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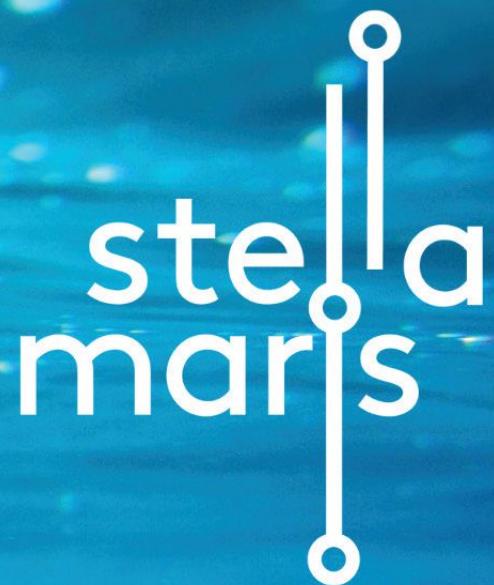
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ON THE COVER:

The Mayflower Autonomous Ship (MAS) is set to embark on an uncrewed three-week transatlantic crossing in April 2022. (Photo credit: IBM/ProMare)

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[WITH THANKS - Ed.]

The recent and rapid surge in interest, application, and scalability of Uncrewed Surface Vehicles (USVs) is one of the more pronounced trends to suggest that AI-driven automation will revolutionize offshore practices over the coming decade.

Whether engineered to pursue quality marine survey data or inspect submerged infrastructure or run patrol and surveillance missions, USVs—also known as ASVs depending on how Autonomous their programming—have proven increasingly effective in terms of optimizing at-sea operational ROI while eliminating some of the HSSE exposure and carbon emissions associated with traditional, crewed deployments.

January's contributing authors all operate on the leading edge of USV development, whether designing fully integrated systems or developing the critical components that make these modular platforms so versatile. Special thanks to the COVE Ocean community, IBM (with our best wishes for the Mayflower Autonomous Ship's upcoming crossing), and Torqeedo.

editor@oceannews.com

Ed Freeman

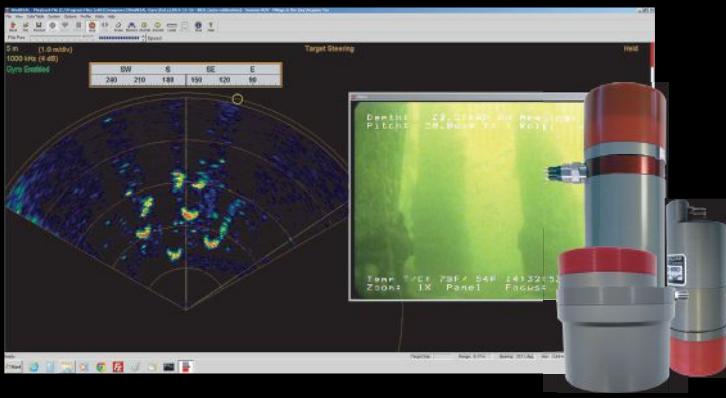
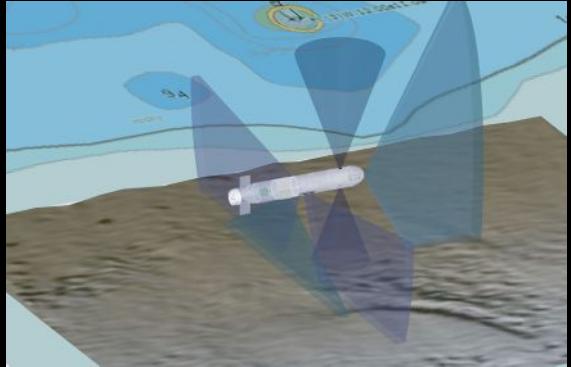
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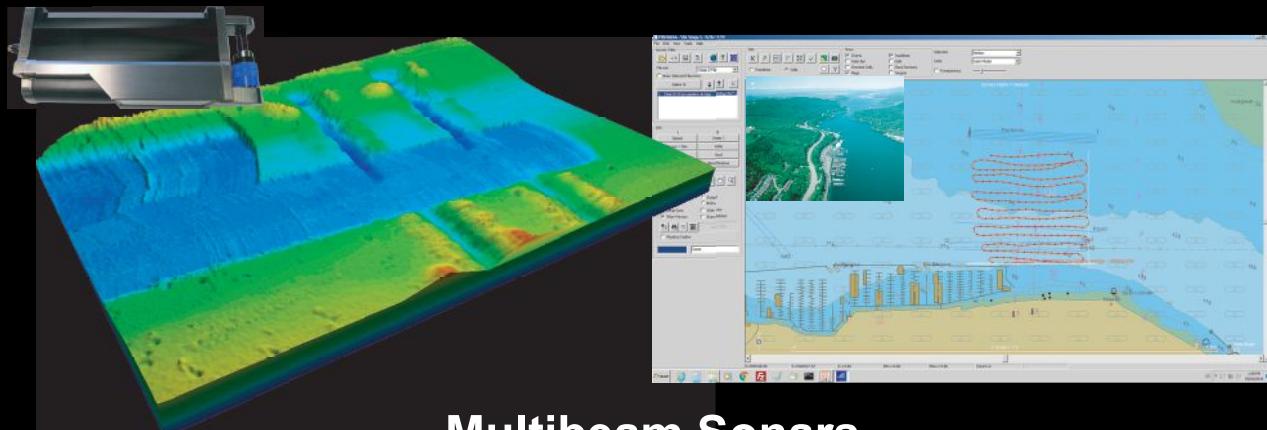
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ELECTRIC USVs CONQUER THE SEAS – WHAT'S NEXT?



By Steve Trkla,
President, *Torqeedo*



The global market for uncrewed surface vessels (USVs) is growing rapidly, and reliable and durable battery-electric propulsion systems are already transforming the way we collect data at sea. Automation to enable remote uncrewed operations improves safety, operational efficiency and, of course, lowers CO₂ emissions.

As the ocean and offshore industries invest in uncrewed assets, minimizing carbon footprint is paramount. Electric USVs not only achieve this, but they also produce less air and water pollution, offer quieter operation, less downtime, and lower operating costs over the life of the vessel.

SMART AT-SEA OPERATIONS

For most offshore and ocean applications today, USVs are under the remote command of qualified pilots located onshore or onboard nearby crewed vessels. XOCEAN's XO-450 UV is a custom-designed composite wave-piercing catamaran powered by four electric drives. Solar panels keep the batteries charged and deliver an operating range of 1,500 nautical miles. XOCEAN estimates its USVs emit 1,000 times less carbon than traditional survey vessels, but there are secondary benefits to electrifying USVs.

Station-keeping during data collection often requires rapid cycling between forward and reverse thrust, especially in challenging offshore conditions. Electric drives can do this indefinitely without damage and deliver considerable savings in maintenance costs and reduced downtime over fossil-fuel-powered vessels. Electric USV developers are now integrating renewable onboard charging from solar, wind and wave generators to extend time on-station.

The hybrid-electric SR-Endurance 7.0 by SeaRobotics is another field-proven model. All onboard systems and data interfaces are monitored with data connections to the remote base station, with throttle and steering of the 50 kW electric drive-train under full computer control.

BEYOND MARINE SURVEY

The automation systems we are developing and deploying today also have the potential to trans-

form shipping and urban transportation. Researchers at MIT and AMS in Amsterdam have successfully tested highly autonomous electric vessels called "Roboats" that are able to navigate busy urban waterways. They believe that these small aluminum boats might be the first Level 5, or fully autonomous, vehicles on the planet.

But first, this leading-edge tech will be taking out the trash. Combustion-powered garbage trucks cause traffic jams in Amsterdam's narrow streets, pollute the air, and damage historic bridges and buildings along the canals. When Roboat comes online, residents will drop their rubbish into the nearest collection vessel. When full, the Roboat silently drives itself outside the historic center to be unloaded. Eventually, the Roboats will serve as water taxis for commuters, or even link themselves together to provide an additional pedestrian bridge in times of high demand.

SAFE SHIPPING

Fully autonomous vessels will also sail the high seas. Artificial Intelligence (AI) systems are already being tested for cargo ships and recreational boats, which operate much like driver-assisted technologies available today in passenger cars. These AI systems can detect and identify obstacles, alert the pilot, and even take evasive actions to avoid collisions.

Approximately 90% of marine casualties and incidents are rooted in human error, so there is huge potential for AI technology to make the oceans safer. Experts believe that fully autonomous, self-driving cargo ships may set sail as soon as 2035. Will they be emission-free? It's hard to say, but advancements in alternative fuels like hydrogen show promise, whether used to generate electricity onboard or to power engines directly.

Electric, connected, and autonomous technology is transforming how we work on water. A cleaner, safer, and more efficient ocean industry lies ahead.

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IN SITU SENSOR TESTING: ENABLING RAPID COMMERCIALIZATION

By COVE (Centre for Ocean Ventures and Entrepreneurship)

The most recent technical infrastructure added to the COVE offering is Stella Maris, a multi-sensor seabed test platform with the capacity to host 16 marine sensors and devices for ocean technology firms. Stella Maris was designed, built, and deployed in less than one year from conception, a feat only possible thanks to the collaboration of over 30 organizations. Users can remotely monitor, control, and configure equipment on the platform and access real-time ocean data feeds.

COVE, the Centre for Ocean Ventures and Entrepreneurship in Halifax, Nova Scotia, is an ocean technology innovation hub with extensive marine facilities. COVE is home to more than 60 ocean technology firms, from start-ups to multinationals. In addition to over 40 national and international partnerships, COVE has a global network of over 200 organizations directly engaged in ocean technology. The COVE network includes commercial firms, venture capital groups, innovation hubs, research institutes and government agencies.

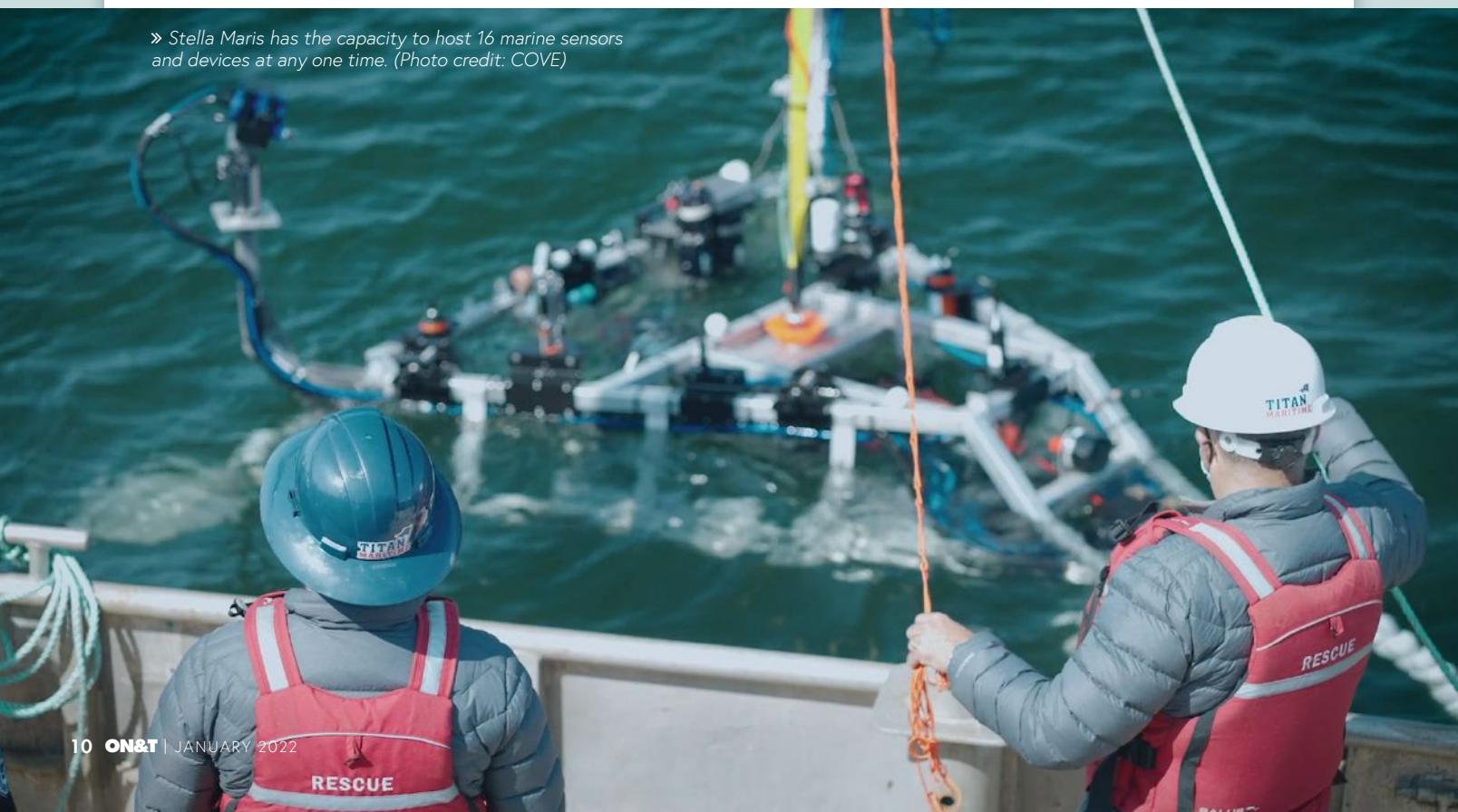
Ocean instrumentation is an especially strong sector in Nova

Scotia. The Canadian Ocean Enterprise 2020 White Paper points to a clear surge in new Ocean Enterprise companies in the region. Many of these firms develop and market sensors, components, and systems destined for oceanic use, while others offer data-driven solutions. COVE is a central pillar for this burgeoning sector.

A STELLAR CAST

Turbulent Research, for example, develops broadband recorders, processors, real time digital hydrophones and noise mitigation products, whereas Dartmouth Ocean Technologies Inc. (DOT) specializes in ocean sensor platforms, including a family of towed stable depressors called the V Wings. Xeos Technologies Inc. provides reliable and innovative ways to track, monitor and control moorings, buoys, and autonomous vehicles in harsh environments, while Sensor Technology Ltd. is a leading designer and manufacturer of piezoelectric ceramic solutions, custom acoustic transducers, and custom hydrophones. These are just some of the names making waves in the ocean ecosystem in Atlantic Canada.

» *Stella Maris has the capacity to host 16 marine sensors and devices at any one time. (Photo credit: COVE)*



At COVE, companies support operations both at sea and in the laboratory or workshop. LeeWay Marine is a leading provider of fully crewed vessels and specializes in supporting a range of offshore activities, from hydrographic and geophysical surveys to rapid environmental response; Precise Design Engineering Solutions offers customers one-stop design and manufacturing solutions, addressing projects from the conceptual design stage through to volume production and assembly; J-Squared Technologies Inc. has been supplying the North American electronics marketplace for over 25 years with electronic products in a component or sub-assembly form, while also specializing in logistics management.

COVE has become fertile ground for the emerging fields of data analytics and Data as a Service (DaaS), as exemplified by PanGeo Subsea, a marine geophysical-geotechnical service delivery company that delivers high resolution 3D acoustic imaging solutions to mitigate risk in offshore installations by providing detailed seabed imaging and detailed soil stratigraphy. Kraken Robotics Inc. is another leader in the development of advanced sensors, including Synthetic Aperture Sonar (SAS), an ultra-high-resolution underwater imaging technology that promises superior coverage rates. The company market this as Robotics as a Service (RaaS).

Today, while the global community faces the immediate concerns of a pandemic, there are many long-term challenges to our ocean planet. Maritime safety and security in an opening arctic, expanded aquaculture for a protein hungry planet, understanding and adapting to climate change, and increasing development of renewable offshore energy are some core concerns for the entire ocean community as the 2020s open.

STELLA MARIS

Harnessing innovation to navigate some of the pressing challenges that this new decade poses is what binds the COVE community, and this is no better illustrated by a recently inaugurated *in situ* testing platform, known as Stella Maris. Exclusively designed to support the commercialization of ocean technology, as opposed to scientific research, Stella Maris provides companies with a low-cost, easily accessible way to conduct product development tests and sea trials.

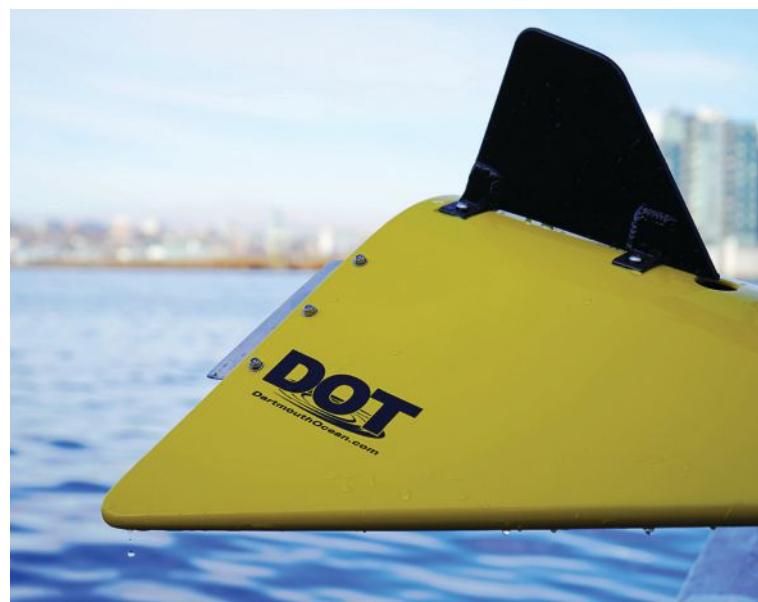
Located on the seabed 10 meters below the surface and 100 meters from COVE's wharf, the sensor platform is cabled to a shoreside operations center to ensure reliable power and data-communications, allowing users to remotely monitor, control, and configure equipment and access real-time ocean data and video.

Stella Maris offers:

- Real-time, steerable video (via two underwater cameras with pan and tilt capabilities), giving a view of the sensors and equipment on the platform.
- A 3-month launch and retrieval cycle, allowing users to manage sensors and equipment on the platform for a set timeframe.
- User data generated by sensors on the platform is stored in a secure, cloud-based system.
- Access to data sets generated by the core platform sensors, such as temperature, dissolved CO₂, Phosphate, and salinity.



» Stellar Maris is supported by a shore-side command center. (Photo credit: COVE)



» Dartmouth Ocean Technologies, manufacturer of towed stable depressors, is a COVE tenant. (Photo credit: DOT)



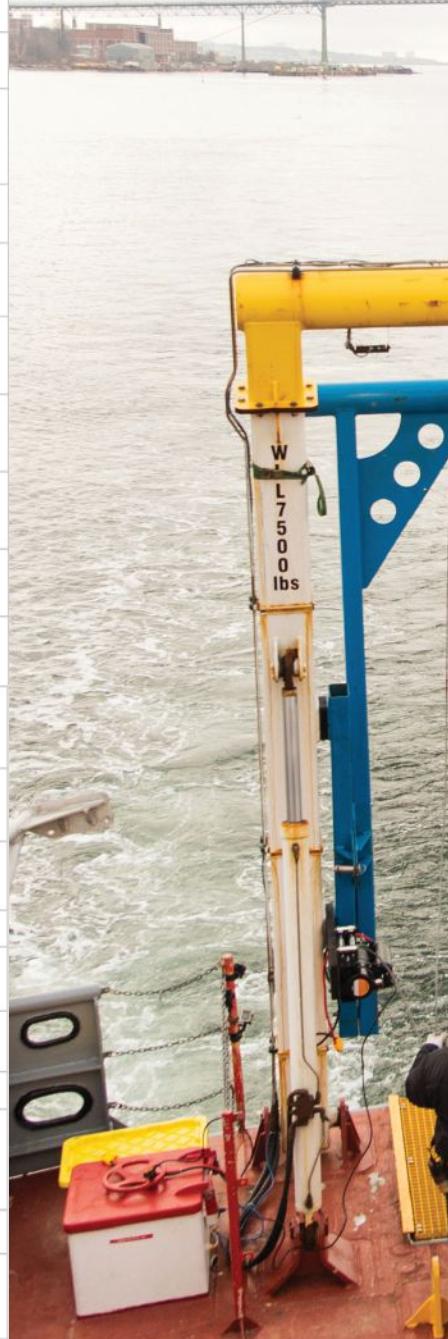
» COVE, the Centre for Ocean Ventures and Entrepreneurship in Halifax. (Photo credit: COVE)

The Stella Maris system architecture has been designed to maximize rapid and flexible deployment of new sensors, significantly reducing costs of testing in an actual field environment.

The Stella Maris provides a new resource for ocean technology firms to test and demonstrate their products in a cost-effective environment, replacing costly vessel-based test sorties.

COVE
centre for ocean
ventures & entrepreneurship

COVE Tenant & Stella Maris User	Product / Service Type
 AML Oceanographic	Sound Velocity Sensors, CTDs, Multiparameter Sondes & Deployment Winches
 integraSEE	Ocean Tracking & Monitoring Services
 DOT Dartmouth Ocean Technologies Inc	Towed Underwater Depressor, Autonomous Vertical Profiler, Nutrient Detection, eDNA Sampler
 enginuity	Bend Restrictors & Advanced Engineering
 Tritech	Gemini SONAR – The world's smallest multibeam imaging sonar
 KRAKEN	Data as a Service and developers of Synthetic Aperture Sonar (SAS)
 MacArtney UNDERWATER TECHNOLOGY	Subsea / Shore-side Multiplexers, LUXUS LED lights (2)
 MARECOMMS Maritime Environment Communication Systems	Geospectrum Transmitter
 SEATAC nscc	Seabed Platform Ground Fault Circuit Interrupter (GFCI) panel
 OCEAN SONICS	IClisten Hydrophones
 Precise Design ENGINEERING SOLUTIONS	Engineered sensor mounting systems
 PRO OCEANUS	CO2 Sensor
 RBR	RBRbrevo ³ CTD (Conductivity, Temperature, Depth) RBRvirtuoso ³ Single Channel Tide & Wave Sensor
OTAQ Offshore	OTAQ Eagle IP underwater camera, OTAQ Green Laser
 SEDNA SENSOR TECHNOLOGY	SEDNA Globe to measure water Oxygen, pH, Temperature, and acceleration and shock
SIDUS	Pan and Tilt assembly
 turbulent research	Porpoise hydrophones for real-time acoustic data
 ULTRA	SubSea Fiber Optic Cables
 Xeos Technologies Inc.	Turbidity Sensors



A GUIDING LIGHT IN TROUBLED TIMES

The COVID-19 pandemic forced most companies to focus on near-term sales and the development of new customer relationships under curtailed travel. New product introduction and cost efficiencies became more essential. The Stellar Maris allowed firms to evaluate the feasibility and viability of new instruments in advance of developing final system solutions for end users. With the functionality of an in-water calibration facility, the array can be employed for acceptance testing and/or performance comparisons in a third-party venue under controlled conditions. With remote data access and remote monitoring capabilities, the project capitalizes on the fact that design teams no longer need to be co-located. It facilitates ready access to data measurements while products, or new services from the generated data, are under development. Similarly, it provides for higher quality virtual interaction with prospective customers and/or innovation partners.

