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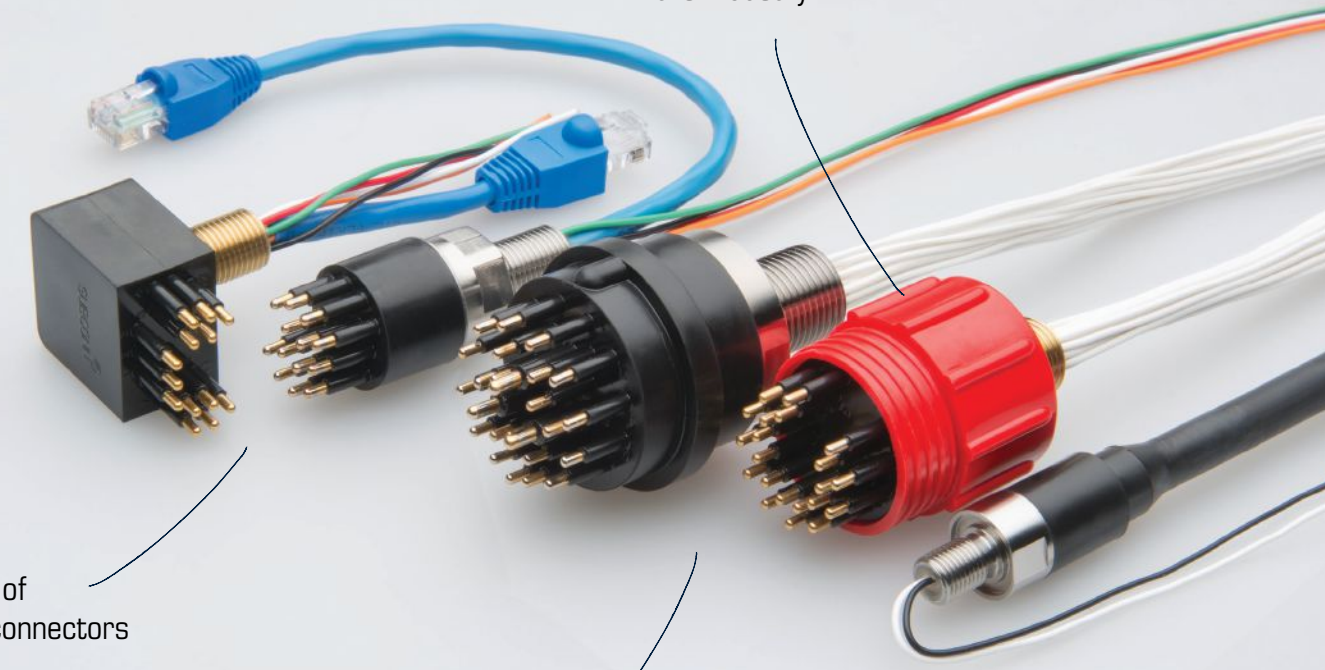

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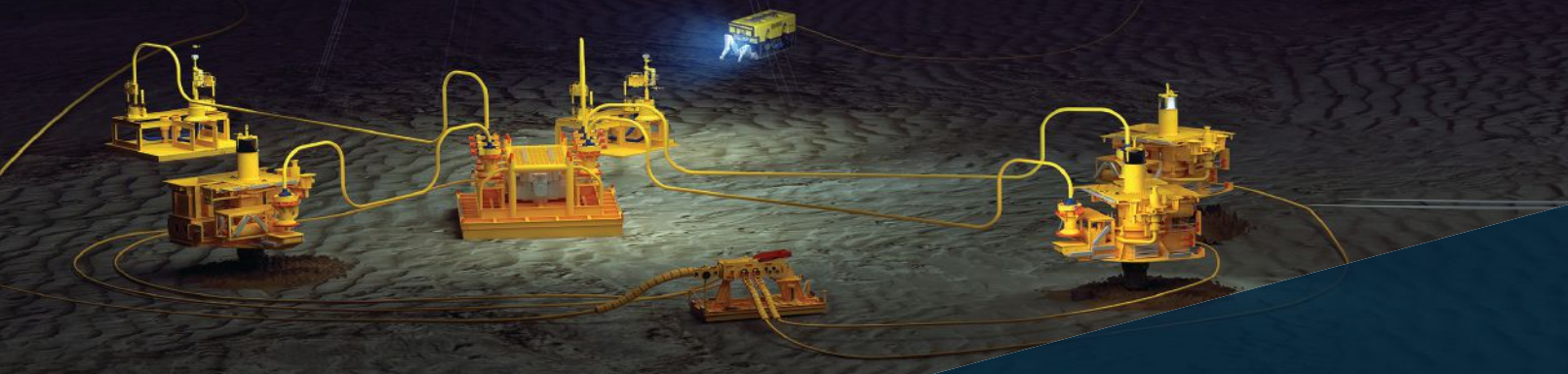

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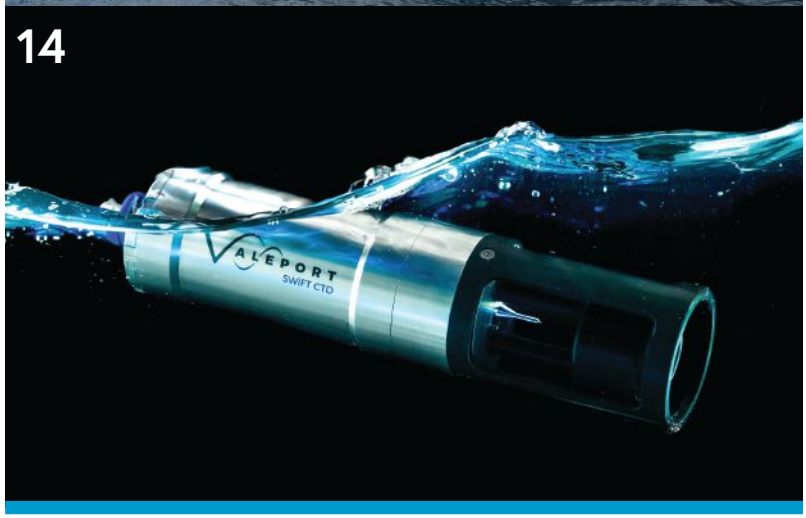

FEATURES & SPOTLIGHTS

DEPARTMENTS

IN EVERY ISSUE

ON THE COVER:
Cannons to corals: The LULA100 submersible examines how the wreck of a German U-581, sunk off the Azores in 1942, is slowing transforming into an artificial reef at a depth of 870 meters. (Photo credit: The Rebikoff Foundation)

[WITH THANKS - Ed.]

Submersible technology, whether for scientific discovery or subsea exploration, represents the pinnacle of subsea engineering. These underwater vehicles not only afford us unforgettable immersive experiences, but also act as critical assets for marine data capture. In short, they help propel our understanding of the oceans.

This month's line-up of guest contributors includes some of the leading names in developing this market. Our thanks go to the Rebikoff Foundation, Nortek, SubCtech, and Valeport for their expert insights. We also thank SENEDIA and UTIC for shining a spotlight on the submarine shipbuilding and undersea technology defense industry ecosystem, in this issue's exclusive defense feature.

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Ed Freeman

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WHERE WILL WE GO NEXT?

BY ANNA MICHELE,
Chief Scientist at WHOI's National Deep Submergence Facility

& ANDY BOWEN,
Director at WHOI's National Deep Submergence Facility

After 57 years and more than 5,000 dives (more than all other research submersibles combined), it's easy to forget that *Alvin* made some of the most iconic discoveries in ocean science and exploration while confined to a maximum depth of "only" 4,500 meters. Even within that limited range, which put roughly two-thirds of the world's seafloor within reach, *Alvin* enabled some remarkable discoveries and supported the development of novel sensors. Soon, *Alvin* will have a new, deeper limit of 6,500 meters. When it does, nearly 99% of the seafloor will be within reach and it's only natural to wonder: What will *Alvin* show us next?

UPGRADED FOR DEPLOYMENT

Since it was constructed in 1964, *Alvin* has gone through many changes. Today, the only thing that remains of the original submersible is the name and the knowledge that has been handed down through generations of engineers and pilots within the Alvin Group that operates and maintains the sub. In 2013, during one of *Alvin*'s regular maintenance periods, its titanium personnel sphere was replaced with a new, stronger sphere and roughly 70% of the sub's other systems were upgraded to 6,500 meters. When *Alvin* returned to Woods Hole, Massachusetts at the start of the COVID-19 pandemic, the Alvin Group began the final steps in that upgrade.

But in a way, those technical challenges are only a fraction of the daunting task facing anyone who wants to dive in *Alvin* or in any of the world's human-occupied submersibles.

CHARTING THE UNCHARTERED

The real challenge is largely one of imagination and curiosity: Where do we go and what do we look for? Carrying people into a world that is so hostile to life on the surface will always carry risks, but doing so has reaped incalculable rewards. It has revealed the inner workings of our planet, as well as the ability of life to sustain itself and even thrive under seemingly impossible conditions. *Alvin* has even dared us to imagine how life might exist beyond Earth by expanding our view of the spectrum that encompasses life here at home.

And now we're poised to step off into another world entirely. What will Alvin show us next? Based on *Alvin*'s history, we have little idea other than to know it's likely to be astonishing. We have hypotheses and we have a fantastic exploration tool at our disposal—one that has stood the test of time, changed with the times, and yet remained consistent in its mission to challenge us and to show us more about our planet than we ever imagined. The choice is ours. Where will we go and what will we find?

WOODS HOLE OCEANOGRAPHIC INSTITUTION

» *The LULA1000 is the only deep diving HOV in the world operable from a support vessel as compact as the 17-m long ADA REBIKOFF. (Photo credit: Fred Buyle/Rebikoff Foundation)*

THE REBIKOFF SYSTEM: A WORLDWIDE UNIQUE SYSTEM FOR OCEAN AND DEEP-SEA RESEARCH AND EXPLORATION

By Kirsten Jakobsen & Joachim Jakobsen,
LULA1000 Operations, Rebikoff Foundation

The REBIKOFF SYSTEM consists of a 17-meter catamaran, the ADA REBIKOFF, and the LULA1000 submersible (depth rated to 1,000 meters for a crew of up to 3).

The ADA REBIKOFF was specifically designed as a diving vehicle carrier and bathymetric survey vessel. The vessel has been used for multibeam and sidescan surveys and as support vessel for submersible missions during the past 12 years by the Rebikoff-Niggeler Foundation (www.rebikoff.org), in the Northeast Atlantic, namely the Azores and Madeira Archipelagos. But its versatility and possible uses go way beyond this.

The vessel can also easily be used for wreck search and recovery. The precision sidescan equipment allows for high-res acoustic imagery at depths up to 900 meters. She is also an ideal tool for scuba diving or ROV operations, or for any kind of missions that require the collection of oceanographic data or samples. The huge workspace can host an additional cable winch and a work class ROV (with all its accessories) or be used for lab space.

With the moon pool between the hulls and a 10-ton hoisting system, deployment, recovery, and transport of a human occupied diving vehicle (HOV), ROV or AUV is an easy and safe task. The vessel only needs a crew of two to operate, making coastal or oceanic research accessible to research groups without mega budgets.

The vessel is equipped with an ELAC multibeam sonar system for bathymetric surveys to 3,000 meters, a motion sensor, sidescan sonar with magnetometer, and a winch with 2,200 meters of cable, a USBL tracking system, and voice communication system for the underwater vehicle, and a workshop with lathe, milling machine, welding equipment, stock of spare parts, etc.

SIZE MATTERS

Though only 17 meters in overall length, the ADA REBIKOFF is perfectly engineered to carry the 1,000-meter depth rated LULA1000 submersible onboard, which has full DNV classification for a crew of 3. In this unique combination, the LULA1000 is the only deep diving human occupied vehicle (HOV) worldwide operated from a support vessel only 17 meters in length.

Working with a HOV this size usually requires a much larger vessel and crew, heavier logistics, and weightier budgets. The REBIKOFF SYSTEM can be kept small, safe, and simple because the LULA1000 is

launched in port, between the catamaran's hulls, and towed to the dive site. Between harbors, the submersible is transported onboard the ADA REBIKOFF. At the dive site, the submersible crew is brought to the sub with a dinghy, and the catamaran stays near the dive spot for communication and tracking. The submersible could easily be replaced by a ROV or AUV, or the moon pool be used for scuba diving or wet lab activities.

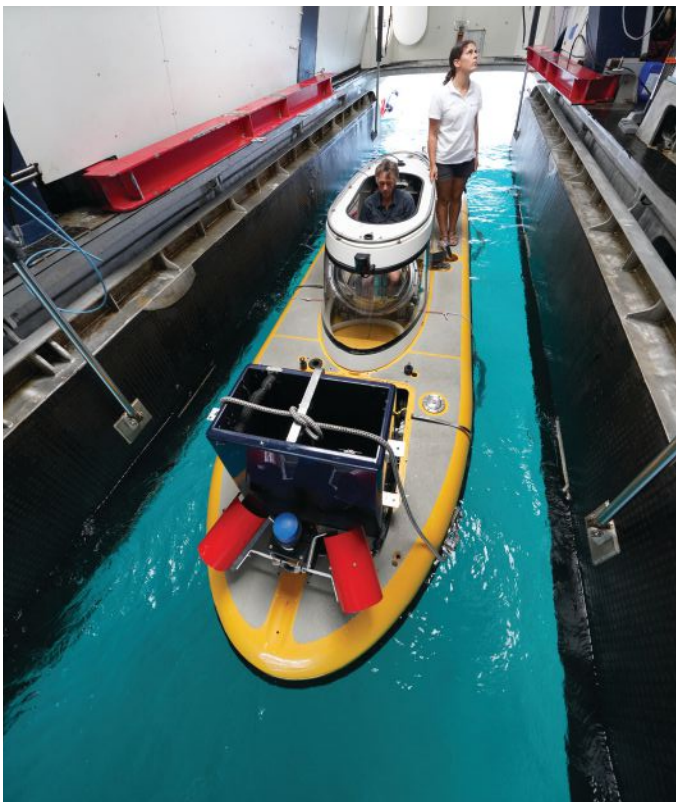
A LEGACY OF EXPLORATION

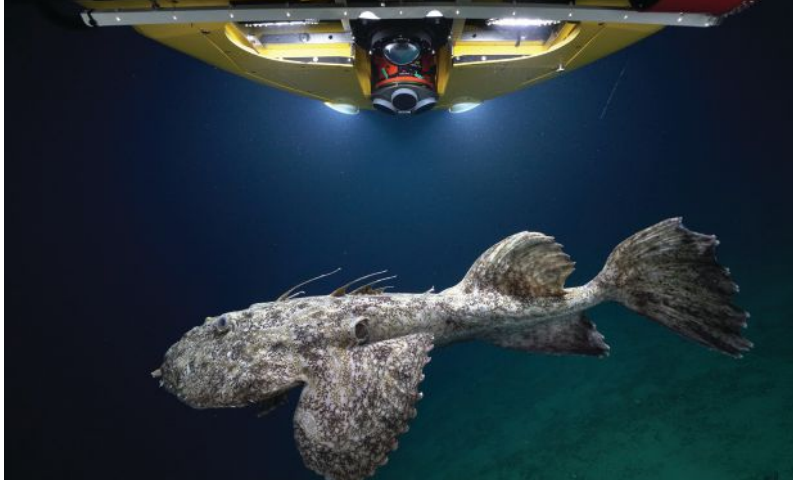
Dimitri Rebikoff and his wife Ada were pioneers in developing diving technology (1948-1990). Today, the Rebikoff Foundation reflects 70 years of experience in technical development. The primary goal has always been to find simple solutions to complex projects. This principle has guided the Rebikoff Foundation through the last 20 years of safe and incident-free deep diving.

Working in the Azores often means operating in rough sea conditions, and the 8-ton LULA1000 is often transported long distances aboard the ADA REBIKOFF. The catamaran also serves as a platform for any necessary maintenance work on the sub.

The vessel can accommodate 8 people during multi-day missions. Battery charging and refilling of the submersible's air tanks can easily be done at open sea. During longer missions, the time allocated for re-charging is usually used for multibeam surveys and processing of the multibeam data, so previous bottom characterization using a fine-scale bathymetric map helps define the dive transect for the next day(s).

To date, the REBIKOFF SYSTEM has successfully completed multiple scientific, technological, and natural heritage expeditions—some lasting five days or longer—in collaboration with prestigious research institutions. By tracking submerged slopes and seamounts, the LULA1000 has already helped significantly advance the knowledge of oceanic ecosystems in the fields of marine biology, habitat mapping, archaeological research, and contributed to wildlife studies and ocean filming





» *Depth rated to 1,000 m, the LULA1000 has been instrumental in the documentation of unique marine ecosystems and species. (Photo credit: Rebikoff Foundation)*

for several groundbreaking nature documentaries.

