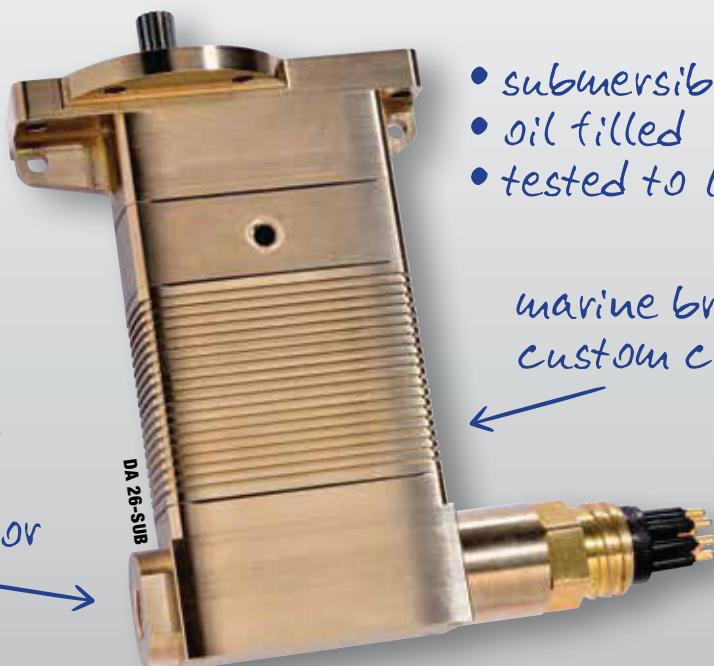
Gregory Boyle, Asset Integrity Regional Manager, Middle East, at Oceaneering, said: "We're proud to continue our strong relationship with this operator and we will continue to focus on providing safe, cost-efficient

integrity, fabric maintenance, and inspection solutions that optimize our customer's operations.

"Our track record for delivery and our resolute commitment to safety over the last five years has significantly contributed to us being awarded the new scope. We look forward to enhancing our existing service provision to add further value and to working with them to adopt the latest technologies and introduce digitized inspection capabilities."



Submersible Actuators



SERVOS | German manufacturer of actuators since 1983

VOLZ-SERVOS.COM

FUGRO BEGINS NOAA PROJECT TO UPDATE FLORIDA'S NAUTICAL CHARTS



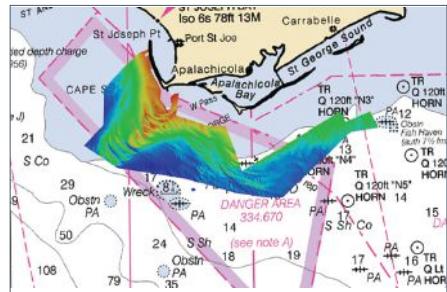
» FAS-900 equipped with multibeam echosounder technology for data acquisition.

Fugro has begun work on its first task order under a recently awarded multi-year hydrographic services contract with the US National Oceanic and Atmospheric Administration (NOAA). Located off the north-west coast of Florida, the project involves acquisition of high-resolution bathymetry data over four sites totalling approximately 1475 km². Deliverables will be issued to NOAA by December and they will use this information to update charted depths and features in the region, many of which predate the 1950s.

To streamline the data collection, Fugro will deploy its new FAS-900 unmanned surface vessel (USV) as a force multiplier on the project. The fit-for-purpose USV is equipped with multibeam echosounder technology and designed to increase the rate of data acquisition on medium- to large-scale mapping programmes. USVs reduce health and safety exposure and increase operational sustainability, all of which helps NOAA to achieve more efficient and effective nautical charting updates.

"We are pleased to continue working with NOAA to update nautical charts in Florida using our own industry-leading technology," said Mark MacDonald, Hydrography Director for Fugro in the Americas. The company completed similar task orders in 2018 and 2019 under a previous hydrographic services contract with NOAA using crewed hydrographic survey vessels. "Deploying the FAS-900 on this year's project will help ensure accurate and timely data collection ahead of peak hurricane season."

In addition to addressing concerns related to migrating shoals in the region, Fugro's 2020 task order will provide the first-ever comprehensive mapping in the western portion of the Big Bend Region, which is a priority of the Florida Coastal Mapping Program, a federal-state initiative to collect modern high-resolution bathymetry for all of Florida's coastal waters.



» Fugro to perform hydrographic surveys for NOAA at north-west coast of Florida. The multibeam imagery shown here was collected during the 2018 and 2019 task orders.

For more information, visit
WWW.FUGRO.COM

EVOLOGICS MODEMS

NOW AUTHORIZED FOR US NAVY USE

EvoLogics underwater acoustic modems were recently listed as Authorized for Navy Use (ANU), following a lengthy period of testing and technical evaluation by Naval Sea Systems Command (NAVSEA) and The Emergency Ship Salvage Material (ESSM) System. The ANU Program provides a list of selected diving equipment, tools and accessories which have undergone design safety reviews, testing and evaluation to ensure diver safety and acceptability.

Engineers at ESSM who conducted the testing of the EvoLogics 18/34 kHz USBL modem system concluded "the system to be more accurate than our ability to physically measure the angle and distances between the USBL and the modem...these tests gave us confidence in the system."

The investigation of EvoLogics USBL positioning system was driven by ESSM in hopes of more efficiently locating fuel tanks in submerged shipwrecks for oil salvage. Specifically, ESSM were hopeful to use the system to locate fuel tanks on the wreck of the Prinz Eugen (shown below), a German battleship sunk in 1946 at Bikini Atoll.

ESSM tested the EvoLogics USBL system in Yorktown, PA using concrete floating piers. The USBL receiver was mounted in

a fixed-location for the duration of the tests, suspended on a pole affixed to the side of the pier about 4' below the surface. Repeated trials were conducted with the downside beacon modem moved to various positions to simulate a diver locating specific points on the hull of a vessel. EvoLogics modems utilize proprietary Spread-Spectrum Communication (S2C) technology, which stems from bionic concepts and allows for data delivery in challenging, shallow water conditions for a wide range of subsea applications. The EvoLogics system repeatedly demonstrated the necessary accuracy necessary to locate specific points on the hull.

The ANU listing for EvoLogics and other authorized devices can be found here:

<https://www.navsea.navy.mil/Portals/103/Documents/SUPSLV/Diving/03-03-2020.pdf?ver=2020-03-03-102953-147>



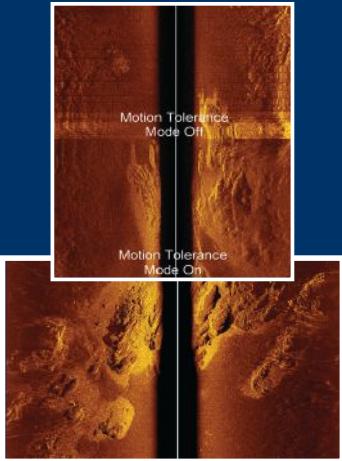
» U.S. Navy photo by Leighahn Ferrari, Chief Mate, U.S. Naval Ship Salvor



NEW

4205

MULTIPURPOSE SIDE SCAN SONAR SURVEY SYSTEM



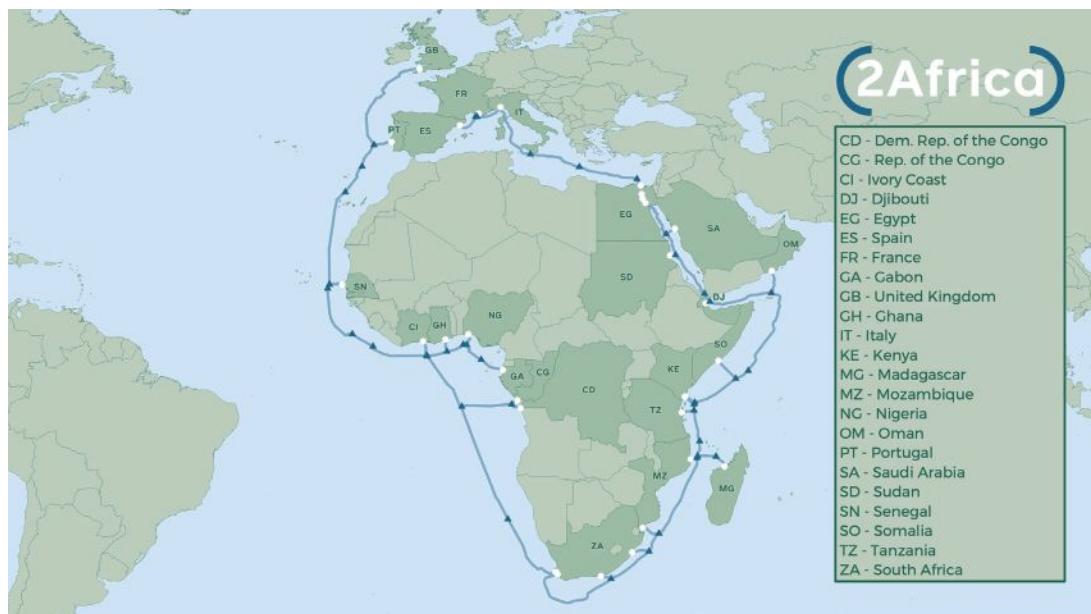
- Tri-Frequency
- Motion Tolerant
- Increased Power
- New Low Noise Electronics
- Superior Resolution



EdgeTech.com

info@edgetech.com
USA 1.508.291.0057

2AFRICA ANNOUNCED BY GLOBAL AND AFRICAN PARTNERS



» 2Africa cable map connecting 23 countries in Africa, the Middle East and Europe.

China Mobile International, Facebook, MTN GlobalConnect, Orange, stc, Telecom Egypt, Vodafone and WIOCC announced that they will partner to build 2Africa, which will be the most comprehensive subsea cable to serve the African continent and Middle East region.

The parties have appointed Alcatel Submarine Networks (ASN) to build the cable in a fully funded project which will greatly enhance connectivity across Africa and the Middle East.

At 37,000 km long, 2Africa will be one of the world's largest subsea cable projects and will interconnect Europe (eastward via Egypt), the Middle East (via Saudi Arabia), and 21 landings in 16 countries in Africa. The system is expected to go live in 2023/4, delivering more than the total combined capacity of all subsea cables serving Africa today, with a design capacity of

up to 180Tbps on key parts of the system. 2Africa will deliver much needed internet capacity and reliability across large parts of Africa, supplement the fast-growing capacity demand in the Middle East and underpin the further growth of 4G, 5G and fixed broadband access for hundreds of millions of people.

In countries where the 2Africa cable will land, service providers will obtain capacity in carrier-neutral data centres or open-access cable landing stations on a fair and equitable basis. This will support healthy internet ecosystem development by facilitating greatly improved accessibility for businesses and consumers alike.

The 2Africa cable has been designed to improve resilience and maximize performance, including the option of a seamless optical crossing between East Africa and Europe. The 2Africa parties

and Airtel have signed an agreement with Telecom Egypt to provide a completely new crossing linking the Red Sea and the Mediterranean, the first in over a decade. This includes new cable landing stations and deployment of next-generation fibre on two new, diverse terrestrial routes parallel to the Suez Canal from Ras Ghareb to Port Said, and a new subsea link that will provide a third path between Ras Ghareb and Suez.

The 2Africa cable will implement a new technology, SDM1 from ASN, allowing deployment of up to 16 fibre pairs instead of the eight fibre pairs supported by older technologies, bringing much greater and more cost-effective capacity. The cable will incorporate optical switching technology to enable flexible management of bandwidth. Cable burial depth has also been increased by 50% compared to older systems, and cable routing will avoid locations of known subsea disturbance, all helping to ensure the highest levels of availability.

"The launch of 2Africa enables us to offer our customers seamless connection between Africa and Europe, together with our SEA-ME-WE 5 and AAE-1 subsea cable resources to further extend to Asia, which is an important milestone of our global development strategy," said Jessica Gu, Director & Chief Technology Officer of China Mobile International. "The utmost capacity and faster transmission allows us to satisfy the needs of African nations today and in the future, reflecting our firm commitment to building a global digital life."

"We're excited to be collaborating with our 2Africa partners on the most comprehensive subsea cable that will serve the continent," said Najam Ahmad, Vice President, Network Infrastructure at Facebook. "2Africa is a major element of our ongoing investment in Africa to bring more people online to a faster internet. We've seen first-hand the positive impact that increased connectivity has on communities, from education to healthcare. We know that economies flourish when there is widely accessible internet for businesses. 2Africa is a key pillar supporting this tremendous internet expansion as part of Africa's surging digital economy."

According to Frédéric Schepens, CEO of MTN Group's wholesale operation, MTN GlobalConnect, "MTN GlobalConnect is delighted to participate in this bold 2Africa subsea cable project. This initiative complements MTN GlobalConnect's terrestrial fibre strategy to connect African countries to each other and to the rest of the world. We are proud to be playing a key role in providing the benefits of a modern connected life – a core MTN belief."

Alioune Ndiaye, CEO of Orange Middle East and Africa, said, "As one of the world's leading multi-service telecommunications operators and present in 18 countries in Africa and the Middle East, it was natural for Orange to be part of the 2Africa project. This major investment will complete our existing submarine and pan-African terrestrial infrastructures to provide access to international connectivity in a redundant fashion throughout the west coast of Africa. It will enable Orange to securely meet the demand for increased bandwidth necessary for the continued digital development of regions throughout the 2Africa system."

Mohammed A. Alabbadi, Wholesale VP in stc commented, "stc is delighted to be a Partner in 2Africa. The 2Africa cable will be integrated into stc's MENA Gateway (MG1) datacenter in Jeddah, enabling customers to access our extensive international content and extend their regional connectivity through stc terrestrial geo-mesh network that extends to all neighboring countries. This will undoubtedly play a significant role in enhancing stc's international network capabilities, whilst also positioning stc as a leading regional digital player in the MENA region. The partnership demonstrates stc's commitment, in line with Saudi Vision 2030, to deliver meaningful digital transformation and build a digital society for all."

Adel Hamed, Telecom Egypt's Managing Director and Chief Executive Officer, commented, "Telecom Egypt's contribution to 2Africa marks an important milestone in our endeavor to contribute to digital transformation in Africa. Egypt's relationship with African states has and will always be one of Egypt's top priorities, it extends here to align with Egypt's strategy to contribute in the current development in Africa. We are honored to be part of such a revolutionary project alongside renowned global and African partners. For years, we have accomplished tangible steps in revamping our international infrastructure and increasing our assets' geodiversity in order to keep pace with the rising global demand for large bandwidth and global reach. We trust that 2Africa will be a rich addition to our diversified investments in the subsea cable industry."