Some specific examples highlight the true utility of Stella Maris:

Dartmouth Ocean Technologies (DOT) is pioneering new instruments for biological and chemical measurements in the ocean. In collaboration with regional leaders, such as Innovasea they utilized Stella Maris to advance the commercialization of their phosphate sensors. The drive to measure phosphate stems from it being a limiting nutrient, meaning that microbe growth will be limited by the accessible phosphate in a region. As such, tracking phosphate concentrations can provide predictive ability in detecting the onset of harmful algal blooms, notably in the Aquaculture industry. Elsewhere, phosphate concentrations in discharge water are regulated to prevent unwanted blooms and eutrophication in nearby rivers, lakes, and public waterways. Using Stella Maris, DOT's phosphate sensor has been functionally de-risked, producing valid data *in situ*. With these results the company is delivering units for numerous end users.

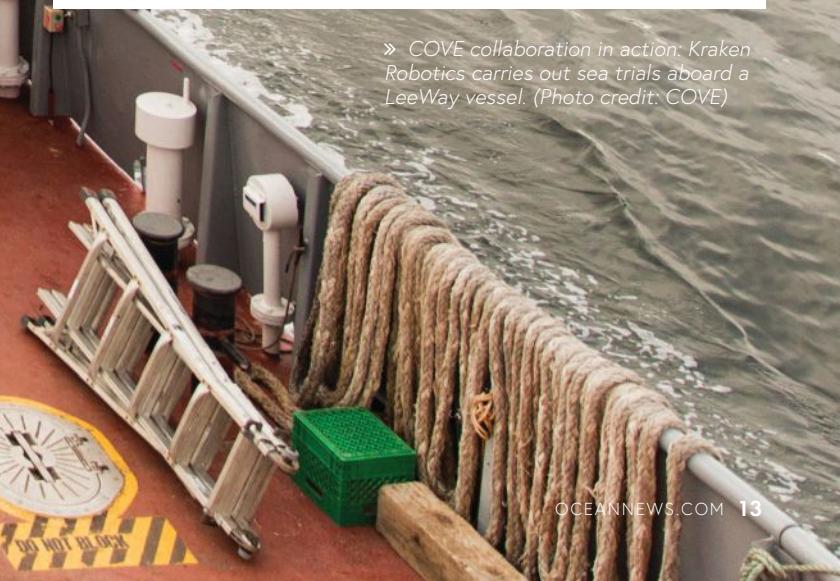
Xeos Technologies develops water quality sensors for *in situ* measurement of the aquatic environment. Xeos is applying its expertise in optical sensor development in new products through the use of Stella Maris. The Ares Turbidity Sensor is based on the optical measurement principle, using ultrabright, energy-efficient LEDs as an excitation source and detectors with narrow bandpass filters to measure infrared light reflected by suspended particulate material in water. These digital optical sensors are programmed with a calibrated response to reflected light that can be converted to quantitative measurements of turbidity. This technology can be used to measure water clarity for environmental water quality, oceanographic research, marine operations, and aquaculture monitoring. The Ares Turbidity Sensor prototype deployed on Stella Maris enabled assessments of both sensor performance and bio-fouling risks and accelerated the commercialization of a new product.

A BRIGHT FUTURE

Stella Maris is just beginning to support rapid commercialization of new ocean technologies in Atlantic Canada. The physical infrastructure and supportive ecosystem at COVE are distinctive and dedicated to advancing ocean industry. While these resources are in Atlantic Canada, the wider ocean technology sector is welcome to both visit and engage the specialized facility and warm community in Halifax.

For more information, visit www.coveocean.com
www.covestellamaris.com.

» COVE collaboration in action: Kraken Robotics carries out sea trials aboard a LeeWay vessel. (Photo credit: COVE)





» A NOAA ocean glider, equipped with sensors to measure the salt content (salinity) and ocean temperature at different depths. (Photo credit: NOAA)

NEW NOAA REPORT SHOWS U.S. OCEAN ENTERPRISE SECTOR GREW 60% SINCE 2015

The U.S. Ocean Enterprise Report, released by NOAA, shows significant growth in businesses that provide the technological means to observe and measure ocean dynamics. Called the Ocean Enterprise, this cluster of businesses, which provides essential support to the \$2 trillion global Blue Economy and has revenues of \$8 billion, saw a 60% growth of businesses—from 500 to 800—between 2015 and 2020. These businesses deliver essential information services to support sustainable use of ocean resources, understand Earth's climate, and protect ocean health.

"Ocean Enterprise businesses provide observational technology and equipment essential to NOAA's mission to take the pulse of the planet. Those businesses are also important users of NOAA's publicly available data that they turn into actionable information and value-added products and services for a broad spectrum of end-uses—the raw material for building out the New Blue Economy, addressing everything from supporting renewable offshore energy development to ensuring efficient maritime commerce," said Rick Spinrad, Ph.D., NOAA Administrator.

"Understanding the trends affecting these businesses allows NOAA to identify new opportunities and partnerships to further support the Blue Economy."

Building on the foundational study conducted by NOAA in 2015, this report analyzes trends in the Ocean Enterprise as it responds to the growing and changing information needs of the Blue Economy.

The report also details:

- The changes in the markets for Ocean Enterprise products and services as it pivots towards rapidly developing areas, such as offshore renewable energy.
- The changes in technologies to meet the needs of present and future Blue Economy markets, most notably a doubling of the number of businesses providing autonomous surface and underwater vehicles as platforms for ocean observations and measurements.
- The opportunities and challenges the Ocean Enterprise faces in supporting a growing Blue Economy, particularly in terms of navigating changing markets and the technological means of serving them.

"The combination of people, technology, and data analysis is a powerful way to address societal challenges related to our changing climate and rising seas," said Carl C. Gouldman, director of the U.S. Integrated Ocean Observing System Office at NOAA. "To thrive in the decades ahead, we are going to need a robust Ocean Enterprise to innovate and problem-solve along the way. Our report and study results will help us understand and work with Ocean Enterprise companies to advance innovation more quickly and comprehensively."

CSA OCEAN SCIENCES COMPLETES WORLD'S DEEPEST PELAGIC BIOTA SAMPLING CAMPAIGN

CSA Ocean Sciences Inc. (CSA), a marine environmental consulting and survey company, recently completed a ground-breaking deepwater sampling campaign in the Tropical Eastern Pacific for The Metals Company (TMC), which included successfully collecting pelagic biota from a record depth of 4,000 meters below the surface.

CSA mobilized a team of marine technicians and essential oceanographic equipment to support Environmental Expedition 5C, TMC's fourth in a series of five multidisciplinary marine survey projects in 2021 designed to characterize the potential impacts of harvesting polymetallic nodules from the seabed, and, more specifically, to explore the biological communities, organic flux, and food web structures present between the

ocean's surface and benthic boundary layer (BBL), located just above the abyssal seafloor, in TMC's NORI-D block in the Clarion Clipperton Zone (CCZ).

Despite having to operate in swells of up to 6 meters, the CSA team deployed a range of technologies—including a 10m² Multiple Opening/Closing Net and Environmental Sensing (MOCNESS) system and rosette samplers—to recover biological samples and collect other diagnostic information related to the Tropical Eastern Pacific's surface salinity, temperature, oxygen, and turbidity, as well as the nutrient and trace metal dynamics of the local aquatic ecosystem.

"CSA has run numerous deepwater marine sampling campaigns around the world, including in the CCZ, but operating



successfully at this record-breaking depth represents another milestone for the team in terms of planning, mobilizing, and executing advanced collection techniques in some of the most remote and hazardous waters on the planet," said CSA CEO Kevin Peterson. "Thanks to tenacious teamwork and the skillful deployment of our robust technologies, these data will help establish a better understanding of the symbiotic relationship between the physical environment and local inhabitants of the Tropical Eastern Pacific."

On deck operations were supported by Maersk Supply Service, the University of Hawaii, Texas A&M University, and the Japan Agency for Marine-Earth Science and Technology (JAMSTEC).

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USVs FUSE INTELLIGENCE, AI AUTOMATION, AND AGILITY TO PROGRESS OCEAN RESEARCH



By Brett Phaneuf
Director of the Mayflower Autonomous Ship Project

As human activity continues to impact the health of our planet, it is vital we harness the power of modern science and technology to safeguard our ocean ecosystems, find new resources, and build futureproof societies. Uncrewed surface vehicles (USVs) like the Mayflower Autonomous Ship (MAS) are fusing intelligence, automation, and agility to help chart a more sustainable relationship with the ocean.

A NEW TRANSATLANTIC JOURNEY

Guided by a new "AI Captain" and built using IBM cloud, Artificial Intelligence (AI), and edge computing technologies, MAS will re-embark on a three-week transatlantic journey in April 2022. This is our second attempt at a transatlantic crossing. The first attempt in 2021 was thwarted by a mechanical issue when a coupling broke on the hybrid generator exhaust system, forcing us to abort the mission. After a few months of repairs—essentially making a new custom exhaust and reworking how it fit into the ship—we began a new series of sea trials, in December 2021.

This initial setback was difficult for the entire team. But the only way to achieve true autonomous performance with any level of predictability is to suffer through the unpredictable parts now. Innovation is never achieved without risk; and by comparison to our namesake, the original Mayflower that crossed the Atlantic in 1620, our risk is infinitesimally low.

APPLYING INTELLIGENCE, AI AUTOMATION, AND AGILITY

Navigating an ever-changing seascape depends on the ability to collect and process oceanographic data locally so that mission-critical decisions can be made. To date, this has somewhat limited the applications for uncrewed vessels. MAS is making tangible progress to overcome this challenge.

With no human assistance for the entirety of the voyage, MAS will use cameras, RADAR, AIS and other sensors to intelligently detect and navigate around obstacles, solar panels to generate green energy, and an operational decision manager to weigh marine regulations and protocols (COLREGS) against environmental conditions and vessel operating status. Computer vision technology deciphers images streaming in from the ship's six on-board video cameras. Trained on millions of maritime images gathered since 2016, this vigilant AI-powered system is now able to recognize a wide range of threats in the vicinity of the ship—whether physical outcroppings of land, floating debris, marine life, other vessels, or various other potential perils. Even paddle boarders!

The AI Captain technology we've installed was created using agile methodologies. Even before the ship was built, the AI Captain machine learning models were built and tested on an IBM AC922 Power server—the same technology behind some of the world's most powerful supercomputers. This reduced the time and expense of physical testing and means that MAS's algorithms can be constantly tweaked and updated by the MAS support team on shore. It also means that the AI Captain can be easily installed onto other vessels.

To facilitate ocean research, MAS has 3 payload bays for scientific equipment and the capacity to carry 1,000 kg of scientific equipment. Research pods located on MAS collect data relating to a multitude of inputs around ocean health and chemistry: sampling water for microplastics, monitoring sound patterns associated with marine life, and measuring water depth and determining sea surface heights and wave patterns. When MAS achieves connectivity, it will upload this data to the cloud for researchers from IBM, ProMare, MarineAI, University of Plymouth, Newcastle University, University of Exeter, and University of Liverpool to access. Live

» MAS uses cameras, RADAR, AIS and other sensors to detect and avoid obstacles. (Image credit: IBM/ProMare)





» MAS Sea Trials in preparation for a three-week transatlantic journey in April 2022. (Photo credit: IBM/ProMare)

weather data will be downloaded from The Weather Company to optimize performance of the AI Captain. When network connectivity isn't available, MAS's on-board weather station keeps the weather data flowing. The



» Researchers from IBM, ProMare, MarineAI, and several UK universities will have direct access to real-time ocean data during the uncrewed voyage. (Photo credit: IBM/ProMare)

AI captain fuses different data sets together to make rapid and informed decisions.

AI AT SEA

In the world of finance, retail and commerce, automated decision management systems are used to analyze customer activity and automate the process of recommending relevant offers and services. Such automation also enhances privacy and security, identifying possible cases of fraud, as well as reducing the amount of personal and sensitive information that staff members are required to process.

Likewise, MAS needs to be able to operate independently through its own decision automation system. This Operational Decision Manager (ODM) system assesses all available data against a pre-determined set of rules (COLREGS, among others) to help the AI Captain make the best decision in response to real-time events. ODM accesses a broad range of data sources, including the ship's computer vision system, weather data, radar, sonar, and other marine navigation systems to better understand the surrounding environment. And because it is trained on two key sets of rules—International Regulations for Preventing Collisions at Sea, as well as International Convention for the Safety of Life at Sea—ODM helps MAS follow maritime regulations, while considering real-time data to optimize its decision making.

MAS, like many businesses, also has a decentralized computing architecture. Edge computing is essential for enabling the autonomy required for continuous operations.

Small, powerful, and lightweight edge devices provide just enough compute power for an uncrewed vessel to operate independently, even without network connectivity.

When a connection with the network cloud is made, performance data is uploaded, system updates are downloaded, and the autonomous system continues.

MAS has agility built into its core. Its trimaran hull form ensures high levels of hydro- and aero-dynamics. Waterproof photovoltaic panels fitted to its upper surface enable it to draw on energy from the sun when available, with a modern, high-efficiency generator acting as backup in case solar power is low in supply.

The ship has high levels of redundancy built into it, meaning that its systems are both isolated and duplicated to reduce the chance of a single-point failure. And rather than mindlessly following a precharted course, MAS's AI Captain handily evaluates all available data and constantly updates the ship's route and speed, second by second.

As we continue to explore extreme ocean environments, our vision is for humans and machines to continue to work in tandem, using agile, intelligent, and autonomous solutions to augment and extend people's capabilities. It is smart tech at its finest.

For more information, visit: www.mas400.com.



» Artie the seaptopus works with the USV's AI Captain as it fuses different data sets together to make rapid, informed decisions. (Image credit: IBM/ProMare)

NEW EFFICIENT AND SUSTAINABLE ENERGY SUPPLY ON THE SEAFLOOR

Autonomously operating robotic systems are increasingly used to obtain more data from the ocean. In order to provide a powerful, safe and sustainable energy supply for such long-term observations, a submarine fuel cell for mobile observation systems was developed within the framework of a research project led by GEOMAR Helmholtz Centre for Ocean Research Kiel. Initial tests, which were carried out in November in cooperation with the Defense Technology Service Unit 71 were very successful.

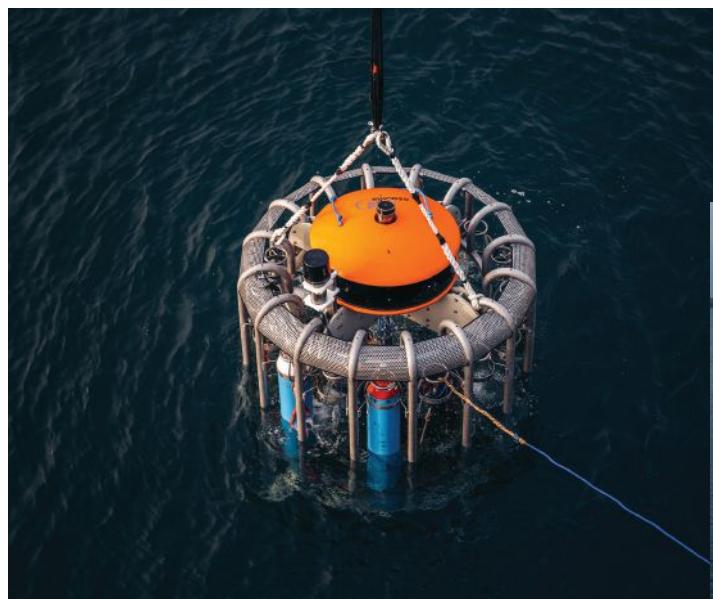
Under water, electricity is usually not supplied by a socket. Mostly, instrumentation for ocean observations is supplied with the necessary energy via conventional battery technology or, more rarely, via complex cable solutions. However, in particular mobile energy-intensive robotic systems for exploration and environmental monitoring on the seafloor require greater amounts of energy. As part of a research project led by GEOMAR Helmholtz Centre for Ocean Research Kiel, fuel cell technology been successfully tested for use in a long-term seafloor observatory.

"The need for long-term observation systems on the seafloor has risen considerably and will continue to move into focus in the future," said project manager Dr Sascha Flögel from GEOMAR. Both, industry and science need data from the seafloor for various issues, for example to reliably identify trends in environmental and climate parameters or for exploration projects. Mobile, modular systems are particularly well suited for this, says Dr Flögel. Unfortunately, the increasingly complex systems also need more energy, which require larger energy storage devices. If at all possible, wiring is only an option near the coast and is very expensive.

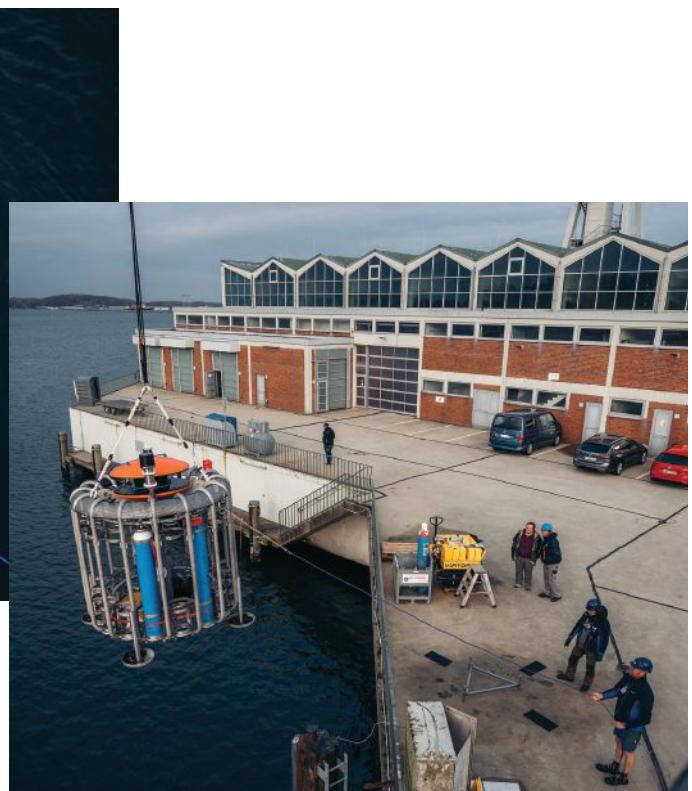
Therefore, in Sascha Flögel's view, it is indispensable to use significantly larger energy storage systems in order to operate spatially and on long time scales (4D ocean observation). As part of the ARIM-FUEL project funded by the German Federal Ministry of Economics and Technology, GEOMAR, together with the Centre for Solar Energy and Hydrogen Research, Ulm (ZSW), has developed a deep-sea fuel cell with intermediate storage that meets the requirements of modern observatories and robotic applications. "Such a system was not available until now," said Dr Flögel. The system developed in the project has a capacity of about 120 kilowatt-hours and a maximum output of one kilowatt. This means that this approach has ten times the capacity of previous solutions that draw their energy from primary cells or rechargeable batteries. This project also makes a valuable contribution to more sustainable ocean observation, as it can save more than 13,000 primary batteries that are used in conventional systems.

"At the beginning of November, we conducted the first successful underwater test of the system at the Defense Technology Service Unit 71 of the German Army in Eckernförde, where we found ideal test conditions," added Dr Flögel. The finalization of the system is planned for February 2022 during an expedition with the research vessel ALKOR.

In the medium term, the researchers at GEOMAR want to use the new energy source in the context of a series of robotic monitoring projects in the coming years. "The new energy supply for under water systems creates completely new possibilities for us to use the devices over longer periods of time," concluded Sascha Flögel.



» Launch of the measuring platform with fuel cell.
(Photo credit: Finn K. Flögel)



SEA-KIT TO STRENGTHEN FLEET WITH NEW 12-METER USV

SEA-KIT International, an award-winning pioneer in the Uncrewed Surface Vessel sector, has announced plans to build another of its X-class, 12-meter USVs as a fleet vessel for launch in 2022.

This build, the sixth X-class to be constructed at the company's Essex (UK) base, will pave the way for the company to meet increased market demand for unmanned vessels and to penetrate new sectors of the global maritime industry.

SEA-KIT CEO, Ben Simpson, commented: "Our X-class USV has changed very little since we won the Shell Ocean Discovery XPRIZE with USV 'Maxlimer' back in 2015. The fact that this will be the sixth build of this class is testament to its robust and now well proven design. We want to continue to push boundaries in other sectors of the maritime

industry and this new addition to our fleet will enable us to demonstrate the benefits of uncrewed vessel technology to new markets."

From the outset, SEA-KIT has positioned itself as being sharply focused on driving down the environmental impact and cost of geo-data collection. This latest build is set to be even more versatile and fuel efficient than its predecessors, with the potential for three different propulsion packages within one hull: diesel-electric, hybrid and hydrogen hybrid.

SEA-KIT is currently leading a Clean Maritime Demonstration Competition funded project to demonstrate zero emission maritime operations using a hydrogen fuel cell manufactured by Bramble Energy. The silent running and low vibration that

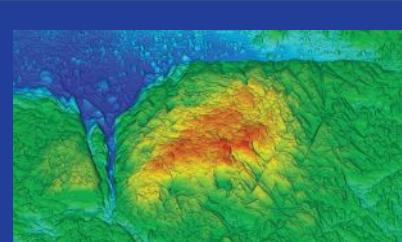


» SEA-KIT's 12-meter USV. (Photo credit: SEA-KIT)

can be achieved with hydrogen propulsion enables highly sensitive acoustic devices and sensors to monitor underwater environments more efficiently and with minimal disturbance, a huge benefit for activities such as marine mammal observation.

Ben Simpson continued: "Interest in SEA-KIT's designs is increasing now that we have vessels operating on commercial

offshore projects globally and we are keen to develop new strategic partnerships to build our client base. With the launch of this vessel, we will be able to offer tailored capability demonstrations as well as charter options and additional services from next summer. It opens the door for customers to order zero emission vessels as the industry collaboratively works towards its net zero goals."



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SUBSEA DATA SYSTEMS RECEIVES NATIONAL SCIENCE FOUNDATION INVESTMENT FOR SMART REPEATER DEVELOPMENT

Subsea Data Systems, Inc., a new partnership between Samara/ Data and Ocean Specialists, Inc., recently announced a new investment from the National Science Foundation's Small Business Innovation Research (SBIR) program toward the company's efforts to develop SMART (Sensor Monitoring and Reliable Telecommunications) Cable technologies. SMART Cables include sensor-enabled repeaters (amplifiers) that will be incorporated into future trans-oceanic internet cables.