SEABED DISCOVERIES

Seabed mapping activities in the Azores and Madeira have led to the discoveries of coldwater coral reefs, sponge fields, coral gardens, or other vulnerable marine ecosystems, and never-before documented species.

Experimental structures for coral restoration, bioerosion projects and for longtime studies on abyssal unicellular organisms have also been deployed and recovered.

A sunken WWII German U-boat was located and documented resting at a depth of 870 meters, first using the onboard multibeam and sidescan sonar systems, and then doing ground-truthing dives with the LULA1000 submersible. Some discoveries have made headline news around the globe.

Images have been collected and used for the most ambitious and groundbreaking wildlife series, such as six gill sharks feeding on a whale carcass for the BBC´s Blue Planet II. Other iconic images have also been used in the final editing of the BBC´s Atlantic series, Netflix's Our Planet, National Geographic's Hostile Planet, and iTV´s Life at the Extreme.

Ocean research does not necessarily have to be exclusive to major research institutions and those that can afford to operate large oceanographic vessels. Arquipelagoes, or coastal regions with ocean research and management responsibilities, may need to operate a research infrastructure without access to major budgets. A research vessel needs to be appropriately dimensioned according to its pre-defined mission profile, considering the specific research demands that determine the kinds of equipment needed onboard and in what sorts of sea conditions the vessel needs to operate in, etc.

SMALL DIMENSIONS, BIG ACHIEVEMENTS

It is all too easy to overestimate the scale of research vessel required, leading to an avoidable hike in operating costs for crew, maintenance, supplies, insurance, administration etc. This ultimately renders the whole system less flexible. And then, inevitably, the vessel easily ends up spending more time moored in the harbor rather than doing work at sea.

The solution is to "think small, achieve big": Operating the highly reliable and compact REBIKOFF SYSTEM in recent years has consistently proven that first-rate ocean research is possible at a fraction of the cost normally associated with level of quality of marine research.

» *LULA1000 is launched in port, between the catamaran's hulls, and towed to the dive site. (Photo credit: Rebikoff Foundation)*

» *The NMEA 2000® certified SmartBoat system. (Photo credit: Airmar)*

AIRMAR'S SMARTBOAT® SYSTEM PROVIDES INTEGRATED NETWORK AND DEVICE MANAGEMENT

AIRMAR® Technology Corporation has launched their new SmartBoat® system, a groundbreaking vessel-management solution for all marine-sensor protocols and network types. The NMEA 2000® certified SmartBoat system offers a highly configurable sensor interface, supports a wide range of sensors and protocols, and provides remote discovery, management, programming, and wireless features. These unprecedented capabilities significantly reduce the equipment, protocol-conversion devices, cabling, complexity, and labor costs associated with conventional networking products, saving thousands on every install.

"All onboard sensors, such as switch-input, run-time, current-loop devices, thermistors, thermocouples, resistive-sender units, DC voltages, fuel-flow monitors—even engine data—can be connected to a SmartBoat module, which converts their protocols to NMEA 2000. This eliminates the need for over half of the NMEA 2000 protocol-conversion devices and cabling used in a typical installation," said Jennifer Matsis, Airmar's VP of Sales and Marketing. "By interfacing directly to sensors, there's no need for numerous expensive single-sensor modules."

Once the SmartBoat module is connected, the status of all connected sensors can be easily accessed. Airmar's SmartFlex® View is a browser-based tool enabled in each module and accessible directly from any laptop, tablet, mobile device, or via Airmar's CAST™ app. Features within SmartFlex View include SmartFlex® Alert, a comprehensive alert configuration system. Alerts can be custom defined based upon NMEA 2000 message-field values, timers, and counters, and can be combined as needed. Also, SmartFlex® Filter can be used to control PGN message traffic between the primary and secondary NMEA 2000 buses.

All models in the SmartBoat system share a common set of features, including built-in wireless networking support and browser-based configuration (SmartFlex View) and NMEA 2000 support. They can also be configured as wireless-access points, clients, or both, allowing full flexibility with other external networks on the boat. Advanced SmartBoat models support multi-network bridging and management such as multiple NMEA 2000 networks, NMEA 0183, SAE J1939 engine interfaces, and digital sensors.

SmartBoat modules are designed to meet the needs of marine electronics installers and boatbuilders, with features like quick-disconnect terminal blacks for prewiring, full electrical isolation of each bus, remote access through connected networks, built-in configuration and diagnostic tools, and the ability to easily back up and clone modules for duplication on the next install. All SmartBoat modules are rated IP67.

SmartBoat modules will be available by the end of 2021.
www.airmar.com

XOCEAN TRANSFORMING MARKET WITH €8 M INVESTMENT AND AMBITIOUS CARBON REDUCTION PLANS

XOCEAN has received an €8 m investment to accelerate its growth and deliver its exciting ambitions of driving down emissions in the offshore industry and is delivering on its sustainability goal of displacing the emission of one million tons of carbon.

Having tripled its revenue growth for two consecutive years, XOCEAN is no longer just an industry disrupter but a serious contender within the market. The new funding will see XOCEAN continue to scale up operations and increase headcount from over 100 staff to 350 in the next 24 months whilst tripling the size of their fleet to over 60 Uncrewed Surface Vessels (USVs).

The company uses its proprietary marine robotic technology to collect ocean data sustainably across a range of industries including Offshore Wind. Already a key player in the market, XOCEAN has successfully delivered over 100 projects accumulating over 35,000 hours of operation.

STUDY REVEALS VESSELS USING JOTUN HPS REPORTED 20% LOWER CARBON INTENSITY

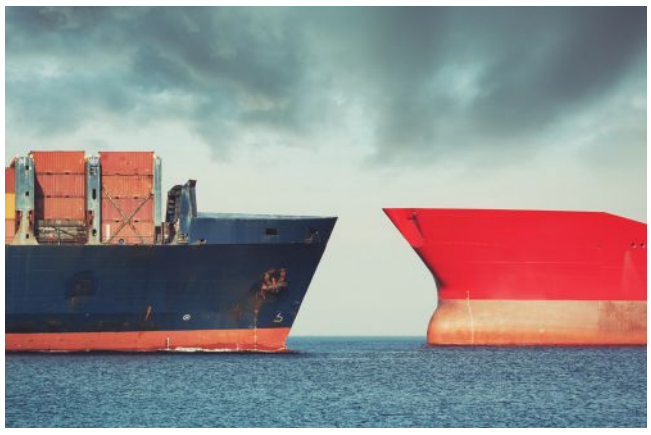
A new Jotun study based on European Union Monitoring, Reporting and Verification (MRV) data has revealed that cargo vessels using Jotun's Hull Performance Solutions (HPS) reported a 20% lower carbon intensity in operations when compared to non-HPS peers in 2019 and 2020.

The study carried looked at all major cargo vessel types, including bulk carriers, chemical tankers, and oil tankers, with a dataset of almost 9,000 vessels, and the emissions report was verified by accredited parties.

The Carbon Intensity Index (CII)—set to be implemented by the IMO in 2023—focuses on the yearly reduction in emissions during operations. So, vessel owners cannot simply rely on the "out-of-dock" effect of a hull maintenance. They need a reliable and effective antifouling solution that will perform consistently throughout the service interval. Maintaining a cleaner hull with minimal fouling means a vessel creates less friction when sailing through water. Consequently, less power and fuel are required for the same speed, and this directly reduces the amount of carbon dioxide released.

Jotun recognized the owners and operators of these vessels for their efforts in leading the shipping industry towards decarbonization. "Vessels using Jotun's HPS typically have farsighted owners and operators that are willing to invest to achieve the most efficient operations," said Stein Kjolberg, Global Category Director for Hull Performance at Jotun. "The fact that fuel savings translate directly into lower carbon emissions will further add to the return on investment in that stakeholders in the shipping industry will more strongly prefer and reward vessels with lower carbon emissions moving forward."

While there are multiple ways to reduce the carbon intensity of operations, fouling protection is perhaps one of the most important and easiest to take advantage of and is already part of every maintenance docking.



» *Sofar's interface shows currents and other ocean conditions. (Image credit: Sofar Ocean Technologies)*

SOFAR OCEAN DEBUTS MARITIME OPEN STANDARD, BRISTLEMOUTH

Sofar Ocean Technologies, the world's largest real-time ocean intelligence platform, has introduced a new marine hardware standard, Bristlemouth, aimed at catalyzing more collaboration, research and innovation for big data from the oceans.

Sofar CEO, Tim Janssen, joined partners from the Office of Naval Research (ONR), Oceankind and others to unveil Bristlemouth and its full-stack capabilities for ocean sensing, discovery, and intelligence. Potential applications of Bristlemouth range from climate science research and extreme weather forecasting to commercial sectors including global shipping and insurance.

"While big data on land and in space have grown rapidly through standardized methods, economies of scale and distributed sensor networks, the ocean remains largely unmapped and unexplored, due to a lack of scalable ocean sensing strategies," said Mike Wardlaw, Program Manager at the Office of Naval Research. "We believe Bristlemouth solves that gap and will enable increased levels of data from the oceans that will in turn accelerate growth in marine technology and applications, empowering an ecosystem of innovation and cross-industry collaboration."

Traditionally, ocean discovery platforms and sensors require customized components and protocols, making integration efforts costly and difficult and ultimately, creating a barrier to scaling innovation. The launch of the Bristlemouth open standard unleashes a low-cost connector, interface module and application protocol to deliver true flexible inter-connectivity. Its compact, ocean-proof design functions at full ocean depth for long dwell deployments and delivers hundreds of watts and up to hundreds of megabits per second of data, providing critical insights into the unexplored depths of our oceans.

"With the availability of low-cost IoT hardware, advances in battery and photovoltaic technologies, and development of alternative satellite communications, scalable ocean sensing is already within reach," said Evan Shapiro, CTO at Sofar Ocean. "Until now, what has been missing is a full-stack connectivity standard. We developed Bristlemouth in response to the gaps in ocean sensing connectivity and are providing new components and third-party sensor packages to make it frictionless."

"At the end of the day, building a more sustainable future requires collaboration, integration and greater transparency into our oceans, which drives most of our climate," said Tim Janssen, CEO and co-founder of Sofar Ocean. *www.sofarocean.com*

THE SWiFT CTD: TECHNOLOGY AND INNOVATION SIMPLIFYING CTD DATA COLLECTION

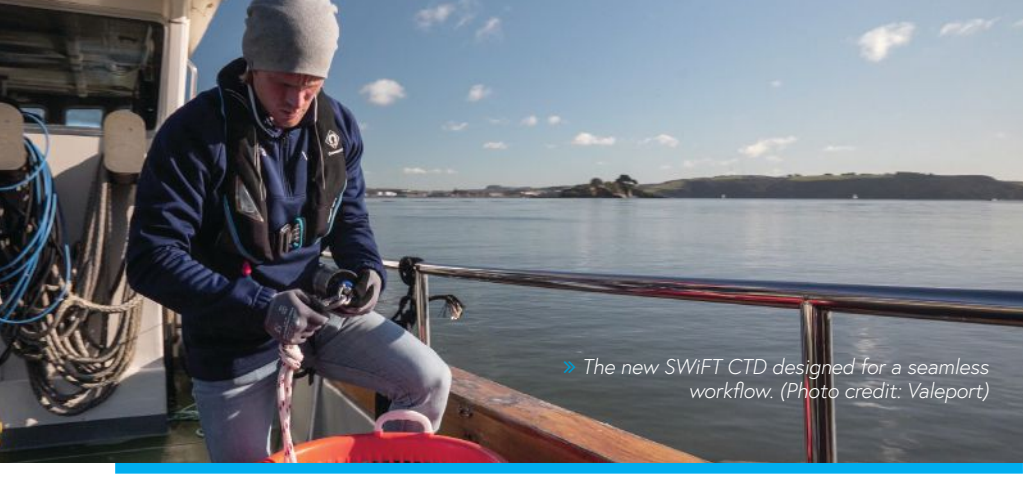
By Guy Frankland,
Head of Marketing, Valeport Ltd

Oceanographers have relied on CTD devices for decades, as differences in salinity, temperature and depth are recognized as the primary parameters distinguishing water masses. What is probably the most commonly used instrument by oceanographers, has now been evolved to make it not only easier to use, but also to deliver direct measurements for those requiring measured Conductivity, Temperature and Depth data.

Valeport introduced the new SWiFT CTD in 2021 in response to market demand, and it is the next generation in the SWiFT profiler range which provides survey-grade sensor technology coupled with the convenience of **Bluetooth®** wireless technology, rechargeable battery, and an integral GPS module to geo-locate each profile.

Ease of use is at the heart of the SWiFT range and every profile the SWiFT CTD produces is time-stamped and geo-located without the user having to log positions manually or cross-reference with another GPS source. The SWiFT CTD makes any problematic battery changes a thing of the past as there is no need to open the instrument to replace the battery. The easily rechargeable battery can provide up to five days operations fully charged and a one-hour fast charge will typically give 12 hours operation. Delivering fully automated data transfer with no user input required, the SWiFT CTD features Valeport's signature SWiFT magnetic switch ring. The switch ring is easy to operate even with cold or gloved hands, it simply turns through 90 degrees and reassuringly clicks into position. The end cap features user-friendly LED status indications for operational status, GPS, battery, and **Bluetooth®** communications.

With **Bluetooth®** connectivity the SWiFT CTD doesn't need to be plugged into a cable to be configured or to download data, instead data can be quickly and easily downloaded wirelessly, and uses Valeport's new Ocean software Windows and Connect Pathway Edition for iOS and Android. The CTD data can then be easily instantly shared in industry standard data formats.



» *The new SWiFT CTD designed for a seamless workflow. (Photo credit: Valeport)*

» *Made from titanium the SWiFT CTD and CTDplus deliver the highest quality profiles in a compact, robust, and portable package. (Photo credit: Valeport)*

HIGH PERFORMANCE, HIGH PRECISION

Using Valeport's world-leading high accuracy sensor technology to combine sensors for multiple profiles in a single drop, the SWiFT CTD features a new temperature compensated piezo-resistive pressure transducer and a new fast response thermistor temperature sensor. It operates down to 500 m as standard, delivering directly measured Conductivity, Temperature and Depth.

In addition to the directly measured CTD, it delivers computed Salinity, Density and Sound Velocity which is calculated using the UNESCO international standard algorithm and the Chen and Millero equation, delivering highly accurate data.

With an operational battery life of up to five days and the convenience of charge via USB, the SWiFT CTD is intended for offshore, coastal, harbor and inland environmental and hydrographic survey use. The SWiFT CTD is an ideal partner for ASV/USVs where profiled parameters are needed with quick data transfer via **Bluetooth®**.

» *The robust CTD profiler operates down to 500 m as standard and the conductivity sensor is housed in a strong acetal protective cage. (Photo credit: Valeport)*

The SWiFT CTD is robust. It is constructed from titanium to provide unrivalled durability and for its corrosion resistant properties in salt water. The conductivity sensor with its ceramic core is housed in a strong acetal protective cage, addressing traditional concerns sometimes levelled at the fragility of CTD profilers to withstand deployment in harsh conditions. An additional deployment cage is also available to bolt onto the instrument to secure additional weight and so help the SWiFT CTD get to depth in fast-flowing currents.

Easily portable the SWiFT CTD measures ø78mm x length 350mm, weighs just 2.7kg (in air) / 1.65kg (in water) and is supplied in a durable system transit case, with PC Bluetooth adapter, USB interface and charging cable, Valeport Ocean software and the operating manual.

» *Ease of use is at the heart of the new CTD profiler, here the end cap shows the user-friendly LED status indications for battery and communications. (Photo credit: Valeport)*

TAKING SWiFT TO NEW DEPTHS

More recently, Valeport has introduced the **SWiFT CTDplus Turbidity**, a new addition to the SWiFT family. The CTDplus version is currently only available with Turbidity at present and combines CTD measurements and Turbidity observations, in addition to providing computed Salinity, Density and Sound Velocity. Valeport's Research & Development team are continually working to evolve the SWiFT range of profilers.

The SWiFT profiler range is designed with the intention of a seamless workflow at its core. Common to all the SWiFT profilers is the high accuracy sensor technology which has been combined with Bluetooth wireless technology, a rechargeable battery, and an integral GPS. The Valeport R&D team created the new CTD profiler to integrate direct CTD readings with these SWiFT features to deliver the benefits of reliability and ease of use which are consistent across the whole SWiFT range.

Hundreds of SWiFT profilers are now in operation across the globe in 40 different countries and used by customers in the oceanographic and scientific communities and in industries such as dredging.