"Improving connectivity for Africa is a significant step which lays the groundwork for increased digitalization across the continent," said Vinod Kumar, CEO Vodafone Business. "2Africa will give local businesses and consumers a better online experience while more connectivity between Africa, Europe and the Middle East will help to build a wider, more inclusive digital society across the globe. We're delighted to work with our partners in the project to help deliver this."

WIOCC CEO, Chris Wood, commented, "For over a decade WIOCC has been the hyperscale capacity provider for Africa, based upon a strategy of ongoing strategic investment in key subsea and terrestrial infrastructure. Participation in 2Africa continues this commitment to providing large capacity users with the resilient network they need to support their customers' ever-growing bandwidth requirements. Our investment both future-proofs our network capabilities and provides additional resilience to maximize uptime for our critical infrastructure."

Alain Biston, President of Alcatel Submarine Networks said, "We are honored by the trust of our partners and proud to have been selected for this project. With this state-of-the-art subsea system, Africa will take a giant leap to the digital age thanks to the best-in-class technologies. Africa is a long story for ASN: we have deployed the majority of submarine cables around the continent. 2Africa will be a great new chapter!"

For more information, visit
WWW.2AFRICACABLE.COM

CTG, ANGOLA CABLES EXPAND LONG-HAUL DIGITAL CONNECTIVITY

China Telecom Global (CTG) has announced that the company has selected Angola Cables as their preferred carrier to bolster their long-haul links between Asia, Africa and Latam.

Through joint co-operation, the two companies will launch an express transmission route to connect three BRICS countries (China, South Africa and Brazil) via the South Atlantic Cable System (SACS). CTG will be in a position to extend its global reach by accessing the robust, high capacity network comprising the WACS, SACS and Monet subsea cable systems of Angola Cables including their Points of Presence (PoP's) and data centers in Africa and Latin America.

CTG and Angola Cables have also agreed to set-up a network interconnection in South Africa, and by leveraging both companies' advanced network capabilities, the transmission capacity and latency between China, South Africa, Angola and Brazil will be significantly improved.

In today's evolving digital economy, content sharing and data exchange has become vital for all markets. With its extensive network coverage and capacity, this initiative showcases not only CTG's strategic deployment in Africa but also provides a highly effective and reliable digital highway to connect East and West.

"Africa is a rapidly growing market, and we at China Telecom Global have been building up our service capabilities in the market since 2010. Our relationship with Angola Cables underlines our strong commitment towards improving regional connectivity and support-



ing our local partners in growing their international presence," said Mr. Changhai Liu, Managing Director of China Telecom (Africa and Middle East) Limited.

"We are very excited about the collaboration with Angola Cables. With this cross-continental express route, we can better serve the growing demand for digital connectivity and business interactions between Asia, Africa and South America - including the BRICS countries."

CTG in conjunction with its partners is committed to establishing a high-quality ecosystem and global network that offers reliable, diversified international routing resources. Through the current network infrastructure – and leveraging the capabilities and potential of SACS, CTG customers can enjoy secure, cost efficient low-latency speed of ~156 ms connecting Johannesburg to São Paulo.

"Angola Cables is in a unique position to provide a seamless solution to China Telecom Global through our robust network connections in the transatlantic region. Using our advanced network of WACS, SACS and Monet submarine cables, we are able to offer a more direct routing of traffic and data between markets in the East to the rapidly expanding Latin American markets and busy IP traffic centres worldwide," said Mr. António Nunes, CEO of Angola Cables.



Prysmian Group has finalised a contract for a project awarded by Vattenfall, a leading European energy company, to provide the submarine inter array cable systems for the Hollandse Kust Zuid III and IV offshore wind farm in The Netherlands, following Vattenfall's successful bid for the permit to develop these nonsubsidised wind farms.

The award was already announced on 29 July 2019 and the notice to proceed is expected later this year.

This project is an important addition to

PRYSMIAN FINALIZES VATTENFALL OFFSHORE WIND CONTRACT

Prysmian's growing portfolio of 66 kV inter-array cable systems, alongside projects such as Borssele III & IV, Hornsea 2 and Provence Grand Large.

Prysmian shall design, test and supply about 170 km of 66 kV XLPE-insulated inter-array cables, as well as the related accessories. The cables will be produced in Nordenham, a Prysmian centre of excellence located in Germany. Delivery is due by 2022.

"We are proud to support Vattenfall in this important project, providing The Netherlands with CO2-free electricity. Our 66 kV inter-array cables system, compared to 33 kV, can save up to 15% in costs for offshore wind farms, thus supporting the development and growth of the offshore renewable market

and its sustainable supply of energy," stated Hakan Ozmen, EVP, Projects Business Unit, Prysmian Group. Catrin Jung, Head of Offshore Wind Vattenfall declared, "Hollandse Kust Zuid is a flagship project for Vattenfall and for the Dutch energy transition. We look forward to working with Prysmian, a highly experienced company, to make this project a success."

The Hollandse Kust Zuid 3 and 4 offshore wind farm will have an installed capacity of around 750 MW, and an annual electricity production equal to the consumption of approximately 1-1.5 million Dutch households. This project is part of a wider energy plan supported by the Dutch government aimed at making 16% of the country's overall energy consumption sustainable by 2023.

HAWAIKI, ASH AND ASTCA FORM NEW PACIFIC ALLIANCE

Hawaiki Submarine Cable LP, American Samoa Telecommunications Authority (ASTCA) and American Samoa Hawaii Cable LLC (ASH) announced an agreement forming a powerful three-way alliance dedicated to significantly boosting capacity linking Pacific territories and nations to Hawaii and the US mainland.

The multi-million dollar deal brings three operators together to take advantage of the Hawaiki branch to American Samoa, securing trans-Pacific connectivity into the future and providing critical diversity to help drive ASH's wholesale business and deliver fast, reliable international broadband to local operators and ISPs in American Samoa, Samoa, French Polynesia and other nations and territories.

Completed in 2018, the Hawaiki Transpacific Cable is a 15,000 km, 67 Tbps, carrier-neutral subsea fibre network linking Australia, New Zealand, American Samoa, Hawaii and five points-of-presence on the US West Coast.

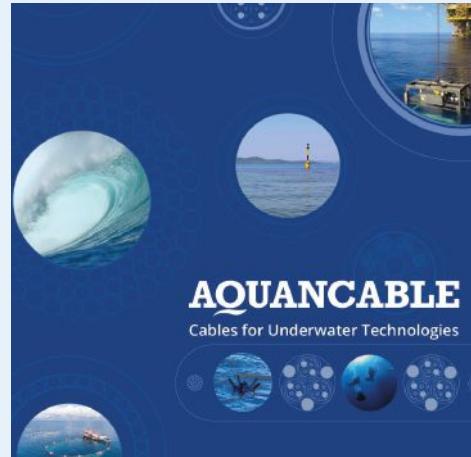
ASTCA, a state-owned telecom in American Samoa, owns the 400 km subsea branch that connects the Hawaiki trunk to the United States territory.

ASH, jointly owned by Fiji's ATH Group and the American Samoa Government, owns the Samoa to American Samoa (SAS) cable and allows Hawaiki bandwidth and circuits to reach beyond American Samoa to Samoa and all interconnected points, including French Polynesia, Cook Islands, and Niue (via the soon-to-be-RFS Manatua cable), as well as Fiji and Wallis and Futuna (via the Tui Cable, commissioned in 2018).

Hawaiki CEO Remi Galasso described the agreement as an important milestone for communications in the South Pacific, forming the basis for future collaborations between the company and the growing number of carriers servicing the region.

"Bridging the digital divide in the Pacific is something that has been part of Hawaiki's DNA from the beginning," he said, adding: "In these challenging times, communications infrastructure and reliable connectivity have an even more critical role to play in supporting the continuity and development of businesses and communities in regions that have traditionally been underserved."

Galasso highlighted the importance of Hawaiki's partnership with ASTCA in bringing the transpacific cable into operation, and said he looked forward to working with ASH as part of the newly formed alliance.



NOVACAVI LAUNCHES SELECTION OF CABLES FOR UNDERWATER TECHNOLOGIES

NOVACAVI's long-term expertise in custom cable design and manufacturing has led to the development of a selection of subsea and marine cables suitable for a wide variety of underwater technologies where no cable customization is required. Standard cables in various lengths and combination ready in stock to be delivered or to be manufactured in short delivery times to cope with any request.

AQUANCABLE standard range includes a selection of cable solutions for underwater technologies: multipurpose communication, video, power, data, composite hybrid cables, armoured cables and more.

NOVACAVI guarantees the same highest quality of engineering, manufacturing and testing as for the whole custom cable production.

"NOVACAVI is far from standard, but we realized sometimes customers need a dedicated service of reliable ready to use cable solutions. That's what this selected range is conceived for," said Francesca Faverio, Business Development Manager.

Specialist in custom cable design & manufacturing for advanced technology since 1975, NOVACAVI develops any cable solutions with engineering expertise, comprehensive knowledge of materials and a high degree of manufacturing.

DOWN TO THE SEA IN USVs

By Norman Polmar and Scott C. Truver
via CIMSEC



» *Sea Hunter, an entirely new class of unmanned sea surface vehicle developed in partnership between the Office of Naval Research (ONR) and the Defense Advanced Research Projects Agency (DARPA), recently completed an autonomous sail from San Diego to Hawaii and back—the first ship ever to do so autonomously. Photo by Moraima Johnsto.*

"How often can you be at the christening of a robot warship?" Deputy Secretary of Defense Robert Work asked the crowd at the baptism of the Navy's Sea Hunter unmanned surface warship in 2016.¹ "... You're going to look back at this day just like... when the USS *Nautilus* was christened, or when the USS *Enterprise* was commissioned," he said. "And you are going to look back on this and say, 'I was part of history.'"

Also part of that history, President Trump and the Navy Department are in tenuous agreement that the U.S. Navy requires 355 manned and unmanned ships, a significant increase from the current force of some 290 ships. This requirement is in part based on great power competition with China and Russia, which involves a growing renaissance in naval and maritime activities. Further, the world situation continues to witness crises, terrorism, and civil wars raging across Africa, the Middle East, and Asia. Yet even in "peacetime" naval ships are invaluable to represent U.S. political and economic interests in many areas of the world. Considering this global political-military environment, innovative concepts are essential to sustaining U.S. sea power.

A family of large, medium, and small USVs will take advantage of new technologies – some only dimly perceived in early 2020 – to provide increased capabilities to the Fleet with reduced

construction, maintenance, and manpower. Getting there from today's fiscal environment is critically important, and there is still much work to do to increase trust and develop CONOPs, but the potential for these unmanned vehicles to transform the future Navy is astounding.

"But I got to tell you," Vice Adm. Richard Brown, commander of Naval Surface Forces and Naval Surface Force Pacific, warned the Surface Navy Association, "the security environment isn't getting any more secure, it's getting less secure, and it's a maritime security environment hands down. And when the United States Navy's not there, it creates a sucking vacuum and people fill it in. And it's usually not good people."²

Significantly, in December 2019, during deliberations on the president's budget, the Navy proposed a 287-ship force by fiscal year 2025. "But that level," Bloomberg News explained, "which includes the decommissioning of 12 warships to save money, would be well below the long-term 308-ship target set by the Obama administration and even farther from President Trump's goal of 355 ships."³

The Office of Management and Budget (OMB) has directed the Navy and the Department of Defense to review force level goals, and reiterated the need for a "resource-informed plan to achieve

a 355-ship combined fleet, including manned and unmanned ships, by 2030." Acting Navy Secretary Thomas Modly issued a 6 December 2019 memo to his staff that was "in sync" with the White House/OMB directive. He called for a plan to achieve a fleet of 355 or more ships "for greater global naval power within ten years" that includes robust levels of unmanned systems.⁴

U.S. shipyards could deliver the additional ships, even taking into account the accelerated retirement of outdated ships, but it would not be easy. Several yards are short of skilled workers, contributing to increasing ship construction and maintenance times. There are other constraints listed by *Bloomberg*: "Looming over the push to accelerate shipbuilding is an inconvenient truth outlined on December 4 by the Government Accountability Office: The Navy continues to face persistent and substantial maintenance delays that hinder its ability to stay ready for operations and training. Since fiscal year 2014, Navy ships have spent over 33,700 more days in maintenance than expected."⁵

Another problem with a larger fleet is the requirement for even more personnel: The Navy currently is short some 7,000 sailors. More ships will demand more sailors, a problem in the current, highly favorable U.S. economy.

"I think the number we identified matches the ownership costs that we identified," said Rear Adm. Brian Luther, deputy assistant secretary of the Navy for budget, during congressional testimony.⁶ "So we grow in lead of some of the equipment because we have to train people ahead of when the ship arrives. It was a disciplined approach to ensure we didn't procure a ship without people, [and] we didn't procure a ship without armament. So, it's a very balanced and disciplined approach."⁷

A practical and near-term Surface Force solution is unmanned surface vessels (USVs). Successful testing of the DARPA and Office of Naval Research prototype *Sea Hunter* underscores the feasibility of USVs. During her evaluation, the 132-foot-long trimaran *Sea Hunter* sailed—unmanned—from San Diego to Pearl Harbor, and back, and conducted a variety of demonstrations, showcasing the ability to host a variety of mission payloads. While important lessons were learned, there were no significant problems during her 5,000-mile voyage.⁸ The *Sea Hunter* has since transitioned to the Navy's Surface Development Squadron ONE (SURFDEVRON-1), and the Navy is testing two other USVs as part of the Pentagon-sponsored Ghost Fleet program.⁹

"Because it is big and it has a lot of payload capacity, and because it also has a lot of range and endurance, it can potentially carry out a range of different missions," Scott Littlefield, former DARPA program manager in the tactical technology office, predicted in 2016.¹⁰

Follow-on USVs are now being developed and procured by the Naval Sea Systems Command to provide increased capabilities at reduced costs. The Navy is shaping multiple competitions for successors—a "family" of small, medium, and large USVs—that look to operationalize how a more advanced USV could be employed for a broad spectrum of missions and tasks. In December, the U.S. Fleet Forces Command (FFC) issued a notice asking the service's



» SAN DIEGO, (Oct 20, 2016) Rep. Mike Rogers (R-Ala.) toured Sea Hunter, Defense Advanced Research Projects Agency (DARPA)s newest unmanned surface vessel being moored at the Space and Naval Warfare Systems Center Pacific (SSC Pacific) for testing, with Rear Adm. C.D. 'Boris' Becker, program executive officer for C4I and Space Systems; Capt. Gisele Bonitz, SSC Pacific's executive director; and Lee Zimmerman, SSC Pacific's deputy executive director. (Photo by Alan Antczak Released)
Photo Credit: Petty Officer 2nd Class Tamara Vaughn.

surface force to develop a concept of operations (CONOPS) for the large and medium USVs in development.¹¹

"The MUSV will initially focus on intelligence, surveillance and reconnaissance (ISR) payloads and electronic warfare (EW) systems, while the LUSV will focus on surface warfare (SUW) and strike missions," the FFC explained. "The fundamental capabilities of these platforms may necessitate changes in how Carrier Strike Groups, Expeditionary Strike Groups and Surface Action Groups conduct operations. The CONOPS will describe the capabilities at initial operating capability (IOC), the organization, manning, training, equipping, sustaining, and the introduction and operational integration of the Medium Unmanned Surface Vehicle and Large Unmanned Surface Vessel with individual afloat units as well as with Carrier Strike Groups, Expeditionary Strike Groups, and Surface Action Groups."