"The investment from the NSF's SBIR program catalyzes our efforts to develop the world's first SMART repeater system and represents a major first step in SMART Cable hardware development. The competition for these grants for startups and small businesses is fierce. The early warning and scientific communities have been asking for over a decade that industry develop this technological innovation, and we recognized that the SBIR program was an ideal fit to jumpstart this effort. NSF's investment in Subsea Data

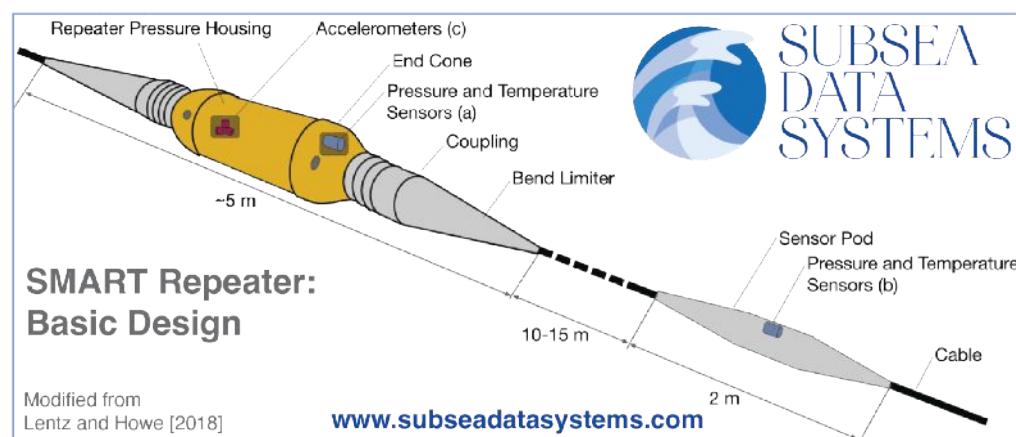
Systems further strengthens our ability to bring SMART hardware, software, and data management solutions to the commercial marketplace," said Matt Fouch, President of Subsea Data Systems.

SMART Cables are an innovative real-time deep ocean monitoring technology that will facilitate fundamental improvements in Tsunami Early Warning (TEW), Earthquake Early Warning (EEW), global climate monitoring and telecommunications resiliency. The innovation is to tightly

integrate sensors into the amplifiers ("repeaters") used to boost signals in the optical fibers. Commercial off-the-shelf (COTS) components will be utilized for nearly all physical elements of the system. The research-grade package includes a 3-axis accelerometer, absolute pressure gauge, and temperature sensor, integrated with data acquisition circuits with suitable dynamic range and precision, a common communications module, an interface suitable for fiber optic cable spans up to 120 km in length, software and firmware

necessary to support the data path, an isolated power source, and precision timing. The SMART repeater design is modular, allowing different sensors, adaptation to different repeater housings, or use as a standalone unit.

The development and deployment of SMART Cables will enhance scientific understanding of Earth's oceans, seafloor, and subsurface via a fundamentally new approach to long-term subsea sensor network deployments. SMART will therefore provide essential new data to reduce disaster risk and improve global climate understanding, thereby reducing societal and environmental vulnerabilities to these long- and short-term threats.



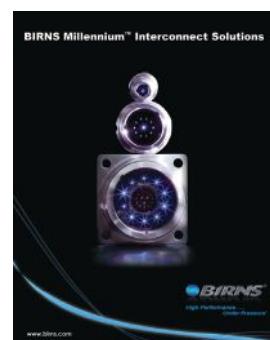
BIRNS, INC. LAUNCHES NEW ADVANCED BIRNS MILLENNIUM™ INTERCONNECT CATALOG

Industry leader in subsea connectivity, BIRNS, Inc., has introduced the all new, comprehensive BIRNS Millennium™ Interconnect Catalog. It includes major enhancements, like a significant expansion of pin configurations, direct links to downloadable configuration drawings, and comprehensive, strategic additions to product selection and part numbering guides, as well as highly detailed specification tools to walk the user through the selection process.

The 6-km-rated BIRNS Millennium™ series provides quantifiably superior performance characteristics, and the data supporting it is outlined clearly in the new catalog. For example, it features a new, highly detailed RF section, which highlights BIRNS' recent breakthroughs with low losses and better VSWR, for example: -.32dB loss and 1.17 VSWR at 1.5GHz. It also outlines the company's revolutionary new 1V series of 75Ω coax contacts with the same footprint as a 50Ω.

The BIRNS Millennium™ Interconnect Catalog details the company's ultra-high speed data rates—cable assemblies with data transfer rates

of 9.4+/- 0.1 Gigabits per second, and incredible optical performance data, including the industry's lowest insertion and return losses. It also includes a range of rigorous qualification and testing capabilities, such as 48 hour+ continuous testing of electro-optical cable assemblies at 6 km in a controlled 2°C ($\pm 1^\circ\text{C}$) environment.



From detailed custom cable stock configurations and color coding to full, clear explanations of Cable Plug materials and torque data—this thoughtfully designed catalog will help make BIRNS customers' interconnect decision-making process easy and seamless.

AUTOSUB TO TRAVEL UNDER ANTARCTICA'S MELTING THWAITES GLACIER



» Autosub Long Range (ALR) aka Boaty McBoatface in the water. (Photo credit: NOC)

Engineers from the National Oceanography Centre (NOC) have headed out to the Thwaites Glacier in Antarctica with renowned autonomous underwater vehicle, Boaty McBoatface, to help understand what is causing ice loss from the glacier and better predict how its deterioration could contribute to sea level rise.

The NOC is providing its innovative technology as part of the TARSAN project, a 101-day ship-based expedition that will investigate atmospheric and oceanic conditions on two ice shelves on the coast near Thwaites Glacier. Boaty McBoatface, the state-of-the-art Autosub Long Range (ALR) vehicle, will travel under the glacier to largely uncharted territory, enabling scientists from the University of East Anglia (UEA) to identify how variations in its conditions may influence the behavior and stability of ice shelves in the region. The study will shed light on how badly the glacier is being weakened by warming water and produce research that will benefit scientists around the world studying ice sheet behavior in other locations.

The research mission will measure ocean properties into sub-ice shelf cavities, using the ALR and other complementary Autonomous Underwater Vehicles (AUV) to detail ocean transports and heat fluxes to better understand the impact of ocean and atmosphere on the ice-sheet change. Findings from the project will better predict how future changes in air, ocean or the ice will affect the loss of ice to the ocean in this region.

The team from the NOC is sending the Boaty under the ice shelf into poorly mapped and potentially very rough submarine topography and will control it from the Nathaniel B Palmer research ship using the NOC-developed Command and Control system (C2), which can re-task Boaty over Wi-Fi, via iridium satellite or using an acoustic modem once it is submerged. The ALR will measure temperature, salinity, current velocity, turbulence, turbidity and dissolved oxygen content of the water, as well as surveying several transects from the edge and towards the grounding line of the ice shelf. Depending on sea ice conditions, the shortest ALR dive could be a 24-hour, 540 km round trip. Or, if the ice is favorable, dives could last up to three days.

The NOC has been developing obstacle avoidance technology to be placed on Boaty, with engineers completing trials in Loch Ness last month to ensure the success of the deployment. NOC engineers have added a forward-looking sonar to avoid steep obstacles ahead, and new retreat behaviors will enable the vehicle to turn around and return to the ship if the cavity gets too tight or if the terrain is impassable.

Dr Alex Phillips of the NOC said: "Our science and engineering teams have made enormous strides in pushing the boundaries of how we explore the world's oceans with underwater technology. Autonomous underwater vehicles are vital equipment to enable oceanic research and we're so excited to be joining the wider TARSAN team with Boaty, which will travel further under the Thwaites Glacier than ever before. The research the ALR is supporting at Thwaites Glacier will be fantastic for the science community, marking an important change in how we collect important ocean data to understand the effects of climate change."

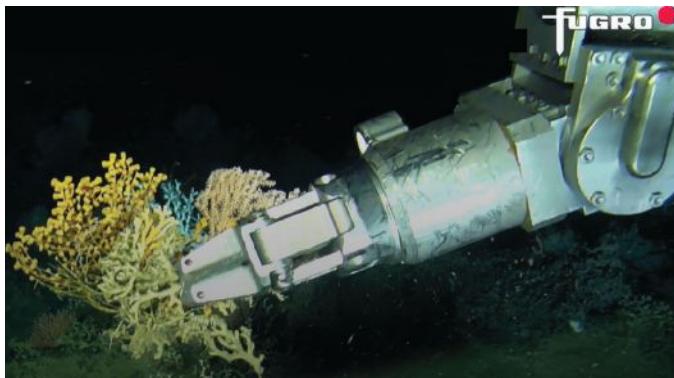
The TARSAN project is one of eight International Thwaites Glacier Collaboration's (ITGC) research projects, which study the entire glacier to establish the impacts of what is known to be one of the most unstable glaciers in Antarctica.

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» The collection of coral and sponge samples at 600-800 m water depth about 100 km offshore Brazil. (Photo credit: Fugro)



» The Fugro Aquarius ROV support vessel preparing for deployment. (Photo credit: Fugro)

FUGRO SUPPORTS SCIENTISTS STUDY CORALS RESISTANCE TO ENVIRONMENTAL STRESS | By Yamin Sodré, Fugro |

Coral reefs are often called the "rainforests of the sea," contributing to marine biodiversity and food security worldwide. As environmental changes threaten the survival of these critical ecosystems, scientists are working to improve corals' resilience. Fugro recently supported this work during an expedition onboard the Fugro Aquarius.

Corals get their color and most of their food from symbiotic algae called zooxanthellae. Environmental changes, such as warming ocean temperatures, can stress corals, causing them to expel zooxanthellae from their tissues. Referred to as bleaching, this stress response makes the coral more vulnerable to disease and can lead to their death.

Rio de Janeiro Federal University's Laboratory of Molecular Microbial Ecology (UFRJ-LEMM) has been leading research to reverse the deterioration of deep-sea coral reefs and help to prevent coral bleaching. Their work includes cultivating coral samples and then selecting microbes from these samples to improve corals' stress resilience. UFRJ-LEMM refers to the research as Beneficial Microorganisms for Corals (BMC), and it is well known across the scientific community.

FUGRO GETS INVOLVED

UFRJ-LEMM approached Fugro about participating in an expedition sponsored by Shell Brasil to study deep-water corals' and sponges' response to environmental changes and to develop BMCs. The project required collection of coral and sponge samples at 600-800 m water depth about 100 km off the coast of Brazil. Fugro's experience providing remotely operated vessel (ROV) services in the region made the company a perfect fit.

After consulting extensively with UFRJ-LEMM and Shell to discuss the project's technical requirements and operational challenges, a window of opportunity opened to deploy the Fugro Aquarius ROV support vessel for the project in August 2021.

VESSEL PREPARATIONS

To support the unique needs of UFRJ-LEMM, the Fugro Aquarius was transformed into a true floating science facility. Modifications included installing the FCV 3000 ROV systems with bio boxes beneath their frames for sample recovery, as well as an environmental laboratory to conduct several experiments; a cold unit for the storage of live species in 28 aquariums; and four tanks on the main deck comprising a total of 12,000 L of deep seawater for sample storage. In addition,

two box corers, two deep-sea soil grabbers, water samplers and other sensors to collect current speed and direction, depth, pressure and temperature data were mobilized.

A BRAZILIAN MULTI-UNIVERSITY AFFAIR

Collaboration was one of the main drivers for the success of the scientific mission. Two representatives from UFRJ-LEMM were assisted by thirteen scientists from UFRJ and five other universities. Experts onshore were also connected through real-time streaming of the ROV camera images.

PROGRESS TOWARD A HEALTHIER OCEAN

At the end of the 10-day mission, Fugro had successfully performed more than 100 ROV dive-hours, supporting the collection of more than 150 samples and the execution of 10 onboard scientific experiments. Collected samples were transported to the UFRJ LEMM laboratory and to the AquaRio aquarium, where additional and more complex studies are being performed to develop the BMCs.

Outcomes from this project will help the scientific community conserve deep-sea reefs around the globe, a pursuit that complements the United Nations Decade of Ocean Science for Sustainable Development (2021-2030).

For more information, visit: www.fugro.com.



» The ROV control room onboard the Fugro Aquarius. (Photo credit: Fugro)



THE VERSATILITY OF ASVs IS OFF THE CHARTS



By Rob Collaro

Director, Morgan & Eklund, Inc.

The marine survey industry has reached an inflection point when it comes to the day-to-day application of autonomous systems, amply evidenced by the growing trial, adoption, and integration of Autonomous Surface Vehicles (ASVs). Today, essential survey instrumentation—such as multibeam sonars, LiDAR, ADCPs, etc.—rather than being administered by traditional topside support can be incorporated into uncrewed platforms capable of running survey lines and standard sampling missions with unmatched speed and precision.

STREAMLINING MARINE SURVEY

The advent of commercial ASVs signals a new era of cost-efficiency and accuracy for hydrographers. Compact, easy-to-deploy units allow operators to significantly scale back operational overheads by minimizing vessel or crew requirements. With survey set-up time optimized, there is more emphasis on mission outputs (quality data) than inputs (means to gather the data). With an uncrewed asset operating as programmed, surveyors can focus on the key objective—capture the very best data possible—without stressing about the margin of human error associated with manual control.

The preset survey plan allows hydrographers to concentrate on other important aspects of operations from a shore-based command or workboat and, where necessary, adjust based on real-time data. It also frees up bandwidth to expedite other stages of the project while still in the field, like processing and QA/QC, which ultimately means that clients receive validated results sooner. And this data delivery lead time is sure to shrink

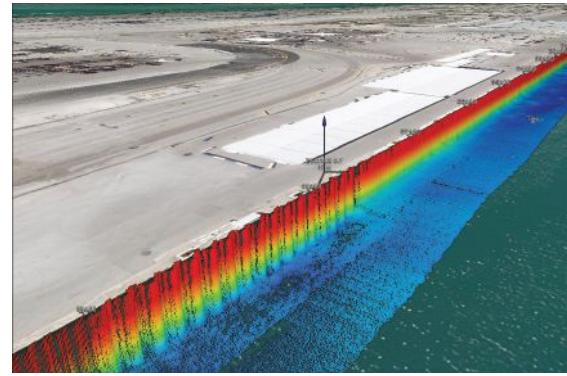
further; future upgrades to hardware and software will not only further enhance the hydrographer's toolkit but enable survey companies to leverage the force multiplier effect of multi-ASV deployment to cover greater areas even more efficiently.

IN-FIELD GAMECHANGER

Beyond unprecedented operational efficiencies, autonomous systems also have the potential to completely redefine HSSE records and requirements by removing personnel from potentially hazardous waters, or areas with restricted access where conventional survey boats may be impeded.

In recent years, ASVs have become instrumental to most of M&E's nearshore and specialized surveys for ports, harbors, and infrastructure, where our preference is always to keep people out of harm's way. Surveying port waters can be notoriously dangerous, where the most common task is to inspect manmade structures and vertical features—such as, large pilings, vertical sheet pile walls, bulkheads, etc.—to help port authorities identify any of structural anomalies, deficiencies, or need for routine maintenance. The ASVs we use are outfitted with the latest high-resolution sonar systems with wide-angle arrays (upwards of 200 degrees) and so allow data to be collected from the surface down to the seafloor, all from the safety of a dockside lookout.

Other examples of how ASVs have become integral to our remotely managed surveys of hard-to-navigate shallows include hardbottom mapping and beach profiling as part of our ongoing effort to assess the hydrographic and topographic variables up and down Florida's coast following major weather events; high resolution bathymetric mapping of sand and aggregate mining pits



» ASVs offer a safe and efficient way to inspect the vertical features of a port or harbor. (Photo credit: M&E)



» M&E deployed ASVs in the Bahamas as part of the local search and rescue efforts following the widespread destruction caused by Hurricane Dorian in 2019. (Photo credit: M&E)

in Central Florida; and multibeam and side-scan sonar deployment to verify seafloor conditions and accurate placement of artificial reefs offshore eastern Florida. In short, modular, plug-and-play ASVs offer hydrographers in-field versatility like never before.

For more information about M&E's Autonomous Remote Surveys division, visit: www.morganeklund.com.

SIGNIFICANT GAS DISCOVERY AT ANCHOIS-2 WELL OFFSHORE MOROCCO

Chariot, an Africa-focused transitional energy company, has announced the result of the Anchois-2 appraisal and exploration well on the Anchois gas project within the Lixus license, offshore Morocco. Chariot has a 75% interest and operatorship of Lixus in partnership with the Office National des Hydrocarbures et des Mines ("ONHYM") which holds a 25% interest.

- Anchois-2 well has been safely and efficiently drilled to a total measured depth of 2,512 m by the Stena Don drilling rig in 381 m of water.
- Comprehensive evaluation of the well has been undertaken through wireline logging, including petrophysical evaluation, subsurface formation testing including reservoir pressures and gas sampling, sidewall cores and well bore seismic profiles.
- Preliminary interpretation of the data confirms the presence of significant gas accumulations in the appraisal and exploration objectives of the Anchois-2 well with a calculated net gas pay totaling more than 100 m, compared to 55 m in the original Anchois-1 discovery well.



» Anchois-2 well has been drilled to a depth of 2,512 m by the Stena Don drilling rig in 381 m of water. (Photo credit: Chariot)

Appraisal Target

Gas Sand B has a calculated total net gas pay of more than 50 m in two stacked reservoirs of similar thickness. The upper reservoir is a continuation of a reservoir drilled in the original discovery well, Anchois-1, with the lower reservoir being newly identified.

Exploration Targets

Gas Sands C, M & O were successfully encountered with multiple gas-bearing intervals across a gross interval of 250 m measured distance with no water-bearing reservoirs identified, materially exceeding pre-drill expectations.

- Previously discovered Gas Sand A was not targeted in the Anchois-2 well, due to the intention of evaluating it in the subsequent Anchois-1 re-entry operations, however, the Anchois-2 well encountered gas bearing sands at this level providing important additional subsurface data.

- High quality reservoirs were encountered in all gas sands.
- Further analysis will be undertaken to fully understand the positive implications on:
 - Gas resources within the expanded Anchois field and the scale of the potential gas development.
 - De-risking of numerous additional material exploration prospects within the Lixus license area with similar seismic attributes to the Anchois discovery now considered to be low risk.
- The well will now be suspended for potential future re-entry and completion as a production well in the development of the field.
- The Stena Don rig will then move to the Anchois-1 gas discovery well to perform re-entry operations with the objectives of assessing the integrity of the previously drilled well, and if successful, providing a future potential production well for the development of the field.

Adonis Pouroulis, Acting CEO of Chariot, commented: "I am delighted to announce that Chariot, as well as conducting a successful appraisal well operation, has made a significant gas discovery at the Anchois-2 well which materially exceeds our expectations. This is a tremendous outcome and I would like to thank ONHYM, our partners on the license, and everyone involved for their invaluable support, which enabled the well to be drilled safely, successfully and on time during a time of significant operational and logistical challenges posed by the current pandemic."

FEBRUARY'S HISTORIC WIND ENERGY AUCTION

Secretary of the Interior Deb Haaland announced on Wednesday, January 12, 2022, that the Bureau of Ocean Energy Management (BOEM) will hold a wind auction next month for more than 480,000 acres offshore New York and New Jersey, in the area known as the New York Bight.

The February 23 auction will allow offshore wind developers to bid on six lease areas—the most areas ever offered in a single auction. Leases offered in this sale could result in 5.6 to 7 GW of offshore wind energy, enough to power nearly 2 million homes. As offshore wind technology continues to advance, these areas may have the potential to produce even more clean energy.

A recent report indicates that the United States' growing offshore wind industry presents a \$109 billion opportunity in revenue to businesses in the supply chain over the next decade.

HEXICON TO DEVELOP FLOATING WIND POWER PROJECTS IN ITALIAN WATERS

Hexicon has created a 50-50 Joint Venture—AvenHexicon SRL—with Avapa Energy with the purpose of developing floating wind power projects in Italian waters. In addition, Hexicon will license its patented technology to AvenHexicon for use in its projects and by third parties. Italy is one of the main recipients of the EU Green Deal and is hence assessed to be a key market in Europe for floating wind power.

In line with its strategy to be an early-stage developer in key markets and to work with local companies, Hexicon has been looking for a partner to join forces within developing floating wind power projects in Italy. Based in Bologna, Avapa Energy has many years of experience from developing solar and wind parks on land and has the know-how and local knowledge that match Hexicon's profile in floating wind power.



» Hexicon will license its patented technology to AvenHexicon. (Image credit: Hexicon)

As one of the main recipients of the EU Green Deal, Italy has initiated the regulatory changes needed to develop offshore wind power. In parallel with the national preparations, AvenHexicon will identify suitable sites for floating wind power parks in order to initiate the necessary permit processes as quickly as possible. AvenHexicon will also adopt and promote the use by other players of Hexicon's patented technology for floating platforms with tilted towers.

Marcus Thor, CEO of Hexicon, said: "An important part of our business model is to enter new and promising markets as early as possible and to establish both our project development skills and technology together with local partners. We have found a perfect partner in Avapa Energy, and with AvenHexicon we are looking forward to support Italy in its expansion of fossil-free electricity production."

Alberto Dalla Rosa, Partner at Avapa Energy, said: "Floating wind power with its advanced low-impact technology will play a material role in the Italian energy transition process, and we are happy to collaborate with Hexicon to develop floating wind parks in Italian waters."

A close-up photograph of a blue and black multi-beam imaging sonar unit, labeled "blueprint subsea oculus", being held by a gloved hand near a ship's hull. The background is dark and textured. The text "SEE THE DIFFERENCE" and "REAL-TIME IMAGING IN ALL CONDITIONS" is overlaid on the left side of the image.

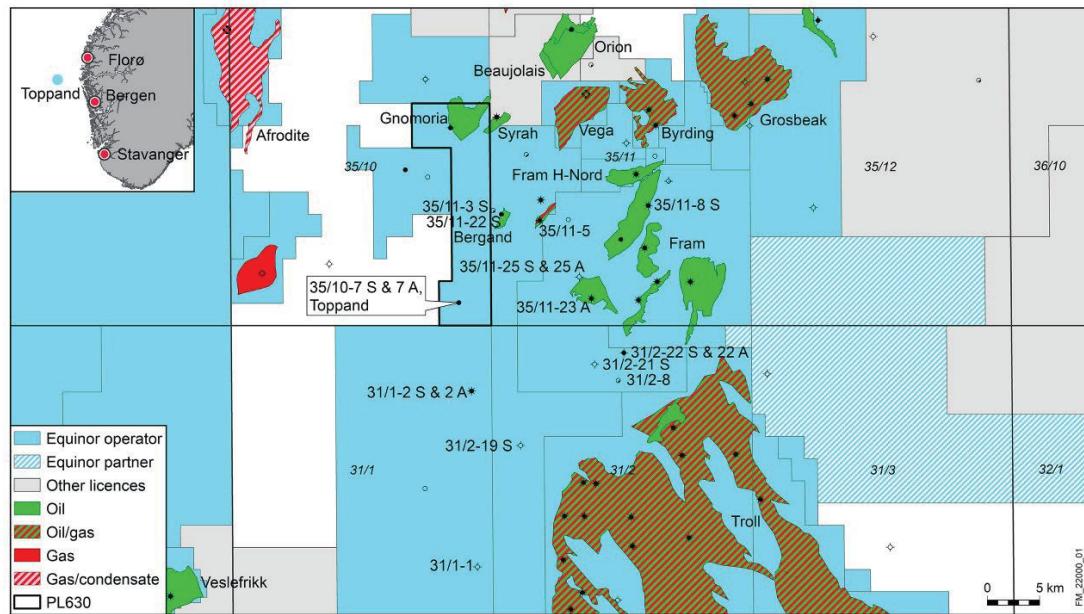
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EQUINOR AND WELLESLEY DISCOVER OIL NEAR THE FRAM FIELD IN THE NORTH SEA

Equinor has, together with its partner Wellesley, discovered oil in the Troll and Fram area in exploration wells 35/10-7 S and 35/10-7 A in the Toppand prospect. Preliminary calculations of the expected size indicate between 3.3 and 5.2 million standard cubic meters of recoverable oil equivalent, or around 21–33 million barrels of recoverable oil equivalent.