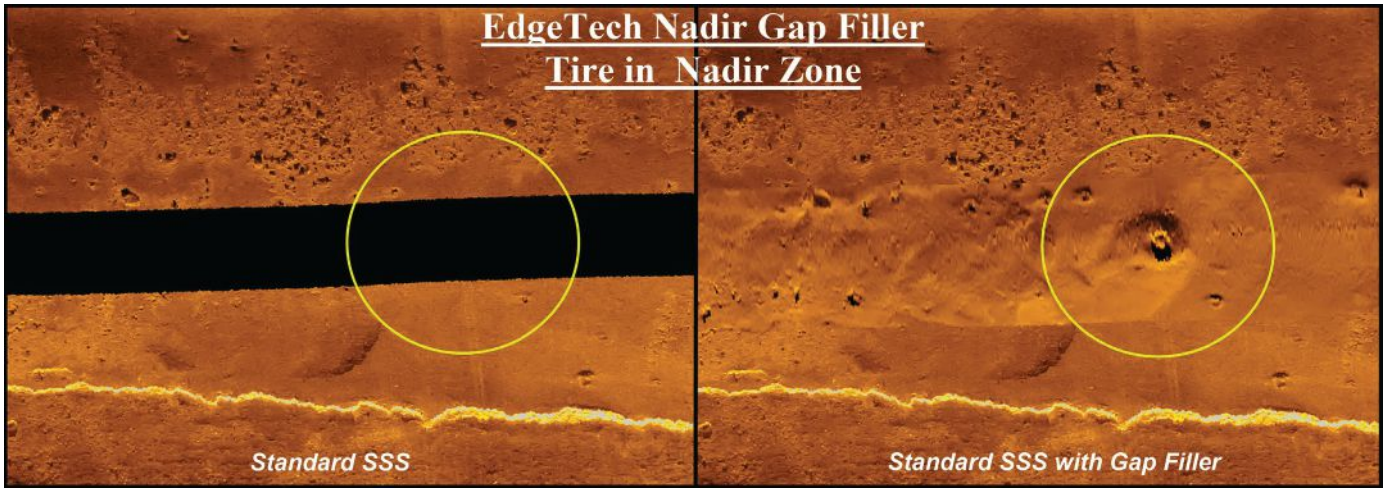
The SWiFT portfolio of environmental sensors currently includes: the new SWiFT CTD and SWiFT CTDplus Turbidity, the SWiFT SVP, as well as the SWIFT SVPplus enhanced with the following multi-parameter options: SWiFT SVPplus Turbidity, SWiFT SVPplus Chlorophyll a, SWiFT SVPplus Rhodamine, SWiFT SVPplus Fluorescein, SWiFT SVPplus Phycocyanin.

TECHNOLOGY YOU CAN TRUST

Valeport is a British manufacturer of hydrographic, oceanographic, and hydrometric instrumentation which includes: CTD & Environmental, Current, Echosounders & Bathymetry, Sound Velocity and Tide Gauges.

Valeport technology is selected by leading subsea, hydrographic, hydrometric, metrological & positioning, oceanographic, ports, harbors & dredging, renewable energy, and scientific research organizations worldwide by visiting: *www.valeport.co.uk*

» *The SWiFT CTD has a three-year warranty and is supplied in a strong transit case. (Photo credit: Valeport)*



» *New nadir gap-fill sonar provides shadows from either direction and a three-dimensional aspect. (Image credit: EdgeTech)*

EDGETECH INTRODUCES NEW NADIR GAP-FILL SONAR FOR THE 2205 AUV, ROV AND USV BASED SONAR SOLUTIONS

EdgeTech recently introduced an innovative and new method to provide nadir gap coverage on the EdgeTech 2205 sonar platforms. Complementing this new technology is SonarWiz from Chesapeake Technology, providing a software solution to support processing and mosaicking the new gap fill solution.

The 2205 system with gap-fill technology was designed specifically for hosted platforms operating in shallow water or within close proximity to the bottom. The sonar is ideal for Unmanned Surface Vehicles (USV) and Unmanned Underwater Vehicles (UUV/ AUV). The new 2205 system is available in a number of dual and tri-frequency configurations and the gap fill technology is available in a number of frequency options. The most popular frequency set, the 850kHz and 1600kHz dual frequency combination, is ideal for high resolution side scan sonar surveys where the nadir gap can now be filled with data while the vehicle performs single pass survey operations.

Unique to EdgeTech's gap-fill solution is the ability to "see" the nadir gap from both the left and right sides, providing shadows from either direction, as well as in a three-dimensional aspect in the nadir gap. Gap fill shadows are perpendicular to the vehicle's path and consistent with traditional side scan methods enabling easy interpretation of data. Additionally, gap fill data in the 2205 system is coincident with the side scan data and is therefore geospatially the same, unlike other solutions that look forward and across the vehicle path making target positions between the side scan and gap fill data less robust. The area directly below the vehicle, until now often lacking in coverage, can now be viewed with the gap data mosaicked right into the main side scan sonar display using SonarWiz. Harold Orlinsky, General Manager of Chesapeake, said: "This data combination removes the digital seam seen at the sidescan nadir. SonarWiz makes a GeoTIFF image of the seafloor with the data set."

The EdgeTech 2205 is a compact, extremely flexible and configurable sonar system for integration on 3rd party underwater and surface vehicles. This modular unit can be configured, based on the customers' application, to collect side scan sonar imagery, sub-bottom profiles and bathymetric data, singly or in concert with one another. The system is available either as packaged 2205 electronics enclosed in a pressure vessel, or alternatively the core electronics can be provided as boards mounted onto a chassis so the customer can integrate the system into their vehicle's dry electronics area. Two transducer arrays, one on each side of the vehicle, provide side scan sonar, gap-fill and bathymetry. Optional sub-bottom profiler is available as well. The system can operate independent of the hosted platform by simply storing the data, or it can be configured to autonomously interoperate with the vehicle during its mission.

MACARTNEY LAUNCHES NEW NEXUS 8 MULTIPLEXER

Underwater technology specialists MacArtney have launched the latest addition to the NEXUS multiplexer family, the NEXUS 8. This new, future-proofed model is smaller and lighter than not only its predecessor, but also its competitors, specifically designed for environments where space is at a premium and to fit into virtually any existing subsea system.

NEXUS 8 is an HD video and multibeam sonar multiplexer, with ultra-high bandwidth and three full HD video interfaces for up to 3 HD cameras, able to provide real-time monitoring without any latency, and to run instruments and sensors for measurement, surveys, sonar, manipulation and control.

The NEXUS 8 features intelligent programmable eFuses for dynamic performance and to save space. eFuses are ideal for subsea systems, offering flexible, dynamic programming, and avoiding time-consuming and expensive recovery operations for minor repairs.

The new NEXUS 8 is specifically designed and developed to meet the market's demands for technology and data acquisition now and in the future.

ISLAND OFFSHORE TO DIGITALIZE ITS ENTIRE FLEET WITH VESSEL INSIGHT FROM KONGSBERG DIGITAL

Kongsberg Digital has signed a contract to deliver its Vessel Insight infrastructure solution to the entire Island Offshore fleet of 26 highly advanced offshore service vessels. This is one of the largest contracts for Vessel Insight since the software solution was launched in 2019.

By installing the Vessel Insight infrastructure, Island Offshore will collect all the data from its fleet using a common platform. The data collected will enable the company to use advanced decision support tools and benchmark its vessels, comparing operational data from all vessels to reduce fuel consumption and emissions. It will also facilitate automation of reporting processes.

"We are very pleased to contribute to further strengthening KONGSBERG's collaboration with Island Offshore," said Andreas Jagtøyen, Executive Vice President of Digital Ocean at Kongsberg Digital. "We look forward to working closely with them to deliver and further develop solutions that can give them a competitive advantage in the market, as well as helping them to achieve their goals for safety, efficiency and sustainability."

Four vessels in the Island Offshore fleet are already connected to the Vessel Insight platform, using the Kongsberg Maritime Vessel Performance application and MARESS, a partner application from Yxney Maritime, available via Vessel Insight's Maritime Ecosystem. This has led to the four vessels moving from manual to automated reporting in a very short time. Kongsberg Digital is now installing the Vessel Insight platform on the remaining vessels in the fleet.

» *Island Offshore will deploy Kongsberg Digital's Vessel Insight cloud data infrastructure solution across its 26-vessel fleet. (Photo credit: Island Offshore)*

"By collecting all data on one common platform, we gain a correct and efficient starting point to analyze our operations and compare all the vessels in the fleet," says Trond Hauge, Technical Manager, Island Offshore. "In this way we can share experiences between the vessels and ensure that we operate as efficiently and safely as possible, while at the same time making our fleet even more sustainable by reducing fuel consumption. With increasing demands for reporting, moving from a manual to an automated reporting process will save us a lot of work."

FULFILLING THE CHANGING NEEDS OF THE SUBSEA VEHICLE MARKET

By Rory Findlay,
Navigation Business Development Manager, Nortek Group

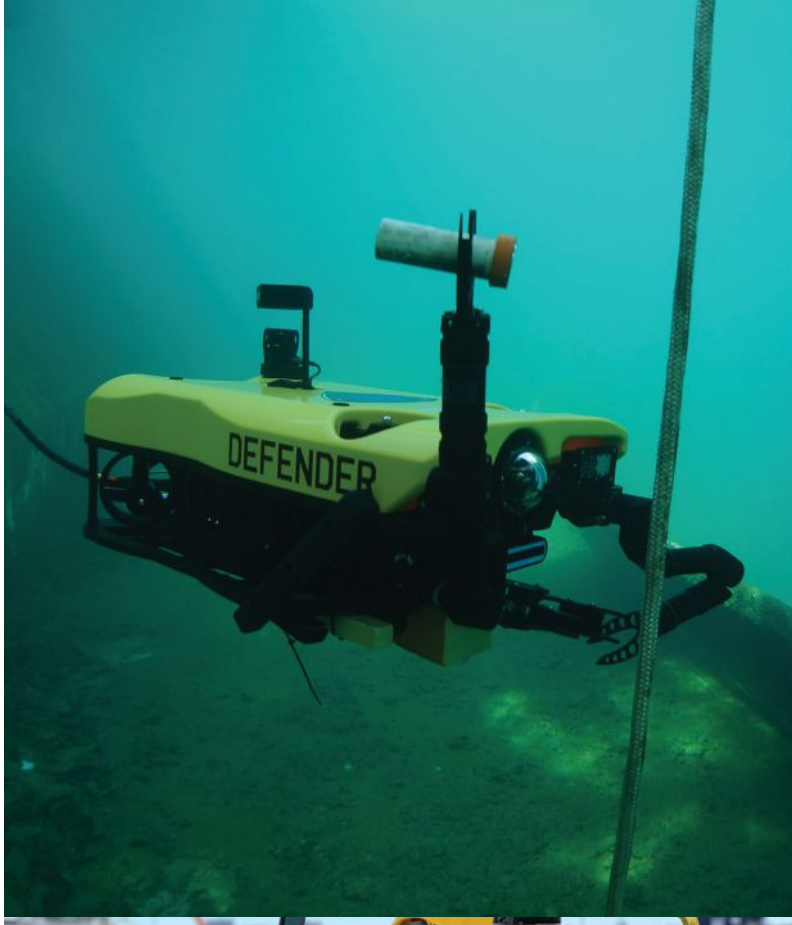
Doppler Velocity Logs (DVLs) are an essential navigational aid used in subsea operations where GPS is unavailable. DVLs use the Doppler effect to provide estimates of velocity relative to the seabed, preventing errors from accumulating within a vehicle's navigation system. These sensors ensure that remotely controlled and autonomous underwater vehicles (ROVs and AUVs) can perform a variety of tasks accurately and consistently with minimal human input.

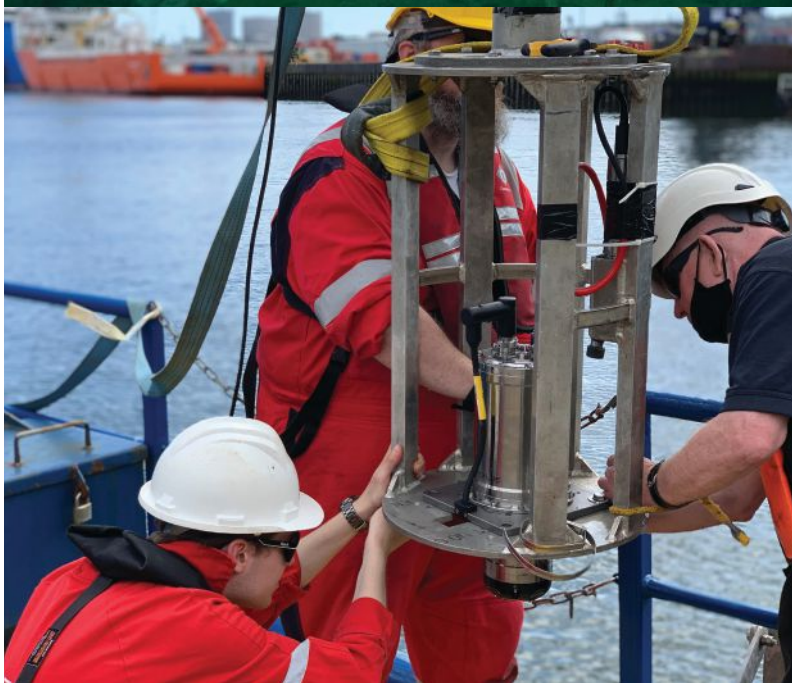
Nortek's DVL product line is marking its 5th year in the world of marine robotics. Integrators turn to them seeking high performance and reliable navigation, ranging from commercial grade ROV/AUV operations to groundbreaking scientific research platforms. Let's examine some of the reasons behind the success of the product line, and where the field of subsea navigation is heading.

DEVELOPING A NOVEL DVL SOLUTION

Development of Nortek's DVL product line made strides during the 2014-2016 oil and gas downturn. The offshore industry was being squeezed to achieve more with less, meaning demand for large Work Class ROVs was replaced with a demand for smaller, multi-purpose ROVs. Expectations of their capabilities remained, meaning high performance survey and navigation sensors became a central focus. Most commercially available DVLs at the time were not suitable for smaller platforms, due to their size and weight; something that had not been an issue for Work Class ROV systems.

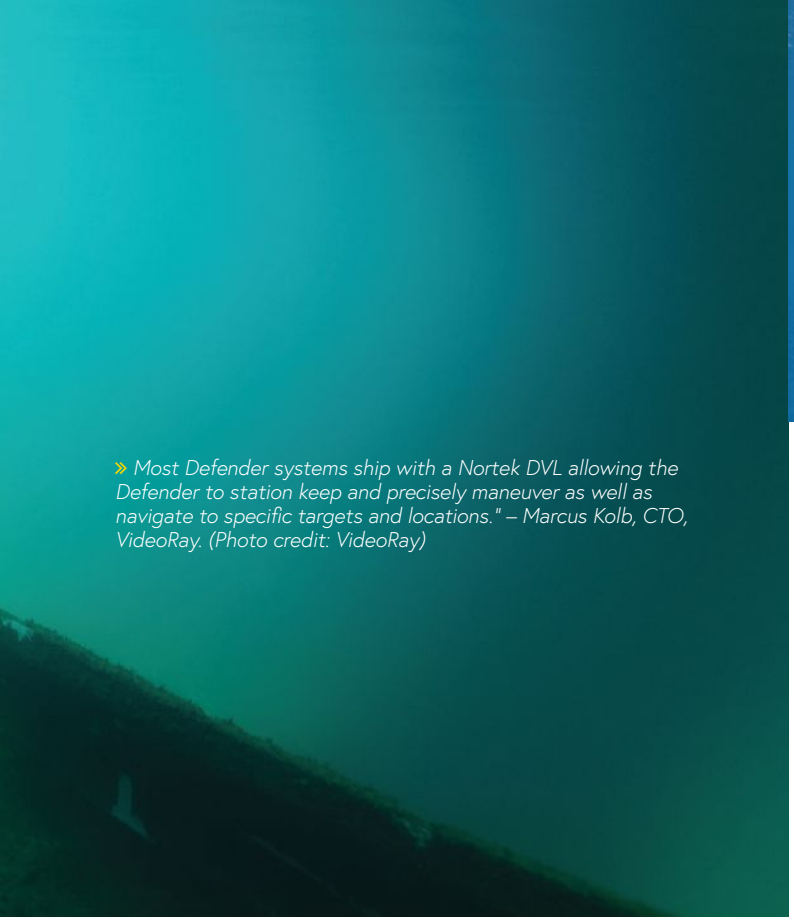
Nortek set out to use its decades of expertise in Doppler subsea measurements to make something specifically for small vehicles. The goal? Provide greater range and survey grade performance in a drastically reduced SWaP (Size, Weight and Power) footprint. This had to be done at a cost which would enable wider use of sophisticated navigation without sacrificing the accuracy required for survey or autonomous navigation. The new Nortek DVL supported the offshore industry's requirements during the downturn, but also awakened development possibilities for a new breed of intelligently controlled, compact ROV and AUV systems. Such vehicles are now becoming more common across the survey, inspection, and defense markets.