"Knowing what's going on out there is extremely important," Admiral James Foggo, the commander of U.S. Naval Forces Europe and Africa and NATO's Allied Joint Force Command Naples, remarked in December. "So, for unmanned systems, [intelligence, surveillance and reconnaissance] is probably one of our limitations and we could use more of it. Indications and warnings are important. If you could put an unmanned system up, then there's less of a risk, less of a threat."¹²

Speaking at the U.S. Naval Institute's defense forum in December 2019, the new Chief of Naval Operations Admiral Michael Gilday said that unmanned systems will be part of the Navy's Integrated Force Structure Assessment expected in early 2020. "I know the future force has to include a mix of unmanned systems. We can't wrap \$2 billion platforms around missiles."¹³

There has been programmatic success that looks to invigorate the USV family. According to *Defense News*, the Navy will get two large unmanned surface vessels (LUSVs) in 2020.¹⁴ The 2020 Defense appropriations bill funds the two LUSVs that the

Navy requested, but prohibits funding for integrating/testing of vertical launch systems on those vessels, which is the heart of the LUSV mission. Congress also directed the service to prepare a comprehensive unmanned surface vessel plan before it charges ahead.

In that context, the White House and OMB told the Navy to develop a proposal for counting at least some of its unmanned surface vessels and underwater vehicles among its "Battle Force," the portion of its fleet that has historically included larger, manned warships, such as aircraft carriers and destroyers, and support ships, according to *The Drive*.¹⁵ This would be a major shift that would create a more realistic path for the service to meeting the ambitious congressionally mandated goal of a 355-ship Battle Force fleet and would help solidify the already growing importance of unmanned platforms in its future concepts of operation."

The U.S. Navy is on the threshold of a new era in maritime-naval operations. "I think it's well within the possibility that we'll fight fleet on fleet with unmanned surface vessels deep into that fight," Vice Adm. Brown predicted, "calling it a fundamental change to how the fleet fights akin to the introduction of carrier-based aviation to a battleship-centric fleet ahead of World War II."

"[...]n the United States Air Force, there are airplanes and drones," Deputy Defense Secretary Bob Work remarked. "The Navy cannot make that mistake. There have to be warships. And it doesn't matter whether they are manned or unmanned. They will take the fight to the enemy."

Norman Polmar is a naval analyst, historian, and author. He is a consultant to Leidos on naval and maritime issues.

Dr. Scott Truver is a Washington-based naval analyst.

References

1. Bob Work, *Deputy Secretary of Defense Speech, Remarks at the ACTUV "Seahunter" Christening Ceremony, April 7, 2016, Portland, OR*, 779197.
2. Meghan Eckstein, "VADM Brown: Future Fleet Must be Bigger, Leverage Unmanned Vessel Vessels, USNI News, 13 January 2020.
3. Tony Capaccio, "White House Presses Navy to Stick with Trump's 355-Ship Target," Bloomberg News, 20 December 2019.
4. David B. Lartner, "US Navy to add 46 Ships in five years, but 355 ships won't come for a long time," Navy Times, 12 February 2018.
5. Ibid. See also, David Sharp and Lolita Baldor, "Navy Considers Shipbuilding Cuts for Upcoming Budget," Associated Press, 28 December 2019.
6. Lartner, "US Navy to add 46 Ships in five years, but 355 ships won't come for a long time," Navy Times, 12 February 2018.
7. Eckstein, "Sea Hunter Unmanned Ship Continues Autonomy Testing as NAVSEA Moves Forward with Draft RFP," USNI News, 29 April 2019.
8. Ibid.
9. "US Navy starts second phase of Ghost Fleet Overlord Programmed," Naval Technology, 3 October 2019.
10. Adam Stone, 'ACTUV on Track for Navy Success Story,' C4ISRNET, 21 December 2016.
11. Nathan Gain, "US Navy Issues Request for LUSV/MUSV CONOPS Development," Naval News, 6 January 2020.
12. Epstein, "Foggo: Navy Needs Unmanned ISR, Tankers to Counter Russia," USNI News, 18 December 2019.
13. Matthew Cox, "The new acting Navy secretary wants a fleet larger than the current 355-hull plan," Military.com, 10 December 2019.
14. Lartner, "The U.S. Navy Gets Its Large Unmanned Surface Vessels In 2020 With Strings Attached," Defense News, 21 December 2019.
15. Joseph Trevithick "White House Asks Navy To Include New Unmanned Vessels In Its Ambitious 355 Ship Fleet Plan," The Drive, 20 December 2019.



» Sea Hunter is part of ONR's Medium Displacement Unmanned Surface Vehicle (MDUSV) project. (U.S. Navy photo) Photo by Moraima Johnsto.

CHANGING THE NATURE OF MINE WARFARE

More than 90% of the world's trade happens by sea, so any disruptions to the global flow can have serious consequences. Sea mines are an inexpensive but low-tech weapon that can cause havoc with trade and communication, but Saab's new MuMNS mine neutralization system could be a breakthrough in countering mine warfare.

Since the end of the Second World War, more ships have been lost to one maritime weapon than any other. But it's not anti-ship missiles, torpedoes, or terrorist attacks; it's sea mines.

Sea mines don't make much impact on the public consciousness because they're unremarkable-looking, iron-encased explosives, most often placed under the water's surface (buoyant mines) or on the seabed (ground mines). There they float or sit silently for weeks, months or years, until a ship or submarine strikes them directly, or produces the right magnetic, acoustic or pressure signal to set them off.

The resulting explosion can be every bit as devastating as, say, a missile. In just a four-day period during the first Gulf War in 1991, the US Navy saw the USS Princeton and USS Tripoli put out of action for several months due to the damage caused by Iraqi sea mines.

And when you consider that 90% of global trade occurs by sea routes, while many of the world's trans-continental communications lines are laid on the ocean floor, it's clear that sea mines can have an effect that is out of all proportion to their modest cost.

STRATEGIC IMPACT FOR LOW COST

"A sea mine gives you area denial. They are an inexpensive and highly effective way of waging a maritime campaign," explains Chris Lade, Engineering and Defense Sales Manager at Saab Seaeye. Before joining Saab, Lade spent 31 years with the British Royal Navy, as a navy diver who actually laid charges to neutralize sea mines, and as a planner in operations during the second Gulf War to clear strategic Iraqi waters for Allied vessels.

"They are used in key waterways, such as the Straits of Hormuz in the Middle East, the Malacca Strait in Indonesia, the Bosphorus in Turkey or the Kattegat entrance to the Baltic Sea. If these 'chokepoints' are closed off due to mines, they make a big strategic impact at a relatively low cost.

"Sometimes forces have even made it look like they have laid mines. The threat alone is enough to disrupt sea lines of communication, affecting trade, logistics and naval patrols," says Lade, though he also points out that it contravenes the Hague Convention on mine usage.

Saab receives many requests concerning the production of sea mines because they are still as relevant as ever due to their cost effectiveness, and the fact that they give large or small navies the ability to adapt their naval infrastructure and to compensate for or add to their existing resources.

THE DRAWBACKS OF EXISTING TECHNOLOGIES

Over the past 40 years, the introduction of Remotely Operated Vehicles (ROVs) has



» Saab Multi-Shot Mine Neutralization System (MuMNS) attached to an ROV.

largely removed the need for divers to dispose of mines, although certain circumstances still demand their expertise.

One early system, eCA's PAP, used a camera to check it's a mine (and not a rock) before laying a charge. The more recent, 'one shot' system employs a much smaller, shaped charge that delivers a high energy slug that is effective against all mines even those filled with insensitive explosives.

But these systems are either too slow, due to the need for the search and recovery phases, or, are 'fire and forget'. "Once a live one-shot mine system has been launched, it can't be brought back on board; it's armed," says Lade. These lighter 'one shots' also struggle to manoeuvre effectively in strong sea currents.

'One shot' systems are also costly, since every single sea mine requires the use of the system on a one-to-one basis, with no reuse possible. History tells us that sea mines are laid in the hundreds or thousands, making this a potentially very expensive approach.

SAAB'S SOLUTION

Saab's solution to these problems represents a breakthrough for safer seas. It has been six years in the making, involving a core team of 12 people, including Lade. It starts with combining the best features of the PAP and one-shot systems. The Saab

Multi-Shot Mine Neutralization System (MuMNS) can go down and use a camera to identify a target, just as the old PAP system can, but it also has a shaped detonation charge like the lighter 'one shot'.

"The beauty of MuMNS is that you have three weapons rather than one, and you have an ROV that has 'six degrees of freedom': it can fly upside down, manoeuvre through 360 degrees, and look at a whole range of targets over a large area. It can be left in the water rather than needing to be retrieved by the ship to be rearmed," says Lade. Add to that its ability to operate from an Unmanned Surface Vessel, a 12-metre-long platform that is remote controlled.

Once the MuMNS charge is attached, a radio receiver floats up to the surface, the charge is then fired remotely from the mother ship on the horizon or beyond.

"It's taking the man out of the minefield," says Lade.

With two European navies due to take delivery of the MuMNS in 2020, Lade has all the anxiety and excitement of an expectant father.

"MuMNS will change the nature of mine warfare around the world and keep a lot of ships and people safe."

WWW.Saab.COM

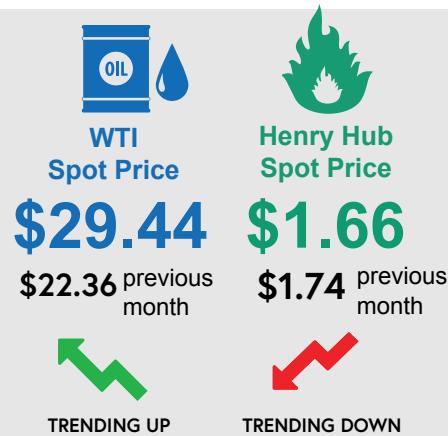
CRUDE & NATURAL GAS Spot Prices

PRICES IN US DOLLARS AS OF MAY 15, 2020

Oil prices have stabilized a bit since dropping into the mid-teens per barrel range during March and April. WTI Spot Prices moved upward in the past month; nearly doubling from \$15.99 per barrel on April 24 to \$29.44 per barrel on May 15, the latest available data at press time. According to CNBC, the easing of the coronavirus lockdowns and indications that suppliers are reducing production.



Natural gas prices continued to trend downward during the past month. The Henry Hub natural gas spot price was at \$1.66 per billion BTU. That is down over the past month and only slightly above the yearly low of \$1.5 per billion BTU recorded in early April. The U.S. Energy Information Administration (EIA) reported on May 21 that U.S. supplies of natural gas remain high while demand is weak.



KEY EQUITY Indexes

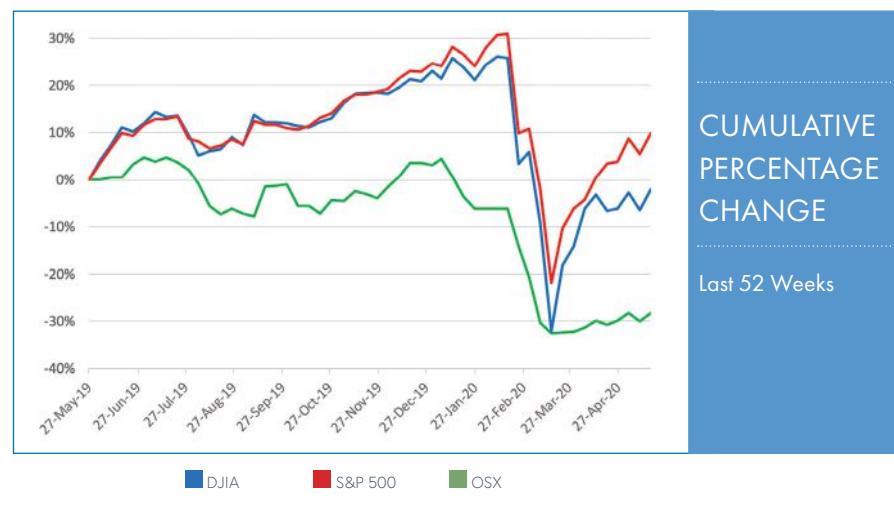
PRICES IN US DOLLARS AS OF MAY 18, 2020

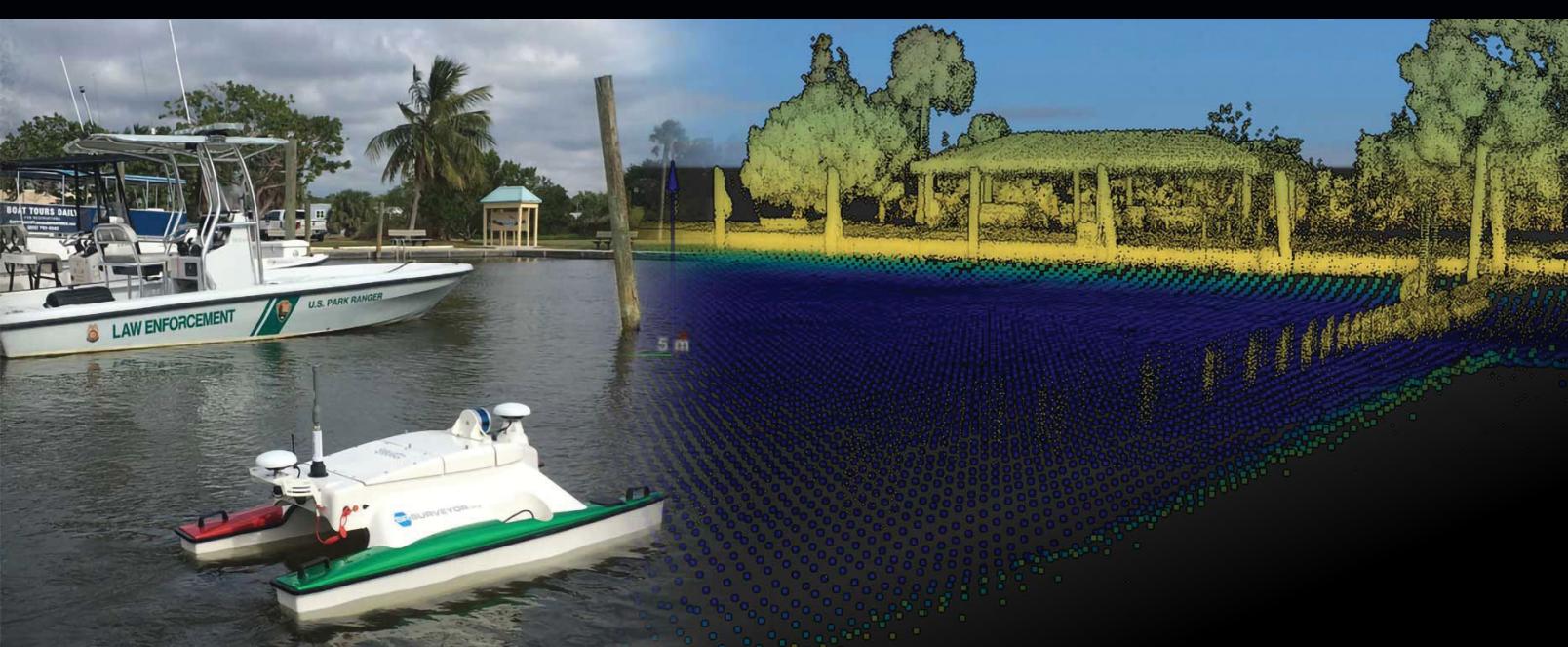
After record losses that saw the Dow Jones Industrial Average drop below 20,000 points and the S&P 500 drop below 2,400 points in mid-March, both indexes have experienced a rebound. Between mid-March and mid-April, the Dow rebounded to above 24,000 points and the S&P above 2,800 points. The Dow has been largely flat since then, with a weekly close at 24,465.16 points on May 18 only slightly higher than its close five weeks earlier on April 13 at 24,242.49. The S&P performed better during

that five-week period, gaining nearly 200 points from 2,761.63 to 2,955.45. According to CNBC and other news sources, hopes for a coronavirus vaccine are pushing the markets upward.