"We are pleased to see that our success in the Troll and Fram area continues. We also regard this discovery to be commercially viable and will consider tying it to the Troll B or Troll C platform. Such discoveries close to existing infrastructure are characterized by high profitability, a short payback period and low CO₂ emissions," said Geir Sørteit, senior vice president for E&P west operations.

After more than 50 years of exploration drilling, there is still much to learn about the NCS underground. Exploration wells provide important data for geologists and geophysicists, continuously developing insight and understanding which in turn form the basis for new exploration opportunities. In parallel new digital tools are introduced.

Several discoveries in the Troll and Fram area during the past few years demonstrate that even mature areas can be revitalized

based on new information and modern exploration technology. Toppand is the fifth discovery in the area, and proven resources might exceed 300 million barrels of oil equivalent.

These wells are the second and third exploration well in production license 630. The license was awarded in the 2011 Award in Predefined Areas (APA). The wells were drilled around 8 kilometers west of the Fram field and 140 kilometers northwest of Bergen.

Well 35/10-7 S encountered an oil column of around 75 meters in the lower part of the Ness formation and in the Etive formation. There were also traces of hydrocarbons in the shale and coal dominated upper part of the Brent Group. A total of around 68 meters of effective sandstone reservoir of good to very good reservoir quality was encountered in the Ness and Etive formations combined.

The Oseberg formation was around 48 meters thick and filled with water. It mainly consisted of sandstone of moderate reservoir quality. The oil/water contact was not proven in the well, but by aid of pressure data it is estimated to be located at around 3,303 meters. Sandstone of moderate to poor reservoir quality was encountered in the Cook formation, but the

reservoir was filled with water.

Exploration well 35/10-7 A encountered a 60-meter oil-filled sandstone-dominated interval in the lower part of the Ness formation and in the Etive formation. A total of around 67 meters of effective sandstone reservoir of good to moderate quality were encountered in the Ness and Etive formations combined.

Well 35/10-7 S was drilled to a vertical depth of 3,509 meters below sea level and a measured depth of 3,563 meters below sea level and was completed in the Dunlin Group of early Jurassic rock. Well 35/10-7 A was drilled to a vertical depth of 3,370 meters below sea level and a measured depth of 3,574 meters below sea level and was completed in the upper part of the Dunlin Group.

Water depth in the area is 354 meters. The wells have been permanently plugged and abandoned. The wells were drilled by the West Hercules drilling rig, which has moved to drill exploration well 6407/9-13 in production license 1060 in the Norwegian Sea.

Ownership interests in Toppand is 50% Equinor and 50% Wellesley.

EXXONMOBIL MAKES TWO DISCOVERIES OFFSHORE GUYANA

ExxonMobil has announced two oil discoveries at Fangtooth-1 and Lau Lau-1 in the Stabroek block offshore Guyana. The Fangtooth-1 well encountered approximately 164 feet (50 meters) of high-quality oil-bearing sandstone reservoirs. The well was drilled in 6,030 feet (1,838 meters) of water and is located approximately 11 miles (18 kilometers) northwest of the Liza field. The Lau Lau-1 well encountered approximately 315 feet (96 meters) of high-quality hydrocarbon-bearing sandstone reservoirs. The well was drilled in 4,793 feet (1,461 meters) of water and is located approximately 42 miles (68 kilometers) southeast of the Liza field. These discoveries will add to the previously announced recoverable resource estimate for the block, of 10 billion oil-equivalent barrels.

"Initial results from the Fangtooth and Lau Lau wells are a positive sign for Guyana and continue to demonstrate the potential for the country's growing oil and gas sector, ExxonMobil and our co-venturers in the Stabroek block," said Mike Cousins, senior vice president of exploration and new ventures at ExxonMobil.

"Both discoveries increase our understanding of the resource, our continued confidence in the block's exploration potential, and our view that the many discoveries to date could result in up to 10 development projects."

Fangtooth was drilled by the Stena DrillMAX, and Lau Lau was drilled by the Noble Don Taylor, which are two of six drillships supporting exploration and development drilling across three blocks operated by ExxonMobil offshore Guyana.

Separately, progress continues on infrastructure for future field development. The Liza Unity floating production storage and offloading (FPSO) vessel is undergoing hookup and commissioning after arriving in Guyanese waters in October 2021. The Unity is on track to start production in the first quarter of 2022 and has a target of 220,000 barrels of oil per day at peak production.

The hull for the Prosperity FPSO vessel, the third project on the Stabroek block at the Payara field is complete and topside construction activities are ongoing in Singapore for planned production start-up in 2024. The Field Development Plan and Environmental Impact Assessment for the fourth potential project, Yellowtail, have been submitted for government and regulatory review.

These new projects continue to drive investment in Guyana's growing economy. More than 3,200 Guyanese are now employed in supporting project activities, and ExxonMobil and its key contractors have spent more than \$540 million with more than 800 local companies since 2015.

The Stabroek block is 6.6 million acres (26,800 square kilometers). ExxonMobil affiliate Esso Exploration and Production Guyana Limited is operator and holds 45% interest. Hess Guyana Exploration Ltd. holds 30% interest and CNOOC Petroleum Guyana Limited holds 25% interest.



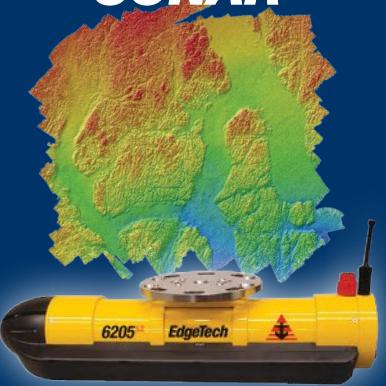
» Noble Don Taylor. (Photo credit: Noble Corporation)

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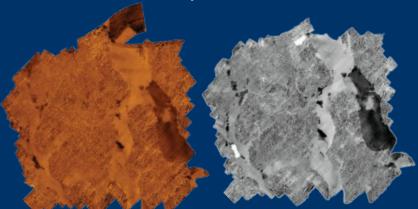
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WELCOME TO 2022 – LIKELY ANOTHER YEAR OF COMMODITY PRICE VOLATILITY



By G. Allen Brooks
*Expert Offshore Energy Analyst
& ON&T Contributor*

CRUDE OIL:

U.S. crude oil led all commodity prices higher in 2021, rising 58 percent. That was not surprising given the strong rebound in global economic activity, including a sharp increase in air travel. Demand growth outstripped the industry's ability or desire to boost production, as concerns over virus upticks and environmental, social, and governance (ESG) pressures spooked managements about the long-term future of their business.

Today, WTI sits at about \$80 per barrel, already up six percent since New Year's Eve, as the Omicron variant, while more easily transmissible, is proving to be less severe, and thereby is expected to have less of an impact on oil demand than experienced in prior variant outbreaks during the past two years. While the future of oil demand is always a question mark, focus is now shifting to global supply and whether it can meet the projected consumption increases.



Catalysts that may influence oil prices in 2022 largely involve geopolitical events and are almost evenly divided between positive and negative outcomes.

Factors that could positively impact oil prices in 2022, and possibly send them to \$100 or greater levels, include: Russia's political moves; possible political instability in Saudi Arabia with an aging king; Chinese Asian expansionism; U.S. environmental and infrastructure legislation; U.S. oil production; COVID-19's trajectory; and inflation. Of these factors, the one that is not on many radar screens is the potential for Saudi Arabia to experience a leadership struggle if, and when, 86-year-old King Salman passes. Such an event would reverberate throughout OPEC, potentially creating political instability within the Middle East region, and altering Saudi's relations with its Western Allies. Anyone or all three of these outcomes would have profound repercussions within the global oil and gas industry.

On the negative side of the oil price ledger, we would list the following forces: diplomatic developments with Iran; President Biden's relaxation of regulations on energy; a Republican sweep of the midterm elections; U.S. production and exploration growth; the cohesion of OPEC+, and China's oil imports. The most revolutionary event would be a surprise relaxation of energy regulations, but with an event probability we would rank extremely low. In fact, for many, such a surprise would be considered a Black Swan.

Implicit in these catalysts that would move oil prices is their impact on oil producer financial discipline. Producers have bent to the will of their shareholders to live within cash flows, deleverage balance sheets, limit reinvestment in exploration, and return more money to their owners. A financially stronger industry, in the face of sharply higher oil and gas prices, will have more cash flow available in 2022. Producers could boost their E&P budgets, while still increasing returns to shareholders, and likely not be punished in the stock market. Such a path could lead to meaningful U.S. oil output growth, something the world will need to avoid sharply higher oil prices in the longer-term. Current oil market conditions reflect a view that we are in the early innings of a traditional 5-7-year oil industry cycle, which should be good for participants and investors.

NATURAL GAS:

The final months of 2021 demonstrated to the world the importance of the global natural gas industry, and especially the role of the United States. The outlook for natural gas in 2022 sees the U.S. continuing its Superman role ensuring the electric power markets in Europe and Asia have sufficient supply. For natural gas, the last 12 months have shown that a fuel once dismissed as irrelevant in the global energy mix, is now the linchpin for ensuring that the lights stay on around the world.

The role of U.S. liquefied natural gas (LNG) in keeping the lights on cannot be

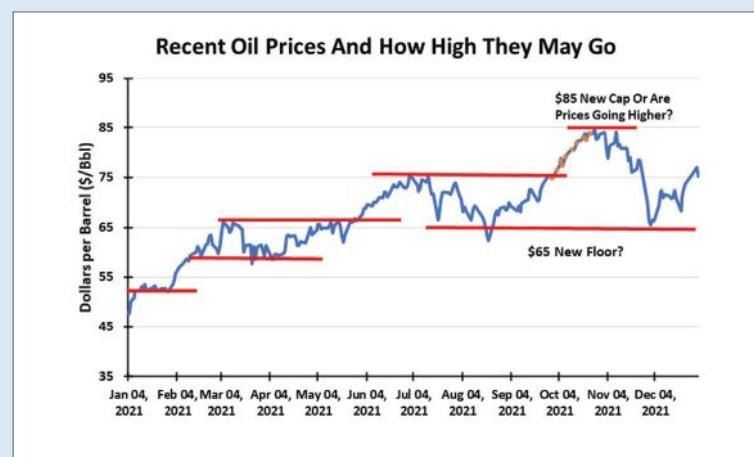
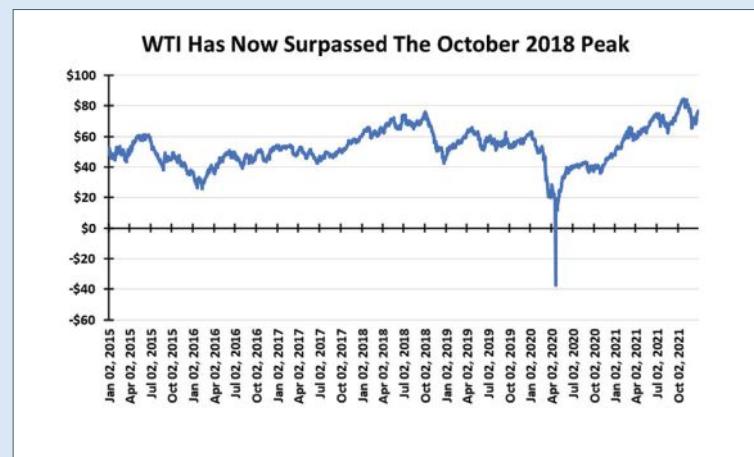
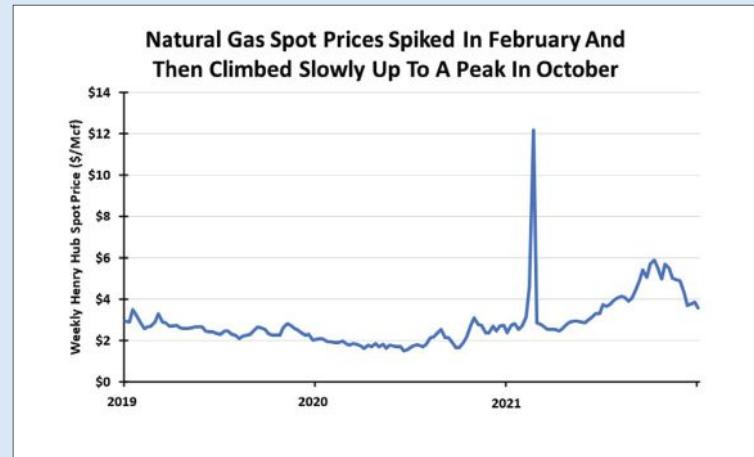
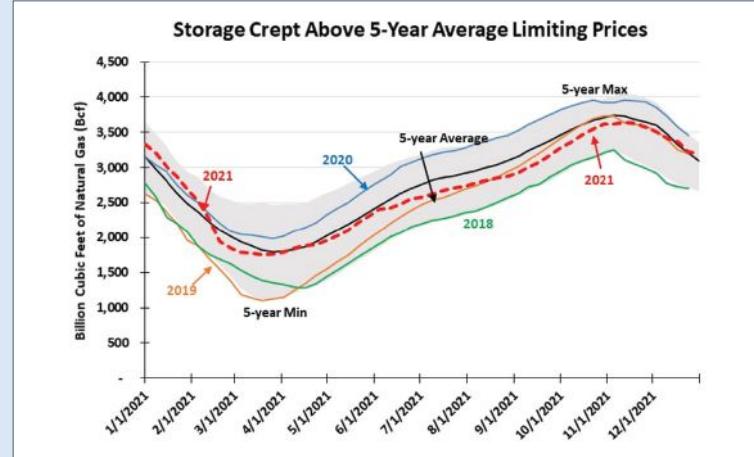


understated. Shortly before Christmas, natural gas prices in Europe skyrocketed as early cold weather blasted the continent, limited gas storage volumes were aggressively drawn down, and Russia was slow to boost pipeline shipments. An energy crisis was under way! Dutch TTF natural gas futures for January delivery traded near €190 (\$215) per megawatt-hour on December 21, up from €20 (\$23) at the start of 2021, but importantly up from €80 (\$90) at the start of December. The announcement that 15 LNG cargos from the U.S. were being diverted from Asian destinations to Europe in response to high gas prices caused the TTF price fell to €70 (\$79) on New Year's Eve. Amazingly, those LNG cargos would only supply roughly two and a half days-worth of European winter gas consumption. The TTF price collapse on the cargo news demonstrates the outsized impact of speculators who had been driving up European gas prices.

Since the price crash, European gas prices have jumped up again, as 2022 ushered in more cold weather, and Asian gas buyers were willing to pay more for LNG cargos. The TTF is now trading in the mid-€90s (\$102s), up more than 35 percent in a matter of days!

For the first time ever, in December the U.S. became the world's largest exporter of LNG. Chinese and Japanese LNG buyers have arrived in the U.S. and are willing to negotiate long-term purchase agreements that support expansions and construction of U.S. LNG terminals. After decades of striving, the world is on the cusp of developing a truly global natural gas market, much like that for crude oil. What the gas market does not have, however, is a cartel like OPEC.

Natural gas demand in the U.S. is hitting a peak, supported by industrial demand along with LNG and pipeline exports. Weather will create consumption fluctuations, but overall demand should remain high this winter. Producers will need to step up gas drilling and boost associated gas production to meet this high level of demand. Better natural gas prices will help stimulate drilling activity, but producer response will still be governed by the adherence to financial discipline demands from shareholders. Is the U.S. poised for a higher level of sustainable gas prices?



MAERSK DRILLING LAUNCHES HORIZON56 TO DRIVE DIGITALIZATION OF THE INDUSTRY

For the past two years, Maersk Drilling has spearheaded an innovative effort to develop a first-of-a-kind product to support digitalization of offshore drilling processes. The solution, known as RigFlow, has now been segregated into the digitally focused company named Horizon56 A/S to drive further development and commercialization. Horizon56 has been founded as a fully-owned Maersk Drilling subsidiary, with the ambition over time to attract strategic investors to further develop the company and its products and services.

The RigFlow solution standardizes and digitalizes the core workflows involved in the well construction process within offshore drilling operations, including real-time exchange of information between energy companies' onshore planning units, the offshore drilling operations teams operating the rig, and the service companies supporting the operations. Other benefits of RigFlow include a convenient and user-friendly solution for providing digitalized drilling instructions, as well as automated reporting of data and insights to support quicker and deeper analysis of drilling operations.

"From our dialogues with global oil and gas operators we see that the timing for the RigFlow offering fits well with market trends, and we expect global demand to build over the years to come. We're thrilled to be part of driving industry digitalization

forward, and our product roadmap includes additional exciting solutions that will increase the value creation for operators and contractors even further," said Esben Thorup, MD of Horizon56.

Developed In Collaboration With Offshore Operators

Originally called Drilling Process Platform (DPP), RigFlow has been scoped and developed by Maersk Drilling's Innovation team from early ideation and validation in 2019. Following extensive operational and market research, the solution has been designed, tested, and now deployed across several Maersk Drilling rigs. Scoping and development have been performed in collaboration with digital leaders in the oil and gas sector, including Aker BP and Equinor.

"Horizon56 will become the first digital company that solely focuses on creating an industry-leading solution for offshore, and by doing so we ensure that it has the necessary agility to operate and quickly adapt to market trends, as well as enabling the team to independently engage with the market in the pursuit of customers, partnerships, and investors," added Marika Reis, Chief Innovation Officer, Maersk Drilling.

About Horizon56

- The purpose of Horizon56 is to develop and provide digital solutions and services to both oil and gas companies and drilling contractors, with a goal to branch out to adjacent markets outside the oil and gas sector.
- The company's first offering is the RigFlow solution which digitalizes core workflows including the information and data flow between the operator's well plan and the offshore rig operations, and by doing so significantly increases efficiency and transparency for both onshore and offshore teams.
- The new entity will continue to provide RigFlow services to Maersk Drilling, supporting the delivery of more efficient, consistent, and digitalized drilling operations to Maersk Drilling's customers.
- Horizon56 will have offices and employees located in Copenhagen, Stavanger and Aberdeen, and support customers globally.

For more information, visit:
<https://horizon56.io>.

» RigFlow standardizes and digitalizes the core workflows involved in the well construction. (Photo credit: Maersk Drilling)



NEPTUNE ENERGY NEW DIGITAL TWINS SUPPORT DUTCH NEW ENERGY PROJECTS

Neptune Energy has announced the development of new "digital twins" of two platforms in the Dutch North Sea, which will accelerate work schedules, and reduce costs and environmental impacts by enabling engineers to work onshore. They will also support planning of Neptune's major Carbon Capture and Storage project in the L10 area.

Leading UK-based 3D technology specialist, Eserv, is creating digitized versions of the L10-A complex's drilling and production platforms where the large-scale offshore CCS project is planned.

It follows the development of five digital twins of Neptune-operated platforms in the UK, Norway and elsewhere in the Dutch sector. This will enable engineers and integrity specialists to carry out an estimated 4,100 hours of work from onshore locations, improving efficiency and cutting carbon emissions associated with offshore travel.

Neptune Energy's Chief Information Officer, Kaveh Pourteymour, said: "These two new additions will allow us to maximize those benefits while also expanding the use of 'digital twins' beyond our traditional E&P activities. We believe their implementation can help accelerate our drive to repurpose existing facilities to deliver large-scale CCS facilities."

Progressing with the CCS project in the L10 area would see it become one of the largest CCS facilities in the Dutch North Sea, with the depleted gas fields around the L10-A, L10-B and L10-E areas capable of storing more than 50% of the CO₂ volumes being targeted by the Dutch industrial sector.

Lex de Groot, Managing Director of Neptune Energy in the Netherlands, said: "As the largest offshore gas producer in the Dutch sector of the North Sea, we are well-positioned to help the Netherlands achieve



» L10-A in the Dutch North Sea. (Photo credit: Neptune Energy)

its climate goals by repurposing existing assets for CO₂ storage or green hydrogen production. Embedding modern technologies in this way ensures we can plan work, inspect plant equipment and monitor changes in the physical structure, or identify potential issues early and accurately, increasing our chance of success and enabling us to deliver against much shorter timescales."

Developing digital twins of assets in the UK, Norway and the Netherlands has enabled Neptune engineers to carry out survey, inspection and verification work from onshore. A digital twin of the Cygnus platform in the UK also supported the development of detailed flight plans for drone-based surveys as part of a ground-breaking methane emissions study.



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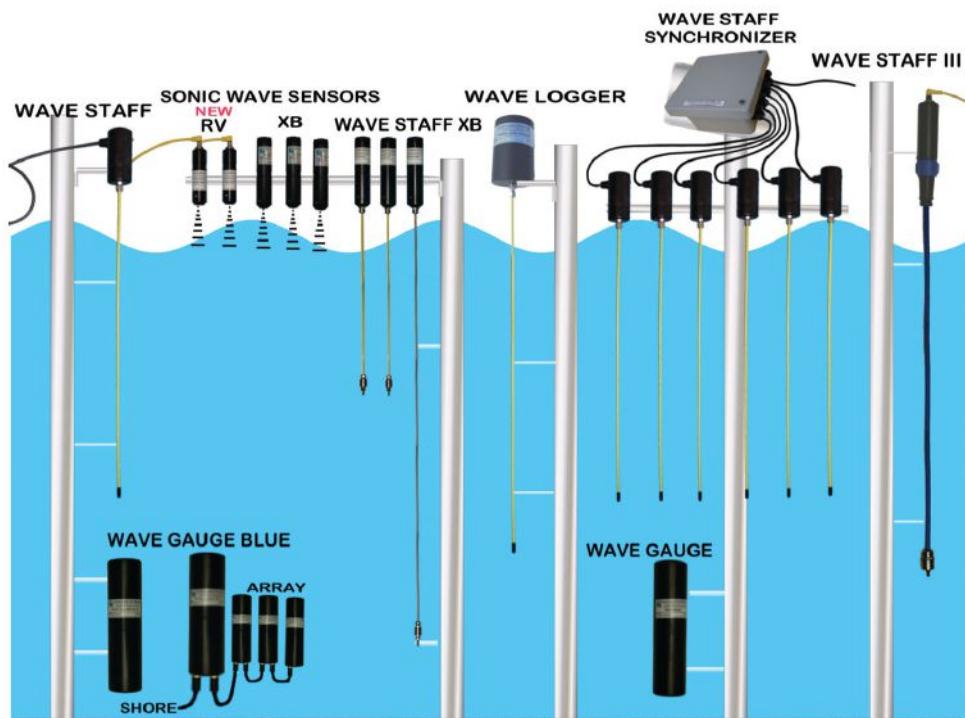
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JAMES FISHER RENEWABLES BAGS TRIPLE OFFSHORE SUBSTATION CONTRACT

James Fisher Renewables, part of James Fisher group, has won three multi-million pound 13-15-year contracts supplying specialist operations and maintenance (O&M) services to support informed decision-making for offshore transmission asset owners (OFTOs) at Thanet, Gwynt-y-Môr and Humber.