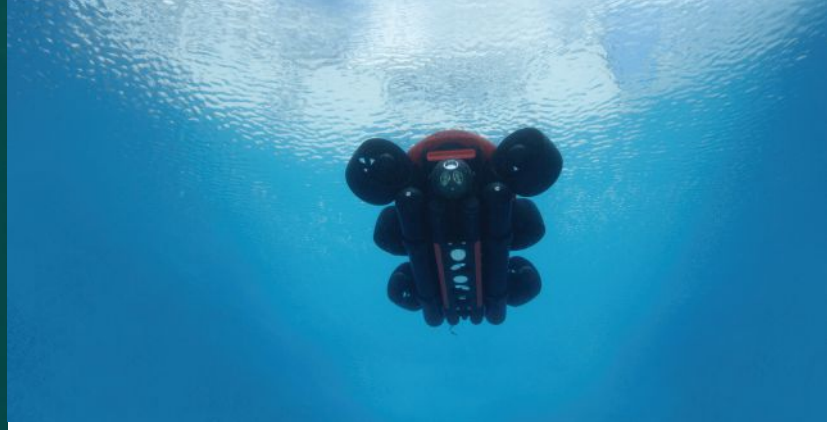


» *INS/DVL rig being calibrated by iXblue engineers. These two separate, high end sensors give optimal performance through time synchronization between INS and DVL. (Photo credit: iXblue)*

Marcus Kolb, Chief Technology Officer at VideoRay, a global leader in small, but powerful ROVs, recalls: "Not surprisingly, we weren't getting the performance we needed from any DVL manufacturer. The VideoRay Defender is a very powerful and compact system with 7x 1 hp thrusters and a 1.5kW power converter all in close proximity to the DVL. Nortek stepped up, learned about our unique challenges, and figured out how to make a good solution into something that



» *Most Defender systems ship with a Nortek DVL allowing the Defender to station keep and precisely maneuver as well as navigate to specific targets and locations." – Marcus Kolb, CTO, VideoRay. (Photo credit: VideoRay)*



» *The SRS FUSION is a unique approach to underwater vehicle development by building around key sensors. At the onset Nortek was singled out as the leading DVL, however, the nature of FUSION required a custom configuration. Nortek was able and willing to work with SRS on the perfect solution." – Jesse Rodocker, CEO, Strategic Robotic Systems. (Photo credit: Nortek)*

exceeded the requirements and our expectations. We continue to work with Nortek on improvements and have delivered several 4 km rated DVLs that are performing very well and drop into the Defender without modifications."

DESIGNING FOR CHALLENGING SITUATIONS BENEFITS ALL

As small vehicles become more capable and assume work previously done with larger vehicles, large ROVs push forward into more complex missions and greater autonomy, demanding more from their navigation systems. Swapping older units with drop-in replacements which feature the most modern processing allows commercial survey companies to employ more advanced autonomy and station-keeping without overhauling their entire navigation system.

This key benefit is in part due to tight coupling between DVL and Inertial Navigation Systems (INS). "Tight coupling" is a technique that improves synchronization between DVL velocity and INS measurements. This is primarily achieved by providing time of validity readings for bottom track velocity estimates, which in turn improves overall navigation system performance. This technique has now become a standard and most high-performance INS now require DVLs to provide this.

Further, for these vehicles performing complex, long-term missions in deeper waters and changing conditions, the addition of simultaneous current profiling allows users to monitor environmental conditions in real-time when operating at dynamic sites.

CUSTOMIZATION DELIVERS FIT-FOR-PURPOSE VEHICLES

Supporting innovation means responding to novel requirements. This leads to unconventional designs—from deconstructed DVLs to imaginatively arranged sensor heads—which have pushed DVLs beyond their normal performance capabilities and ushered in an era of specialized, purpose-built vehicles. These vehicles allow jobs to become more efficient, safer, and often more cost-effective. A partnership approach in design means sensor manufacturers are headed where the industry is going, elevating the ease-of-use, and making vehicles more commonplace tools, thereby expanding the market.

Challenges encountered in demanding custom designs inevitably inform technological advances for COTS (Commercial off the Shelf) products. One such situation is ensuring consistent performance when sensors and electronics are in close proximity inside small vehicles. The refinements that make this possible have resulted in versatile and reliable DVLs, benefiting vehicle manufacturers.

"We turned to Nortek for our subsea navigation needs because of the accurate, reliable and repeatable data provided by the system. Coupled with the small form factor and integration support from Nortek, this makes it a perfect solution for VALOR," points out Scott Gray, Regional Manager at Seatronics.

THE FUTURE OF SUBSEA NAVIGATION

Moving into an era where remote operations and autonomy will play a significant role in how we work offshore, subsea navigation is once again at a crossroads. There is a growing requirement for long endurance, uncrewed survey capabilities. These require highly accurate navigation over long distances, coupled with system reliability, low power consumption and redundancy.

On the other hand, there is a drive to make subsea navigation more accessible. This relates to micro-ROVs/AUVs and even divers, who need simple, economical, and compact navigation. As before, the theme of achieving more with less persists, and the onus is on sensor manufacturers to develop solutions that can deliver on these requirements.

While divergent in technical requirements, cost, and form factor, these trends converge on the path of institutionalizing these tools in operations, inspection, construction, and research. Development of sensors like the DVL500-Compact or the coming Fusion DVL1000 is part of a drive to allow vehicles to become more capable at any size and cost. As we look towards decarbonizing the offshore industry, extending autonomous/uncrewed mission durations, and enabling operations in coastal and deep water, it is critical to improving the viability of such technologies.

USM OCEANOGRAPHERS SELECT SEATRAC SP-48 FOR RAPID SENSING OF OPTICAL PROPERTIES IN MARITIME ENVIRONMENTS

SeaTrac Systems recently announced the sale and delivery of one of its SP-48 persistent Uncrewed Surface Vehicles (USVs) to a team at The University of Southern Mississippi's (USM) School of Ocean Science and Engineering (SOSE). The SOSE team has collaborated with SeaTrac, developing an innovative solution for rapid sensing of in situ optical properties using a SeaTrac Sp-48 autonomous platform.

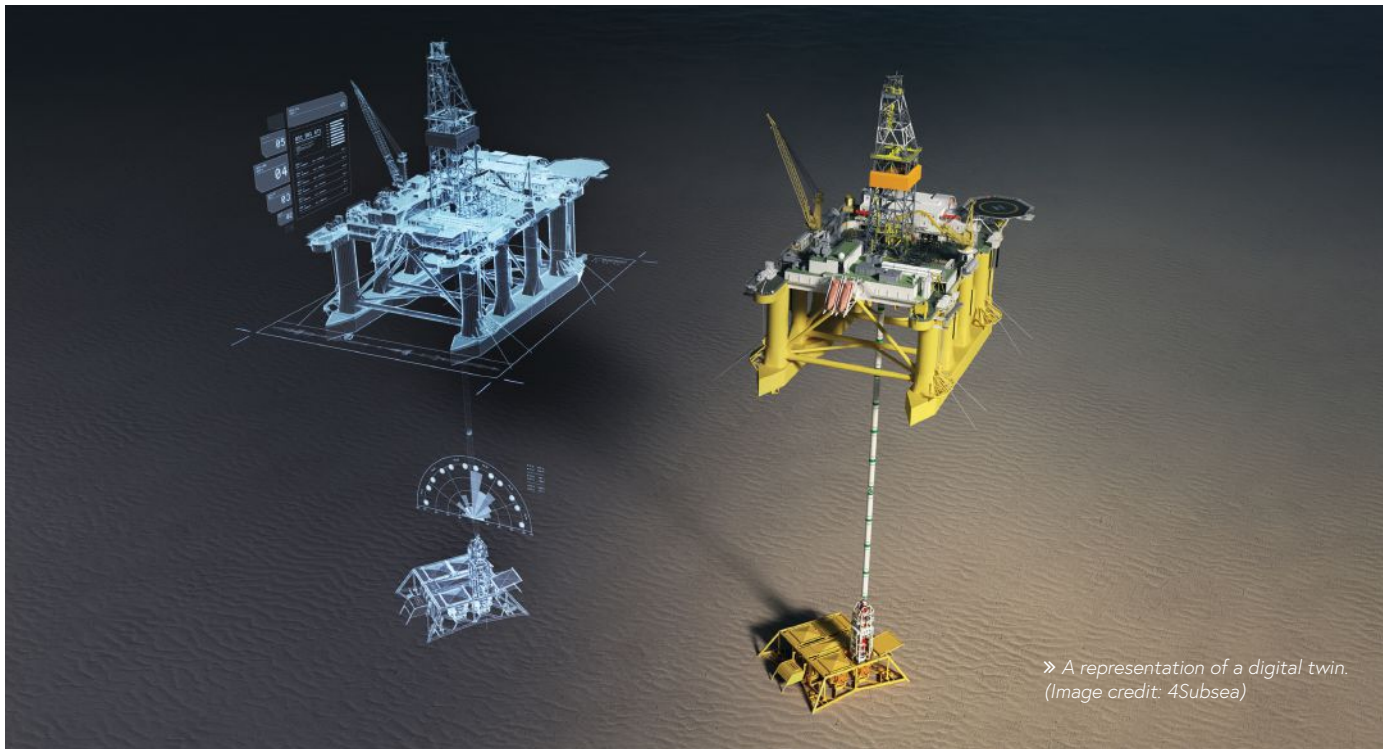
"There is a critical need for rapidly mapping localized hydrodynamic and turbidity conditions in nearshore-ocean and coastal marine environments for natural resource management, environmental protection and national security," said Dr. Xiaodong Zhang, Endowed Chair and Professor with SOSE's Division of Marine Science at USM. "The SP-48 has the persistence and the payload power we were looking for to host a SeaBird ACS to measure hyperspectral absorption and a Sequoia LISST-VSF to track angular scattering," Zhang explained.

"Once the capability for rapid sensing of optical properties is demonstrated in turbid or "brown" water coastal environments, several Federal agencies would like to incorporate the capability in ongoing R&D programs in maritime environments," said Dr. Jason McKenna, Director of Research, Development, Testing, & Evaluation (RDT&E) at USM's Roger F. Wicker Center for Ocean Enterprise located at the Port of Gulfport in Gulfport, MS. "Ocean Enterprise will continue to support Testing and Evaluation of the SP-48 platform with SeaTrac, SOSE and federal agencies to satisfy emerging requirements in port resiliency and maritime domain awareness," added Dr. McKenna.

"Increasingly customers' missions have grown in complexity requiring a range of sensors, and they're looking for less costly, less resource-intensive and more flexible solutions to carry out a variety of tasks simultaneously in challenging marine environments," commented Jigger Herman, Co-Founder, SeaTrac Systems. "We are pleased to help the USM team push the envelope in rapid mapping of the optical field."

The SP-48 is designed for users who require a flexible data gathering and communications platform that adapts to a wide variety of operational scenarios and payloads. The solar-powered, 4.8-m SP-48 is a low-logistic, sensor-agnostic persistent USV with Automatic Identification System (AIS) collision avoidance, speed of 5kts, 500W payload power, and 70 kg payload capacity that can host a variety of sensors perfect for the collection and communication of real-time ocean data over long durations. Built to operate in all marine environments—from inland, near shore to open ocean—the SP-48 has a self-righting hull and efficient electric motor that frees it from reliance on wind or waves for propulsion. It is easily deployed from a boat ramp, pier or ship. Communications is achieved by line-of-sight Radio Frequency (RF), cellular, high-bandwidth satellite or custom networks.

» *SeaTrac SP-48 will be deployed for rapid sensing of optical properties in maritime environments. (Photo credit: SeaTrac)*



» *A representation of a digital twin. (Image credit: 4Subsea)*

4SUBSEA DELIVERS DECADE OF DIGITAL TWIN TECHNOLOGY

4Subsea, a leading provider of digital technology and services to the energy and maritime sector, has successfully completed more than 300 measurement campaigns across the North Sea following the launch of its digital twin technology, significantly increasing uptime and mitigating risk during well operations.

The SWIM™ (Subsea Wellhead Integrity Monitoring) system employs retrofittable subsea sensors to monitor and measure stability, load, fatigue, and structural integrity of the wellhead system during drilling operations. It has an extended battery life from one to five years and can operate in water depths down to 3,000 meters.

Since it was first tested in 2010, the technology has identified wellhead integrity issues, such as shallow gas and water, conductor stability issues related to wash-out or fatigue challenges, on nearly a third (30%) of exploration and satellite wells monitored in depths below 150 meters.

Peter Jenkins, CEO of 4Subsea, said: "Digital twin technology provides early warning and improved accuracy in structural health monitoring than traditional analyses and its use has grown exponentially over the last decade. In its first five years of operation, SWIM™ performed around 80 measurement campaigns. This has grown three-fold since 2015, with over 250 campaigns successfully completed across the UK and Norwegian continental shelves.

"We expect that steep escalation to continue as the industry puts more trust in digital twin technology and the financial, logistical and environmental benefits it brings."

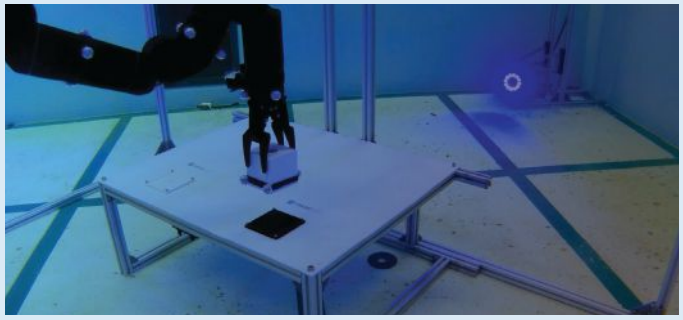
Advanced algorithms, combined with deep domain expertise, are used to analyze fatigue damage accumulation, well support and structural integrity on conductors, wellheads, BOPs and Christmas trees up to the floating drill rig. This critical data can be used to assess performance, provide prediction analysis and, importantly, rapidly inform decision-making to reduce risk and cost.

Data is shared in real-time via a user-friendly web application that is easily accessible to the rig crew and the onshore support team. Measured data is securely stored and can be re-used for future model calibration.

"Combining our expert engineering and operational experience, we can offer an industry-leading digital service, including advanced autonomous, retrofit sensor technology," added Jenkins.

With SWIM™, operators can re-use critical wells and maximize the lifetime of wellheads by scheduling drilling operations based on well criticality, historically accumulated load on wellheads, and predictive models. The predictive models estimate the expected load on the wellheads from future planned drilling and intervention operations.

4Subsea has recently launched the SWIM™ Live app, which provides live data streaming from sensors installed on the BOP and lower flex joint through integration with the BOP MUX umbilical Microsoft Azure. This allows real-time updates and the ability to optimize operations with instant insight.



» *The Reach Bravo 7 Manipulator in action during a test in a controlled tank environment. (Photo credit: INESC TEC)*

INESC TEC CHOOSES BLUE-PRINT LAB MANIPULATOR FOR OFFSHORE ENERGY O&M RESEARCH

INESC TEC is a private, non-profit organization specializing in research and development (R&D) within science and technology sectors as well as consulting, training and developing emerging tech-centric companies. Operating at the intersection of business and academia, INESC TEC applies research and knowledge acquired throughout its various undertakings in technology transfer projects.

As part of their continuing R&D efforts, INESC TEC developed the ATLANTIS project, a test-platform initiative for maritime robotics installed in the Atlantic Ocean. The project is geared specifically towards applying robotics and autonomous systems at offshore wind farms. This application aims to 'reduce the levelized cost of energy' (LCOE) by minimizing expenses associated with human-diver lead operation and maintenance (O&M) activities.

These expenses include requirements for skilled operators, specialty vessels, sensor technology and complications regarding underwater access. The ATLANTIS infrastructure will overcome these concerns by establishing a real-world subsea environment to substantiate key robotic capabilities for O&M tasks at offshore structures.

To develop their research INESC TEC selected Blueprint Lab's, 'Reach Bravo 7' manipulator, noting its dexterity, rugged build and durability in underwater environments. In their own words: "Bravo 7 was used in realistic underwater manipulation conditions to distinguish the performance of multiple planners for particular movement conditions contributing to the inspection of maritime structures."

Furthermore, INESC TEC is seeking to enhance the manipulation capability of autonomous underwater vehicles (AUVs) during close range operations using the Bravo 7 robotic arm.

With innovative vision and control systems, The Bravo 7 breaks down previous limitations of ROVs by offering advanced manipulation, inspection and intervention capability. Our robotic manipulator technology minimizes the need for specialist divers during maintenance activities as well as reducing operator training requirements with intuitive control options available. Furthermore, the Reach Bravo range allows for third party sensors and measurement tools to be affixed at the end-effector, offering limitless configuration opportunity.