The Philadelphia Oil Services Index (OSX) continued to gain following its low point in mid-March. The index moved past the 30-point mark in May for the first time since sliding down below 24 points in March.

SELECTED EQUITY INDEXES





Intelligent Marine Robotics

Solutions that put you in control



Autonomous Surface Vehicles



ROVs for Hull & Tank Cleaning



Engineering & Design



Manufacturing & Fabrication



We engineer and manufacture unmanned systems for an increasingly data-centric world.

Our portfolio of marine robotics and specialized services provide commercial, government, and defense markets around the globe with solutions to optimize the efficiency and sustainability of inter-coastal and offshore activities.



SeaRobotics.com



THE GREAT RECOVERY BEGINS – BUT HOW FAR?

BY G. ALLEN BROOKS | Author, *Musings From the Oil Patch* | www.energymusings.com

CRUDE OIL:

Barely a month ago, for the first time ever, crude oil futures traded at a negative \$37 a barrel. Today, they are nearly \$70 higher. From one of the worst collapses in oil industry history to one of the sharpest recoveries ever, crude oil price volatility has returned. Volatility creates opportunities for traders to make money, but in the real oil world, it creates operational and structural hurdles. Remember, today's crude oil price is about \$30 a barrel below year-ago prices, and even then, the industry struggled to generate profits.

The one-day oil price collapse was created by investors ignorant of their obligation at the contract's expiration. When it ends, you must be prepared to take delivery of thousands of barrels of oil. At the time the contract expired, there was a panic over inadequate oil storage capacity. To the contrary, more storage appeared—and it wasn't swimming pools, bathtubs or tankers.

The greatest oil price collapse impact was to force producers to stop drilling, and importantly, to shut in flowing wells, something thought unimaginable. Lost profits due to low oil prices could not be offset by producing more oil. With customers telling producers, "no más," drastic changes were needed.

The sharp oil price rebound has traders nervous. Prices have been driven up by the expectation for a rapid return to normality, meaning some semblance of pre-COVID-19 economic life. The scary issue is that some producers are reportedly turning Permian Basin wells back on. Will that upset the scenario for a rapid rebalancing of the oversupplied oil market? A recent analysis of government oil production data shows U.S. output may have already fallen by 25 percent—a drop of nearly three million barrels per day. Much more than anyone previously believed possible.

With new well economics destroyed, producers are stopping drilling and well completions. At the end of 2018, over 400 frac crews were supporting nearly 1,100 rigs drilling new shale wells. At mid-May, there were 70 percent fewer rigs working along with only 15 percent of the frac crews. And we may not have hit bottom.

Not many months ago, the industry would have been shocked to even contemplate \$30 oil. Now they are almost giddy with oil at this level. While some forecasters believe prices have nowhere to go but up, given the cutback in oil company capital spending and sharply reduced activity, they may be ignoring the tidal wave of supply arriving due to the Russia-Saudi Arabia oil war. More cars on the road mean falling oil inventories, but 50 million barrels of Saudi oil arriving soon may overwhelm that improvement. Prepare for lower oil prices before they go higher.

NATURAL GAS:

Natural gas prices are now primarily controlled by weather and LNG, but the oil price crash will affect gas supply. A sharp drop in associated natural gas from oil wells is a wildcard in the gas pricing equation. We have now entered the gas storage rebuilding phase of

the annual industry cycle. How high temperatures climb this summer will influence the storage rebuilding pace. Hot temperatures equate to more air conditioning load and greater gas-fired power generation. More renewable electricity will provide some of that power, but summer temperature patterns often don't match renewable supply peaks. Wind output is highest at night, which is why negative power prices often prevail then, as electricity companies must shed too much supply. Daily peak summer temperatures usually arrive in late afternoons, just as solar power's contribution starts declining, leaving a supply/demand imbalance. These patterns are often upset by rainy days and still nights. Natural gas will continue to play an important role in the power generation business.

Tropical storm Arthur, which recently formed off the East Coast, is the first of what may be a significant number of storms this season. The tropical storm season runs between June 1 and November 30. Historically, 97 percent of tropical storms form in that period, with three percent occurring outside of it. While the early-forming Arthur is not unique, it is a wake-up call that gas markets might be upended this summer by storms.

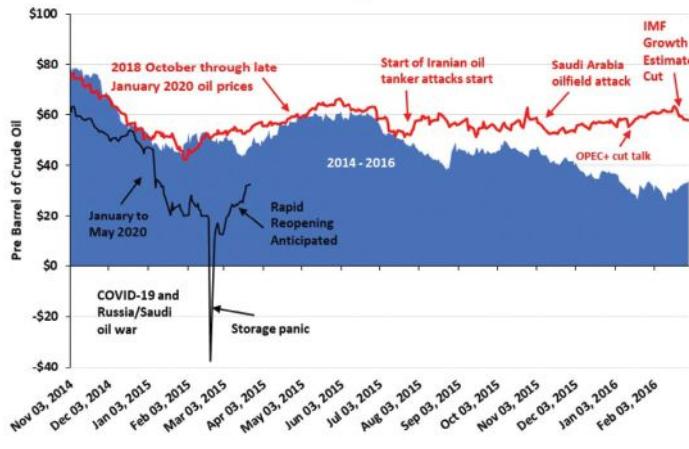
The real story for natural gas prices is how quickly supply falls, as associated natural gas output declines due to lower oil production. At the same time, LNG demand is falling, a key component of demand growth over the past few years. Which supply and demand factor will be the most powerful gas price influencer?

Early reports suggest there may be a number of LNG cargoes cancelled in June due to weak European and Asian demand due to COVID-19. Europe has unseasonably high gas storage following consecutive warm winters and heavy storage fills last year, as the continent moved to protect against failure to renegotiate a 10-year gas supply deal with Russia. With additional gas pipeline capacity supplying European markets—Gazprom's 3-Bcf/d TurkStream pipeline that commenced service in January, and the 1-Bcf/d Trans Adriatic Pipeline, currently in start-up mode—the possibility of a gas supply shortage this winter is low. Additionally, Gazprom's delayed Nord Stream 2 pipeline should begin operating in early 2021. All of this supply makes LNG sales into Europe less attractive.

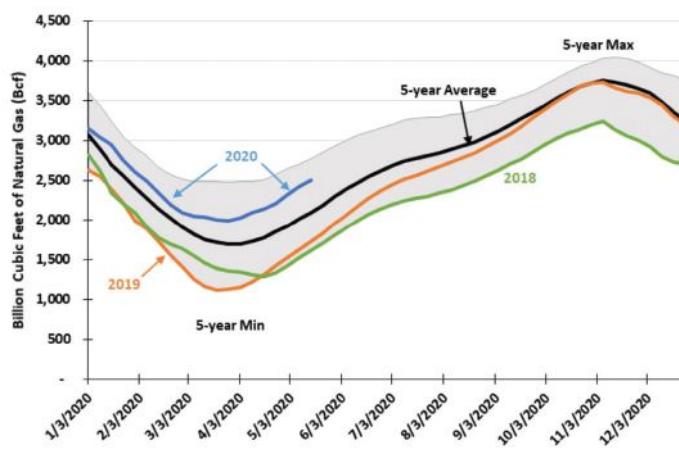
While China has resumed taking LNG cargoes, after declaring force majeure earlier this year during its COVID-19 shutdown, the abundance of cheap gas in neighboring markets makes long-distance U.S. LNG less appealing due to its higher transportation cost.

All of these market trends make predicting near-term gas prices a game of three-dimensional chess. A hot summer could help, but cooler weather might hurt. A rebound in oil prices might boost gas supply, just when lower associated gas supply is assumed. Dry gas output could rise in response to higher gas prices. Factor in an active Gulf of Mexico hurricane season, which could cut supply, or maybe damage demand. Lastly, the global economic reopening offers potential pluses and minuses to LNG supply and demand dynamics. The best guess now is for gas prices to struggle heading into the heat of summer.

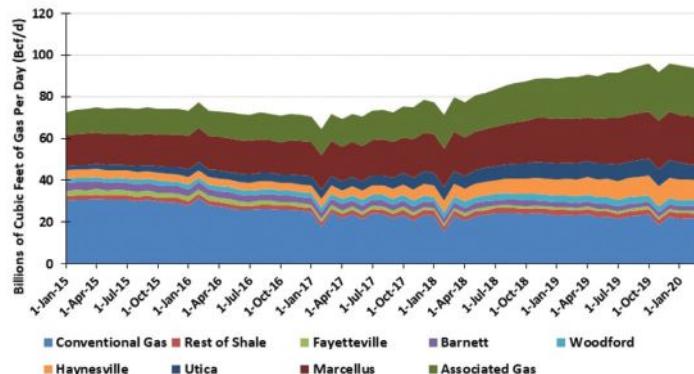
2020 Oil Prices Are
Mirroring 2014-2016
and 2018-2020



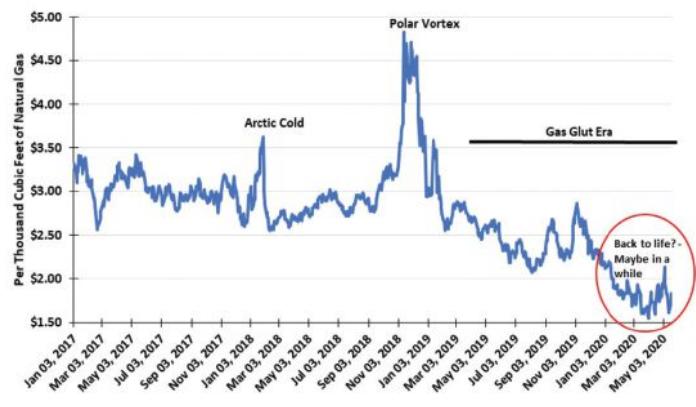
Low Prices and High
Output Rebuilt Gas
Storage



Associated Natural
Gas Has Been an
Important Contributor
to National Supply



2020 Natural Gas
Prices: Rising From
the Dead?





AMERICAS

IPF

Online Only » June-August
www.offshorewindus.org/2020ipf

Financing Wind North America

Boston, MA » September 2-3
northamerica.financingwind.com

Underwater Mining Conference

St. Petersburg, Florida
 » September 27 - October 2
www.underwatermining.org

AUVSI XPOENTIAL

Dallas, TX » October 6-8
www.xponential.org/xponential2020

OilComm

Houston, TX » October 14-15
www.oilcomm.com

MTS Dynamic Positioning

Houston, TX » October 12-14
www.dynamic-positioning.com

AWEA Offshore WINDPOWER

New York, NY » October 13-14
www.awea.org/conferences/awea-offshore-windpower-conference

World Ocean Tech and Innovation Summit

Halifax, Nova Scotia » October 14-15
<https://events.economist.com/events-conferences/americas/world-ocean-tech-and-innovation-summit/>

OCEANS'20 Gulf Coast

Biloxi, MS » October 19-22
gulfcoast20.oceansconference.org

Clean Gulf

San Antonio, TX » October 20-22
www.cleangulf.org

EUROPE

Deep Sea Mining Summit

London, UK » August 18-19
www.deepsea-mining-summit.com

MCE Deepwater Development

London, UK » September 7-9
www.mcedd.com

All-Energy

Glasgow, UK » September 14-15
www.all-energy.co.uk

Int'l Naval Engineering Conference

Delft, The Netherlands » October 6-8
www.imarest.org/events/inec-2020

Offshore Energy

Amsterdam, The Netherlands
 » October 26-28
www.offshore-energy.biz/offshore-energy-2020/

Ocean Energy Europe

Brussels, Belgium » December 1-2
www.oceanenergy-europe.eu/annual-event/oee2020

Oceanology International

London, UK » December 1-3
www.oceanologyinternational.com

WindEnergy Hamburg

Hamburg, Germany
 » December 1-4
www.windenergyhamburg.com/en

UDT

Rotterdam Ahoy, NL » December 8-10
www.udt-global.com

OTHER REGIONS

Offshore Well Intervention APAC

Kuala Lumpur, Malaysia
 » September 17-18
www.interventionasiapac.ofsnetservices.com

Submarine Networks World

Singapore » September 23-24
www.terrapinn.com/conference/submarine-networks-world

Mediterranean Offshore Conference

Alexandria, Egypt » October 13-15
www.moc-egypt.com

Telecoms World Asia

Bangkok, Thailand » October 28-29
www.terrapinn.com/conference/telecoms-world-asia