The contracts will be performed by JF Renewables' specialist high voltage business EDS HV Group (EDS) for BBEC (Balfour Beatty Equitix Consortium), leading investors and long-term fund managers of core infrastructure assets. The addition of three further transmission infrastructure sites further expands EDS' asset management portfolio with the customer benefiting from the combination of significant project management experience implemented by a highly trained, multi-skilled team.

Transmission infrastructure owners can find that unaddressed underlying problems can often result in an unplanned outage that reduces transmission capacity necessitating an emergency response at short notice with commercial consequences. EDS' unique approach allows them to focus the annual operating charge and focus on critical assets that require attention, allowing them to flex in-line with the natural deterioration that occurs in all assets over time.

The agreement will see EDS provide enhanced O&M services for the offshore assets, ensuring safety of the system in-line with HV safety rules and the maintenance of HV transmission assets, alongside the integration of provisions for heating and ventilation systems, fire suppression, lifesaving equipment and corrosion inspections. Building on its honest, transparent maintenance philosophy, this partnership represents the next step towards full turnkey O&M solutions, delivered to fortify the safe and sustainable growth of the offshore wind industry.



» Gwynt-y-Môr wind farm, off the north coast of Wales. (Photo credit: JF Renewables)

Jonathan Ball, head of OFTO projects, EDS, said: "Our flexible approach to contract maintenance, combined with our expertise in delivering on complex projects, is what sets us apart when it comes to our maintenance philosophy, and we are thrilled to be able to continue rolling this out with BBEC."

Wayne Mulhall, managing director, JF Renewables, said: "The combination of EDS and JF Renewables enables us to offer a much broader suite of services bolstered by our multi-skilled team. Paired with the introduction of remote technology, such as condition monitoring tools that offset in-person requirements, we can operate leaner without compromising on safety or cost. This win represents the next step in our journey to being a complete end-to-end O&M service provider, and we are excited to be continuing our relationship with Equitix, through this contract with BBEC."

This follows the 15-year contract awarded in 2019 to provide operations and maintenance services on OFTO assets at Greater Gabbard Offshore Wind Farm.

IMCA FINALIZES 'GUIDELINES FOR WALK TO WORK (W2W) OPERATIONS'

The International Marine Contractors Association (IMCA) has expanded its '*Guidelines for Walk to Work (W2W) Operations*' (IMCA M254). Originally published in October 2020, the guidelines were produced to help standardize the way in which vessels give personnel safe access to offshore structures, both in the wind and oil & gas industries, and were developed under the direction of IMCA's Marine Division Management Committee.

Vessel owners, wind farm operators and motion compensated gangway manufacturers worked alongside an offshore energy industry focused steering group consisting of representatives from leading manufacturers of motion compensated gangway systems to develop the guidelines.

The document was originally published containing just two of six planned appendices while the industry steering group concentrated on developing the remaining appendices over an additional 12 months, representing an excellent example of industry collaboration.

The guidelines now include nine sections covering walk to work motion compensated gangway operations for the offshore energy industry. The

document advises on choosing the appropriate vessel and gangway as well as operational planning which includes gangway maintenance and ensuring the competence of key personnel. The guidelines also cover emergency preparedness including details on the IMCA incident reporting scheme and how to contribute lessons learned.

The six appendices cover emergency protocols, a framework for hazard identification, training and experience requirements, a safety report template, an induction curriculum, and guidelines covering workability analysis.

Captain Andy Goldsmith, Technical Adviser – Marine at IMCA commented: "The IMCA guidelines, covering W2W operations, has been extremely well received by industry during the past twelve months. The finalizing of the appendices provides additional information, direct from the manufacturers of motion compensated gangways, to further improve operational efficiency and safety standards for the offshore energy sector."

The publication is available for free download by Members via the publications section of the IMCA website, <https://www.imca-int.com>.

SeaTrac ➤

SEATRAC'S USV PROVES INSTRUMENTAL TO COLLABORATIVE SHALLOW MAPPING CAMPAIGN IN GOM & TAMPA BAY



» SeaTrac SP-48 on survey mission. (Photo credit: SeaTrac)

» The 4.8-meter SP-48 can support a full customizable payload of up to 70 kg. (Photo credit: SeaTrac)

More than 50 percent of our nation's Exclusive Economic Zone (EEZ) remains unmapped, and experts say new approaches are needed. "Coastal areas may be the easiest to get to, but they are the hardest to survey from large ships that have depth limitations and may be less nimble than smaller craft," according to Steve Murawski, who heads the Center for Ocean Mapping and Innovative Technologies (COMIT) at the University of South Florida's College of Marine Science (USF CMS).

AN ORCHESTRA OF TECHNOLOGIES

To this end, Murawski and a team of scientists from COMIT are presently conducting a novel hydrographic survey and mapping mission that combines SeaTrac's solar-powered uncrewed surface vehicle (USV) equipped with a NORBIT iWBMSh-N multibeam sonar system, and Fugro's airplane-mounted lightweight laser survey technology called a Rapid Airborne Multibeam Mapping System (RAMMS). Each technology has its place in a 90-square-mile test area that exhibits an array of conditions with differences in depth, water clarity, boat traffic and habitat types. The survey data will be used to improve storm surge modeling and prediction, maritime safety, fisheries management and more.

HIGH-QUALITY DATA

After three weeks of survey, the high-resolution hydrographic and bathymetric data acquired by SeaTrac's 4.8-meter solar

powered SP-48 yielded valuable insights, not to mention a surprise or two (e.g., several previously undiscovered small boat wrecks). "The vehicle has performed admirably, even under some challenging conditions," said Matt Hommeyer, Technical Operations Manager at COMIT.

"Getting a high-quality mapping sensor on a platform that's small, nimble, and—most importantly—quiet is absolutely key for a shallow water survey like this one. That's allowed us to collect very good data despite being in some tight areas where a traditional inshore survey vessel would not be comfortable at all," added Hommeyer.

"COMIT and its partners have achieved a significant milestone in advancing USV technologies with this mission," said Neil Weston, chief scientist in NOAA's Office of Coast Survey. "Our office is particularly interested in the outcomes from these field trials, especially when new technology approaches can improve our national priorities such as shallow water mapping, coastal resilience and emergency response."

ENGINEERED TO BE VERSATILE

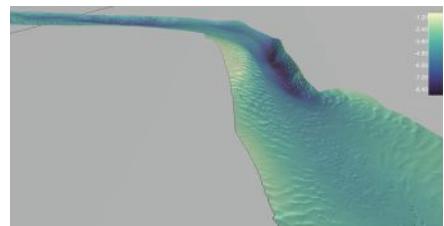
SeaTrac's highly configurable USV is designed to host an extensive range of sensors – including but not limited to sonars, lidar, sub-bottom profilers, USBL/LBL, INS, ADCP, and water quality sensors – and other custom payload modules for a wide variety of commercial, defense and scientific

applications. The solar powered SP-48 can support a total payload of up to 70 kg (150 lbs), speed of 5 knots, up to 500 W of payload power and operates from near shore to open ocean, making it the ideal platform for marine research, monitoring, or surveillance tasks where autonomy, cost, and ease of deployment matter.

For more information, visit www.seatrac.com.



» Wreck of a small vessel in the upper Pass-a-Grille Channel of Tampa Bay, Florida. The wreck is approximately 9 meters long and lies in 6-7 meters of water. (Image credit: USF CMS)



» Bathymetry of Blind Pass, St Pete Beach, Florida (December 2021). Oblique view, looking east. Surface is gridded at 25cm cell size. Depth scale is in meters. (Image credit: USF CMS)

OCEANEERING AND BP CONDUCT FIRST ROV REMOTE PILOTING OPERATION OFFSHORE WEST OF SHETLAND

Oceaneering International, Inc. has successfully conducted the first onshore remote piloting of a remotely operated vehicle (ROV) in the UK sector for bp. The operations were conducted from Oceaneering's Onshore Remote Operations Center (OROC) in Stavanger, Norway.

This project was the first implementation of ROV remote piloting in the UK, the first cross-border implementation, and the first operational implementation for bp.

Oceaneering was tasked with observing drilling operations at bp's Clair Ridge facility West of Shetland, at 141 meters water depth. The operation ran from 20 July to 5 August 2021.

ROV remote piloting from shore can increase safety and reduce the environmental footprint of operations, potentially achieving up to 25% reduction in offshore personnel on board (POB) and provide a significant reduction in emissions associated with the work.

Oceaneering and bp worked together to ensure secure offshore connectivity for the remote ROV piloting operations. This required a complex setup process to establish a bridge between the data networks of both companies, without compromising their respective cyber security policies. The result of the collaboration established a



» Oceaneering's Onshore Remote Operations Center (OROC) in Stavanger, Norway. (Photo credit: Oceaneering)

secure data link via subsea optical fiber to the worksite offshore.

The Stavanger-based remote piloting team operated the ROV for over 70 hours during the campaign program with 100% uptime. The implementation of this project was achieved by a global support team comprising members from the UK, Norway, India, and the US.

"The operation was a successful demonstration of not only new technology, but a demonstration of continued resilience and protection of the offshore workforce during COVID-19," said Martin McDonald, Senior Vice President, Subsea Robotics, at Oceaneering. "Oceaneering's OROC team can continue to operate and remain the eyes and ears of an operation—from any location around the world—during unforeseen disruptions and report back information to the client."

"The success of this innovative solution at Clair Ridge builds increased credibility and familiarity to remote ROV operations. By using experts located onshore in Norway instead of offshore personnel, the safety risk was reduced," said Tom Fuller, VP Wells at bp North Sea. "It's also a great example of how remote technologies can deliver emissions reductions on our assets, aligning with bp's ambition to be a net zero company by 2050 or sooner. This project has helped bp to better understand the benefits and challenges of implementing remotely piloted ROVs—learnings that we can take forward into future opportunities here and across our global operations."

Katy Heidenreich, OGUK's Supply Chain & Operations Director, said: "This project demonstrates how operators are empowering supply chain companies to develop innovative techniques to help cut greenhouse gas emissions. Industry collaboration is bringing innovative technologies to the fore and accelerating the process for getting them from field trials to deployment in the North Sea, helping us on the journey to deliver the UK's target of net zero emissions in 2050."

The Stavanger OROC was established in 2015 and has conducted numerous ROV remote piloting operations in the North Sea and Gulf of Mexico for other clients.

CSA CONCLUDES DEEPWATER ENVIRONMENTAL BASELINE SURVEY OFFSHORE BARBADOS

CSA Ocean Sciences Inc. (CSA), a US-based marine environmental consulting firm, recently announced details of a recently completed two-year Environmental Baseline Survey (EBS) in waters offshore southeast Barbados, at depths of up to 2,400 meters. Scientists from CSA's local Trinidad and Tobago office conducted a series of EBSs in the Carlisle Bay Block and Bimshire Block during the wet and dry season in 2019 and 2021, respectively, to assess temporal variability of environmental parameters.

The survey campaign, designed to characterize the existing physical, chemical, and biological marine resources within a study area of approximately 5,000 km² included

the collection of hydrographic profile data to depths of 2,000 meters; sediment and water samples; air quality data; characterization of plankton; and high-definition imagery to help document the existing condition of the local seabed environment.

CSA deployed two "I"-shaped moorings within the study area (one in each block) to measure baseline current data within the water column at depths of approximately 2,000 meters. The moorings incorporated two 55-kHz Nortek Signature 55 Acoustic Doppler Current Profilers (ADCPs), flotation buoys, dual acoustic releases, and weights. The ADCPs, deployed from November 2019 through April 2021, successfully captured hydroacoustic

data from depths not previously achieved in the region.

"Despite the operational challenges presented by the COVID-19 pandemic, CSA's field team and scientists were able to plan, execute, and demobilize a series of multidisciplinary Environmental Baseline Surveys on time and on budget," said Ms. Candice Leung Chee, CEO of CSA Ocean Sciences (Trinidad) Ltd. "This achievement is not only representative of the local CSA team's resolution and professionalism, but was also made possible thanks to our extensive pool of deepwater sampling and surveying equipment, based in Trinidad, available for rapid mobilization in the region and deployment at record depths."

FIRST DECOMMISSIONING UNDERWAY IN AFRICA

Angola sees Africa's first offshore oil platform decommissioning underway as EQS (Environment Quality Services) successfully deploys their Saab Seaeye Falcon for determining safer upcoming decommissioning operations.

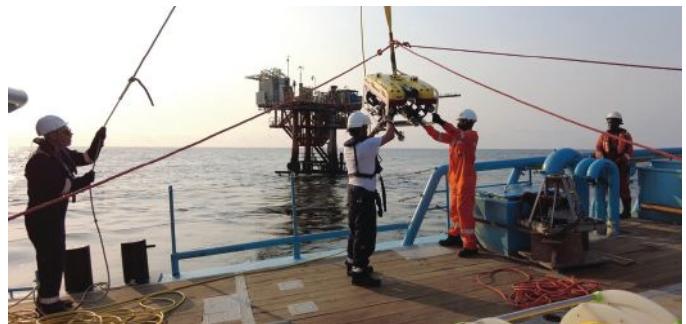
Dubai-based EQS assesses the integrity of offshore structures using their Falcon for visual inspection and image gathering.

The range of offshore structures inspected to assess integrity includes platform (jacket), wellhead, protection dome, pipelines and umbilical.

EQS helps offshore energy clients navigate the complex environmental regulatory landscape to achieve regulatory compliance, protecting employee health and safety, and managing business liabilities.

"The Falcon supports EQS in their aim to fulfil specific works in a safe and cost-effective manner by delivering accurate and relevant information," said EQS CTO Carlos Rodrigues.

He sees the Falcon as an ideal resource for their specialist work as it can handle an array of cameras, sensors, tooling and complex data gathering systems that can easily be added or changed thanks to the Falcon's iCON™ intelligent module-focused distributed control architecture.



» Falcon deployed by environmental services company to assess Africa's first offshore decommissioning project.

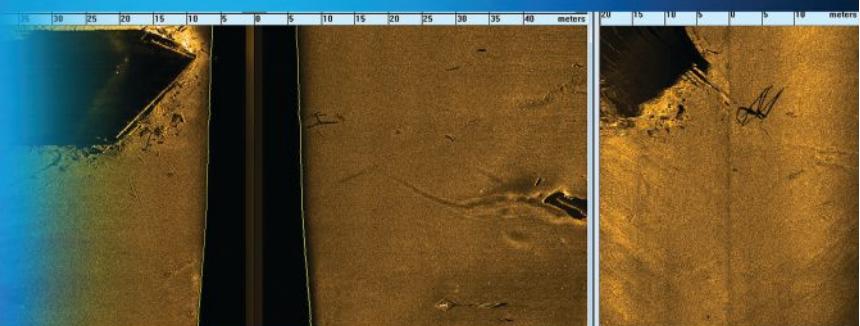
The world's top selling robot of its class, the Falcon's 20-year success comes from being a portable, meter-sized, intelligent, powerful, five-thruster, highly manoeuvrable, multi-tasking, easy to use vehicle, depth rated range to 1,000 meters.

With a reliability record covering over a million hours underwater, including deep tunnel work, the Falcon can remain stable in turbulent waters and strong currents whilst undertaking both robust and precision tasks.

For EQS, the Falcon supports their wide range of complex and routine environmental projects where solutions are created by combining the right people with the right technologies to meet each project's unique challenges.

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Real-time image of a subsea structure.
On the right the nadir window shows a tubed frame off the bottom.



CHECK THE TECH

» SEA-KIT's USV Maxlimer during recent capability demonstrations. (Photo credit: SEA-KIT)

INTEGRATING DVLs ON USVs FOR ROBUST NAVIGATION CAPABILITIES

There is no "one size fits all" solution when it comes to sensors on Uncrewed Surface Vehicles (USVs). A diverse array of USVs inevitably means that sensor payloads have to be adapted to ensure their suitability for the intended application.

Aiming to meet very specific user needs, SEA-KIT International, designer and builder of hi-tech USVs, has been integrating a Nortek DVL with ADCP functionality on their vehicle to obtain extended navigational capabilities in GPS-denied zones.

Nortek's DVL is typically used below the sea surface to inform the position of autonomous or uncrewed vehicles. Instead, UK-based USV manufacturer SEA-KIT opted to use a DVL on their USV while operating from the sea surface. Utilizing uncrewed platforms in operations for the offshore energy sector means that requirements for navigational redundancy and oceanographic information are becoming intertwined.

Varied requirements such as these can blur the lines of sensor specification, meaning that what might spring to mind as the most obvious choice for some is not always the best tool for the job. As part of a project running over spring and summer 2021, SEA-KIT worked with several sensor providers to demonstrate extended

capabilities of their USVs. A crucial part of this process was technical insight from those involved to narrow down the most suitable sensors for their application.

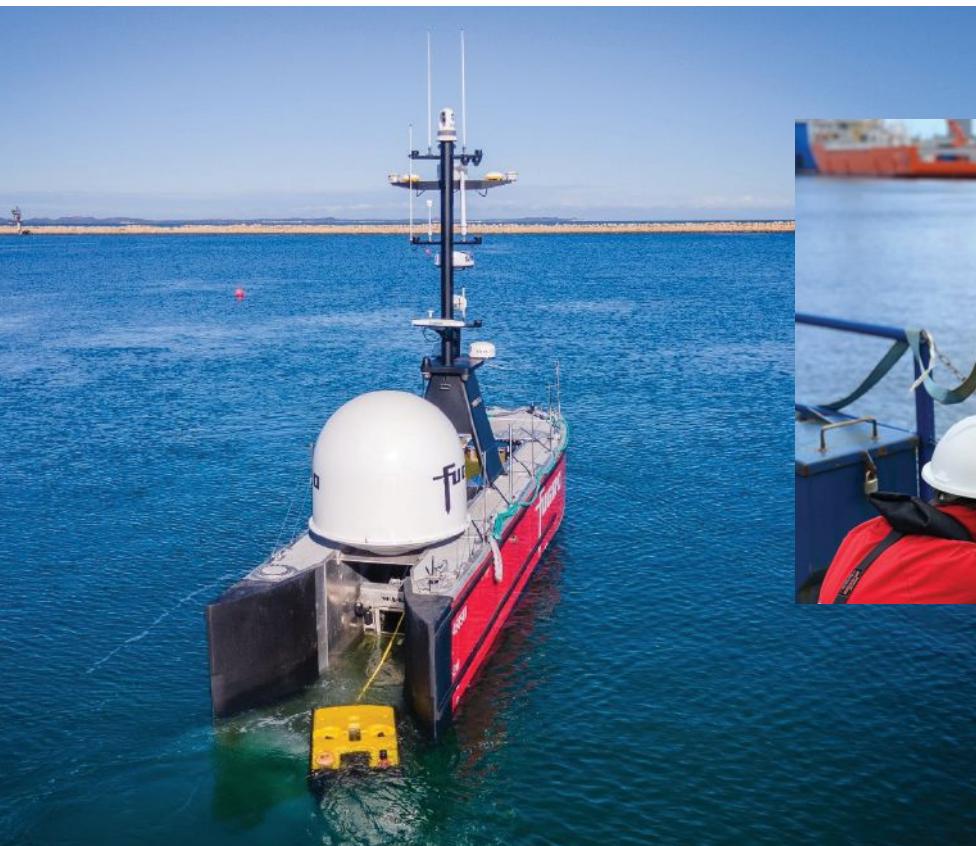
NORTEK'S DVL ENSURES SAFE USV OPERATIONS

Following discussions concerning sensor choice, Nortek and SEA-KIT decided on a DVL—a sensor typically used for subsea navigation—to enable navigation in GPS-denied zones, improving reliability of uncrewed operations.

"Addition and integration of new sensors are part of SEA-KIT's constant focus on safe operations and our drive towards full autonomy. The DVL from Nortek has proven to be a highly capable tool which we will continue to use to help us achieve these ambitious targets," said Ashley Skett, Operations Director at SEA-KIT.

DVL FOR ROBUST USV NAVIGATION PERFORMANCE

By interfacing Nortek's DVL500 with an Inertial Navigation System from iXblue to provide speed over ground measurements, SEA-KIT were able to equip their 12-meter USV Maxlimer with an alternative to satellite navigation. This capability is becoming increasingly important in a world where GPS signals cannot be guaranteed in all locations. Having a non-GPS-reliant navigation source ensures



► iXblue engineers preparing a DVL/INS pairing for calibration (in connection with another project). (Photo credit: iXblue)

» SEA-KIT's remotely-controlled USVs are designed with an adaptable payload area for multiple mission configurations. (Photo credit: SEA-KIT)

robust performance of vehicles in virtually all conditions, using technology that until recently has been the reserve of the subsea industry.

Following demonstrations to a number of industry operators, SEA-KIT were able to show the importance of such technologies.

"Clients agreed that redundancy of positioning is a critical USV function, and a number of use cases were identified, such as operating within the 500-meter zone and around wind turbines. They were impressed with the clear demonstration of the GNSS position versus the DVL position on a custom-made radar-style display," according to Skett.

"A DVL combined with an INS will help ensure that the desired autonomy can be achieved by uncrewed vessels. With the combined iXblue and Nortek solution you get peak sensor performance with great flexibility, meaning you do not need to make space for a larger single-housing system as you can configure the INS and DVL in a way that fits your vehicle's constraints without sacrificing performance," added Maverick Piccininni, Regional Sales Manager at iXblue.

CROSS-COMPANY COLLABORATION

Crucially, full navigation systems are a suite of sensors, each performing a specific role.

Given that different components come from different manufacturers, a good working relationship between companies like Nortek and iXblue is essential when looking to provide coherent, tightly integrated navigation packages.

"The adoption of uncrewed operations has emphasized the need for sensor providers to collaborate and work closely with the integrator," said iXblue's Piccininni.