Blueprint Lab is proud to be working with INESC TEC, applying advanced robotic solutions to technically challenging operations in complex environments. The pioneering ATLANTIS project and autonomous systems research using our manipulators will change the future of O&M for maritime structures where performance and safety is critical.

NOAA'S LATEST RESEARCH VESSEL EMPLOYS IMPRESSIVE SUITE OF FURUNO MARINE ELECTRONICS

When the National Oceanic and Atmospheric Administration (NOAA) specced their newest research vessel, they looked to Teknicraft and All American Marine for the hull design and Furuno for electronics. Their new 50' semi-displacement catamaran, launched with a full suite of quality Furuno marine electronics, is ready to assist in their research missions in the Olympic Coast National Marine Sanctuary (OCNMS) in Washington State.

The ultra-stable semi-displacement catamaran features a TZTL12F MFD (Multi-Function Display) and TZ Pro on the bridge, connected to the powerful Solid-State DRS6ANXT Radar. Installed by Radar Marine in Bellingham, Washington, the lightning-fast 12" NavNet TZtouch2 display comes pre-loaded with all of the charts the crew will need for safe and reliable navigation. The NXT series of Solid-State Doppler Radar provides the power and signal clarity researchers need to track hazardous targets. Furuno features such as Fast Target Tracking augment situational awareness at all times by tracking nearby vessels. Dual wide-screen monitors provide the displays for a dedicated PC running the intuitive and powerful TZ Pro software.

An SCX20 Satellite Compass stabilizes the vessel's electronics by calculating and providing extremely accurate heading, pitch, roll, and heave information. Reliable communication with other nearby vessels is achieved with the inclusion of the LH5000 Loud Hailer, allowing the crew to instantly notify nearby ships of their presence regardless of limited visibility. It also includes the ability to immediately sound any of the eight built-in, internationally acknowledged warning signals.

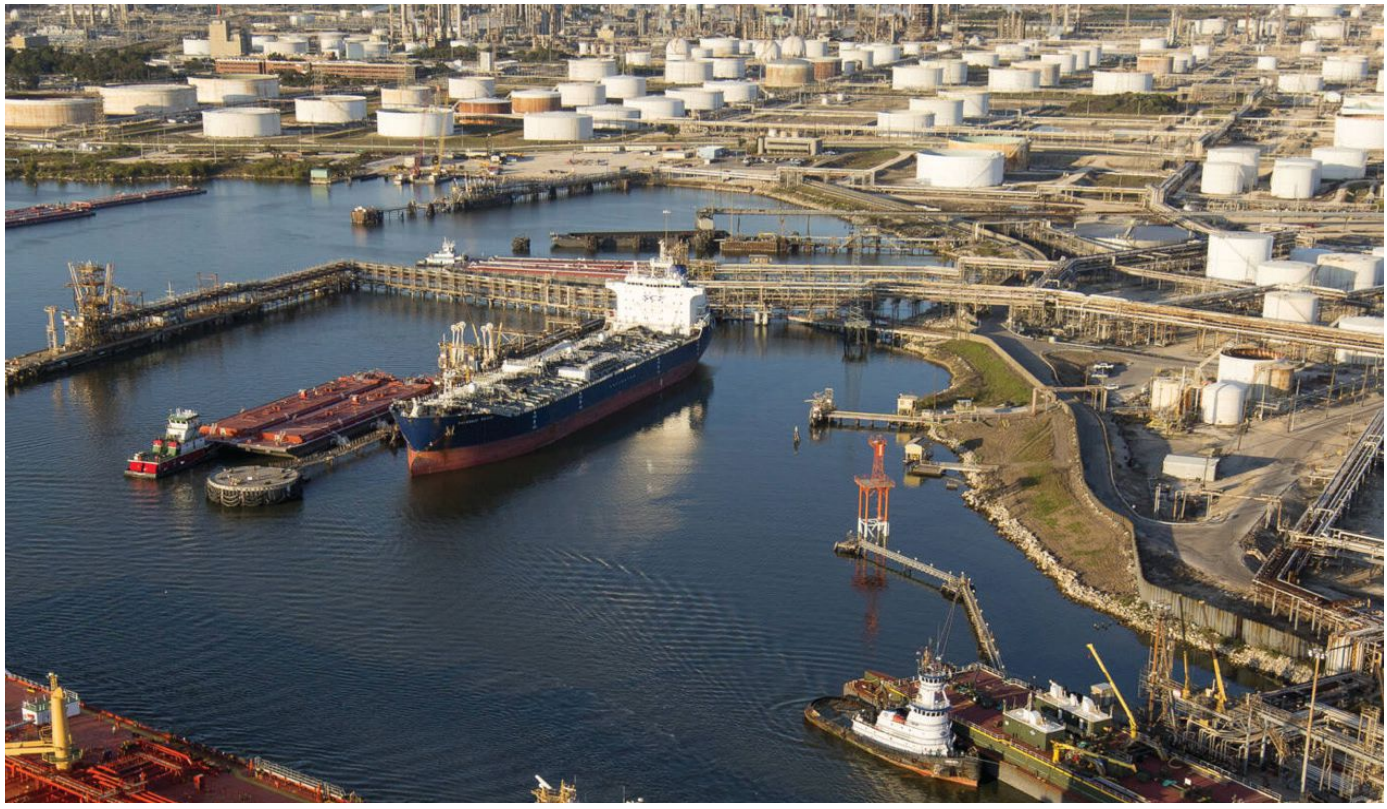
The vessel was purpose-built to help NOAA and their partners at OCNMS to study and provide science-based solutions to the evolving environmental pressures on our ocean and coasts. OCNMS encompasses 3,188 square miles of marine waters off the rugged Olympic Peninsula coastline, extending up to 50 miles seaward—roughly the size of Delaware and Rhode Island combined. This important sanctuary is home to many marine mammals and seabirds, thriving kelp forests, deep-sea coral and sponges, and diverse intertidal communities teeming with fish and other sea life.

» *NOAA's latest purpose RV will assist research missions in Washington State. (Photo credit: All American Marine)*

FOR SALE: 17m oceanographic multi-purpose vessel ADA REBIKOFF

Diving vessel carrier and oceanographic survey vessel "ADA REBIKOFF"
17m catamaran with moon pool and 10 ton lifting crane for any kind of diving vehicle.
Equipment: ELAC multibeam sonar, Klein sidescan sonar with winch and 2,200m cable, USBL tracking system, CodaOctopus motion sensor, workshop, work area, accomodates 8.

Ideal for: scientific research/wet lab, bathymetric surveys, HOV/ROV/AUV operation, wreck search and recovery, scuba diving operations. Flag: Portugal, Location: Madeira
Full information and specs: https://www.rebikoff.org/technology/catamaran/
Contacts: Tel: +351 91 985 8539 E-Mail: info@rebikoff.org



» *The Houston CCS hub could help the city of Houston meet its climate goal of becoming carbon neutral by 2050. (Photo credit: ExxonMobil)*

CARBON CAPTURE AND STORAGE GAINS WIDE INDUSTRY SUPPORT IN HOUSTON

Eleven companies have expressed interest in supporting the large-scale deployment of carbon capture and storage (CCS) technology in Houston. Calpine, Chevron, Dow, ExxonMobil, INEOS, Linde, LyondellBasell, Marathon Petroleum, NRG Energy, Phillips 66 and Valero have agreed to begin discussing plans that could lead to capturing and safely storing up to 50 million metric tons of CO2 per year by 2030 and about 100 million metric tons by 2040.

The companies plan to help address industrial CO2 emissions in one of the largest concentrated sources in the United States. Collectively, the 11 companies are considering using CCS technology at facilities that generate electricity and manufacture products that society uses every day, such as plastics, motor fuels and packaging.

If CCS technology is fully implemented at the Houston-area facilities these 11 companies operate, nearly 75 million metric tons of CO2 could be captured and stored per year by 2040. There are ongoing discussions with other companies that have industrial operations in the area to add even more CO2 capture capacity. They could announce their support at a later date and add further momentum toward the city of Houston's ambitions to be carbon neutral by 2050.

"Houston can achieve our net zero goals by working together, and it's exciting to see so many companies have already come together to talk about making Houston the world leader in carbon capture and storage," said Sylvester Turner, Mayor of Houston. "We're reimagining what it means to be the energy capital of the world and applying proven technology to reduce emissions is one of the best ways to get started."

Wide-scale deployment of CCS in the Houston area will require the collective support of industry, communities and government. If appropriate policies and regulations are put in place, CCS could generate tens of thousands of new jobs, protect current jobs and reduce emissions at a lower cost to society than many other widely available technologies. The 11 companies will continue to advocate for policies that enable the long-term commercial viability of new, expanded and existing CCS investments in Texas.

CCS is the process of capturing CO2 from industrial activity that would otherwise be released into the atmosphere and injecting it into deep underground geologic formations for safe, secure and permanent storage. With supportive regulations, CO2 from the Houston industrial area could be safely stored in the U.S. Gulf Coast region in formations thousands of feet below the surface or seabed. The U.S. Department of Energy estimates that storage capacity along the U.S. Gulf Coast is enough to hold 500 billion metric tons of CO2—more than 130 years of the country's total industrial and power generation emissions, based on 2018 data.

Although renewables will continue to play an important role in a lower-carbon energy future, CCS is one of the few proven technologies that could enable some industry sectors to decarbonize, such as manufacturing and heavy industry. The International Energy Agency projects CCS could mitigate up to 15 percent of global emissions by 2040, and the U.N. Intergovernmental Panel on Climate Change (IPCC) estimates global decarbonization efforts could be twice as costly without CCS.

PONDERA AND SOLARDUCK SIGN MOU FOR DEVELOPING 555 MWP OF OFFSHORE SOLAR PROJECTS

Pondera, a renowned consulting company and project developer in renewable energy, and SolarDuck, a key player in the floating offshore solar market, have signed a memorandum of understanding detailing the development of 555 MWp of offshore solar projects over the coming years. The companies plan to develop these projects between 2023 and 2025. Near term projects shall be located in the Netherlands, while those further into the future shall be located in South-East Asia.

While both companies have their headquarters in the Netherlands, they have a shared global ambition to make a tangible difference in climate change and contributing to global sustainable energy goals. Pondera, founded in 2007, has been involved in more than 10 GW of renewable energy projects, of which over 3 GW is operational and another 3 GW under construction. The company has seen steep growth over the past years and is gearing up to become a key player in the South-East Asian market. SolarDuck was founded by a group of likeminded maritime and energy professionals, who found a way to generate solar power offshore at utility scale. Their patented and certified technology is robust, scalable, and able to withstand sea conditions and hurricane force winds. This technology allows for solar energy to be generated at sea, which opens a new and very promising market.

The companies plan to develop projects using this technology to deliver solar energy to cities and regions for whom solar is the cheapest renewable energy source, but that normally have trouble accessing this renewable energy source due to land scarcity constraints. SolarDuck technology allows these communities and businesses to obtain clean energy, while safeguarding competitive energy pricing. In 2023, the parties aim to develop 5 MWp. By the end of 2025, the companies aim to have developed a total of 555 MWp. The energy produced shall be used to power communities and local business.

Following the signing of the MoU, the companies have started scouting appropriate areas to place the aforementioned projects. "I am excited about our cooperation, and the scale of our combined projects," said SolarDuck CEO Koen Burgers. "In Pondera, we found a partner who not only shares our global ambitions, but also the drive to make these plans become reality. They have a long and impressive track record which we intend to broaden with the addition of Offshore Floating Solar."

Pondera CEO Hans Rijntalder commented: "The floating offshore solar market is very promising, and within that market SolarDuck has developed an interesting technological platform for the countries we are active in. We have watched SolarDuck scale up over the last year, and we are very impressed with their accomplishments so far. Their technology is promising—they received the world's first certification for offshore floating solar by Bureau Veritas—and I see interesting opportunities for its application in countries like Indonesia and Vietnam. From our offices in these two countries, we are able to support our development activities directly on location."

» *SolarDuck CEO Koen Burgers (left) and Pondera Director Hans Rijntalder.*

SIEMENS ENERGY TO ASSIST EQUINOR IN REDUCING OFF-SHORE PLATFORM EMISSIONS IN THE NORTH SEA

Siemens Energy has received a contract from Aker Solutions to supply the complete packages for the electrical transmission, distribution, and power management system (PMS) for the Troll West electrification project in the North Sea. The Troll field is operated by Equinor and contains considerable oil and gas reserves.

A key objective of the Troll West electrification project is to reduce NOx and CO2 emissions by replacing existing gas turbine-driven generators and compressors on the Troll B and C facilities with power from shore. The plan is to supply electrical power to Equinor's Troll B and Troll C semisubmersibles with a 40-mile (65-kilometer), 150-megawatt subsea transmission cable from the Kollsnes natural gas processing plant on the island of Ona.

Equinor has communicated that they estimate that reducing the power from the gas turbines on the Troll B and Troll C facilities will reduce annual carbon emissions by approximately 500,000 tonnes—an amount equivalent to about 1% of all emissions from Norway. In addition, NOx emissions from the field will also be reduced by an estimated 1,700 tonnes per year.

Siemens Energy's scope of supply for the project includes a range of electrical equipment, including transformers, reactors, and switchgears. Siemens AG is also part of the project consortium and will provide static frequency converter systems, large-scale drive trains, and special frequency converters, which will allow power to flow bi-directionally for normal and island operation. The PMS provided by Siemens Energy will help maintain a safe balance between power demand and consumption, thus ensuring overall grid stability.

"Siemens Energy has been working in the Troll Field for more than two decades and is proud to support Norway's ambitions to reduce greenhouse gas emissions by 40% through 2030 and by 80- 95% through 2050," said Jennifer Hooper, Senior Vice President, Industrial Applications Solutions for Siemens Energy. "Our ability to provide a large portion of the equipment package for this project, coupled with our electrification experience on other offshore platforms operated by Equinor, including Martin Linge, Johan Sverdrup, and Goliat, were key factors in the contract award and will ultimately reduce project execution risks."

Installation and commissioning of the electrical equipment for the Troll West project are scheduled for 2022 – 2023.

INDUSTRIAL LITHIUM-ION BATTERIES FOR THE SUSTAINABLE AND SAFE USE OF THE OCEANS

By Stefan Marx,
CEO & Founder, SubCtech GmbH

Lithium-ion batteries are used for a wide range of activities and applications in the oceans such as to power vehicles, sensors, and energy storage systems, as well as to electrify oil and gas production. Kiel-based SubCtech has solutions for a sustainable, reliable, and safe energy supply with Li-Ion batteries. In the spirit of UN's Decade of Ocean Science for Sustainable Development, and the advance of the Blue Economy, SubCtech is on a mission to revolutionize underwater technology.

Over the years, SubCtech has tracked the ever-increasing demands for subsea power capacity from the offshore industries. The company recently responded by introducing a new Li-Ion battery series engineered specifically for large subsea storage, vehicle propulsion, and the electrification of oil and gas production facilities.

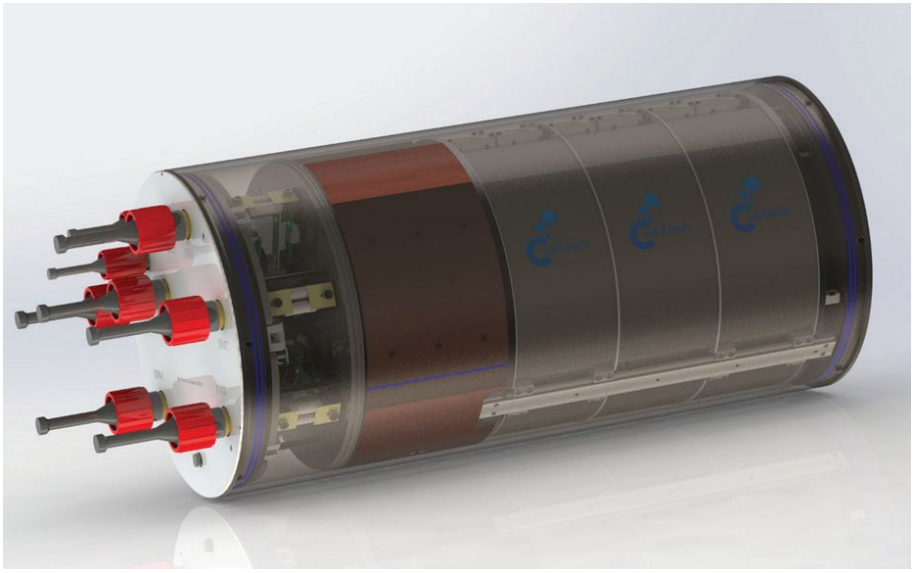
Offshore developers acknowledge that as exploration of oceans advances, so must the need for a more sustainable and safer approach. With the aim of making technologies more efficient and using ocean resources cost-effectively, future solutions must prioritize protection and sustainability.