Telecoms World Middle East

Dubai » November 3-4
www.terrapinn.com/conference/telecoms-world-middle-east

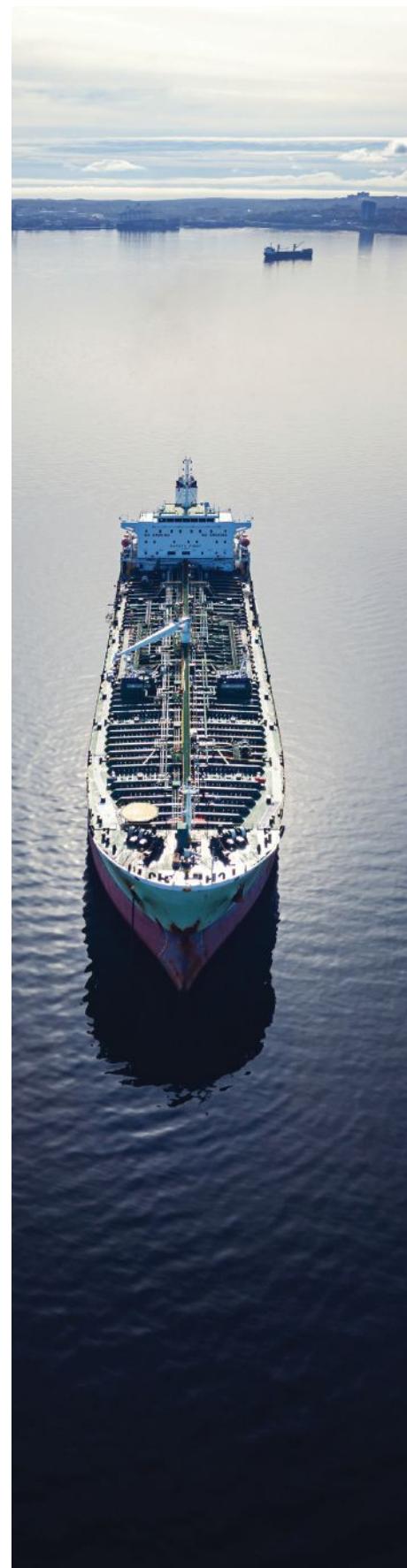
ADIPEC

Abu Dhabi » November 9-12
www.adippec.com

MAST Asia

Tokyo, Japan » November 9-11
www.mastconfex.com/asia2020

EDITORIAL FOCUS	PRODUCTS & SERVICES FOCUS	SHOW DISTRIBUTION
JANUARY		
» Mapping / Survey » Unmanned Vehicle Tooling	Manipulator Arms & Tools; Pumps, Hoses & Hose Connectors; Cameras, Lights; Bathymetric Mapping & Charting	Underwater Intervention » February 4-6 Subsea Expo » February 11-13 Canadian Hydrographic » February 24-27
FEBRUARY		
» Oceanology » Metocean	Data Acquisition & Processing; Metocean Buoys; Transducers; Hydrophones, Altimeters, Profilers, Velocity Loggers, Telemetry, & Pressure Sensors	Oceanology International » December 1-3
MARCH		
» Offshore Technology » Subsea Cables	Simulators; Autopilots; Digital Twins; Cybersecurity Services; UAVs; Echosounders and ADCPs	IPF Virtual » August 18-21 AUVSI XPONENTIAL » August 10-12 Deep Sea Mining Summit » October 6-8
APRIL		
» Deepwater Inspection, Repair, and Maintenance » Defense & Security	Sonar Systems & Vessels; Imaging & GIS, Magnetometers, Open Architecture Robotics & Unmanned Defense Systems	UDT » December 8-10
MAY		
» Offshore Exploration	Mining Machines; Cloud-based Computing & Software	Deep Sea Mining Summit » August 18-19
JUNE		
» Surface Vehicles	Mounting Systems & Gimbal; Small Survey Boats; Control Systems; USVs; Towed Vehicles & Gliders	TBD
JULY		
» Buyers' Guide: Unmanned Vehicles	ROV, AUV, USV, Gliders & Towed Vehicles	TBD
AUGUST		
» Submersibles	Cranes & Winches; LARS & Control Systems; Sensors, Profilers & Measurement; Thrusters; Umbilical, Tether, Cables & Connectors	AUVSI XPONENTIAL » October 6-8
SEPTEMBER		
» Marine Renewables	Current Meters / ADCP, Wave / Metocean Buoys, Bottom Survey Equipment, Cable Protection Equipment, Inspection Services and Equipment, Service Vessels, Materials and Coatings, Installation Equipment	Offshore Energy » October 26-28 Ocean Energy Europe » December 1-2
OCTOBER		
» Ocean Science & Technology	Acoustic Modems; Acoustic Releases, Transponders, Command & Control Systems; Oil Spill Prevention; Oceanography Tools, UW Video Cameras	OCEANS'20 » October 19-22
NOVEMBER		
» Maritime » Tracking and Positioning	Transponders / AIS; S/P Power Systems; Workboats & Supply Vessels	UDT » December 8-10
DECEMBER		
» Future of Ocean Technology	Ocean Technology	TBD





JOIN

MOTN Marine & Oceanographic Technology Network

MOTN is a US-based professional business association committed to expanding opportunities for our members. We do this through networking, local and regional development, and strategic partnerships. Member companies include industry suppliers, consultants, representatives, research institutes and manufacturers – all working together to increase business opportunities both within and outside of the organization.

www.motn.org

SeaState

THE ON&T PODCAST

SEASON 1 / EPISODE 1

FROM INNER TO OUTER SPACE: THE RACE FOR AUTONOMY

ON&T is excited to announce the first episode of SeaState! During these difficult times we hope you can find the time to take a break, sit back, and plug in to our new podcast series. In episode 1 of SeaState we chat with Dr. James Bellingham of the Center for Marine Robotics at the Woods Hole Oceanographic Institution. Dr. Bellingham founded the MIT Autonomous Underwater Vehicle (AUV) Laboratory in late 1988, where he developed the scientific and technical focus for AUV development, and managed the resulting research activity. As the technology matured, he created an operational group and led over 20 field programs. Dr. Bellingham led several multi-organizational research initiatives, including the ONR Autonomous Ocean Sampling Network project. The MIT AUV laboratory is widely recognized as having pioneered the introduction of small, high performance AUVs and their use in multi-platform observation systems.

In 1997 Dr. Bellingham founded Bluefin Robotics as a spin-off from his MIT Laboratory with Frank van Mierlo. The Battlespace Preparation AUV (BP AUV) was Bluefin's best-selling platform. This platform led to the Knifefish program of record for the US Navy. Dr. Bellingham was later recruited to lead the Engineering Department at MBARI. MBARI is a not-for-profit founded by David Packard with a budget of approximately \$40M/year and a charter to create technology for the ocean sciences. Under Bellingham, Engineering completed the development of the 4000 m rated Tiburon Remotely Operated Vehicle. Today MBARI Engineering has a reputation as a world leader in the development and fielding of advanced marine technology.

In 2014 Dr. Bellingham was recruited to become the founding Director for the Center for Marine Robotics at WHOI. Over the past several years he has undertaken a range of initiatives to strength both WHOI robotics capabilities and the New England marine robotics ecosystems. The DunkWorks advanced design and prototyping center is a particularly visible outcome of Dr. Bellingham's facility modernization efforts, formally opened by the Lt Governor in 2017. The Arctic Long-Range AUV program he initiated has evolved to become the largest single DHS initiative funded under the Center of Excellence Program.

● WWW.OCEANNEWS.COM/SEASTATE

ODE ACHIEVES SIGNIFICANT MILESTONE ON BABBAGE INSTALLATION

ODE Asset Management Ltd (ODE) confirms that it has secured a contract from NEO Energy (NEO) for the Babbage Field in the Southern North Sea.

This is a significant ODE milestone as the first installation and pipeline operator (duty holder) appointment in the UK Continental Shelf (UKCS).

ODE is no stranger to the Babbage asset. The company has acted as operations and maintenance provider since the project phase and successfully transitioned the platform from normally manned to not normally manned status in recent years.

ODE's continued involvement in Babbage is important business continuity for NEO Energy, in particular securing existing jobs managing the offshore asset.

Sandy Reid, managing director of ODE Asset Management, commented: "This is the first of two outsourced duty holder contracts we're bringing across the line in

2020 and is a tremendous achievement for our Great Yarmouth and Aberdeen teams. We're delighted to have the trust of NEO as their operations partner for Babbage and hope to further build our relationship by helping them achieve their ambitious growth plans. We've got an excellent track record of keeping the facility performing above platform design efficiency levels whilst also safely minimizing the cost of ownership. We intend to maintain this track record despite the current industry challenges and those of maintaining an aging asset."

He added: "This contract recognizes ODE's experience and expertise in operations support and builds on our long history of supporting producing assets. It also demonstrates that ODE's offering and approach, focused on efficiency and bespoke integration with clients, challenges the market norm. As the North Sea matures, the ODE approach addresses the industry's cost related challenges."



Lynne MacPherson, NEO's asset manager, commented: "The Babbage operatorship is an important milestone for NEO as we develop the company in the UKCS. We continue to see significant value in the region with a strategy to grow, both organically and through acquisition, to achieve production of 80,000-100,000 boepd. In these challenging times, we've worked closely with our operations partner ODE to safely and effectively transition operatorship of the Babbage asset. We look forward to a successful long-term partnership managing the facilities."

PLANET OCEAN SIGN EXCLUSIVE DISTRIBUTION AGREEMENT WITH SIDUS SOLUTIONS

Planet Ocean Ltd has signed an exclusive representation agreement with San Diego based SIDUS Solutions LLC. SIDUS provides the very best undersea situational awareness equipment available today. Their extensive product offerings include high-definition cameras, electric pan and/or tilt positioner systems, feature rich underwater lighting and projection lasers. The SIDUS product range also includes laser scan video systems and integrated light/strobe/laser systems. Moreover, SIDUS has the full technical capability to undertake bespoke challenges to address emerging problems in automated undersea inspection and visualisation.

Planet Ocean M.D Terry Sloane commented: "Our partnering with SIDUS builds upon our experience of supplying high quality

underwater robotics in the form of ROV & AUV technology and we are delighted to once again team with an innovative, industry leader in their field who provides cutting edge equipment with capabilities that push the boundaries."

Planet Ocean will be providing pre and post-sales support and first level service from their Camberley Surrey base.

For more details about SIDUS Solutions products and Planet Ocean Ltd, visit: www.sidus-solutions.com and www.planet-ocean.co.uk



EX-FORMULA 1 ENGINEER JOINS WFS TECHNOLOGIES

WFS Technologies has further strengthened its senior management team with the appointment of a former Formula 1 engineer as Head of Engineering and Projects.

Colin Drysdale takes up the post and will be responsible for leading the successful delivery of projects at WFS which specializes in subsea wireless automation.

With more than 20 years' experience of delivering transformational change and new technology development, Colin was previously Head of Technical Projects at McLaren where he was responsible for delivery across motorsport, electric vehicles and public transport. His career also spans aerospace and defense sectors, developing radar for Eurofighter Typhoon, sensors for the A400M Atlas program and military communications systems.

He will oversee the engineering and technical team which has been also been further reinforced with the appointment of three



» Colin Drysdale

specialists across the electronics and software disciplines.

Peter Sharpe, interim CEO at WFS, said: "We are thrilled to welcome on board Colin who, through his background, brings an exciting new dimension to the company and will form a key part of the leadership team.

"Colin has an impressive breadth of skills which are fully transferrable to our business and technologies, and this will be integral to supporting our growth strategy. As well as providing technical leadership to the engineering team, Colin will establish a robust project management function in line with WFS's expansion plans which harness our capabilities to help customers reduce costs, increase production and improve their carbon footprint."

A chartered engineer and a member of the Association for Project Management, Colin graduated from Glasgow University with a BEng (Hons) in microcomputer systems engineering. Previous employers have included Siemens, BAE Systems and Roke which is a research and development center of excellence for communications, networks and electronic sensors.

During his career, Colin has led number of major projects including creating improvements in engineering and project management processes that delivered quality and consistency of project results and significantly reduced development costs. In motorsport and public transport, he delivered complex projects which involved the development and integration of software,

hardware and mechanical design elements as well as establishing a data center and service desk to support customer operations.

He said: "WFS has established a suite of smart subsea technology which is a major game changer for a diverse range of sectors including offshore wind and oil & gas. Their holistic approach to developing solutions was of particular appeal because this, combined with WFS' edge computing and digitization of its tools, is more critical than ever to significantly increasing productivity and efficiencies while substantially reducing costs.

"I look forward to working with the engineering and management teams, and applying my experience in sensors, communications and data analytics, to help WFS enhance our customer's operations and reduce the cost of maintenance."

WFS is a world leader in subsea digitalization through its range of true wireless Subsea Internet of Things® (SloT) products that provide offshore operators with asset integrity monitoring with embedded edge computing for real-time insight.

The award-winning company has delivered more than 7,000 of its proprietary Seatooth® devices through its team of dedicated software and hardware engineers based in Livingston, Scotland.

An industry first, the wireless Seatooth® products have the potential to disrupt the offshore energy industry by providing operators of oil and gas platforms and wind farm installations with the ability to digitalize their subsea assets, reducing cost and increasing asset life through insight derived from real-time data.

GEOFF DEAN JOINS TELEDYNE CARIS AS USA SALES MANAGER

Teledyne CARIS, a Teledyne Technologies company [NYSE: TDY], has welcomed Mr. Geoff Dean to the group as USA Sales Manager. In this role Geoff will concentrate on expanding the reach of Teledyne CARIS software products, while using his in-depth industry experience to provide seamless service and support for existing clients.

"I am extremely pleased to welcome Geoff to the sales team," said Andy Hoggarth, Director of Sales and Business Development – Teledyne CARIS. "His 20 years of industry experience in Sales and Strategic Business Development, most recently at RJE Oceanbotics, and previously at Jeppesen Marine and Fugro make him very well versed and connected to our industry."

Geoff will spearhead the continued expansion of Teledyne CARIS software especially in the ports, waterways and hydrographic survey markets in the US. He joins the company at an exciting time

when the newest CARIS AI processing tools and cloud-based technologies are creating waves across the hydrographic industry. As a licensed drone operator, he is also well placed to assist sister company Teledyne Optech as they develop and deploy their latest LiDAR sensors and payloads.



» Geoff Dean

INTERIOR ISSUES NEW OFFSHORE AIR QUALITY REGULATIONS

In support of President Donald Trump's America-First Offshore Energy Strategy, the Department of the Interior (Department) and the Bureau of Ocean Energy Management (BOEM) recently announced a final rule to update air quality regulations for applicable BOEM activities in the Central and Western Gulf of Mexico and off the coast of Alaska's North Slope Borough. The new rule does not relax any standards for regulating air quality, uses the best available science and makes important technical and compliance-related updates to bring the regulation into this century.

"Under the President's leadership, the Department has taken numerous, commonsense actions resulting in billions of dollars in deregulatory savings, and we will continue to take actions to better serve the American people," said Secretary David L. Bernhardt. "The final rule incorporates current standards, creates consistency with the statutory authorities and is one more step in the right direction."