He stresses that adopting a truly collaborative approach to solving emerging challenges with uncrewed and autonomous systems is becoming increasingly important.

"It becomes evident with new vessels with evolving capabilities that this collaboration will encourage innovation and increased sensor performance."

Piccininni also emphasizes that the close working relationship between iXblue and Nortek should inspire confidence in the sensors' performance and reliability.

"Years of collaboration between Nortek and iXblue has led to best-in-class solutions for subsea and surface navigation that will continue to develop alongside the rapidly advancing USV market," he concluded.

For more information, visit:
www.nortekgroup.com
 and www.sea-kit.com.



STROHM'S FIRST TCP WITH INTEGRAL WEIGHT COATING SUPPORTS TRIDENT OFFSHORE EQUATORIAL GUINEA

In an industry first, Strohm has developed and manufactured a Thermoplastic Composite Pipe (TCP) with an integrated weight coating which offers clients on-bottom stability for its game-changing technology.

The first fully bonded 2,5-inch ID, 2,200-meter TCP Flowline with the unique weight coating innovation has been supplied to Trident Equatorial Guinea Inc. (Trident) to support operations at its Elon-C tie-back, located offshore on the west coast of the Central Africa region. Strohm were able to offer a fast-track delivery to support Trident's schedule, with order placement in February 2021 and delivery in May.

Strohm has the largest track record globally for the production and delivery



» A technician preparing TCP with centralizer to be lowered to the seabed for installation. (Photo credit: Strohm)

of TCP. It is a strong, corrosion resistant composite pipe solution with a long, maintenance free service life. Compared to conventional steel alternatives, TCP is lightweight, spoolable, and delivered in long lengths allowing operators to use existing field support vessels on long-term charter rather than mobilizing dedicated pipelay assets and making significant efficiencies and supporting lower carbon emissions targets. TCP has a 100% track record of no failures on installed pipe.

The technology is increasingly being applied in the renewables sector, including offshore hydrogen and carbon capture and storage as well as in conventional oil and gas applications. The project for Trident saw the technology being delivered on a transportation and installation reel before being laid between two platforms and connected to the topside facility allowing single length riser to flowline application. The Integrated weight coating minimizes on-bottom stability issues for the pipe in such shallow water whilst maintaining flexibility and ease of installation. The unique nature of Strohm's TCP and end termination methodology allowed the vertical section of the flowline to be pulled through smaller J-Tubes and terminated on a platform. This provided flexibility in installation as well as reduced fabrication costs.

Simon Lorelli, subsea operations manager for Trident, said: "This is the first use of TCP which was successfully installed on our Okume Complex. The integrated weight coating, in addition to other means, helped us ensuring an on-bottom stability of this TCP in such shallow water. In addition, the use of Strohm's TCP product offers the flexibility of terminating the flowline offshore, which considerably, de-risked the offshore execution."

As well as passing on cost savings for the fully installed package, in parallel TCP

also allows clients to reduce their own CO₂ emissions whilst contributing to an overall reduction in CO₂ footprint. Strohm has conducted an in-depth analysis of the CO₂ footprint related to the manufacture and installation of a TCP Flowline, and found that it results in a 50% reduction compared to that of a steel alternative. The company is continuing this work to assess the operational life, including assessing the impact of the non-corrosive nature of TCP which negates the need for any injection of chemicals related to inspection and pigging.

Paul McCafferty, Strohm VP Europe & Africa, said: "This is an extremely important award from Trident and marks a major milestone in terms of it being the first TCP flowline manufactured with an integrated weight coating providing on bottom stability whilst in service."

This recent award by Trident demonstrates a growing confidence from energy companies in TCP and the benefits the product offers in terms of transportation, installation and reduced Opex costs. Strohm's track record for TCP is exemplary and this success in Africa is helping to extend our track record in the region while supporting the sector's focus on lowering carbon emissions."

For more information, visit:
<https://strohm.eu/>

Strohm ||

AKER SOLUTIONS TO DELIVER SUBSEA COMPRESSION MODULE FOR ÅSGARD

Aker Solutions has been awarded a sizeable contract by Equinor to deliver engineering, procurement and construction (EPC) of a subsea compression module to be installed subsea at the Åsgard gas field, offshore Norway.

The scope covers EPC of the fifth subsea compression module to be delivered by Aker Solutions for the Åsgard subsea gas compression system. The new module will be a copy of the previously awarded fourth module, and will partly be built reusing existing equipment. It will be installed at the actively producing field with limited need to interrupt production. Engineering will be carried out mainly at Aker Solutions' offices in Fornebu, Norway, and the fabrication work will be done at Aker Solutions' yard in Egersund, Norway. The work starts immediately, and the module is planned to be ready for delivery in August 2024.

"This award continues to demonstrate the value of our leading subsea gas compression technology and is closely aligned with our strategy to deliver solutions that help the industry drive towards more sustainable energy production, with lower environmental footprint versus traditional solutions," said Aker Solutions CEO Kjetel Digre.

The Åsgard subsea gas compression system was delivered by Aker Solutions and installed in 2015. The two-train compression system has been running successfully for more than six years with an impressive uptime of close to 100 percent. Aker Solutions has since the concept phase been working closely with Equinor to prepare for extended operations at the field. As part of this work, the existing compression modules are in cooperation with Equinor and MAN Energy Solutions being refurbished and upgraded to accommodate a higher compression ratio for the system. The purpose is to enhance production and extend the field's lifetime as the pressure in the reservoir naturally declines. The system is also designed for continuous liquid injection in the compression module, making it a wet gas compression solution.

"The continued Åsgard development demonstrates how we can help further enhance recovery rates at existing fields, while maintaining and reusing existing infrastructure and subsea equipment. It also demonstrates the value of Aker Solutions' modular compression system which is scalable and flexible to support enhanced production at declining reservoir pressures," said Maria Peralta, head of Aker Solutions' subsea business.

About the Field

The Åsgard field development ranks among the largest developments on the NCS. It is located in the Norwegian Sea, around 200 kilometers off mid-Norway, in water depths of around 240-310 meters. The gas from the Åsgard field is piped, via Kårstø, to continental Europe, and, according to Equinor, the field supplies about 11 billion cubic meters of gas annually to European customers. This makes the extended operations at the field important to help the expansion of Norwegian gas exports in order to meet European gas needs.



» The subsea compression module is planned to be ready for delivery in August 2024. (Photo credit: Aker)

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SUBMARINE CABLE PROTECTION: A USV DEVELOPER'S PERSPECTIVE



Submarine cables are designed and manufactured to withstand extreme forces, both environmental and manmade. As reliable as cable technology has become in recent decades, subsea cables do fail from time to time.

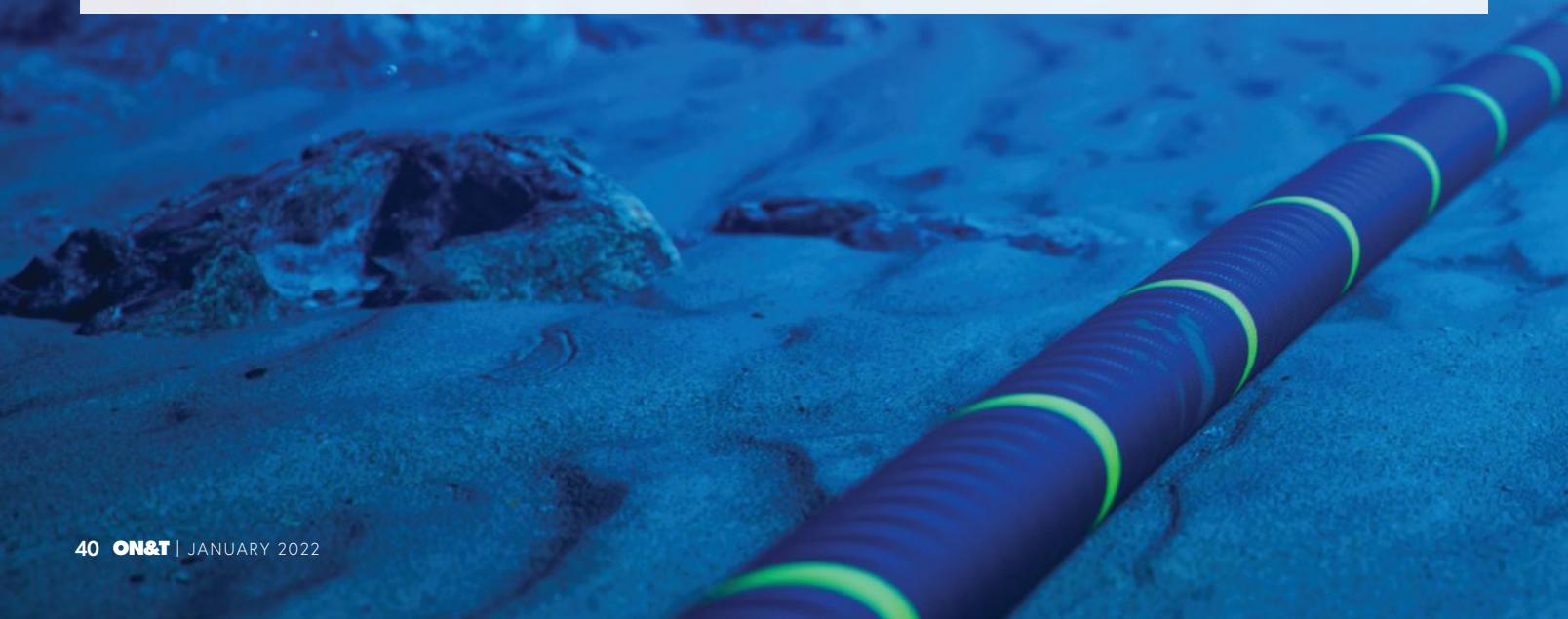
This can have disastrous consequences. Whether it be an intercontinental subsea fiber optic cable hosting an unfathomable volume of business and private communications traffic—including financial transactions—or a critical submarine power cable linking critical offshore energy infrastructure—such as an oil rig or wind turbine—the continuity of 21st Century life is intrinsically linked to efficient cable operations.

Protecting seabed cables has taken on even greater importance in the digital age. Many industries and institutions not only rely on connectivity these days; they depend on it. Today, disruptions to Internet access can escalate to matters of national security. As a result, many countries are setting

up Cable Protection Zones (CPZs) that prohibit anchoring or fishing—the activities most likely to cause damage—in areas where submarine cables are located. Typically, CPZs are monitored by several means: AIS, land-based radar, crewed patrol vessels, and even helicopters.

As the greatest threats to submarine cables are in shallow water, these CPZs are relatively close to shore. While the distance from shore can vary considerably, some CPZs can extend outward to 50 nautical miles offshore, with varying widths several nautical miles across, and of water depth to 2,000 meters or more.

As the submarine cable industry looks to realize ever greater efficiencies at sea, could USVs act as a cost-effective and practical solution for monitoring a CPZ? ON&T sat down with a USV expert, SeaRobotics' VP – Programs Lou Dennis (LD), to assess the viability of uncrewed surface vehicles for such a task.



ON&T: Could USVs provide a low-cost alternative to the current methods for monitoring a CPZ?

LD: Certainly. USVs are currently in use performing coastal mapping operations near shore which could easily be extended further offshore and to the water depth of CPZs.

ON&T: Is the current state of USV technology adequate for this role? If not, what needs to happen to enable USVs to serve in this role?

LD: The USV technology needed is available today and is most deployed for hydrographic survey purposes and other such ocean science campaigns. The drive to streamline marine survey has been a big driving force for USV development over the past few decades. But we are seeing USVs being developed for a broadening range of applications, such as port and harbor security and surveillance. While much of the technology and design parameters of such vehicles is similar, the development of a fit-for-purpose vehicle is fundamentally dependent on a fully defined Concept of Operations (CONOPS). So, this would be the first step. The technology is available; the question is: how do we shape it to serve CPZ monitoring requirements?

ON&T: How would you see USVs working from an operational perspective? What specific capabilities would the CPZ USVs need, and do they currently exist, or would they need to be developed?

LD: Having detailed the CONOPS for a particular CPZ, the USV's operations would be highly tailored. In terms of instrumentation, any USV would need to be outfitted with typical navigation aids, (Radar, INS, AIS, etc.), a suite of both visible light and infrared cameras, LiDAR, and a robust communications suite (wi-fi, VHF, Cellular, Iridium, Satellite Coms). It would need to be equipped with an advanced autonomy system to include obstacle detection, obstacle avoidance, and perception and response capability.

Also beneficial would be the ability to integrate and deploy a multibeam sonar, a sub-bottom profiler, and cable detection sensors to enable seabed surveys of the CPZ to determine any changes or disturbances to the cable or cable route. All these subsystems exist but have not necessarily been integrated into a specific purpose-built USV platform yet.

ON&T: What shore-based facilities would be needed to monitor and control the USVs?

LD: Operationally, it would make good sense to co-locate the land based USV operations hub near the cable landing site to store/maintain/charge/refuel the USV between monitoring watch cycles. A NOC (Network Operations Center) would also need to be staffed; however, it could be remotely located and not necessarily near or within the maintenance site.

ON&T: What would you consider the process of action if a USV spotted activity that could be in violation of the CPZ rules? What direct intervention, if any, could the USV take and what response would be initiated from the shore-based authorities?



» The Cook Strait CPZ protects vital submarine cable links between the New Zealand's North and South Islands. (Image credit: Transpower.co.nz)



» Uncrewed surface vehicles, like SeaRobotics' SR-Surveyor M1.8, are already used for cable route surveys, so why not for monitoring CPZs? (Photo credit: SeaRobotics)

LD: Again, this links directly back to the CONOPS and the importance of specifying the operational objectives of the USV and the scope of activities covered by the proposed system. But if the primary mission of this uncrewed asset is to comb a defined area for other unauthorized vehicles within the CPZ, on detection of such an infringement it could:

1. **Alert authorities:** Sound an alarm, send an e-mail, or even make a phone call to notify the correct authorities of a violation within the CPZ.
2. **Sound a horn,** turn on flashing lights and navigate to a proximity of the violating party and station keep awaiting further supervisory control from the shore-based NOC.
3. **Announce a verbal warning,** instructions of violation and serve as an audible communication conduit between the violators and the CPZ authorities.



PRYSMIAN SECURES US OFFSHORE WIND PROJECTS

Prysmian Group secured two new milestone offshore wind farm projects in the United States for a total of approximately \$900 million.

Both projects have been awarded by Vineyard Wind, a joint venture between Avangrid Renewables and Copenhagen Infrastructure Partners (CIP), thus strengthening Prysmian's partnership with one of the leading developers in the growing offshore wind industry in the US.

Worth around \$300 million, the first cabling project will connect the 804 MW Park City offshore wind farm to the electricity grid in the state of Connecticut. Prysmian will deploy HVAC 275 kV three-core cables with XLPE insulation and single wire armoring. Cables will be produced in the Group's centers of excellence Arco Felice, Italy, and Pikkala, Finland, and will be installed by the *Leonardo Da Vinci* and *Ulisse* vessels. Delivery and commissioning are scheduled for 2026.

The Commonwealth Wind cabling project is worth around \$580 million. Prysmian's award follows the Massachusetts Baker-Polito administration selection of the Vineyard Wind's proposal for delivering 1,200 MW of offshore wind farm capacity. Prysmian will design, supply, install, and commission as many as three export submarine power cable links to connect the Commonwealth Wind to the electricity grid in Massachusetts.

Prysmian will supply HVAC 275 kV three-core cables with XLPE insulation and single-wire armoring. As part of the Commonwealth Wind project agreement and subject to several customary conditions precedent, such as obtaining permits to build the facilities and closing the contractual arrangements with the property owner, Prysmian intends to build a state-of-the-art manufacturing facility for submarine transmission cables at Brayton Point, the site of the former 1,600 MW coal-fired power plant in Somerset.

Both cable supply awards are subject to the finalization of Prysmian Group plans to localize its footprint. The submarine cables are planned to be produced in the new plant in Massachusetts (USA), as well as in Arco Felice and Pikkala. Delivery and commissioning of the export cables are scheduled for 2027.

"The renewed partnership with Avangrid confirms the validity of Prysmian's growth ambition in the fast developing offshore wind farm industry in the US," said Hakan Ozmen, Executive VP at Prysmian Group. "While we still have work to do to finalize the agreement, it is clear that, with the support of the state of Massachusetts and others, we are in a great position to reach a final agreement that will prompt a major expansion of our Company."

After consolidating the prominent position in the European market, the new awards confirm Prysmian's leading role in the development of power grids infrastructures to support energy transition also in the US.

Following the award of the Vineyard Wind and the Coastal Virginia Offshore Wind projects, the Commonwealth Offshore Wind and the Park Wind City projects are important additions to its growing submarine cable and HVDC system portfolio in North America. The Group's track record includes interconnections projects like the SOO Green HVDC link, Neptune, TransBay and Hudson River, as well as the Empire Wind inter-array projects.

NEXANS WINS CONTRACT MORAY WEST OFW PROJECT

Nexans has won a significant turnkey contract of with Ocean Winds to design, manufacture, install and protect the 220kV subsea and onshore export cable system for the Moray West offshore windfarm project.

Nexans cabling solution will connect the wind farm to the national grid, delivering electricity to up to 650,000 Scottish homes and helping achieve Scotland's ongoing commitment to net zero target by 2045.

The Moray West project is an 860 MW offshore wind farm in the outer Moray Firth, located off the northeast coast of Scotland. Nexans' tailor-made export cabling solution will connect the project's substation to the national grid electricity transmission system at Blackhillock, Keith. The project is also an important step towards the UK's goal to provide enough offshore wind energy to power the country and will support Scotland's contribution of 10 GW of wind energy to meet the UK's goal of 40 GW by 2030.

The cable system consists of Nexans' industry-leading High Voltage Alternating Current (HVAC) cabling which will connect the wind turbines to two offshore substation platforms (OSPs). The 220kV cabling, including 170 km of land cables and 100 km of subsea cables, will be installed from each offshore substation platform along the full route to the project specific onshore substation. The cables will be manufactured at Nexans' plants in Halden and Rognan, Norway, Charleston, USA and Charleroi, Belgium and installed by the most advanced cable laying vessel *Nexans Skagerrak*. The onshore part of the project will be overseen and delivered by Nexans' expert personnel based in Edinburgh, Scotland.

OceanWinds is an ambitious and fast-growing offshore wind joint venture between EDP Renewables and ENGIE with around 300 employees. Ocean Winds has a majority shareholding in the adjacent Moray East offshore windfarm which is currently nearing the end of the commissioning phase. The Moray West is fully consented with construction expected to start in 2022. Completion is expected in 2024.

This partnership strengthens Nexans' position in the region as a key player in the energy transition. Nexans has already delivered export cable infrastructure on the adjacent Beatrice offshore windfarm and is currently delivering the export cable system for Seagreen offshore wind farm project, and is as well the cable supplier for the onshore Viking Wind Farm project.

"The UK has significant ambitions to develop the offshore wind market and this contract is another example of how Nexans can contribute its extensive experience and expertise to the renewable energy sector. We look forward to supporting this significant offshore windfarm project and helping Scotland and the broader UK to achieve its net zero ambitions," said Ragnhild Katteland, Executive Vice President Subsea & Land Systems of Nexans.

"The decision to select Nexans was made after an extensive procurement process. Nexans have a strong track record and we are delighted to work with them on the next Ocean Winds project,



Moray West. Nexans will deliver more world class high voltage cable for Moray West to ensure the project can reliably export green electricity to consumers across the UK. While Nexans have experience of utilizing local contractors, the Moray West project team are working with Nexans to maximize the potential for the regional supply chain to secure sub-contracts, primarily supporting the onshore construction, including through Meet the Buyer events," said Adam Morrison, Project Director for Moray West.

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SUBSEA DATA SYSTEMS TEAMS WITH UNIVERSITY OF HAWAII TO SUPPORT NEW SMART CABLE PROJECT

Subsea Data Systems, Inc., a new partnership between Samara/ Data and Ocean Specialists, Inc., has revealed details of their participation in a new 5-year project funded by the Gordon and Betty Moore Foundation to support the University of Hawai'i's SMART Cable efforts. SMART (Sensor Monitoring and Reliable Telecommunications) Cables include sensor-enabled repeaters (amplifiers) that will be incorporated into future trans-oceanic internet cables.

The new grant supports the development of a new SMART Cable between New Caledonia and Vanuatu in the southwest Pacific Ocean, which will provide essential monitoring for tsunami and earthquake early warning. It also supports a series of modeling efforts to better understand hazard warning improvements that can be achieved by deploying SMART cables, local training and workforce development for the system, and the establishment of

a new SMART Cable international project office at the University of Hawai'i.

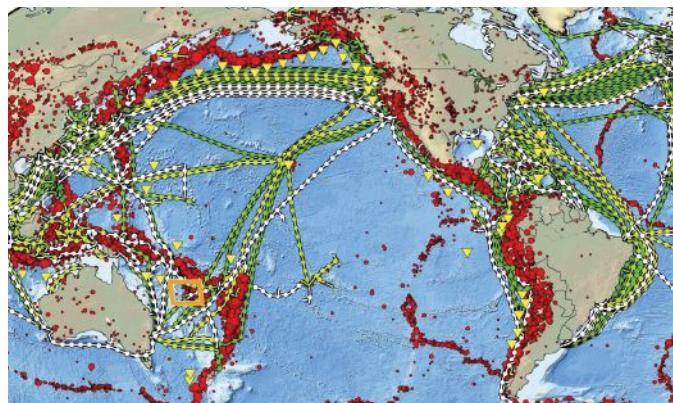
"We're excited to partner with Lead Investigator Dr. Bruce Howe and the rest of the team to support this important new project. The Subsea Data Systems team, particularly Chief Technology Officer Steve Lentz, has been deeply involved in the conceptual development of SMART Cables for several years. Support from a major

philanthropic organization like the Gordon and Betty Moore Foundation provides further recognition of the essential need for SMART Cables, particularly in regions of high risk and low resiliency," said Matt Fouch, President of Subsea Data Systems.

SMART Cables are an innovative real-time deep ocean monitoring technology that will facilitate fundamental improvements in Tsunami Early Warning (TEW), Earthquake Early Warning (EEW), global climate monitoring and telecommunications resiliency. The innovation is to tightly integrate sensors into the amplifiers ("repeaters") used to boost signals in the optical fibers. Commercial off-the-shelf (COTS) components will be utilized for nearly all physical elements of the system. The research-

grade package includes a 3-axis accelerometer, absolute pressure gauge, and temperature sensor, integrated with data acquisition circuits with suitable dynamic range and precision, a common communications module, an interface suitable for fiber optic cable spans up to 120 km in length, software and firmware necessary to support the data path, an isolated power source, and precision timing. The SMART repeater design is modular, allowing different sensors, adaptation to different repeater housings, or use as a standalone unit.