RELIABLE, ROBUST & SAFE

SubCtech supplies batteries that not only make one-way batteries superfluous, but also make applications safe, reliable, and efficient, and therefore sustainable. Over the past 15 years of battery technology development, SubCtech has supplied batteries to underwater markets around the world. In addition to the standard batteries (COTS), which replace disposable batteries or older technologies such as NiMH or lead-gel, underwater vehicles or production facilities are equipped. Voltage, capacity, power and therefore size and weight can be scaled to fit different user solutions with a set of standard components, with a very long service life of 15 to 25 years. The consequent use of standards, from the supply chain through to production, reduces users' costs and overall CO2 footprint.

Developed to be used in manned vehicles and subsea production facilities, the Li-Ion batteries have been developed with maximum safety in mind, following the principles of IEC61508. The batteries are also subjected to extensive shock & vibration, rapid temperature cycling and EMV tests. Such qualifications are compulsory for vehicles and subsea operations in the oil and gas market, as service or even failure would cost millions of dollars and even cause massive damage to the oceans and, therefore, human life.

At present, SubCtech is working on the future revision 5 of the API17F to support the concept of fully electric production systems. With this standardization and focus on functional safety, the safety of future electrical underwater systems is significantly increased.



» *Li-Ion Battery in pressure housing with converter, charge unit for underwater charging (docking stations) and a power distribution unit (PDU, fuse & switch). (Image credit: SubCtech)*

With major companies, standards for safe operation, maintenance and obsolescence, commissioning and removal, and also data communication, are an ongoing concern for product development. SubCtech therefore also supports the further development, standardization, and implementation of the framework of SIIS (Subsea Instrumentation Interface Standardization). With its long-term focus on safety-critical applications, SubCtech is ideally positioned to meet the current and future requirements.

SCALABLE ENERGY SOLUTIONS

The energy of the batteries is easily scalable by stacking different numbers of SmartPowerBlock™ (SPB) submodules. Power distribution (PDU), voltage conversion, and data interface can be added to the single titanium or duplex steel housing completing a battery system. Combining these functions in a single pressure housing reduces the number of subsea connectors and simplifies system integration.

Battery cells with Li-Ion technology offer enormous advantages in terms of energy and power density at moderate costs. Due to the flexible design, the charger can be external or can be integrated into the pressure housing, e.g., for AUV/ROV docking stations or subsea storage solutions. SubCtech has developed DC and AC converter technology that allows high charge power and therefore short charging times without complex cooling.

With our own laboratory for examining Li-Ion cells, optimal operating parameters are configured for robust, reliable, and scalable battery systems. For optimal operation, important characteristics of the battery are the state of charge (SOC) and the state of health (SOH). Aging of the cells is largely determined by the operating conditions e.g., the temperature. SubCtech calculates the battery systems with an available energy EOL under subsea conditions. The nominal energy of the battery is thus higher than the required one, but the battery will reliably and precisely deliver the energy and power that is necessary over its entire service life.

The ability to adjust operating parameters during operation without retrieving and service on board enables simple testing at significantly reduced costs. We prevent surprises through supposedly cheap solutions with a higher risk of failure.

Areas of application for our Li-Ion Batteries are ROV, AUV, offshore oil and gas and Energy Storage Systems (ESS) with a design life of 25 years and UN T38.3, MIL-STD, DNV-GL or API17F qualifications.

BUILT TO LAST

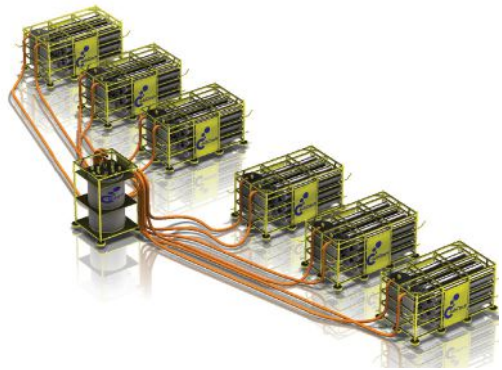
Another product feature that optimizes OPEX and real-world sustainability is the pressure housing. Unlike traditional duplex and 316L steel canisters, SubCtech specializes in the use of titanium. For operation, it is important that damage such as scratches on deck or underwater does not affect the function of our titanium housings. A coating and corrosion protection (CP) is not required and so reduces the possible entry of pollutants into the water. In contrast to regular expensive maintenance of subsea structures with ROV support, titanium housings are 100% maintenance-free over their design life. Our connectors are also made of titanium. Galvanic isolation is only needed for other non-titanium materials such as frames. An important advantage is that there can be no crevice corrosion under the seals—the probability of failure is zero. Since SubCtech also produces large titanium housings, battery systems can also be easily scaled to different water depths and form-factors.

Permits for air freight, export and import, as well as special permits, have been obtained from the German LBA, US DOT, IATA, and other authorities.

With our standardized, long-life Li-Ion batteries, we make durable underwater technology reliable and cost-effective. Our products ensure the highest levels of safety and minimalize OPEX. The transition to "all-electric" subsea technology not only helps us protect the oceans but enables a sustainable use of natural resources.

For more information, please visit:
www.subctech.com

» *Li-Ion battery module with BMS during the shock + vibration tests. (Photo credit: SubCtech)*



» *Large Subsea Energy Storage System can be used with UPS function for AC or DC supplies. (Image credit: SubCtech)*

EQUINOR AND PARTNERS TO INCREASE GAS EXPORTS

Equinor and its partners have received permission to increase gas exports from two fields on the Norwegian continental shelf to supply the tight European market. Production permits for the Oseberg and Troll fields have each been increased by 1 billion cubic meters (bcm) for the gas year starting October 1.

Already in June, Equinor took steps to evaluate and develop concepts for enhancing the production and exports to the European market. This work resulted in enhanced production permits from the Ministry of Petroleum and Energy for the Oseberg and Troll fields.

Specifically, Equinor and its partners have received production permits for the gas year 2021 (starting October 1) which for each is 1 bcm higher than for the current year, i.e., an increase from 5 bcm to 6 bcm for Oseberg and from 36 bcm to 37 bcm for Troll.

"The production permits allow us to produce more gas from these two important fields this fall and through the winter. We believe that this is very timely as Europe is facing an unusually tight market for natural gas. At Equinor we are working on measures to increase exports from our fields on the NCS," said Helge Haugane, senior vice president Gas & Power.

Ramping up at Troll

After 25 years of significant gas exports from Troll, around 50% of the gas is left in the ground. To further develop the Troll-area and reinforce our ability to secure gas deliveries to Europe in the coming decades, Equinor has recently completed the Troll Phase 3 project.

Recoverable volumes from Troll phase 3, which will produce the Troll West gas cap with industry leading low CO2 emissions, are estimated at as much as 347 billion standard cubic meters of gas. Total recoverable gas volume remaining in Troll is estimated to be 715 billion standard cubic meters.

"Now we are ramping up production at Troll following the completion of the Phase 3 project, and we expect to reach plateau production from 1 October. We take pride in being a long-term, reliable supplier of energy and we are happy that we have been able to identify ways to export as much as practically possible into this tight market," said Helge Haugane.

Troll phase 3 will extend the life of Troll A and the Kollsnes processing plant beyond 2050, and the plateau production period by 5-7 years.

» *Oseberg field center in the North Sea. (Photo credit: Ole Jørgen Bratland / Equinor ASA)*

HESS ANNOUNCES OIL DISCOVERY AT PINKTAIL, OFFSHORE GUYANA

Hess Corporation has made another oil discovery on the Stabroek Block offshore Guyana at Pinktail. The Pinktail well encountered 220 feet (67 meters) of net pay in high-quality oil-bearing sandstone reservoir. Pinktail is located approximately 21.7 miles (35 kilometers) southeast of the Liza Phase 1 development, which began production in December 2019, and 3.7 miles (6 kilometers) southeast of Yellowtail-1. Pinktail was drilled in 5,938 feet (1,810 meters) of water by the *Noble Sam Croft*.

» *Drilling vessel Noble Sam Croft. (Photo credit: Noble Corp.)*

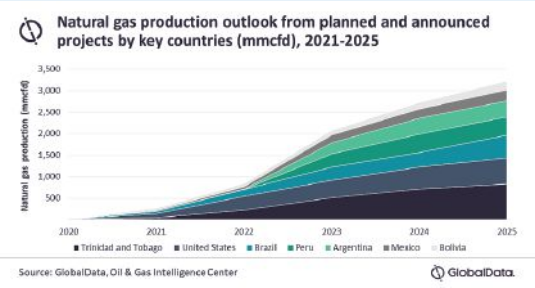
In addition to successful appraisal of the Turbot discovery, the Turbot-2 well encountered 43 feet (13 meters) of net pay in a newly identified, high-quality oil-bearing sandstone reservoir separate from the 75 feet (23 meters) of high quality, oil bearing sandstone reservoir pay encountered in the original Turbot-1 discovery well. These results will be incorporated into future developments. The Turbot-2 discovery is located approximately 37 miles (60 kilometers) to the southeast of the Liza Phase 1 development and 2.5 miles (4 kilometers) from Turbot-1. Turbot-2 was drilled in 5,790 feet (1,765 meters) of water by the *Noble Sam Croft*.

CEO John Hess said: "We are happy to announce our 20th significant discovery on the Stabroek Block, which will add to the discovered recoverable resource estimate of more than 9 billion barrels of oil equivalent."

Separately, the *Liza Unity* floating production storage and offloading (FPSO) vessel set sail from Singapore to Guyana in early September. The FPSO will be utilized for the Liza Phase 2 development, which is expected to begin production in early 2022, with a production capacity of approximately 220,000 gross barrels of oil per day. The *Liza Destiny* FPSO is currently producing approximately 120,000 gross barrels of oil per day.

The Stabroek Block is 6.6 million acres. At least six FPSOs are expected to be online by 2027 with the potential for up to 10 FPSOs on the block to develop the current discovered recoverable resource base. ExxonMobil affiliate Esso Exploration and Production Guyana Limited is operator and holds 45 percent interest in the Stabroek Block. Hess Guyana Exploration Ltd. holds 30 percent interest and CNOOC Petroleum Guyana Limited holds 25 percent interest.

TRINIDAD & TOBAGO TO DOMINATE NATURAL GAS PRODUCTION FROM UPCOMING PROJECTS IN AMERICAS IN 2025



Trinidad and Tobago is expected to contribute around 25% or 820 million cubic feet per day (mmcfd) of the Americas natural gas production in 2025 from planned and announced projects (new build projects, excluding the US L48), according to GlobalData, a leading data and analytics company.

The company's report Americas Oil and Gas Upstream Development Outlook to 2025 reveals that 514 mmcfd of natural gas production in Trinidad and Tobago in 2025 is expected from planned projects with identified development plans, while 306 mmcfd is expected from early-stage announced projects that are undergoing conceptual studies and are expected to be granted approval for development.

A total of seven natural gas projects are expected to start operations in Trinidad and Tobago during 2021-2025. Of these, Colibri and Matapal are some of the key projects that are expected to collectively contribute around 58% of the natural gas production in the country in 2025.

Svetlana Doh, Oil & Gas Analyst at GlobalData, commented: "Despite quite a positive outlook for the country's production in the near term, GlobalData projects that natural gas output in Trinidad and Tobago will start declining after 2024. Since most of the developed and undeveloped shallow water blocks are already licensed, more aggressive exploration work needs to be conducted regarding deepwater acreage. The country offered some deepwater blocks in the 2020 deepwater competitive bid round, but the round was delayed until 2021. Further delays could be expected due to the sudden death of Trinidad and Tobago's energy minister in April 2021."

GlobalData identifies the US as the second highest country in the Americas with 608 mmcfd of natural gas production in 2025 or around 18% of the total Americas natural gas production in the year (excluding the US L48). Brazil follows with natural gas production of 538 mmcfd from planned and announced projects in 2025.

Among oil and gas companies, BP, China National Petroleum, and Petroleo Brasileiro SA lead with the highest natural gas production of 421 mmcfd, 412 mmcfd and 387 mmcfd respectively, in 2025 from planned and announced projects (excluding the US L48).

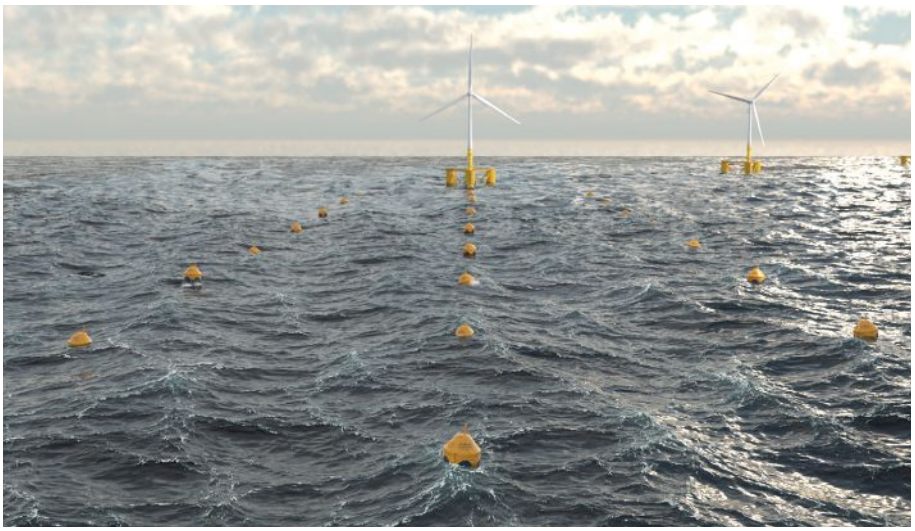
CHEVRON, ENTERPRISE EXPLORE CARBON STORAGE BUSINESS OPPORTUNITIES

Chevron U.S.A. Inc., through its Chevron New Energies division, and a subsidiary of Enterprise Products Partners L.P. have announced a framework to study and evaluate opportunities for carbon dioxide (CO2) capture, utilization, and storage (CCUS) from their respective business operations in the U.S. Midcontinent and Gulf Coast. The companies expect the initial phase of the study in which they will evaluate specific business opportunities to last about six months.

"This joint effort has the potential to advance our ongoing work to grow our lower carbon businesses with commercial scale using the industry expertise both companies bring to the project," said Jeff Gustavson, president of Chevron New Energies. "International climate change scientists working with the United Nations have identified carbon capture as a critical technology needed to help the global energy system transition to a lower carbon future."

The companies have successfully worked together on prior business opportunities and believe they bring complementary capabilities to successfully pursue CCUS. Projects resulting from the evaluation would seek to combine Enterprise's extensive midstream pipeline and storage network with Chevron's subsurface expertise to create opportunities to capture, aggregate, transport and sequester carbon dioxide in support of the evolving energy landscape.

"The joint study with Chevron is part of our growing focus on developing and utilizing new technologies and leveraging our transportation and storage network in order to better manage our own carbon footprint and provide customers with new midstream services to support a lower carbon economy," said A.J. "Jim" Teague, co-chief executive officer of Enterprise's general partner. "Our success in upgrading and repurposing existing assets will be important to the success of any initiative we move forward with."



PORTUGAL'S GREEN ENERGY STATURE GROWS WITH 'WORLD-FIRST' EU SCORES PROJECT

Portugal's stature as a leading force in green energy grew further this month with the arrival of the €45m EU SCORES Project—paving the way for the world's first hybrid offshore energy park.

The European SCalable Offshore Renewable Energy Sources (EU-SCORES) Project will be partly located off the coast of Viana do Castelo, capitalizing on northern Portugal's abundant natural energy resources.

It will see CorPower's pioneering wave energy linked with offshore wind, to create one of the world's first combined offshore energy arrays. A separate element will see floating solar combined with offshore wind in Belgium.

The Portuguese government estimates its coastlines contain circa 34 GW of wave power and is aiming to harness 70 MW by 2030. A key pathfinder in this pursuit, EU SCORES further underpins the nation's wider renewable energy objectives.

Portugal was among the first countries in the world to set 2050 carbon neutrality goals. Its ambitious National Energy & Climate Plan for 2021-2030, otherwise known as PNEC 2030, is pitching for renewable energy to deliver 47% of gross final energy consumption, within the next decade.

More specifically, Portugal is ramping up installed capacity of renewable electricity, aiming to add around 15 GWs to its energy system. This will drive the overall share of 'renewables-produced' electricity to 80%. In addition, it is planning a 35% reduction in the consumption of fossil fuels, by 2030.