The final rule respects the clear and distinct authority Congress delegated to the Department. The Department's jurisdiction is limited to activities authorized under the OCS Lands Act in the Central and Western Gulf of Mexico and offshore the North Slope Borough of Alaska. The U.S. Environmental Protection Agency (EPA) has air quality jurisdiction over all other parts of the OCS. It is also limited to regulating offshore emissions of criteria and their precursor pollutants to the extent they significantly affect the air quality of any state. With this clear mandate, the final rule operates within these parameters to improve air quality.



» The Ram Powell oil platform in the Gulf of Mexico. Credit: BSEE.

"Offshore energy development accounts for 18 percent of our nation's oil production and billions of dollars in revenues for the states, the Land and Water Conservation Fund, and the American people," said Deputy Secretary of the Interior Kate MacGregor. "This commonsense update brings the Department's regulations in line with current standards and within our distinct, statutory mandate."

The final rule provides a commonsense approach to ensure BOEM's Air Quality Regulatory Program remains in compliance with the OCS Lands Act requirements by ensuring that BOEM uses up-to-date air quality standards (i.e., National Ambient Air Quality Standards (NAAQS)) and benchmarks consistent with those already established by the EPA.

More information about the final rule can be viewed here:
<https://www.boem.gov/overview-air-quality-regulations>

OSI COMPLETES PHASE 1 FOR SPEEDCAST COMMUNICATIONS CABLE PROJECT

Ocean Specialists, Inc. (OSI)'s Project Management Team, in partnership with Speedcast Communications, Inc has announced the successful completion of Phase 1 (Engineering) for a private communication cable system offshore East Africa. This marks an important milestone for the Speedcast communications project.

Speedcast awarded the Master Services contract and the release of the Phase 1 work order to OSI in early January. This work order included Project Management and Design/Engineering support for the communications cable system and cable landing station, along with the commencement of the Environmental and Permitting activities that OSI has subcontracted to CSA Ocean Sciences, Inc (CSAOS). The private cable system will serve

the Oil & Gas industry onshore and offshore East Africa.

OSI implements a seamless approach to project management and has the in-house resources to deliver the highly integrated services and customer support needed to help clients mitigate against risk and, where necessary, make certain important adjustments throughout the process.

One such adjustment was necessary due to the unforeseen threat of the COVID-19 pandemic, according to Perry Wright, OSI's project lead: "The normal controls for a project of this nature involve numerous face-to-face meetings, workshops, and site visits which, in this case, had to be adapted to facilitate the participation of multiple stakeholders



located in the US, Europe and East Africa. It is a tribute to the flexibility and commitment of the entire project development team that this was managed with no impact on the completion schedule for this phase or the quality of the work delivered to customer."

For the implementation phase of the project, OSI will continue to provide support that includes project management, design oversight for the integrated cable solution, specification for the Landing Station and co-location facilities, system installation support, which incorporates route development and installation methods oversight, and commissioning and acceptance monitoring.



Looking deeper
and seeing more.

Morgan & Eklund, Inc. specializes in collecting data in the coastal zone providing bathymetric surveying services for project monitoring, beach restoration, dredging and offshore borrow area investigations.



For more information, visit www.morganeklund.com or call (772) 388-5364

OCEAN INDUSTRY DIRECTORY



ON&

ACOUSTIC SYSTEMS

HIGH TECH, INC.
21120 Johnson Road
Long Beach, MS 39560, United States
Phone: 228 868 6632
E-mail: high_techinc@bellsouth.net
Website: www.hightechincusa.com
Contact: Glenn Pollock



Experts in rugged marine sensor systems utilized in geophysical surveys, anti-submarine warfare, marine mammal monitoring and downhole applications. Products include data acquisition systems, hydrophones, array cables, pressure vessels and peripherals related to marine systems.

OCEAN SONICS LTD.

11 Lornevale Road
Great Village, NS, B0M 1L0
Phone: +1 902 655 3000
E-mail: info@oceansonics.com
Website: www.oceansonics.com



Ocean Sonics designs and manufactures icListen, the world's first smart digital hydrophone. Compact and easy to use, its small size makes it the perfect tool for sound data collection. Listen in real-time and improve decision making, or use as an acoustic recorder for long term deployments. The best data is collected by the best tools. icListens internal processing saves time. Digital sound is streamed live.

Ocean Sonics is dedicated to your success. We provide services in deployment, system design and integration, and data processing.

Listen Now. The Ocean Sonics Way.

TELEDYNE RESON

Fabriksvangen 13
3550 Slangerup, Denmark
Phone: +45 4738 0022
E-mail: reson@teledyne.com
Website: www.teledynemarine.com/reson/
Contact: Shannon Searing



Teledyne RESON together with Teledyne BlueView and Teledyne Odom provides a range of high quality underwater acoustic hardware and software solutions for underwater imaging within Teledyne Marine. These solutions are delivered through recognized brands such as SeaBat, BlueView, Odom, HydroSweep and ParaSound Multibeam Echosounder and Teledyne PDS software suite.

Teledyne Marine is a group of leading-edge subsea technology companies that are part of Teledyne Technologies Incorporated. Through acquisitions and collaboration over the past ten years, Teledyne Marine has evolved into an industry powerhouse, bringing Imaging, Instruments, Interconnect, Seismic, and Vehicle technology together to provide total solutions to our customers.

ADCP/DVL

NORTEK AS
Vangkroken 2
1351 Rud, Norway
Phone: +47 67 17 45 00
E-mail: inquiry@nortek.no
Website: www.nortekgroup.com



Nortek excels in the development and manufacture of acoustic Doppler instrumentation. Doppler Velocity Logs (DVLs) are used for subsea navigation. Acoustic Doppler Current Profilers (ADCPs) are used to understand physical processes in the ocean, rivers, lakes and laboratories. We pride ourselves on being innovative in product development and production processes. Nortek provides solutions to engineers and scientists by offering real-time data collection and support from our responsive technical team.

BUOYS

METOCEAN TELEMATICS
21 Thornhill Drive Dartmouth,
Nova Scotia B3B 1R9 Canada
Phone: +1 902 468 2505
Fax: +1 902 468 4442
E-mail: emily@metocean.com
Website: www.metocean.com
Contact: Emily MacPherson



MetOcean Telematics designs and manufactures drifting buoys, environmental platforms, and the world renowned NOVATECH locator beacon product line. In addition to providing complete end-to-end telematics services, is one of the few drifter manufacturers in the world to achieve ISO 9001 certification. MetOcean Telematics's drifting buoy family consists of environmental and weather monitoring, oil spill response, and search and rescue drifters: NOVA profiling float, Iridium SVP (iSVP), iSPHERE, Argosphere, SLDBM, and iSLDBM.

BUOYANCY PRODUCTS

DEEPWATER BUOYANCY, INC.
394 Hill Street
Biddeford, ME 04005
Phone: +1 207 502 1400
Fax: +1 207 221 5718
E-mail: sales@deepwb.com
Website: www.DeepWaterBuoyancy.com
Contact: Dan Cote, Sales Manager



DeepWater Buoyancy Inc. is the world's largest producer of subsea buoyancy products for the oceanographic community and has a vast product line of buoyancy solutions for offshore oil & gas, energy and technology companies. This product portfolio has been built over the course of 40 years serving these industries. Though products are offered for shallow water applications, the company specializes in deepwater, providing solutions to depths of 6000 meters and beyond.

NAUTILUS MARINE SERVICE GMBH

Alter Postweg 24
Buxtehude, 21614, Germany
Phone: +49 (0) 41618 66250
E-mail: info@nautilus-gmbh.com
Website: www.vitroxex.com
Contact name: Steffen Pausch



Nautilus Marine Service provides the finest VITROVEX® glass housings that are capable of operating in the most extreme regions of the Earth. VITROVEX® glass enclosures offer the dual advantage of buoyancy and pressure proof housings - a perfect combination for small and autonomous underwater instrumentation packages.

Simple, reliable and affordable.

SUBSALVE USA

P.O. Box 2030
 North Kingstown, RI 02852
 Phone: 401 884 8801
 Fax: 401 884 8868
 E-mail: richard@subsalve.com
 Website: www.subsalve.com
 Contact: Richard Fryburg

Since 1977 Subsalve USA has been America's #1 manufacturer of standard and custom flotation devices and we are the innovators in buoyancy and engineered inflatables. Our products include: Professional, Commercial, Standard, Shallow Water, Enclosed Flotation Bags, Cable & Pipeline Floats, Water Load Test Bags, Rapid Recovery & Mark V/ORCA EOD Systems.

**CAMERAS / LIGHTS / LASERS****ARTIC RAYS LLC**

382 Chicopee Row
 Groton, MA 01450
 Tel: +1 567 343 2370
 E-mail: lee@articrays.com
 Website: www.articrays.com
 Contact: Lee Fray



Arctic Rays LLC is a specialist in the design and manufacture of deep sea lighting and imaging products specifically for use on AUVs, but also prove ideal for manned vehicles and all other underwater, surface vehicles or platforms. Our designs feature the smallest possible size and lowest power consumption available.

CATHX OCEAN

Unit D3, M7 Business Park,
 Newhall, Naas,
 Kildare W91F780
 Ireland
 Phone: +353 (0) 45 252 786 / UK: +44 (0) 1224 432 180 / USA: +1 (832) 808-3403
 E-mail: apastor@cathxocean.com
 Website: www.cathxocean.com
 Contact: Alberto Lopez Pastor



Cathx Ocean design and manufacture advanced subsea imaging and precision measurement systems for subsea operations.

Designed to meet stringent technical, operational and integration requirements associated with various subsea applications and vehicle types, Cathx Ocean's systems offer precision, reliability and peace of mind. Products include advanced still imaging, colour laser point cloud and video systems, designed to deliver precision subsea data in a way that allows automation for subsea vehicle operations.

The range includes the Hunter system (AUV Imaging and Laser), the Scout system (Observation Class ROV Imaging and Laser Profiling), the Pathfinder system (Work Class ROV Imaging and Laser Profiling) and the Prowler I & II systems (Towed Vehicle Imaging Range and Scale Measurement).

DEEPSSEA POWER & LIGHT

4033 Ruffin Rd.
 San Diego, CA 92123
 Phone: 858 576 261
 Fax: 858 576 0219
 E-mail: sales@deepsea.com
 Website: www.deepsea.com



For over 30 years, DeepSea Power & Light has provided high-quality and innovative products to the oceanographic community. The company's expertise and product line has grown to include underwater video systems, lighting solutions, pressure relief valves, and lasers.

Design criteria for products include ease of service, reliability, high performance, and cost effectiveness. Products are rigorously tested in both the initial design process and manufacturing stage to perform in the harsh marine environment—from wet/dry surface applications to full ocean depth deployments. DeepSea Power & Light offers a versatile product line while developing new designs to continue exceeding market expectations.

SIDUS SOLUTIONS, LLC

7352 Trade Street
 San Diego, CA 92121
 Phone: 619 275 5533
 E-mail: info@sidus-solutions.com
 Website: www.sidus-solutions.com



SIDUS Solutions LLC, 'SIDUS' is a worldwide company that designs, manufactures and installs systems in the most extreme of environments. SIDUS products include Cameras, Pan & Tilts, Lights and Lasers for use in hazardous areas for and SUBSEA, serving the, energy, scientific, military, nuclear, and shipping industries. Engineering experience makes us the perfect choice for application specific surveillance systems to provide end to end safety and security. SIDUS provides complete integration, design, documentation, and commissioning for all systems. From sea-floor observation platforms, to surveillance systems on drilling rigs, or sonar deployment systems - SIDUS is a field proven solution.

CABLES**SOUTH BAY CABLE CORP**

54125 Maranatha Drive
 P.O. Box 67
 Idyllwild, CA 92549
 Phone: 951 659 2183
 Fax: 951 659 3958
 E-mail: Sales@southbaycable.com
 Website: www.southbaycable.com
 Contact: Gary Brown, Sales Manager



Since 1957, South Bay Cable Corp has designed and manufactured specialized electrical, electro-mechanical and electro-optical-mechanical cables for use in demanding marine environments. Cables are designed to meet customer requirements and include tether and umbilical cables for ROVs, tow cables, video inspection, faired cables and a host of other customer specific applications.

CONNECTORS**BIRNS, INC.**

1720 Fiske Place
 Oxnard CA 93033-1863 USA
 Phone: +1 805 487 5393
 Fax: +1 805 487 0427
 USA: +1 888 BIRNS 88 (+1 888 247 6788)
 E-mail: service@birns.com
 Website: www.birns.com
 Contact: Eric Birns



BIRNS has served the subsea industry since 1954, and is an ISO 9001:2015 certified global leader in the design and manufacturing of high performance connectors, cable assemblies and lighting systems. With a NAVSEA PRO-020 certified molding facility, it offers sophisticated connector lines, including 6km-rated electrical, electromechanical, coaxial, electro-coax, optical, electro-optical and electro-opto-mechanical hybrids. BIRNS provides the industry's highest volume of cost-effective hydrostatic and helium pressure testing, and has a wide range of ABS Product Design Assessment (PDA) certified fiber optic and electrical penetrators. BIRNS' LED and tungsten-halogen marine, chamber, security and commercial diving lights are trusted in the world's most extreme environments.

BIRNS AQUAMATE LLC

122 Waltham St.
 Pawtucket, RI 02860 USA
 Phone: +1 401 723 4242
 Fax: +1 401 753 6342
 E-mail: sales@birnsaquamate.com
 Website: www.birnsaquamate.com
 Contact: Michelle DeTerra



Birns Aquamate design and manufacture underwater electrical connectors, cable assemblies, and cable terminations. The company produces a wide range of standard industry products such as the 5500 Series, SC, MC, LP, FAWL/FAWM, NANO, TC, Rubber Molded, etc. Birns Aquamate is the only manufacturer to guarantee compatibility with other uv connectors. Birns Aquamate also specializes in fast turn-around for custom design of special connector solutions. All connectors are manufactured under DNV ISO 9001:2000 certification. Dealers in Canada, Brazil, UK, Belgium, Holland, Norway, Germany, South Africa, Holland, Italy, and China.

SOURIAU - SUNBANK | CONNECTION TECHNOLOGIES

1740 Commerce Way
93446 Paso Robles, USA
Phone: +1 805 423 5046
E-mail: VMansour@souriau.com
Website: www.souriau.com
Contact: Vincent Mansour,
North America Product Manager Marine/Space/Milaero

**SOURIAU - SUNBANK**
Connection Technologies

SOURIAU-SUNBANK Connection Technologies is a global leader in interconnect solutions engineered to withstand the harshest of environments as aeronautics, space, defense, transport, energy, industrial equipment, healthcare devices, and lighting. It invests in R&D and manufacturing facilities to produce solutions that comply with environmental requirements and international trade rules. SOURIAU-SUNBANK's wide range of products are designed using cutting-edge electrical and optical connection technologies. All are suitable for use in non-hazardous environments as well as those involving extreme temperatures, strong vibrations and corrosive liquids, and meet specific international market standards.