The development and deployment of SMART Cables will enhance scientific understanding of Earth's oceans, seafloor, and subsurface via a fundamentally new approach to long-term subsea sensor network deployments. SMART Cables will therefore provide essential new data to reduce disaster risk and improve global climate understanding, thereby reducing societal and environmental vulnerabilities to these long- and short-term threats.



» SMART Cables will facilitate fundamental improvements in Tsunami Early Warning (TEW) and Earthquake Early Warning (EEW). (Image credit: Dr. Bruce Howe, U. Hawai'i)

PROVISIONAL ACCEPTANCE GRANTED FOR NO-UK CABLE SYSTEM

NO-UK Com AS and Altibox announced that Provisional Acceptance has been granted for the NO-UK submarine cable system linking Newcastle and Stavanger.

This milestone marks a significant achievement in North Sea cable system construction, with the project being completed just 22 months after the supply contract with Xtera came into force last year. The 8-fibre-pair system, which forms part of Altibox Carrier's network, is being lit with advanced terminal equipment from Ciena.

NO-UK is a new high-capacity submarine cable linking 700 km across the North

Sea between Norway and the UK that will significantly improve data connectivity for Norway. The system has been designed and manufactured by Xtera, utilizing their new high fiber count submerged amplifiers, and has armored and buried cable for the entire route to maximize system protection and reliability.

"It's great news for the project and for our investors that we have been able to complete the NO-UK system this year. We appreciate all the efforts of our turnkey contractor Xtera, marine installer Global Marine and specialist consultants Subsea Networks Ltd, to create a robust high-capacity connection between the

Green Mountain and Stellium Data Centres," said Geir Ims, Chairman of NO-UK Com AS.

For more information, visit: www.altiboxcarrier.com or www.xtera.com.





» MV Leonardo Da Vinci. (Photo credit: Prysmian)

MIROS EXTENDS SERVICES TO PRYSMIAN ADVANCED CABLE LAY VESSEL

Miros AS has signed an agreement with Prysmian Group, a world leader in the energy and telecom cable systems industry, for the installation of their IoT dry-sensor WaveSystem including Miros Cloud Services, delivering real-time wave and current data onboard the MV *Leonardo Da Vinci*.

"Miros is delighted to build upon our existing relationship with Prysmian Group, bringing the MV *Leonardo Da Vinci* into line with systems installed on both the MV *Normand Pacific* and MV *Cable Enterprise*," said Andrew Wallace, Vice President for Offshore Solutions at Miros AS.

"A key area in our discussions with Prysmian was the ease and availability of real-time data accessible through our cloud-based Graphical User Interface (GUI) Miros.app. We believe the ability for Prysmian to access and share real-time wave and current data across departments is an important aspect for both onshore and vessel-based personnel and key to their digital journey."

"We are very pleased with Miros WaveSystem providing us with wave, current and speed through water data with high accuracy

operating independently of offshore weather conditions. The automatically calibrating cloud-enabled technology allows us to work safe, precise and highly effective fleetwide and at all times," said Hakan Ozmen, EVP Projects Business & CEO Prysmian Powerlink.

The Miros WaveSystem is comprised of the Miros Wavex, a virtual sensor designed for wave and current measurements using data from standard marine X-band radars, and the motion-compensated Miros RangeFinder, a high-frequency vertical microwave radar providing sea level and draught measurements. Miros' IoT sensors are stand-alone devices with embedded processing and a browser-based user interface, meaning no integration or external processing is required. The devices can be complemented with various value-adding cloud services from Miros, such as weather sensors integration, web displays, data download, data push and device management services.

E M P O W E R I N G

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UISS CONDUCTS SUCCESSFUL UNDERWATER EXPLOSION SHOCK TEST

The Program Executive Office for Unmanned and Small Combatants (PEO USC) has announced the successful completion of underwater explosion (UNDEX) shock testing on the Unmanned Influence Sweep System (UISS), a component of the Navy's suite of mine countermeasure technologies. The test was conducted by the Aberdeen Test Center and Naval Surface Warfare Center (NSWC) Carderock with assistance from Textron and NSWC Panama City. The series of shock trials is key for testing the survivability of UISS and its ability to execute its mission in hazardous environments.

Capable of being hosted from littoral combat ships (LCS), operated from shore, or vessels of opportunity, UISS provides acoustic and magnetic minesweeping coupled with the unmanned, semi-autonomous, diesel-powered, aluminum-hulled mine countermeasures unmanned surface vehicle (MCM USV).

"The UISS UNDEX test demonstrates the survivability of the MCM USV," said LCS Mission Modules Program Manager Capt. Godfrey "Gus" Weekes. "This brings us one step closer to delivering the MCM mission package to the fleet."

The series of successful tests demonstrate the growing maturity of the UISS program. The program completed shipboard Initial Operational Test and Evaluation (IOT&E) onboard USS Cincinnati (LCS 20) in June 2021 and Cyber IOT&E in September 2021, ensuring the program is on schedule to achieve Initial Operating Capability in 2022.

"Completion of these tests showcased the capability and resiliency of the MCM USV, and is a critical milestone for the program," said Capt. Weekes. "The MCM USV is the centerpiece of the MCM mission

package, and this test demonstrates the final steps we're taking for MCM mission package IOT&E and fielding."

In addition to minesweeping capability, the MCM USV will employ modular payloads to bring additional MCM capabilities to the fleet. The MCM USV is currently undergoing integration testing of the AQS-20C towed minehunting sonar, which provides detection, identification, classification, and localization of volume and bottom mine-like objects. The MCM USV is an integral part of the MCM mission package, which will replace the Navy's aging Avenger-class minesweeping ships and MH-53Es Sea Dragon helicopters.



» The Unmanned Influence Sweep System (UISS) undergoes an underwater explosion shock test the Aberdeen Proving Grounds, MD. (Photo credit: US Navy)

NAVY CUTS RIBBON ON UNMANNED VEHICLE TESTING FACILITIES AT PORT HUENEME, CA

The Navy conducted a joint ground-breaking and ribbon-cutting ceremony on December 8, 2021 for the first purpose-built and co-located facilities for unmanned maritime vehicle testing.

Located on Naval Base Ventura County (NBVC) Port Hueneme, the facilities will

accommodate testing, evaluation, and technology demonstration for Extra Large Unmanned Undersea Vehicle (XLUUV) and Unmanned Surface Vessel (USV) prototypes.

"These facilities will be the focal point of Navy learning and experimentation on the capabilities, operations and sustainment of Unmanned Maritime Vehicle prototypes to inform future programs," said Capt. Pete Small, Program Manager, Unmanned Maritime Systems (PMS 406).

PMS 406, within the Program Executive Office Unmanned and Small Combatants (PEO USC), oversees the XLUUV, Large USV, Medium USV programs, and their advanced technology capabilities.

» Sea Hunter USV. (Photo credit: US Navy)

The ribbon-cutting recognized completion of modifications to the existing Littoral Combat Ship Mission Package Support Facility (Building 1392) that will house the XLUUV prototypes, and personnel who will perform test and evaluation and training on the vehicles, which are in fabrication under a contract with Boeing. The groundbreaking recognized the start of construction of the modular administrative building for the newly established Unmanned Surface Vessel Division One and Unmanned Undersea Vehicles Squadron One personnel who will operate and maintain the unmanned vehicle prototypes.

In addition to five Orca XLUUV prototypes, the NBVC Port Hueneme site will eventually accommodate one MUSV, two Sea Hunter USV, and four Overlord USV prototypes. NBVC is ideally suited for these facilities with ready access to open-water instrumented ranges, multimodal expeditionary transportation capabilities, proximity to Navy and industry hubs, and synergies with other tenant commands.

BOLLINGER AWARDED CONTRACT FOR A PONTOON LAUNCHER FOR GENERAL DYNAMICS ELECTRIC BOAT

Bollinger Shipyards, LLC will construct a new Pontoon Launcher for General Dynamics Electric Boat to support the construction and launching of the United States' Columbia Class Ballistic Missile Submarines, which will replace the aging Ohio Class Ballistic Missile Submarines and is a top strategic defense priority for the United States.

"Bollinger Shipyards is excited to expand our ongoing relationship with Electric Boat and to continue to support the capitalization and infrastructure improvements that Electric Boat has undertaken in reshaping and modernizing its Groton shipyard," said Bollinger Shipyards President & CEO Ben Bordelon. "We're honored to have been selected to build this Pontoon Launcher with the quality craftsmanship of the hardworking men and women of Bollinger Shipyard and we continue to be laser-focused and committed to being a leader in pushing our industry

forward and ensuring that the U.S. Industrial Base is fully self-sufficient."

"Electric Boat continues to expand and upgrade its infrastructure to support construction of the Columbia class, the nation's top strategic defense priority," said Joe Drake, Vice President, Real Estate and Facilities, General Dynamics Electric Boat. "Our partnership with Bollinger is an important part of that strategy."

The concept and contract design for the 496 ft by 95 ft Pontoon Launcher was performed by the Bristol Harbor Group in Rhode Island. The detail design engineering will be performed at the Bollinger facility in Lockport Louisiana. The Launcher is scheduled to be delivered to Electric Boat's Groton Connecticut shipyard in 2024.

Electric Boat is the prime contractor on the design and build of the Columbia Class



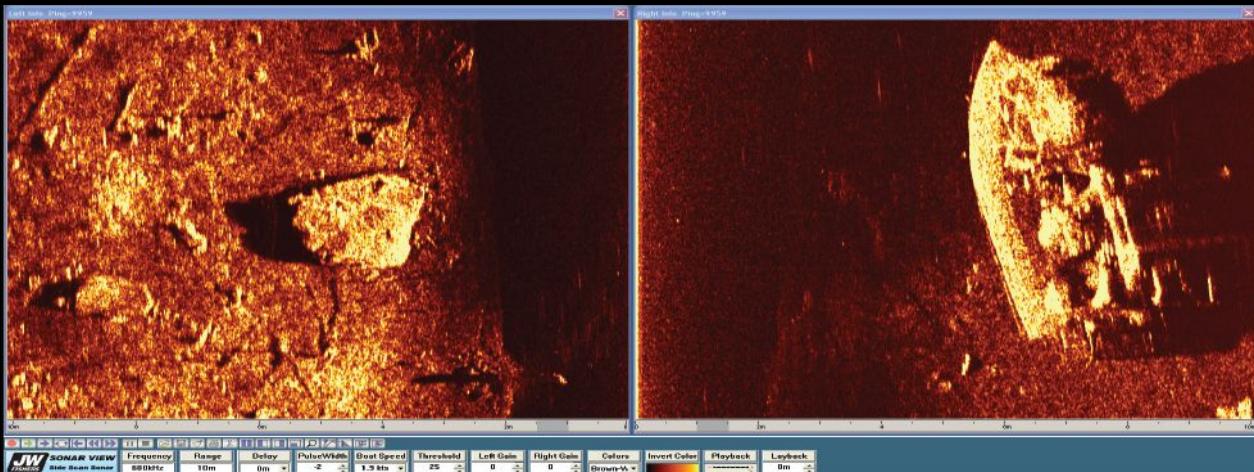
» Columbia Class Submarine. (Photo credit: General Dynamics Electric Boat)

Submarine, which will replace the aging Ohio Class Ballistic Missile Submarines.

This is Bollinger Shipyards' third contract awarded with Electric Boat. In late 2019, Bollinger Shipyards was selected to construct the 400 ft by 100 ft Ocean Transport Barge for Electric Boat which was delivered in 2021 and in late 2020, Bollinger was selected to construct a 618 ft by 140 ft state-of-the-art Floating Dry Dock. All of which support the construction and maintenance of the Columbia Class Ballistic Submarines.

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ROYAL NAVY TO TEST NEW CREWLESS MINEHUNTER SYSTEM

A new crewless minehunter is being tested by the Royal Navy as part of the growing drive towards autonomous systems.

Designed to detect the latest mine threats—and reduce the risk to the lives of those searching for them—the system is the fruit of the joint Anglo-French Maritime Mine Counter Measures program.

Demonstrators have been delivered to both the Royal and French Navies, the UK model handed over in Plymouth by Thales UK, OCCAR and Defense Equipment and Support, the MOD's procurement arm.

The system comprises an uncrewed surface vessel, towed sonar and a portable operation center, and is now undergoing rigorous capability development trials.

"It is exciting to see the first delivery to the Royal Navy from the Maritime Mine Counter Measures," said Commodore Steve Prest, the Royal Navy's Deputy Director Acquisition.

"The future of mine warfare is here: the Royal Navy's minehunting capability program is real; it's happening; it's delivering. We have a lot to learn about this transformational approach to mine warfare, but there is much, much more to come."

Users of the demonstrator will be able to detect and neutralize mines from miles away, ensuring they can keep vital sea lanes open, with much-reduced risk to ships and the lives of sailors.

The Royal Navy already has three autonomous minehunting systems operating out of Faslane under the banner of Project Wilton, Harrier, Hebe and Hazard.

The aim ultimately is to replace crewed Sandown and Hunt-class ships with autonomous systems, keeping the sailor out of the minefield as much as possible.

The demonstrator will undergo operational evaluation alongside other systems being delivered by the UK-France partnership through a £184 million investment agreed by Whitehall in 2020, which is supporting around 215 jobs in the UK.



» The system is a result of the Anglo-French Maritime Mine Counter Measures program. (Photo credit: Royal Navy)



» Sonardyne's portable Micro-Ranger 2 Ultra-Short Baseline (USBL) system. (Photo credit: Sonardyne)

ADVANCED ACOUSTIC CONCEPTS SELECTS SONARDYNE FOR UNDERWATER TARGET TRACKING

Advanced Acoustic Concepts chose Sonardyne's portable Micro-Ranger 2 Ultra-Short Baseline (USBL) system

Undersea weapon, sensors and integrated systems specialist Advanced Acoustic Concepts has chosen underwater positioning technology from maritime technology company Sonardyne to work for the US Department of Defense (DoD).

Advanced Acoustic Concepts chose Sonardyne's portable Micro-Ranger 2 Ultra-Short Baseline (USBL) system following a market review of commercial-off-the-shelf (COTS) systems suitable for its needs, particularly around supporting its existing DoD programs and providing its operatives with increased situational awareness during open ocean missions

Micro-Ranger 2 is designed to provide everything needed to start tracking divers, remotely operated vehicles, autonomous or unmanned underwater vehicles or any other subsea targets, all from a single IP-67-rated ruggedised case small enough to operate anywhere, from anything.

It can track up to 10 targets to over 3,000 ft (995 m) and comes complete with a surface-deployed Micro-Ranger Transceiver, a GNSS antenna, and two of Sonardyne's smallest transponders, the Nano. The one-box solution also houses a built-in battery to support more than 10 hours of continuous use, as well as ethernet and Wi-Fi connectivity to connect to a user's laptop for fast and easy tracking.

Dan Zatezalo, Technical Sales Manager for Sonardyne in the US, said: "We're really excited to be supporting the work of such a technically strong company as Advanced Acoustic Concepts, which plays a critical part in supporting the US Navy."

"COTS equipment is playing an increasing role in supporting wider military operations and systems like Micro-Ranger 2 are part of that ecosystem; providing navies globally with affordable, easy to acquire, mobilize, and dependable maritime technologies."

"The flexibility of the hardware platform and secure digital signal architecture inside Micro-Ranger 2 means that customers can also benefit from being able to use and integrate our different navigation, communications and control mission systems, seamlessly, all with technical and application support from our facilities in the US."

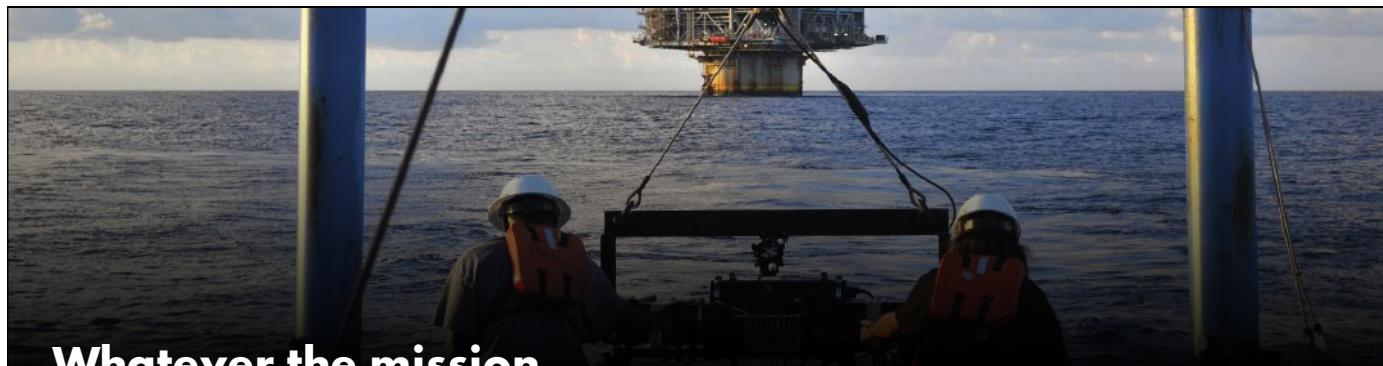
Advanced Acoustic Concepts, which is based in New York and has facilities in Maryland and Pennsylvania, is co-owned by Leonardo DRS and Thales.

MIND TECHNOLOGY ENTERS INTO COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT WITH US NAVY

MIND Technology, Inc. has entered into a Cooperative Research and Development Agreement ("CRADA") with the United States Navy's Naval Surface Warfare Center, Panama City Division (NSWC PCD).

The CRADA, titled, "Advanced Mine Finding," will allow scientists and engineers from MIND and the US Navy to collaborate on optimizing the next generation of mine-hunting sonar systems to ensure that they fit the needs of the warfighter.

Commenting on the agreement, MIND's Chief Technology Officer, Andy Meecham, stated: "Through our subsidiary, Klein Marine Systems, MIND has a long history of supporting the US Navy. I'm thrilled that this CRADA will allow us to leverage the expertise of the scientists and engineers at NSWC PCD to provide innovative solutions to the warfighter, now and into the future. This agreement demonstrates our corporate focus on innovation and new technology, which has delivered game-changing capabilities such as our unique full-swath MA-X™ sonars, will continue to define the gold standard in underwater sensing."



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AMERICAS

Blue Innovation Symposium

Rhode Island » February 22-24

<https://blueinnovationsymposium.com/>

Floating Wind Solutions

Houston, TX » March 1-3

<https://floatingwindsolutions.com/fws-22/>

Canadian Underwater Conference & Exhibition

Halifax, Canada » March 27-29

www.underwaterconference.ca

AUVSI XPONENTIAL

Orlando, FL » April 25-28

<https://www.auvsi.org/events/xponential/auvsi-xponential-2022>

International Partnering Forum (IPF)

Atlantic City, NJ » April 26-28

<https://www.offshorewindus.org/2022ipf/>

Offshore Technology Conference (OTC)

Houston, TX » May 2-5

<https://2022.otcnet.org/>

Canadian Hydrographic Conference

Ottawa, Canada » June 6-9

<https://www.chc2022.org/en>

US Floating Wind

San Francisco, CA » June 7-8

<https://reutersevents.com/events/offshore-wind/content-san-francisco.php>

H2O Conference

Halifax, Nova Scotia » June 14-16

<https://www.h2oconference.ca/>

US Offshore Wind

Boston, MA » July 18-19

<https://reutersevents.com/events/offshore-wind/content-boston.php>

EUROPE

Subsea Expo

Aberdeen, UK »

February 22-24

www.subseaexpo.com

Offshore Pipeline Technology Conference

Amsterdam, The Netherlands »

February 28 - March 2

<https://informaconnect.com/offshore-pipeline-technology/>

Seabed Mapping & Inspection

Geilo, Norway » March 9-11

<https://www.tekna.no/en/events/seabed-mapping-and-inspection-2022-42041/>

Oceanology International

London, UK » March 15-17

www.oceanologyinternational.com

WindEurope

Bilbao, Spain » April 5-7

<https://windeurope.org/annual2022>

MCE Deepwater Development

London, UK » April 12-14

<https://mcedd.com/>

Deep Sea Mining Summit

London, UK » April 26-27

<https://deepsea-mining-summit.com>

EEGR Southern North Sea

Norwich, UK » May 25-26

www.eegr.com/events/sns2022/

Undersea Defence Technology (UDT)

Rotterdam, The Netherlands

» June 7-8

www.udt-global.com

OTHER REGIONS

OCEANS Chennai

Chennai, India » February 21-24

<https://chennai22.oceansconference.org/>

OTC Asia

Kuala Lumpur, Malaysia

» March 22-25

<https://2022.otcasia.org/>

Telecoms World Middle East

Dubai » May 24-25

<https://www.terrapinn.com/conference/telecoms-world-middle-east/index.stm>

Submarine Networks World

Singapore » September 7-8

<https://www.terrapinn.com/conference/submarine-networks-world/index.stm>

Mediterranean Offshore Conference

Alexandria, Egypt » October 18-19

www.moc-egypt.com

Telecoms World Asia

Bangkok » November 2-3

<https://www.terrapinn.com/conference/telecoms-world-asia/index.stm>

MONTH & DEADLINES	EDITORIAL FOCUS & SHOW DISTRIBUTION	CONTENT FOCUS & PRODUCT/SERVICE
JANUARY Editorial: Dec. 17 Ad: Jan. 13	» Uncrewed Surface Vehicles Floating Wind Solutions / March 1-3 Oceanology International / March 15-17	Content Focus: Remote Marine Operations, Force Multiplication, Ocean Research, Search & Rescue, Tooling Product/Service: A/USV manufacturers, multibeam echosounders, side scan sonars, control systems, thrusters, positioning systems, thermal cameras, communication systems
FEBRUARY Editorial: Jan. 24 Ad: Feb. 10	» Naval Defense & Security CUCE / March 27-29 Undersea Defence Technology / June 7-8	Content Focus: Intelligence, Surveillance & Reconnaissance (ISR), Mine Countermeasures (MCM), Harbor Security, Anti-Submarine Warfare (ASW) Product/Service: AUVs, USVs, marine robotics, search and rescue technologies, underwater tracking & communications
MARCH Editorial: Feb. 21 Ad: Mar. 10	» 21st Century Marine Survey AUVSI XPONENTIAL / April 25-28 H2O Conference / June 14-16	Content Focus: Hydrographic Survey, Sensor Innovation, Research Vessels Product/Service: Sensor manufacturers, UAVs, multibeam echosounders, sonars, software & analytics, deck handling equipment, survey companies, research vessels
APRIL Editorial: Mar. 21 Ad: Apr. 07	» Green Energy US Offshore Wind / July 18-19	Content Focus: Renewable Offshore Energy (Wind, Solar, Tidal & Wave), Green Hydrogen, Power Storage Supply Chain Product/Service: Offshore wind supply chain, alternative offshore energy technologies, subsea batteries, hydrogen powered vessels
MAY Editorial: Apr. 18 Ad: May 05	» Subsea IMR Technology Canadian Hydrographic Conference June 6-9	Content Focus: Shore-based Command Systems, Subsea Residency, Digital Twins Product/Service: AUVs, ROVs, robotic tooling, buoyancy materials, cameras & lighting, pressure sensors, propellers, tethers, simulation software
JUNE Editorial: June 06 Ad: June 23	» Oceanography	Content Focus: Data Collection, Transmission & Communication, Data Analytics & Software Platforms Product/Service: Buoys, drifters, acoustic modems, releases & transponders, magnetometers, subsea cables, connectors, weather stations
JULY Spotlights: June 14 Ad: July 11	» Uncrewed Vehicles Buyers' Guide □	Content Focus: Special Edition
AUGUST Editorial: July 25 Ad: Aug. 11	» Submersibles & The Deep Sea	Content Focus: Deep-sea Exploration, Seafloor Archaeology, Deep-sea Science, Ocean Mining Product/Service: Crewed submersibles, support vessels, mining machines, geo-technical technologies
SEPTEMBER Editorial: Aug. 22 Ad: Sep. 08	» Artificial Intelligence & Remote Marine Operations	Content Focus: Swarm Technology, Control Systems, Automation, Ocean Health, Maritime Efficiency Product/Service: Uncrewed vehicles, simulation & modelling platforms, cloud-based data analytics
OCTOBER Editorial: Sep. 19 Ad: Oct. 06	» Offshore Energy	Content Focus: Sector Diversification, Seabed IMR, Sensor Innovation, HSSE, Decommissioning, Oil Spill Response, Renewables Product/Service: Marine survey, oil spill response, renewable energy technologies, geotechnical services
NOVEMBER Editorial: Oct. 17 Ad: Nov. 03	» Underwater Imaging	Content Focus: Bathymetric Mapping, IMR, Habitat Characterization, Acoustic Sensing Product/Service: Observation ROVs, AUVs, cameras, lights, diving innovation, tracking & positioning systems, optical and acoustic sensors
DECEMBER Editorial: Nov. 14 Ad: Nov. 18	» The Future of Ocean Technology	Content Focus: Special Edition



» (L-R) Kirstin Gove, Trish Banks, and Jacqui Taylor

SENIOR APPOINTMENTS TO SUPPORT GLOBAL UNDERWATER HUB'S AMBITION

The Global Underwater Hub (GUH) has announced a series of senior appointments to deliver its ambition of transforming the underwater industry in the UK.