Steady success has been recorded in recent years, going back to May 2016, when the country ran for four days straight on renewable energy alone. This was followed by further progress in March 2018, when renewable electricity production outstripped monthly consumption for the first time in the nation's history. The landmark EU SCORES Project now arrives a pivotal moment in Portugal's renewable energy narrative.

Alongside CorPower Ocean Portugal Lda, three Portuguese institutions will support the project: EDP Labelec, INESC TEC and WavEC. Together, they will contribute to the definition of the solution and its implementation, as well as the monitoring of structures, maritime biodiversity, and the development of control strategies for the operations and asset management.

While attempting to accelerate the energy transition, EU-SCORES also aims to crystallize the value of partnering complementary energy sources, like wave and wind, which can work in tandem to create a more continuous power profile. This combined approach essentially creates a more resilient and stable power system, not only with greater production capacity, at a lower cost per MWh (Megawatt-hour), but also more consistency.

Adding to Portugal's glowing renewables résumé, EU SCORES further supports the nation's Industrial Strategy for Ocean Renewable Energies, designed to create a competitive and innovative industrial export cluster for ocean renewable energy.

As preparations continue to launch CorPower's first commercial scale system, with the flagship HiWave-5 Project, exciting times await on the north Portugal coast welcoming the world's first hybrid offshore energy array.

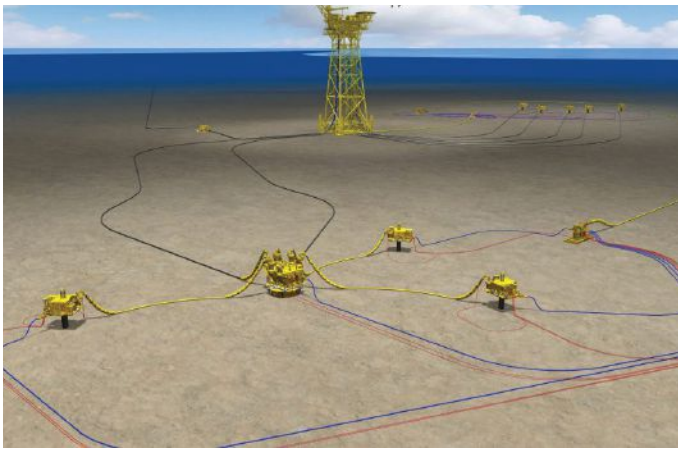
FIRST GAS FOR BPTT'S MATAPAL PROJECT

bp Trinidad and Tobago LLC (bpTT) has confirmed that its Matapal project has safely achieved first gas. The major milestone was achieved ahead of schedule and under budget despite the constraints brought about by the COVID-19 pandemic.

Matapal is bpTT's second subsea development. It's comprised of three wells, which tie back into the existing Juniper platform, helping minimize development costs and the associated carbon footprint. It's located approximately 80 km off the south-east coast of Trinidad and approximately 8 km east of Juniper, in a water depth of 163 meters.

Matapal will deliver gas into the Trinidad gas market from resources discovered by the Savannah exploration well, drilled in 2017. The initial production from this development is expected to be in the range of 250-350 million standard cubic feet per day (mmscfd), once all wells are fully ramped up.

Claire Fitzpatrick, president bpTT, said: "Natural gas will play an important role in the energy transition and to the economy of Trinidad and Tobago for decades to come. This is why our team at bpTT has worked diligently to safely start up our Matapal project which we successfully achieved both under budget and ahead of schedule. We are committed to a strong energy future in Trinidad and Tobago and this project plays a critical role in delivering that."



» *The Matapal project field layout. (Image credit: bpTT)*

Fabrication work on Matapal began in 2019. The project required modification to the existing Juniper platform as well as the construction and installation of new subsea equipment. Importantly, the majority of fabrication work required to adapt the Juniper platform for new production was completed locally. Hydrocarbons from Matapal will be transported to the Juniper platform via two 9 km flexible flowlines.

With 15 offshore production platforms, bpTT is the country's largest hydrocarbon producer, accounting for about 55% of the nation's gas production.

SUBSEA UK CALLS FOR SUBSEA SUCCESS STORIES AHEAD OF GLOBAL UNDERWATER HUB LAUNCH

From surveys under the ice in the Antarctic to monitoring sharks in the Bahamas, underwater companies have been sharing their success stories as part of a campaign to raise awareness of the breadth and depth of the industry by demonstrating its achievements in diverse market sectors.

Launched by Subsea UK, the Subsea Success Stories campaign aims to celebrate the people, companies and ground-breaking technologies that make up the country's underwater industry ahead of the much-anticipated launch of the Global Underwater Hub (GUH) later this year.

Subsea UK is transitioning into a new strategically-focused, intelligence-led organization that will transform the UK's underwater industry into one of the largest and fastest-growing industries in the country, accelerating the drive to net-zero and creating high value sustainable jobs and exports.

Building on Subsea UK's heritage and retaining its experience, knowledge, network and membership, the GUH will harness the UK's combined underwater expertise in engineering, environmental science, technology, services and skills, to enable companies to successfully compete globally in the underwater sectors of offshore energy, defense, aquaculture, telecoms and subsea mining.

Neil Gordon, CEO of Subsea UK, said: "As we transition into the GUH, we want to capture the success of our industry through compelling stories about its people, its companies, its ground-breaking technologies and the markets in which it operates. The best of these tales will be compiled into a film for the launch of the GUH that truly reflects the scale and diversity of our industry, the experience and know-how of the people who work in it. We also want to show how underwater companies are developing solutions to future underwater challenges, particularly in meeting tomorrow's energy needs."

Impact Subsea and Saab Seaeye are among the first subsea champions to share their unique tales of working in the industry and are urging others to join them.

Aberdeenshire-based Impact Subsea manufactures a range of cutting-edge underwater technology which is supplied to clients around the globe. Most recently the company released the game changing ISS360—the world's most compact imaging sonar and won a Queen's Award for Innovation this year for its market leading-underwater altimeter—the ISA500.

This altimeter, used to measure distance to an object underwater, is the only one in the world known to be submillimeter accurate. Several of these are currently being used by the British Antarctic survey team. The altimeter provided critical measurements during the hot water ice drilling process for subglacial access on the BEAMISH project and has also been used on Icefin—the Georgia Tech autonomous underwater vehicle—for exploring the aphotic regions below Antarctic ice shelves.

Impact Subsea managing director, Ben Grant, said: "Companies such as ours are leading underwater technology developments globally. Our technology is used in oil and gas but is also extensively used in other subsea sectors such as scientific research, renewables and defense.

"The UK subsea industry is recognized as a global leader. To continue to excel, we must keep innovating and developing game-changing technology. The GUH could not have come at a better time as we strive to sharpen our competitive edge and secure a larger portion of global opportunities in our market sectors."

Saab Seaeye is the world's largest manufacturer of electric underwater robotic systems with the widest range of vehicles undertaking a vast array of tasks. Headquartered in Fareham, they operate globally in offshore energy, marine science, aquaculture and hydro installations, defense and the nuclear industry.

Recently, their smallest robotic vehicle, the Falcon, was used by global aquatic research partnership, The Ocean Tracking Network, to monitor the behaviors of sharks in deep water habitats around the Bahamas.

Other missions include monitoring anchorage security of Japan's offshore wind turbines and inspecting five-kilometer-long tunnels serving Toronto's city water system.

Saab Seaeye products director, Matt Bates, said: "The subsea industry is varied and exciting with massive opportunities for growth. It's only right that we have an intelligence led organization like the GUH which can support, advise and champion companies looking to expand into new markets.

"We need to broaden our understanding of the potential opportunities within the underwater industry's diverse markets. Exports now account for 80% of our business, supplying to global customers in industries including aquaculture, marine science, renewables, defense and oil and gas so there's a lot to celebrate here and a lot we can be proud of."

As part of the campaign, Subsea UK will be encouraging others to submit their stories with supporting imagery and video. These inspirational tales will be shared on social media using the hashtag #SubseaSuccessStories.

Mr. Gordon added: "Uncovering and telling the great stories of our industry's current success will help us set the scene for the launch of the GUH, which will provide underwater companies with the market information, connections, access and support they need to capitalize on the unprecedented scale of opportunity for future growth presented by the blue economy and the energy transition."

Companies should send their success stories to *subseasuccess@bigpartnership.co.uk*.

» *The Ocean Tracking Network monitor the behaviors of sharks in deep water habitats around the Bahamas.*

TOUGH AND RELIABLE FALCON FOR GEO OCEANS

Further expanding their robotic vehicle fleet, Geo Oceans recently selected the Saab Seaeye Falcon for its "reliable and hard wearing" reputation. As a global underwater services company, Geo Oceans is committed to adding industry-leading robotic vehicles to their fleet for deployment over a wide range of tasks.

Such tasks include non-destructive testing, high-definition visual inspection, 3D modelling and photogrammetry, high pressure water blasting and numerous maintenance undertakings.

The Falcon completed 1,000 dives during a challenging seismic survey project in Southeast Asia, with zero incidents and no loss of productivity.

As the world's top-selling robotic vehicle in its class, performing thousands of hours of undersea operations, the Falcon gives Geo Oceans the versatility, power, and control intelligence to perform the vast array of tasks needed. At the heart of the Falcon's success is Saab Seaeye's iCON™ future-flexible intelligent control architecture, a concept that pioneered distributed control technology.

Together with five powerful thrusters, the meter-sized, 1000-m rated Falcon, makes it a highly maneuverable, multi-tasking vehicle, that can be packed with cameras, sensors, and tools, while holding steady in strong cross currents.

Geo Oceans looks to bring innovative solutions to the subsea and environmental markets with the aim of reducing cost and time whilst increasing safety efficiency. Supporting the sale was Saab Seaeye distributor, BlueZone.

» *A vote of confidence from the Geo Oceans team. (Photo credit: Saab Seaeye)*

» *The Falcon set to undertake a variety of subsea tasks. (Photo credit: Saab Seaeye)*

FUGRO COMPLETES GEOHAZARD SITE INVESTIGATION ACTIVITY ON BLOCK 58 IN SURINAME

Fugro has finalized fieldwork on a site investigation program for TotalEnergies off the north-west coast of Paramaribo in Block 58 of the Guyana-Suriname Basin. The project sits approximately 150 km offshore in water depths ranging from 60 m to 2,100 m and involves acquisition and analysis of geophysical data and geotechnical soil samples. Fugro will use this information to characterize site conditions and identify potential geohazards, helping the client to derisk potential development activities.

The nearly 7-month-long field program was accomplished from the *Fugro Brasilis* using an autonomous underwater vehicle (AUV) for most of the geophysical data collection and piston and box corers for the seabed soil sampling. This approach was informed by 20 years of experience in the region, including the collection of nearly 15,000 line kilometers of geophysical data and dozens of soil core samples in the Guyana-Suriname basin. To streamline project delivery and reduce the carbon footprint, Fugro performed initial data processing and laboratory testing onboard the vessel.

"This work represents one of Fugro's largest site characterization programs in the region over the past several years," said Brian Hottman, Fugro's director for the Caribbean and Pacific South America. "Our history in the region and our shared commitment to safety, sustainability and local content is adding value to the project and helping our client meet their responsible resource development goals for Block 58."

» *The Fugro Brasilis, a highly advanced survey vessel ideally suited to perform geophysical, geotechnical, oceanographic, and environmental surveys in Brazil and South America. (Photo credit: Fugro)*

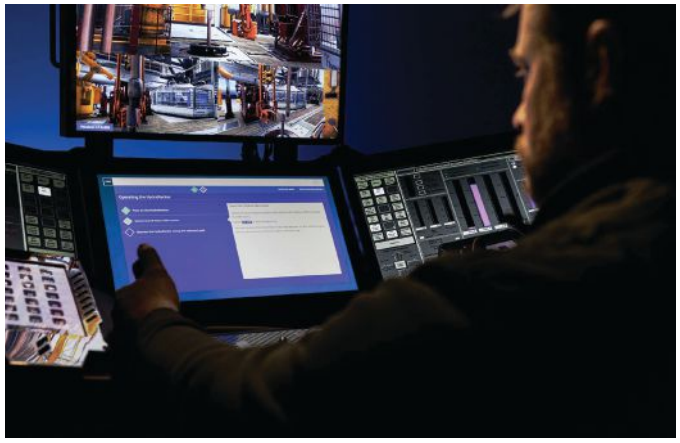
SPE PAPER SHOWS DRILLING SIMULATOR BOOSTS HUMAN PERFORMANCE BY 63%

A DWOS project to train Petronas crew members for a specific deep-water drilling campaign has shown how human performance can be improved by 63% by drilling the well on a simulator beforehand.

Details of the project's success have been presented at the Society of Petroleum Engineers (SPE) in a Whitepaper entitled "Operational Performance Training Using High Fidelity Simulations and Advanced Human Performance Techniques" to demonstrate how this type of training can be used to positively support the oil and gas industry.

Within the oil and gas sector, 92% of well control events can be attributed to human factors, however the vast majority of drilling training focusses on technical excellence. The Petronas project and resulting SPE paper shows how combining human factors training with technical training can significantly improve the performance of drilling crews and reduce human error.

The project began when Petronas commissioned Drilling Systems' mobile 'On-the-Rig' (OTR) drilling simulator to prepare its crew prior to starting a deep-water drilling campaign. A digital twin of the well-specific and equipment-specific conditions was created on the OTR to enable Petronas personnel to drill the well on the simulator (DWOS) beforehand using the exact environment and conditions they would face operationally to fine tune skills.



Coaching specialists, Salos worked closely with Drilling Systems to identify and design eight realistic scenarios and challenges for Petronas personnel to undertake on the OTR. These scenarios were based on previous deep-water project experiences and included: Drilling Ahead, Well Control, Stuck Pipe, Shallow Flow, Total Loss of Circulation, DP Status Change, Stripping and Losses, Ballooning and Wellbore Breathing.

Complete teams comprising of both drilling and supervisory personnel practiced each of these scenarios together in their operational roles and were assessed on 11 elements: six relating to human factors such as communications, teamwork and decision-making and five technical skills including downhole understanding, procedure knowledge and program knowledge.

The scores showed a marked improvement over the course of the training with average marks increasing from 54% to 86% from the first simulator session to the last. This represented an overall improvement of 63%.

Grant Wallace, MD at Salos Sunesis said: "The coaching approach embeds the learning directly at the work site and the Drilling Systems On-The-Rig (OTR) simulator enhances this learning process. It is only through combining technical training with Human Factors training that we will equip teams to face those less visible dangers and in turn improve operational safety and performance."

Clive Battisby, CEO at Drilling Systems, said: "This collaborative project between Petronas, Salos and Drilling Systems shows that tailored and realistic training can not only help improve technical excellence, but it can help to create strong teams with excellent communication, who all work effectively together. As well as helping to mitigate human factors, this ultimately improves overall safety for the industry."

HELIX INKS MULTI-YEAR RISER-BASED WELL INTERVENTION SCOPE IN GULF OF MEXICO

Helix Energy Solutions Group, Inc. has been awarded a multi-year riser-based well intervention scope of work by a major operator for the charter of the Helix Q5000 and 15K Intervention Riser System in the US Gulf of Mexico.

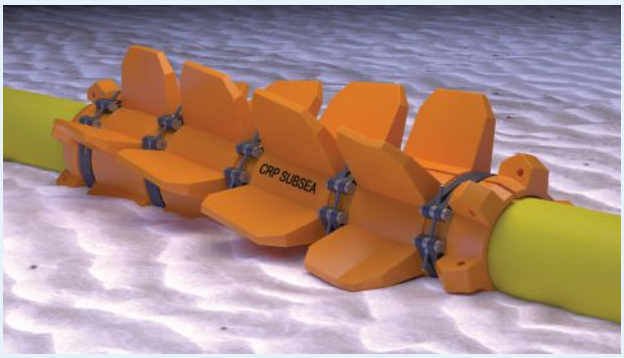
The awarded scope of work is currently contemplated to commence in 2022 on a call-off basis and includes well intervention and production enhancement activities.

The Q5000 and 15K IRS system are part of the Subsea Services Alliance which combines the collective strengths and capabilities of Helix and Schlumberger.

The Q5000 DP3 well intervention vessel is a second-generation design based on the successful Q4000 MODU. The Q5000 provides a stable platform for a wide variety of tasks, including subsea well intervention, field and well decommissioning, installation and recovery of subsea equipment, well testing and subsea construction activities. The Q5000 features a 750 ST tower capable of fulfilling all traditional derrick roles, plus a deepwater crane with lifting capacity to 440 ST and a work crane rated to 176 ST.

The 15K IRS can be utilized for wireline intervention, production logging, coiled-tubing operations, well stimulation and full plug and abandonment operations. The 15K IRS enables access to both vertical and horizontal subsea trees in water depths down to 10,000 ft.