DESIGN & ENGINEERING**HYDRO LEDUC NA, INC.**

19416 Park Row, Ste. 170
Houston, TX 77084
Phone: 281 679 9654
E-mail: bogden@hydroleduc.com
Website: www.hydroleduc.com



Hydro Leduc is a specialist in the design and manufacture of hydraulic piston pumps, hydraulic motors, hydro pneumatic accumulators, and customized hydraulic components satisfying customer needs with reliable products from a reliable source. As the leader in micro hydraulics, it is feasible to obtain several tons of force from a minimal power source within a restricted space envelope. The techniques of micro hydraulics allow simple solutions to problems that are often beyond the limits of traditional mechanical options. Hydro Leduc's expertise is at your service in varied applications such as oil service tools, oceanographic instrumentation, aeronautics, and any extreme working condition of temperature, pressure, medium, and environment.

DIGITAL VIDEO RECORDING SYSTEMS**DIGITAL EDGE SUBSEA, LTD**

Doubletree Court, Cavendish St.
Ulverston, Cumbria
LA127AD
Phone: +44 (0) 1229 206456
E-mail: john@digitaledgesubsea.com
Website: www.digitaledgesubsea.com
Contact: John Benson



The EdgeDVR is currently used worldwide by most of the major ROV and Diving contractors. With our present Version 4 software, we have 6 models. The EdgeDVR has become an essential part of any ROV and Diving system offshore, easy to use and reliable. The system is capable of recording simultaneous High Definition and Standard Definition video, together with auto creation of Dive, Video, Photo and Anomaly logs. Multi channel digital overlay is also available for all recorded channels, logos and realtime survey data can be displayed. With around 500 systems now offshore, we have a proven record of reliability.

Our version 5 software is currently in development and full details will be released soon...

EQUIPMENT RENTAL**OKEANUS SCIENCE & TECHNOLOGY, LLC**

2261 Denley Road
Houma, LA 70363
Phone: 985 346 4666
Fax: 985 346 8444
E-mail: Bleblanc@okeanus.com
Website: www.okeanus.com
Contact: Benton LeBlanc



Okeanus is the premier rental provider for oceanographic and marine scientific research equipment utilized in nearshore and offshore projects around the world. Focused on providing industry-leading customer service, Okeanus offers advanced, high-quality technology coupled with knowledgeable and experienced staff that can deliver dedicated support regardless of a project's location.

**FIBER OPTIC PRODUCTS/SERVICES****OCEAN SPECIALISTS, INC.**

8502 SW Kansas Ave
Stuart, FL 34997
Phone: +1 772 219 3000
Fax: +1 772 219 3010
E-mail: contact@oceanspecialists.com
Website: www.oceanspecialists.com



Ocean Specialists, Inc. (OSI) is a system development and advisory firm for undersea cable projects and technology with global capabilities. OSI works with clients during all project phases of subsea network development, from planning and design to procurement and implementation. Our customers, primarily representing Oil and Gas, Telecommunications and Ocean Observing, recognize the value of fiber optic networks to their field and services solutions, and look to OSI to deliver the skills and experience that developing these networks require.

GYRO COMPASSES**KONGSBERG SEATEX AS**

Pirseteret
N-7462 Trondheim, Norway
Phone: +47 73 54 55 00
Fax: +47 73 51 50 20
E-mail: km.seatex.sales@kongsberg.com
Website: www.km.kongsberg.com/seatex
Contact: Finn Otto Sanne at finn.otto.sanne@kongsberg.com

**KONGSBERG**

Kongsberg Seatex is a leading international marine electronics manufacturer specializing in the development and production of precision positioning and motion sensing systems. Our commitment is to provide quality products and solutions for safe navigation and operations at sea in the commercial offshore, maritime, hydrographics and defence industries.

LIQUID STORAGE**AERO TEC LABORATORIES, INC. (ATL)**

45 Spear Road Industrial Park,
Ramsey, NJ 07446 USA
Phone: +1 201 825 1400
Fax: +1 201 825 1962
E-mail: atl@atlinc.com
Website: www.atlinc.com
Contact: David Dack



ATL specializes in the design/manufacture of custom bladder-type fluid containment systems, including tanks, inflatables, pillows and bellows for surface and subsea. ATL's flexible fluid containers boast unparalleled chemical tolerance, abrasion resistance, and remarkable durability - used with methanol, diesel fuel, gases, ethylene glycol, hydraulic fluids and chemical cleaning cocktails. Expedited deliveries are also available.

MARINE ENVIRONMENTAL CONSULTING SERVICES**CSA OCEAN SCIENCES INC.**

8502 SW Kansas Avenue
Stuart, FL 34997
Phone: +1 772 219 3000
Fax: +1 772 219 3010
E-mail: gstevens@conshelf.com
Website: www.csaocean.com
Contact: Gordon Stevens



CSA Ocean Sciences Inc. (CSA) is a marine environmental consulting firm specializing in multidisciplinary projects concerning potential environmental impacts of activities throughout the world. With extensive experience in environmental sciences and technical field operations, CSA is staffed and equipped to offer a complete range of services for projects in offshore, nearshore, estuarine, wetland, and freshwater environments.able solutions.

MARINE VENTURES INTERNATIONAL, INC. (MVI)

8524 SW Kansas Avenue
Stuart, FL 34997
Phone: +1 772 419 9627
Fax: +1 772 419 9628
E-mail: kcomer@marineventures.com
Website: www.marineventures.com
Contact: Kevin Comer



Marine Ventures International, Inc. (MVI) provides high quality, marine environmental and technical experts to conduct coastal and offshore field operations worldwide. We leverage our wealth of talent and resources to bring you a customized team of independent contractors, subject matter experts and specialized equipment to get the job done. Our professionals work in a variety of sectors from submarine cable projects and engineering services to protected species observation and environmental consulting.

MOTION SENSING EQUIPMENT**KONGSBERG SEATEX AS**

Pirserteret
N-7462 Trondheim, Norway
Phone: +47 73 54 55 00
Fax: +47 73 51 50 20
E-mail: km.seatex.sales@kongsberg.com
Website: www.km.kongsberg.com/seatex
Contact: Finn Otto Sanne at finn.otto.sanne@kongsberg.com



KONGSBERG

Kongsberg Seatex is a leading international marine electronics manufacturer specializing in the development and production of precision positioning and motion sensing systems. Our commitment is to provide quality products and solutions for safe navigation and operations at sea in the commercial offshore, maritime, hydrographics and defence industries.

NAVIGATION & POSITIONING SYSTEMS**ADVANCED NAVIGATION**

Level 8, 37 Pitt Street, Sydney 2000
New South Wales, Australia
Phone: +61 2 9099 3800
E-mail: sales@advancednavigation.com.au
Website: www.advancednavigation.com
Contact person: Tim Laws at sales@advancednavigation.com



Advanced Navigation is a privately owned Australian company that specialises in the development and manufacturing of navigation technologies and robotics. The company has a focus on generating products of the highest quality standard, both in terms of hardware and software. Advanced Navigation has specialised expertise across broad range of fields including sensors, GNSS, inertial navigation, RF technologies, acoustics, robotics, AI and algorithms. Advanced Navigation is an ISO 9001 certified company and maintains a strict quality control system across the two research facilities and three manufacturing facilities that they operate in Australia. Advanced Navigation is a carbon neutral company, offsetting all emissions due to energy use through the planting of trees.

EVOLOGICS GMBH

Ackerstrasse 76
13355 Berlin, Germany
Phone: +49 (0) 30 4679 862 0
Fax: +49 (0) 30 4679 862 01
E-mail: sales@evologics.de
Website: www.evologics.de



EvoLogics provides the world's most advanced spread-spectrum underwater communication systems (S2C) with multi-channel data management, networking capability, built-in tracking and positioning functions with USBL. Data loggers, acoustic wake-up module and releasers optionally included. Deployments in offshore platforms (FPSO, ABS), environmental monitoring, defense systems, ROV and AUV operations and more. Applications include simple positioning and sensor information to transmission of underwater photos.

KONGSBERG SEATEX AS

Pirserteret
N-7462 Trondheim, Norway
Phone: +47 73 54 55 00
Fax: +47 73 51 50 20
E-mail: km.seatex.sales@kongsberg.com
Website: www.km.kongsberg.com/seatex
Contact: Finn Otto Sanne at finn.otto.sanne@kongsberg.com



KONGSBERG

Kongsberg Seatex is a leading international marine electronics manufacturer specializing in the development and production of precision positioning and motion sensing systems. Our commitment is to provide quality products and solutions for safe navigation and operations at sea in the commercial offshore, maritime, hydrographics and defence industries.

RJE INTERNATIONAL, INC.

15375 Barranca Parkway, Ste I-112
Irvine, CA 92617
Phone: +1 949 727 9399
E-mail: sales@rjeint.com
Website: www.rjeint.com
Contact: Bruce O'Bannon



RJE International offers product design, development, evaluation and marketing for military divers, offshore and marine scientific communities, search and rescue teams, and more. RJE has become the industry leader in diver navigation and acoustic relocation. Our team has an extensive background in developing, manufacturing, and supplying underwater acoustic marking and relocation systems, diver navigation platforms, and other subsea equipment.

NETWORK & DATA COMS**KONGSBERG SEATEX AS**

Pirserteret
N-7462 Trondheim, Norway
Phone: +47 73 54 55 00
Fax: +47 73 51 50 20
E-mail: km.seatex.sales@kongsberg.com
Website: www.km.kongsberg.com/seatex
Contact: Finn Otto Sanne at finn.otto.sanne@kongsberg.com



KONGSBERG

Kongsberg Seatex is a leading international marine electronics manufacturer specializing in the development and production of precision positioning and motion sensing systems. Our commitment is to provide quality products and solutions for safe navigation and operations at sea in the commercial offshore, maritime, hydrographics and defence industries.

OCEANOGRAPHIC INSTRUMENTS/SERVICES**ASL ENVIRONMENTAL SCIENCES, INC.**

Victoria, BC, Canada
Phone: +1-250-656-0177
E-mail: asl@aslenv.com
www.aslenv.com



- Metcean Equipment Leasing:** Acoustic Doppler Current Profiler ADCPs (including StreamPro & RiverRay), Ice Profilers, AZFP, acoustic releases, wave/tide gauges, pingers, satellite beacons, CTD+DO+Tu profilers, DO & turbidity loggers, weather station, cages, flotation, bottom frames.

- Oceanographic Products:** Acoustic Zooplankton Fish Profiler (AZFP), Ice Profiling Sonar (IPSS) & shallow water Ice Profiler (SWIP), Imagenex scanning sonar logger (IRIS), instrument cages, bottom frames. Custom acoustic products and system integration.

- Consulting:** Field work, data collection, analyses, numerical modelling, acoustics, remote sensing, oceanographic mooring design and system integration.

- Manufacturer's Representative:** Teledyne RD Instruments, Deep Water Buoyancy, WERA Northern Radar.

RBR

95 Hines Road
Ottawa, ON K2K 2M5
Phone: +1 613 599 8900
E-mail: info@rbr-global.com
Website: https://rbr-global.com/



RBR creates instruments to measure the blue planet. From the ocean abyss to the polar ice caps, our sensors track water parameters – temperature, depth, salinity, dissolved gases, pH, and many others. With design and manufacturing centrally located in Ottawa, Canada, our team works in a fast-paced, dynamic atmosphere to serve customers all over the globe.

ROMOR OCEAN SOLUTIONS

41 Martha Avenue
Mount Uniacke, NS Canada
B0N 1Z0
Phone: +1 (902) 466 7000
Fax: +1 (902) 466 4880
E-mail: Sales@romor.ca
Website: www.romor.ca
Contact: Darrin Verge, President & CEO



ROMOR Ocean Solutions provides instrumentation solutions for the geophysical, oceanographic, defense, security, oil & gas, and renewable energy industries. By partnering with world renowned manufacturers, ROMOR is able to offer technical knowledge, value added services, logistics expertise, and the most reliable instrumentation on the market.

SEA-BIRD SCIENTIFIC
 13431 NE 20th St.
 Bellevue, WA 98005
 Phone: +1 425 643 9866
 Fax: +1 425 643 9954
 E-mail: info@sea-birdscientific.com
 Website: www.sea-birdscientific.com
 Contact: Calvin Lwin, Sales



Sea-Bird Scientific provides best-of-class sensors and systems for oceanographic research and environmental water quality monitoring of physical and biogeochemical properties. Sea-Bird Scientific is the leader in accurate, stable ocean instruments for measuring conductivity (salinity), temperature, pressure, oxygen, pH, chlorophyll, CDOM, turbidity, beam attenuation, irradiance, radiance, PAR, nitrate, and phosphate. Our CTD profilers, water samplers, moored CT recorders, wave/tide recorders, DO sensors, and optical sensors are used by research institutes, ocean observing programs, government agencies, and navies globally.

STAR-ODDI
 Skeidarars 12, 210
 Gardabaer, Iceland
 Phone: +354 533 6060
 Fax: +354 533 6069
 E-mail: baldur@star-oddi.com
 Website: www.star-oddi.com
 Contact: Baldr Sigurðirsson

A manufacturer of miniature data loggers with sensors as temperature, depth/pressure, salinity, tilt/acceleration, compass direction/magnetometer, light levels, acoustic receiving/transmitting. The loggers are used for various researches, including oceanography, fishing gear studies, equipment behavioral monitoring and fish tagging.



CORTLAND COMPANY
 10633 West Airport Blvd Ste 300
 Stafford TX 77477
 Phone: +1 832 833 8000
 E-mail: cortland@cortlandcompany.com
 Website: www.cortlandcompany.com
 Contact: Slobodan Nikolic

Cortland designs, manufactures, and supplies technologically advanced synthetic fiber ropes, slings and synthetic fiber strength members. For example, we offer deep water synthetic fiber rope solutions, oceanographic mooring systems, synthetic reinforcing over braids, hair fairing to reduce drag / strumming, and inline attachments or lifting points (cable grips).

Collaborating with customers, our team uses its experience in high performance materials and market knowledge to transform ideas into proven products. We continue to innovate fit-for-purpose synthetic solutions for the ocean sciences. Cortland is a part of the Enerpac Tool Group (NYSE: EPAC), a diversified industrial company. Visit us online at cortlandcompany.com.