The new intelligence-led organization has appointed a finance director and head of communications to strengthen its team as it sets out on its mission to create strategic alliances and partnerships with other industry organizations and agencies around the world.

Kirstin Gove has joined as head of communications. A former STV news anchor and broadcast journalist, Kirstin has nearly three decades of experience working across various sectors of the energy industry including oil and gas, drilling and decommissioning. She is also a seasoned industry event host and panel chair, having hosted two sessions at Subsea Live earlier in the year.

In her role at the GUH, Kirstin is responsible for developing and implementing all communications and marketing activities which support the GUH membership value proposition. Her new role will have a key focus on recruiting, retaining and engaging members.

Jacqui Taylor has been appointed as a finance director, a position in which she will be responsible for driving commercial strategy design, development and delivery of board reporting and oversight of governance for the GUH.

Jacqui is a qualified chartered accountant with more than 20 years of experience, both in professional services and private industry, having held senior roles across a variety of sectors including upstream oil and gas, oilfield services, renewables, salmon farming, charities, and hospitality. She has worked with businesses of varying sizes and been involved at all stages of the business life cycle from growth through to restructure.

To support the GUH's continued expansion, Trish Banks has been promoted to the role of operations director, having previously played a key strategic role in the growth of Subsea UK and its transformation into the GUH.

Trish is responsible for establishing and managing the organization's membership and also events, which have now become key diary dates in the subsea calendar such as Subsea Expo – the world's largest subsea exhibition and conference, Underwater Robotics – the world's first ROV conference, the popular 'Energise Your Future' program for young talent, and the Subsea UK STEM Challenge.

The three appointments will strengthen the GUH as it works across all sectors of the industry, providing underwater companies with the market information, connections, access, and specialist expertise they need to capitalize on the opportunities presented by the energy transition and the blue economy.

Neil Gordon, the chief executive of the GUH said: "It's an incredibly exciting time to be a part of the underwater industry and this new organization. This trio of strong appointments will underpin the GUH's delivery model as it extends its services to and reach into the underwater industry. Kirstin, Jacqui and Trish bring experience and specialist expertise to their respective roles.

"With rapidly growing global markets and a world-leading position, the UK's underwater industry has what it takes to grow exponentially and the GUH has been established to ensure that it reaches its full potential, increasing company growth, jobs and exports.

"The world is demanding change and, in helping bring that about, we can gain economic advantage not just for the industry, but for the country as a whole."

"With the team's wealth of knowledge, the GUH is uniquely positioned to connect companies and sectors with the market opportunity to deliver the underwater solutions of the future."

The GUH will harness opportunities in global markets, create a step-change in the growth and internationalization of UK underwater expertise, technologies, services and skills, and drive innovation to accelerate the energy transition and capitalize on the blue economy.

GREENSEA APPOINTS VICE PRESIDENT OF BUSINESS DEVELOPMENT – DEFENSE

Greensea, creator of OPENSEA®, the universal open architecture software platform for the marine industry, announces the hire of Paco Santana as Vice President of Business Development - Defense. Paco will immediately begin connecting with and developing relationships with current and future military partners.

"Paco brings a breadth of experience to Greensea having served in the US Navy, as well as having worked with some of the best-known companies in the marine industry," said Ben Kinnaman, Greensea CEO. "Who better to support our military customers than someone who truly understands the challenges and risks that they face? We are excited to have someone who is well regarded within this industry to lead our efforts in this area. I have known Paco for years and am truly honored to have him join the team."

Paco joins Greensea after serving as a Commander in the US Navy for more than twenty-two years. He previously held Business Development positions at VideoRay, iRobot, and Riptide.

"I joined Greensea because of their commitment to the EOD and SOF communities," he said. "I want to be able to serve and support the military communities that are an integral part of who I am as a person. I am also excited to help Greensea meet all their future objectives."

Greensea provides advanced open architecture software solutions, program support, and research and development for EOD and SOF Technologies.



» Paco Santana joins Greensea



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SPARROWS GROUP ABU DHABI FACILITY AWARDED API Q2 CERTIFICATION

Sparrows Group, the engineering and maintenance services specialist for the international energy and industrial sectors, has been awarded API Specification Q2, 2nd Edition by the American Petroleum Institute (API) following a successful audit. The Abu Dhabi facility is the second of Sparrows' global locations to achieve the API Q2 industry stamp of approval.

The quality assurance certificate is the leading standard for drilling service providers in the offshore energy sector and is only awarded to facilities that can demonstrate the highest quality of outcomes including competency of personnel, systems and processes. Following an update of the standard by API in 2021, Sparrows is the first international company to receive the second edition certification.

The award comes at a pivotal time for the company, which recently announced significant investment in its Middle East facilities, including increasing both its footprint and headcount in Abu Dhabi. The decision to expand their facility was in part due to a clear demand and uptick of drilling activity in the region where around 20% of the company's ongoing work is drilling related.

Stewart Mitchell, CEO at Sparrows, said: "This award is a true reflection of the success of our internal processes and our personnel at the Abu Dhabi facility. We recently invested in the region by opening a significantly larger operational base with the aim of offering our customers enhanced service capabilities in-country, including drilling equipment maintenance, at the very highest standard."

"Achieving this significant and incredibly important industry standard is just one of many ways that we can demonstrate commitment to our customers, the region and our people."

The award is one of two API Q2 certifications Sparrows holds, having achieved the standard at its Singapore facility in 2019.

Sparrows has been operating in Abu Dhabi for over 20 years and employs approximately 400 people in-country. The company also has facilities in Saudi Arabia and Qatar offering Sparrows full range of capabilities including specialist engineering, inspection, operations and maintenance services, and offices in Dubai.



TENDEKA APPOINTS NEW BUSINESS DEVELOPMENT MANAGER FOR CANADA

Global completions specialist Tendeka has appointed a new business development manager for Canada to accelerate interest in its technologies across the country.

Marc Carriere will be tasked with raising the profile of Tendeka's innovative technologies such as FloSure, FloFuse and PulseEight EAV across North America.

He previously spent 18 years with Baker Hughes where he took on the role of Innovation Director for Canada. Ahead of joining Tendeka, he worked at Endurance Technologies as manager of corporate services.

Mr. Carriere has vast experience in leading sales integration efforts and an extensive background with completion systems in the Canadian oil and gas sector. Working across artificial lift, completions, drill bits, drilling services, and wireline, he has developed strategies for Canadian market growth across product lines, identified key development areas and aligned teams around customer satisfaction. His prior experience also includes six years

of field work based in Grande Prairie, Alberta.

Mr. Carriere said: "I'm pleased to be joining the company and help drive sales efforts across Canada. Tendeka has so many exciting technologies which can have a real impact on operators in terms of driving down costs and creating efficiencies. I look forward to working alongside this talented team to bring more of these solutions to the market."

Jim McGowin, Vice President for North and South America at Tendeka, added: "Marc is vastly experienced and has built up a large contact base in Canada, which will be important for us to introduce more of our technologies to local operators. I'm pleased to welcome Marc to the team."



» Marc Carriere

AQUALISBRAEMAR LOC GROUP COMPLETES OSD-IMT ACQUISITION

Energy and marine consultancy AqualisBraemar LOC Group (ABL Group) has successfully completed the acquisition of the UK operations of ship design and marine consultancy company OSD-IMT from Damen Shipyard Group.

OSD-IMT is a specialist consultancy in ship design for newbuild, refit and conversion projects. The company operates in all key marine markets—including the renewables, maritime, defense and oil and gas sectors. Its expert knowledge covers a broad selection of vessel types and a wide range of technologies, including design and engineering for alternative fuels. The company in particular specializes in newbuild construction, support and supply vessels for the offshore energy industry, dredger and dredging support vessels, and marine survey vessels.

OSD-IMT, which has launched more than 150 designs to date, will become part of

ABL Group company Longitude Engineering, which specializes in marine operations engineering and marine design, conversion and upgrade of specialized vessels. Further, Longitude has a solid track-record in the design and development of clean shipping technology, with expertise in hybrid-propulsion, LNG and hydrogen fueled-vessels.

"Our plan is to combine OSD-IMT's ship design track record with Longitude's specialist expertise in marine design, consultancy and operations. While OSD-IMT have traditionally focused more on newbuild ship design, Longitude's legacy is rooted in specialist consultancy services including advanced analysis, hybrid power systems and procurement support. The combination is an excellent match," said Jake Anderson, Group MD for Engineering Services at ABL Group and managing director of Longitude Engineering.



"With maritime decarbonization accelerating into focus, bringing together OSD-IMT and Longitude's portfolios in alternative fuel-powered vessel design, will significantly reinforce our offering to support a wide range of maritime stakeholders on the path to net-zero," added Dean Goves, Managing Director Maritime.

Longitude Engineering specializes in independent engineering, design and analysis for renewables, maritime, defense, oil and gas and infrastructure market sectors. It primarily supports clients with marine operations engineering and marine design, conversion and upgrade, supporting marine projects and assets throughout their development lifecycle.

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» North Star's SOV fleet. (Image credit: North Star)

SCOTLAND-BASED NORTH STAR BEING ACQUIRED

Partners Group, a leading global private markets firm, has agreed, on behalf of its clients, to acquire North Star (the "Company"), an operator of specialized vessels that offer emergency response and rescue as well as essential offshore wind maintenance services, from Basalt Infrastructure Partners.

Headquartered in Aberdeen, Scotland, North Star is an established infrastructure company with a fleet of 48 Emergency Response and Rescue Vessels (ERRVs) and Service Operation Vessels (SOVs) and around 1,400 employees. North Star's ERRV fleet is the largest in Europe and provides essential crew rescue, firefighting, and other emergency response services to offshore energy operations in the North Sea.

North Star is also the leading UK provider of SOVs which are used to transport technicians to offshore windfarms and accommodate them for extended periods of time. North Star has strong infrastructure characteristics with an asset-heavy business model and predictable cash flows, supported by the mandatory usage of ERRVs and long-term contracts in the offshore wind sector. The Company is set to benefit from rising demand for SOVs due to structural growth in the offshore wind industry, which is being driven by global decarbonization trends.

Partners Group aims to transform North Star into a leading pan-European next generation offshore wind infrastructure services company, which reflects the firm's focus on investing with sustainability factors in mind. Partners Group will work with management on a transformational value creation plan that will expand the Company's platform through growing its offshore wind fleet and broadening its offshore wind offering.

David Daum, Managing Director, Private Infrastructure, Partners Group, said: "North Star represents an excellent opportunity to acquire a leading energy infrastructure services business that is well-positioned to capitalize on the transformative trends driving growth in the offshore wind industry. The Company provides mission critical services and benefits from steady demand due to high barriers to entry and few direct competitors. We have extensive experience in the offshore wind sector and North Star is a great fit for our platform-expansion strategy. We look forward to working with Matthew and the team."

Matthew Gordon, Chief Executive Officer, North Star, commented: "We have over 50 years of operating experience and maintain a market leading position for both ERRVs and SOVs. Looking ahead, servicing the offshore wind industry represents a huge growth opportunity for us as the decarbonization of economies gathers pace. Partners Group's operational expertise in that industry will be very valuable as we expand into new offshore wind markets in Europe, which are experiencing similar tailwinds to those in the UK."

Nicholas Pepper, Member of Management, Private Infrastructure, Partners Group, added: "The provision of mission critical offshore infrastructure services is a subsector within renewables that we have been tracking through our thematic sourcing approach. Demand for SOVs is being driven by the construction of larger wind farms further from shore, which makes daily maintenance trips inefficient. North Star's home market of the UK, the largest offshore wind market globally, is expected to account for a large proportion of future offshore wind capacity, providing the Company with a good springboard for growth internationally."

EIVA RELEASES ENTRY-LEVEL HYDROGRAPHIC SURVEY SOFTWARE VARIANT

EIVA's NaviSuite Kuda Core provides advanced hydrographic survey software capabilities at an entry-level price. Tailored to support hydrographic surveys using a single USV or small survey vessel outfitted with a multi-beam echosounder (including backscatter), LiDAR and/or camera, this software solution is designed to be simple to configure and run, affordable for entry-level survey professionals, and provide advanced hydrographic survey features from NaviSuite Kuda software, for example enabling autonomous operations.

Thanks to EIVA's decades of experience developing and delivering hydrographic survey solutions, not only does the NaviSuite Kuda software yield high quality and deliverable 3D model results quickly, but users can improve the efficiency of their surveys with software tools for remote operations (including autopilot route planning and onboard processing); real-time optimization of survey area coverage; automatic data cleaning; automatic data processing workflows; patch test for multi-beam calibration; easy registration and classification of observations.

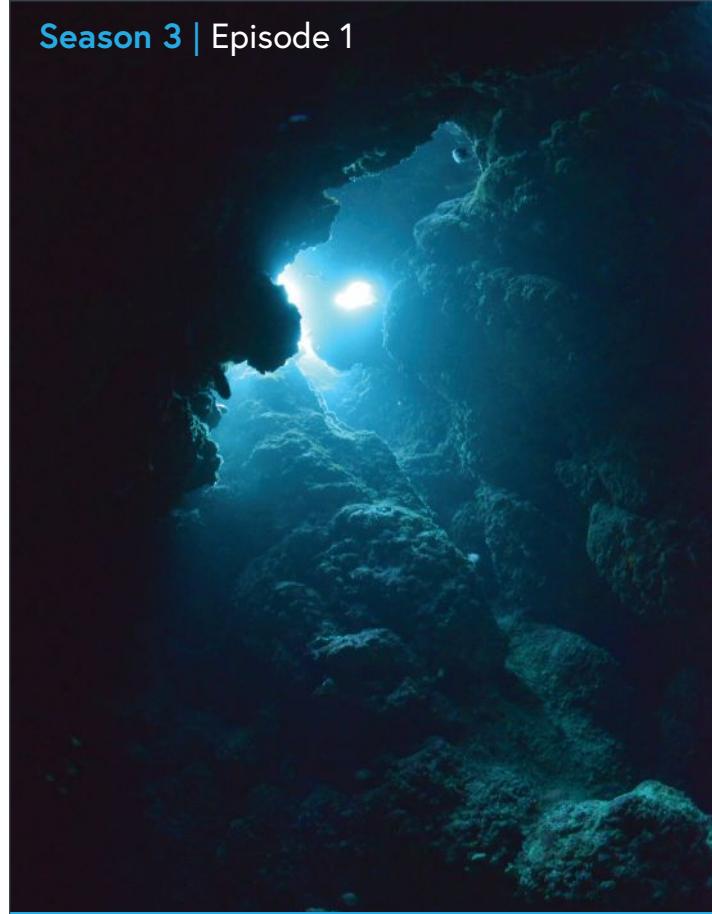
In addition to the new entry-level variant, the list of bundle variants includes NaviSuite Kuda Pro, which supports more complex survey spreads at a reduced price, and + Processing variants, which

provide advanced data processing tools. Since these variants are all part of one big NaviSuite family, users can upgrade between different variants if they scale up operations, meaning it's possible to go from a single vessel setup to a large network installation—without changing software.



» NaviSuite Kuda Core has been designed to support surveys using a single USV or small vessel. (Image credit: EIVA)

Season 3 | Episode 1



Exploring the Deep

Guest: Dr. Brennan Phillips

Dive into the deep with 2022's first episode of SeaState, ON&T's podcast—Available now!

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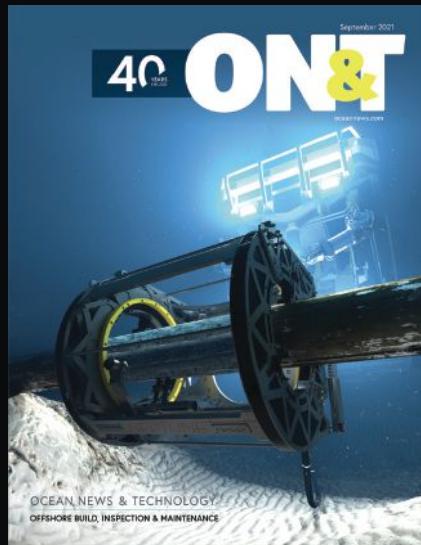
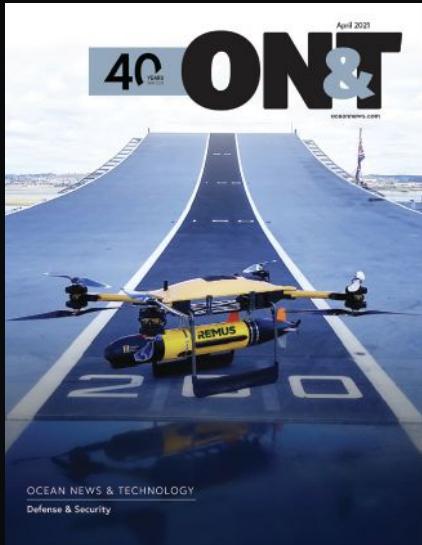
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SeaRobotics Corporation, headquartered in Stuart, Florida, specializes in the engineering and manufacture of intelligent marine robotics, including crewless survey vehicles. Clients include major military and commercial organizations, both U.S. and foreign. Applications for SeaRobotics ASVs range from bathymetric and hydrographic surveys to coastal, harbor, and riverine surveillance. In addition to an expanding line of ASVs, SeaRobotics also designs and builds hull and tank bio-inspired underwater grooming and cleaning systems, as well as a variety of scientific sampling equipment such as box and push corers and suction samplers.

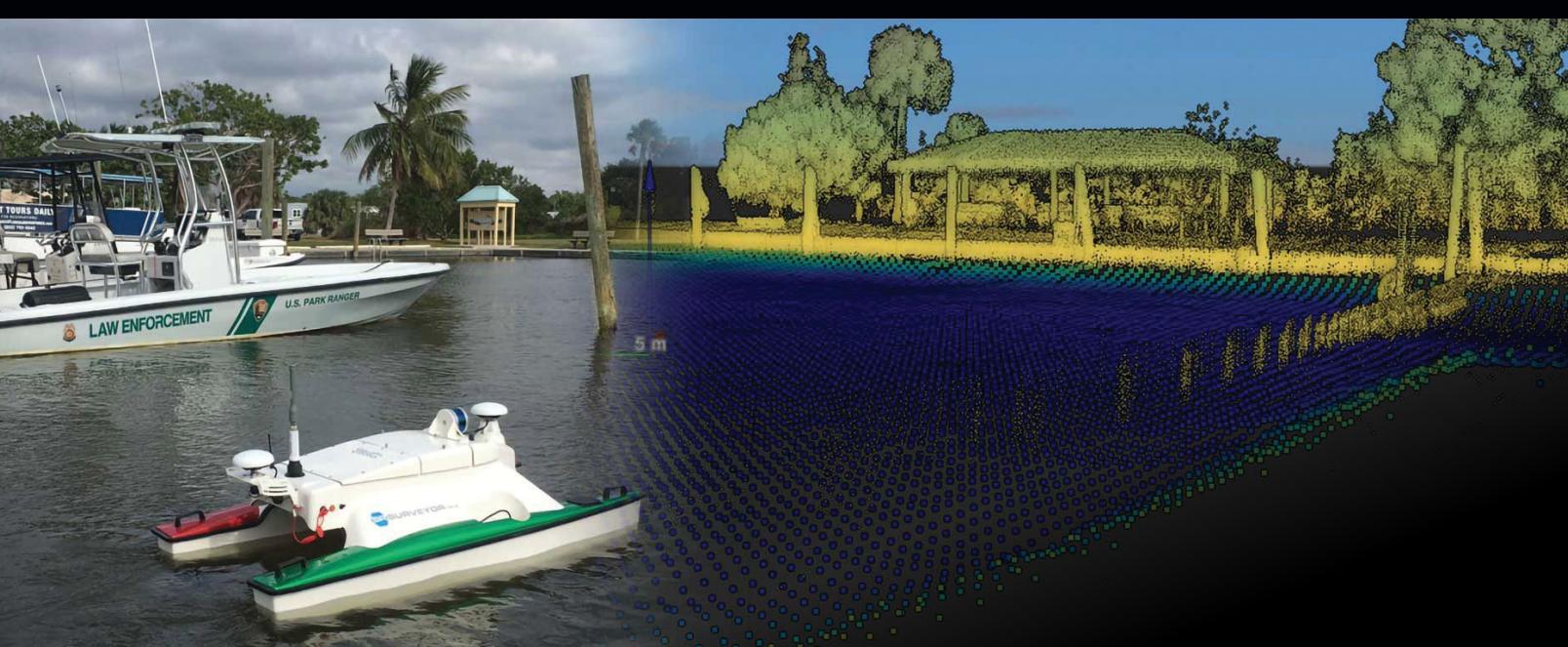
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