SONAR SYSTEMS

EDGETECH
 4 Little Brook Rd.
 West Wareham, MA 02576
 Phone: +1-508 291 0057
 E-mail: info@edgetech.com
 Website: www.edgetech.com
 Contact: Amy LaRose



EdgeTech designs, manufactures and sells industry-leading side scan sonars, sub-bottom profilers, bathymetry systems and combined sonar systems. Additionally, the company produces world class underwater actuated and transponding solutions including deep sea acoustic releases, shallow water and long life acoustic releases, transponders, reliable USBL acoustic tracking and positioning systems, and custom-engineered acoustic products.

KLEIN MARINE SYSTEMS, INC.
 11 Klein Drive
 Salem, NH 03079
 Phone: +1 603 893 6131
 International: 603 893 6131
 E-mail: sales@kleinmarinesystems.com
 Website: www.kleinmarinesystems.com



Celebrating over 50 years in the marine technology industry, Klein Marine Systems continues to be a world leading sensor technology manufacturer of high-resolution side scan sonar equipment and radar-based security and surveillance systems. Klein Marine Systems has developed a worldwide reputation of excellence in the industry by providing quality products and excellent customer service. Klein sonar systems are deployed by government agencies, navies, port authorities, surveyors, oil companies and universities worldwide. Visit our web site at www.KleinMarineSystems.com and discover how Klein is Making the Oceans Transparent!

SOUND VELOCITY PROBES/CTDS

SAIV A/S
 Nygårdsviken 1, 5165
 Laksevåg, Norway
 Phone: +47 56 11 30 66,
 Fax: +47 56 11 30 69
 E-mail: info@saivas.com
 Website: www.saivas.no
 Contact: Gunnar Sagstad

SAIV A/S
Environmental Sensors & Systems

- STD/CTD, Sound Velocity probes/recorder with optional multi-parameter facilities; Turbidity, Fluorescence, Oxygen etc. The new CTD/STD model SD208 with wireless communication and high accuracy: 0.002 mS/cm, 0.002 °C.
- Precision pressure /depth (0.01% accuracy) and temperature sensors/recorders. Applications: hydrographic profilings, installation on ROVs and towed systems, etc. Robust and compact designs are combined with accuracy and "plug and play" compatibility. Output format for sonar equipment, e.g. EM1002, EM3000, SSP, HiPAP and Reson 8125.

SUBSEA FABRICATION

NEW INDUSTRIES
 6032 Railroad Avenue
 Morgan City, LA 70380
 Phone: +1 985 385 6789
 E-mail: bill.new@newindustries.com
 Website: www.newindustries.com
 Contact: Bill New



New Industries provides quality fabrication services to the offshore oil & gas and marine industries focusing on large diameter pressure vessels, suction piles, DNV buildings and deepwater subsea production equipment such as jumpers, PLETs, PLEMs and manifolds.

SUBSEA TECHNOLOGY

SUBCTECH GMBH
 Wellseedamm 1-3, 24145 Kiel,
 Germany
 Phone: +49 0 431 22039 880
 Fax: +49 (0) 431 22039 881
 E-mail: info@subctech.com
 Website: www.subctech.com; www.gosubsea.com



Safe and reliable Li-ion subsea batteries made in Germany for subsea oil & gas applications, measurement systems and vehicles (AUV/ROV). Marine measurement and monitoring technologies, such as high precision pCO₂ gas analyzer and autonomous underway systems (FerryBox). SubCtech provides customized solutions to high industrial standards such as IPC-A-6xx class 3 and qualifications according to MIL-STD, ISO 13628-6 and API 17f.

UNMANNED MARITIME VEHICLES

GENERAL DYNAMICS MISSION SYSTEMS' BLUEFIN ROBOTICS PRODUCTS

553 South Street
Quincy, MA 02169
Phone: +1 617 715 7000
E-mail: adam.mara@gd-ms.com
Website: gdmissionsystems.com/
underwater-vehicles/bluefin-robotics
Contact: Adam Mara

GENERAL DYNAMICS
Mission Systems

General Dynamics Mission Systems' Bluefin Robotics products provide undersea capabilities for defense, scientific and maritime customers worldwide. Bluefin Robotics products offer a range of systems and configurations that can operate in the open ocean and in constrained waterways. Our core autonomous product line includes Bluefin SandShark, Bluefin-9, Bluefin-12, and Bluefin-21, Hovering Autonomous Underwater Vehicle (HAUV), and Subsea Power technologies.

The Bluefin Robotics AUV family shares a free-flooded, modular, and open architecture backbone that has enabled the integration of 70+ sensors. We have developed and delivered AUVs worldwide to research institutes and industry and have provided AUVs to the United States' and International Navies.

INTERNATIONAL SUBMARINE
ENGINEERING LTD. (ISE)

1734 Broadway Street,
Port Coquitlam, BC, V3C 2M8
Phone: +1 604 942 5223
E-mail: info@ise.bc.ca
Website: <https://ise.bc.ca/>



International Submarine Engineering Ltd. (ISE) is a world leader in the design and integration of autonomous and remotely operated robotic vehicles and terrestrial robotics. Over our 40+ years in business, we have accumulated a great deal of expertise in the design, manufacture, and maintenance of:

- Autonomous Underwater Vehicles (AUVs)
- Remotely Operated Vehicles (ROVs) for subsea operation
- Human Occupied (HO) submersibles
- Customized systems for the offshore oil industry
- Customized systems for the Military-Naval sector
- Hydraulic, pneumatic, and electric robotic manipulators
- Teleoperated and autonomous robotic systems
- Robotic systems for nuclear Industry applications
- Communications and real-time control system

L3 HARRIS (OCEANSERVER)

275 Martine Street
Fall River, MA 02723 USA
Phone: +1 508 678 0550
Fax: +1 508 678 0552
E-mail: IVER.Sales@L3Harris.com
Website: www.L3Harris.com
Contact: Jim Kirk



L3Harris Technologies is an agile global aerospace and defense technology innovator, delivering end-to-end solutions that meet customers' mission-critical needs. The company provides advanced defense and commercial technologies across air, land, sea, space and cyber domains.

L3Harris OceanServer develops autonomous, lightweight Unmanned Undersea Vehicles. L3Harris OceanServer has established itself as the leader in man portable UUVs, providing highly capable vehicles to a wide array of military, commercial and research customers. With over 15 years experience in the underwater field, our engineers have developed a reliable and easy to use platform that is trusted to complete marine missions all around the world.

MARISCOPE MEERESTECHNIK

Eichkoppel 21, 24214 Gettorf,
Germany
Phone: +49 4346 6000 490
E-mail: info@mariscope.de
Website: www.mariscope.de
Contact: Niklas Becker



With more than 25 years of experience in the design, development and manufacture of ROVs and towed systems, Mariscope is one of the very few companies that can offer you really customized underwater solutions with actual integration. Instead of just adding accessories or instruments to our vehicles, we design, develop and manufacture the completely integrated solution to the client's needs.

Mariscope offers from small towed systems or compact Observation Class ROVs up to complete multifunction units. The company also provides other solutions such as antifouling devices, side-scan sonars, oceanographic instruments for ports and offshore platforms (current/wave meters), or even manned submarines.

OUTLAND TECHNOLOGY

38190 Commercial Ct.
Slidell, LA 70458 USA
Phone: 985 847 1104
Fax: 985 847 1106
E-mail: jeff@outlandtech.com
Website: www.outlandtech.com
Contact: Jeff Mayfield



Offering the most rugged equipment and unsurpassed customer service, Outland Technology has been the world's leading manufacturer of underwater video, lighting and ROV equipment for over 30 years. We recognize that no two jobs are the same and specialize in products that are customizable for your specific applications.

SEAMOR MARINE LTD.

1914 Northfield Road,
Nanaimo BC V9S 3B5 Canada
Phone: +1 250 729 8899
E-mail: sales@seamor.com
Website: www.seamor.com
Contact: Simon Douthwaite



We design, research and manufacture SEAMOR ROVs and related accessories. The SEAMOR ROVs are at the forefront of the expansion of marine industries and research, providing safe and cost-effective eyes underwater to help guide industrial activity and monitor the health of underwater ecosystems. Our ROVs are very unique because of their modular design and their wide range of capabilities. Our engineers have developed system components (vehicle, controller, tether and power source) to be interchangeable across our product line; Mako, Chinook, and Steelhead. SEAMOR vehicles are quality machines and are built to last. Our vehicles can be easily upgraded and repaired.

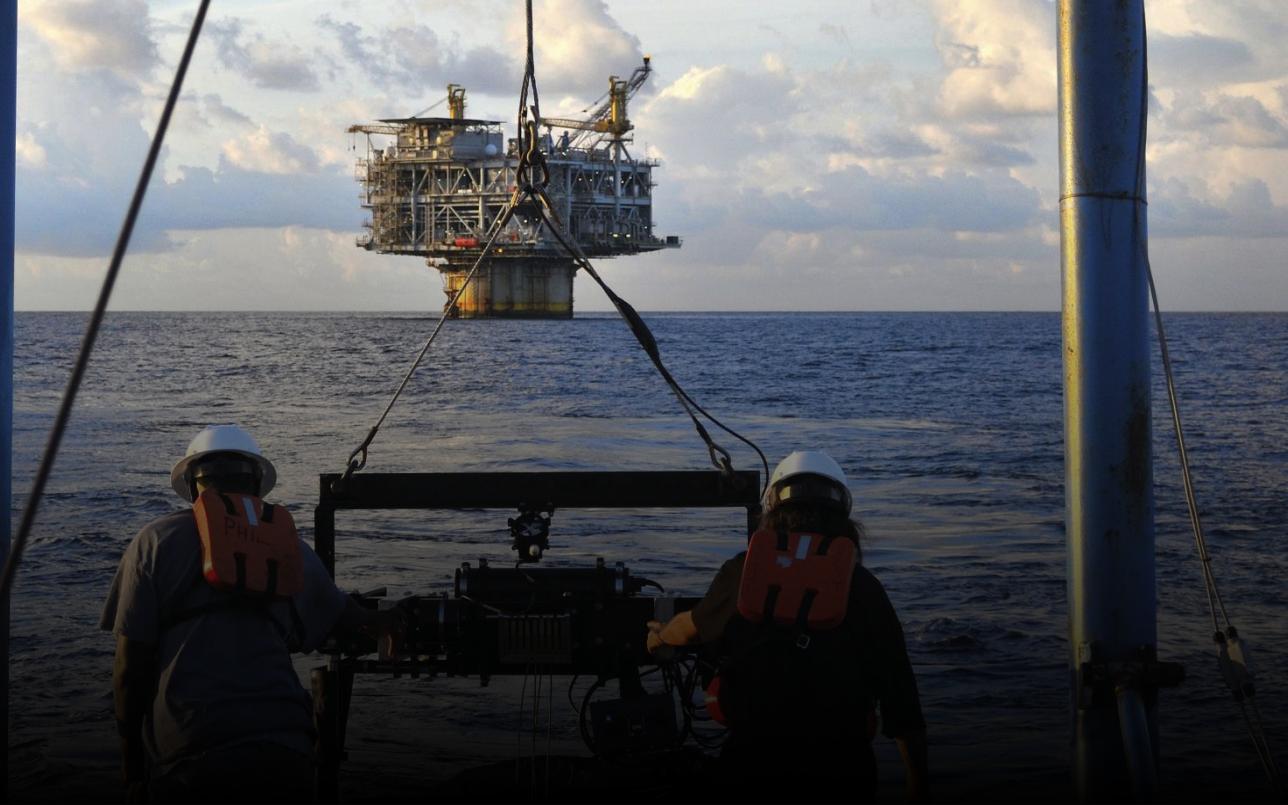
WINCHES, HANDLING, & CONTROL SYSTEMS

OKEANUS SCIENCE & TECHNOLOGY LLC

17455 NE 67th Court, Suite 120
Redmond, WA 98052
Phone: +1 425 869 1834
Fax: +1 425 869 5554
E-mail: info@okeanus.com
Website: www.okeanus.com
Contact: Ted Brockett



SOSI and DT Marine brand winches, handling systems, and engineered solutions are now available exclusively from Okeanus Science & Technology. Proven, reliable, and cost-effective standard and custom designed winches range from small all-electric instrumentation winches to high horsepower all-electric or hydraulic umbilical and multi-purpose oceanographic systems. SOSI brand winches can be packaged and supplied with skids, A-frames, over-boarding sheaves, HPUs, and other auxiliary equipment. Okeanus has offices in Houston, TX, Redmond, WA and Houma, LA. Call, email or visit www.okeanus.com for more information.



Whatever the mission...

Okeanus designs and manufactures mission-critical ocean equipment for commercial and government agencies throughout the world. We harness breakthrough Science and Technology to equip clients with the tools and trusted support they need for the rigors of ocean exploration.

Our comprehensive product portfolio—from customized deck equipment, including winches, LARS and A-Frames, to our extensive range of underwater survey and sampling equipment—is available for purchase or rent, and rapid deployment.

Whatever your mission, Okeanus has turn-key solutions to make it a success.

okeanus.com



Airmar	35	Nexans	33
www.airmar.com			
BAE Systems	68	Ocean Specialists, Inc.	09
www.baesystems.com			
CSA Ocean Sciences	02	Okeanus Science & Technology	65
www.csaocean.com			
EdgeTech	39	SeaCatalog	04
www.edgetech.com			
EvoLogics GmbH	67	SeaRobotics	49
www.evologics.de			
Hydronalix.....	05	SOMAG AG Jena	15
www.hydronalix.com			
J.W. Fishers Manufacturing, Inc.	27	SubCtech GmbH	29
www.jwfishers.com			
MacArtney A/S	03	Teledyne Marine	07
www.macartney.com			
Morgan & Eklund	58	Volz Servos GmbH & Co. KG	37
www.morganeklund.com			
MOTN	54		
www.motn.org			



Evo
Logics®

SMART SUBSEA SOLUTIONS

Delivering data in most adverse conditions: underwater acoustic modems with advanced communication technology and networking

Accurate USBL and LBL positioning of underwater assets

Modem emulator and other cost-saving developer tools

Autonomous surface vehicle for bathymetry, monitoring and AUV support

**ULTRA-COMPACT
“TINY” MODEMS**



S2C M (left) and the new S2C T “tiny” modem - 20% smaller and lighter



Depth, speed, and agility where it counts

BAE Systems' family of Riptide autonomous undersea vehicles can be easily and affordably scaled, tailored, and customized to solve your undersea challenges. By combining best-in-class hydrodynamics, ultra low power processing, and game changing new energy technology, we are bringing next-generation capabilities to the undersea vehicle market.



Join us

We're looking for talented scientists and engineers to join our team. Learn more at jobs.baesystems.com.

baesystems.com/riptide

BAE SYSTEMS