CRP SUBSEA LAUNCHES NEW SUBSEA MOTION STABILIZER TECHNOLOGY



» *Fins along the length of the stabilizer embed into the seabed and create the required resistance per meter of the system. (Image credit: CRP Subsea)*

CRP Subsea is launching its new Motion Stabilizer technology, specifically designed to protect cables, umbilicals and flowlines from motion instability and damage from uncontrolled movement. Engineered to mitigate instability in both axial and lateral directions, the unique Motion Stabilizer design includes customizable fins that anchor into the seabed increasing overall resistance.

Paul Louvain-Walters, Business Group Manager (Elastomers) for CRP Subsea in Skelmersdale, England, stated: "Through ongoing collaboration with our customers, we understand that on-bottom stability, axial walking and lateral sliding can be real issues. Irrespective of the phenomenon causing the instability, our latest innovation Motion Stabilizer is designed to control movement, keeping cables, umbilicals and flowlines in their laid location where desired or allowing movement when needed, reducing the risk of damage or undue stresses."

The Motion Stabilizer incorporates CRP Subsea's established Uraduct® and Tri-strakes® materials and designs. It is supplied in two lightweight halves, which are banded together during pipe lay deployment operations, removing the need for a secondary installation vessel. Fins placed along the length of the stabilizer, are custom-designed for varied soil conditions, ensuring they effectively embed into the seabed and create the required resistance per meter of the system. In tests this proved to give significantly increased resistance compared to cables, umbilicals and flowlines without stabilizers.

"The Motion Stabilizer complements our existing range of subsea ancillary protection technology. It is manufactured from CRP Subsea's highly abrasion resistant API 17L certified and REACH compliant Uraduct® material, which has an enviable track record of over 30 years. The Motion Stabilizers are highly resilient and will survive considerable seabed abrasion and over boarding chutes or S-Lay operations," Louvain-Walters added.

CYPRUS SUBSEA TO REPRESENT HUNTINGTON INGALLS INDUSTRIES, UNMANNED SYSTEMS

Cyprus Subsea Consulting and Services has announced the signing of an independent sales representative agreement with Huntington Ingalls Industries (HII), to represent their Seaglider AUVs to commercial customers in Cyprus, France, Spain, Portugal, Albania, Montenegro, Malta and Norway. In addition to the promotion of Seaglider equipment sales, Cyprus Subsea is authorized to provide after-sale services including mission planning, launch/recovery, piloting, maintenance, training, data management, analysis, and reporting.

"Cyprus Subsea is proud to add sales of HII's Seaglider AUVs to the world-class glider piloting and integration services we have been offering in recent years," said Dr. Daniel Hayes, Managing Director of Cyprus Subsea.

Unmanned Systems, a business group within HII's Technical Solutions division, creates advanced unmanned maritime solutions for defense, marine research, and commercial applications. Serving customers in more than 30 countries, HII provides design, autonomy, manufacturing, testing, operations, and sustainment of unmanned systems, including unmanned underwater vehicles (UUVs) and unmanned surface vessels (USVs).

» *Ridley is a towable Launch and Retrieval System (LARS) for large subsea robots. (Image credit: HonuWorx)*

CHECK THE TECH

SUBMERSIBLE MOTHERSHIP SIGNALS NEW ERA FOR SUBSEA ROBOTICS FOR OFFSHORE WIND

A new project funded by Innovate UK will see Aberdeen technology developer HonuWorx and the Offshore Renewable Energy (ORE) Catapult partner to develop an exciting new submersible mothership designed to make robotics a sustainable and cost-effective solution for offshore wind farms.

"Ridley" is a submersible platform engineered to transport and deploy large ROVs, AUVs, and AIVs (or combinations of these unmanned systems) to offshore sites. The hope is that the project will act as a critical steppingstone to HonuWorx' broader vision, their disruptive Loggerhead concept, which envisions the use of an autonomous mothership as a mobile power and communications hub for ROVs and AUVs.

OVERCOMING BARRIERS

ORE Catapult sees the concept as a means of overcoming some of the persistent barriers to the offshore wind industry's adoption of subsea robotics—concerns associated with high operating costs, carbon footprint concerns, and unreliable battery life and digital connectivity.

Although ROVs are used to execute wind farm IMR, their reliance on crewed and carbon-heavy topside support means that they seldom achieve anything close to their optimal utilization. Conservative estimates suggest that, on average, a 21-day inspection campaign using a traditional vessel may cost up to $2 million and emit more than 500 tonnes of carbon dioxide.

The proposed alternative of transferring the ROVs in a lightweight, autonomous submersible seeks to alleviate some of these financial and environmental burdens. On arrival at a target site, the platform submerges and deploys the robots below the waterline, so also minimalizes the normal disruption and risk of operating in rough weather and high sea states.

ENABLING REMOTE OPERATIONS

A further transformative step will be the coupling of automation software for coordinating multiple platforms with communications technologies via satellite, 4G, and 5G networks (as best suits each at-sea location). HonuWorx's Distributed Control Centres (DCC) will enable remote supervision from shore, while equipping the mothership with charging ports will also deliver a solution to the well-documented battery life restrictions that limit the use of ROVs on prolonged missions.

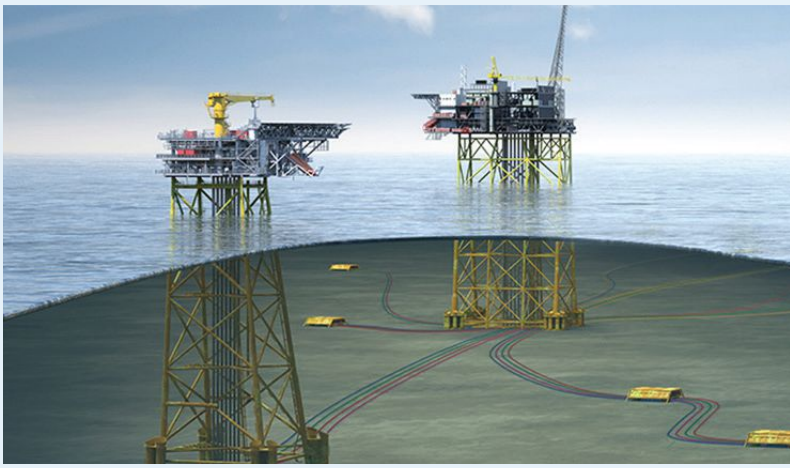
As the global offshore wind industry of tomorrow looks to capitalize the more abundant wind resources found in deeper, more remote waters, the role of intelligent robotics and automaton will prove instrumental to championing efficiency and safety. Ultimately, the successful remote operation of any offshore asset will hinge on the careful balance of cost reduction, safety improvements and a functional integration of new technologies.

Speaking exclusively to ON&T, Lee Wilson, HonuWorx CEO and Co-Founder, said: "We are on a mission to pioneer sustainable subsea technologies for offshore operations at scale, and that includes accelerating the adoption of increasingly intelligent robotics by developers operating in future-proof sectors like offshore renewables."

Working with ORE Catapult on this project affords us exclusive insight to the sorts of issues that wind operators face and ultimately give us the opportunity to put into action the most appropriate technologies to remove them."

For more information, visit: *www.honu-x.com*.

SUBSEA 7 AWARDED FEED CONTRACT BY AKER BP OFFSHORE NORWAY



Subsea 7 S.A has been awarded a contract by Aker BP for the front-end engineering and design (FEED) study for the NOA Fulla development project, offshore Norway. NOA Fulla is located in the southern part of the NOAKA area in the Norwegian North Sea.

The awarded work is required to finalize the technical definition of the proposed development prior to Aker BP and its partners making the final investment decision (FID) late 2022. The FEED study will begin immediately.

Subsea 7 has recognized the FEED award in its order backlog in the third quarter of 2021. The value of a potential subsequent EPCI contract would only be recognized by Subsea 7 in its backlog upon FID, and would represent a substantial project award.

Project management and engineering will take place in our office in Stavanger, Norway. Offshore installation activities would be scheduled for 2025, 2026 and 2027.

Monica Bjørkmann, Vice President for Subsea 7 Norway said: "This award continues our long-standing collaboration with Aker BP, through the Aker BP Subsea Alliance. The partnership enables Subsea 7 to engage early in the field development process, optimizing design solutions and contributing to the final investment decision. We are delighted to continue our alliance with Aker BP for the NOA Fulla development, which is of significant importance for all partners in the Subsea Alliance. Subsea 7 looks forward to working closely with Aker BP to successfully deliver our scope with safety and quality at the forefront throughout."

» *Construction of JDR's new manufacturing facility is expected to begin in 2022 ahead of a 2024 opening. (Image credit: JDR)*

JDR CABLE SYSTEMS ANNOUNCES £130 M SUBSEA CABLE FACILITY TO BOOST UK OFFSHORE RENEWABLES SECTOR

JDR Cable Systems (JDR), part of the TFK Group, recently announced its plans to open a new state-of-the-art subsea cable manufacturing facility in Cambois, near Blyth, Northumberland.

JDR has confirmed its intention to go ahead with the project, subject to final agreements, with construction expected to begin in 2022 ahead of a 2024 opening, creating 170 high-quality local jobs on completion and safeguarding 270 jobs at JDR's existing facilities. The initial project investment is estimated at £130m, which will be part funded by a grant from the BEIS Offshore Wind Manufacturing Investment Support (OWMIS) scheme. JDR and TFK plans to raise the remaining funding with support expected from financial institutions and UK Export Finance.

The new facility is the first stage of JDR's plans to expand its product portfolio to support the growing global renewable energy market, adding high voltage export and long length array cables to its existing capacity and product capabilities. Further stages of the development could result in over 400 staff working at the site, with supplied products complementing JDR's existing capacity provided by the company's Hartlepool and Littleport UK manufacturing centers. When complete, the facility will include a new catenary continuous vulcanization (CCV) line, making it the only facility in the UK capable of full start-to-finish manufacturing of high voltage subsea cables for offshore wind farms to support the growing global renewable energy market.

Tomasz Nowak, JDR CEO, said: "As the energy transition gathers pace and the UK's offshore wind sector continues to thrive, turbines are growing taller and farther from shore, calling for higher voltage subsea cables. We're delighted to build on our legacy as a leading provider of subsea cables to the offshore energy sector by investing in this new facility. We're also delighted to continue our investment in the Northeast of England, and in bringing new jobs to Cambois, Blyth and Northumberland. Our proposed facility is strategically located to capitalize on the rapidly growing and largest offshore renewable energy market in Europe."

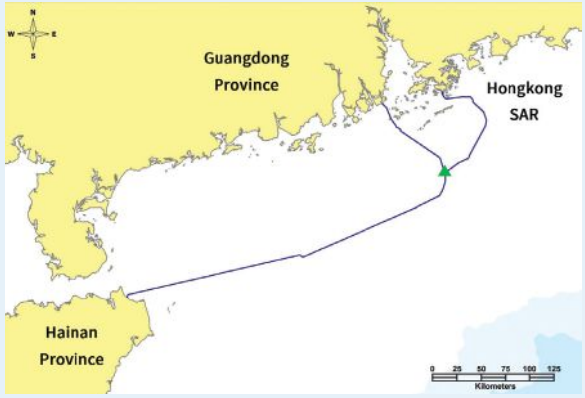
As the UK prepares to host COP26 in November, the project is an example of the country's commitment to its net-zero vision. At the same time, the facility fits with the government's 'levelling-up' agenda in the Northeast of England, as well as its 'Build Back Better' ambition in the wake of COVID-19, helping to deliver on several strategic national priorities.

COMPLETION OF FIRST TRIAL OF SUBMARINE CABLE WITH MULTICORE FIBER

NEC Corporation, its subsidiary OCC Corporation and Sumitomo Electric Industries has announced the completion of the first trial of uncoupled 4-core submarine fiber cable and verified its transmission performance to meet the exacting demands of global telecommunications networks. International data usage is expected to expand by 30-40% CAGR from 2020-2026.

To meet this demand, submarine networks are adopting space division multiplexing (SDM) technology, where the number of independent spatial channels is increased to maximize total system capacity, reduce power consumption, and optimize cost per bit.

Multicore fiber is now expected to further increase the number of parallel optical fiber cores without increasing the submarine cable size and structure, enabling the second generation of submarine SDM systems.



» *H2HE is the world's first 16 fiber repeatered submarine cable system and connects Hainan Province, Guangdong Province, and Hong Kong SAR. (Image credit: HMN Tech)*

HMN TECH 16 FIBER PAIR REPEATERED SYSTEM READY FOR SERVICE

HMN Tech recently announced that the world's first 16 fiber pair repeatered submarine cable system, Hainan to Hong Kong Express (H2HE), has successfully completed system commissioning and testing, and is now ready for service.

H2HE connects Hainan Province, Guangdong Province, and Hong Kong SAR with a total length of 675 kilometers. The network facilitates a direct connection between Hainan and Hong Kong, underpinning Hainan as an emerging interconnection hub in the Asia-Pacific region.

The 16 fiber pair network design incorporates HMN Tech's next generation space-division multiplexing (SDM) technology to achieve a system capacity of over 300 Tbps, sufficient to transmit 57,000 high-definition movies every second.

This is a milestone in technological innovation, as constraints associated with submersible plant have historically limited systems to eight or twelve fiber pairs. HMN Tech's R&D team has achieved this significant breakthrough by improving circuit conversion efficiency, optimizing submersible plant structures and system integration techniques.

Overcoming a multitude of challenges throughout the entire turnkey delivery process, from design to product manufacturing, system integration to marine installation is critical to bring the concept of a repeatered 16 fiber pair solution to reality. This success further strengthens HMN Tech's position to achieve greater technological advances in the near future.

"We are delighted to partner with forward-thinking customers such as China Mobile, to successfully deliver the first 16 fiber pair submarine cable system that is a milestone in the industry," stated Ma Yanfeng, Executive Vice President. "HMN Tech remains committed to developing reliable innovative technology that not only enhances our value proposition but also promotes industry evolution and accelerates the world's digital transformation."

PRYSMIAN TO DEVELOP EXPORT SUBMARINE POWER CABLE SYSTEM FOR FRENCH OFFSHORE WIND FARM

Prysmian Group, in consortium with Asso. subsea, a specialized submarine installation contractor, has signed a contract worth approximately €30 million with RTE, Réseau de Transport d'Électricité, for the development of an export submarine power cable system for the Gruissan floating offshore wind farm located in Southern France.

Prysmian Group will be responsible for the design, supply, termination, testing, and commissioning of one 66 kV three-core export submarine cable with EPR insulation for a total of 25 km and attached another 66kV submarine dynamic cables with EPR insulation for about 1 km connecting the shore to a floating sub-station. The Group will also provide additional 3 km of onshore 66 kV cables with XLPE insulation.

All submarine cables will be produced at Prysmian Group's center of excellence in Nordenham (Germany), while the land cables will be manufactured at the Gron plant (France). The notice to proceed is planned by the end of November. Commissioning is scheduled for July 2023.

Asso.subsea, a technology-driven company specialized in providing offshore solutions worldwide, will undertake the installation services of the Project. Asso.subsea will design and perform all marine works required for the project, such as cable loading, route preparatory works, cable installation and protection and HDD works at landfall.

Following the Kincardine and Provence Grand Large projects, Prysmian further consolidates its position in the floating offshore wind farm market, deploying its knowledge, experience, and capability to cope in this high-profile engineering pilot market.

This contract confirms the trust and confidence that RTE places in Prysmian, having already awarded the Group other projects such as those for the Fécamp, Courseulles-sur-Mer, St. Nazaire and Noirmoutier offshore wind farms.

OSI COMPLETES COMMUNICATION CABLE INSTALLATION IN COLOMBIA

Ocean Specialists, Inc. (OSI), a global provider of marine project development and operations services, announced the successful installation of a subsea fiber optic network serving an offshore oil offloading buoy in the Caribbean Sea for a key energy client in Colombia.

The project is representative of OSI's end-to-end approach to delivering integrated solutions to complex subsea challenges. OSI's project management role included the design and engineering of the submarine and terrestrial cable segments, including selection and procurement of system elements, installation planning and design, and oversight of implementation and commissioning support.

The subsea cable provides high bandwidth and redundant communications to the buoy from an onshore control room. To ensure a robust and fit-for-purpose connection, OSI partnered with MacArtney to design and manufacture a custom cable termination equipped with a dynamic cable riser and spare wet-mate subsea connectors for future network expansion.

The subsea and terrestrial cables were provided by Hexatronic, based in Sweden. Prior to delivery it was decided to run the cable Factory Acceptance Testing remotely. The lessons learned from this process, amid the disruption caused by the COVID-19 pandemic, have proven critically important to the ongoing progress of other OSI projects restricted by the necessary international travel limitations.

Speaking of the successful cable installation, OSI's project lead, Jose Troncoso, said: "This challenging project drew on a wide range of our in-house skills, including network and optical engineering, mechanical design, installation planning, and program management. Managing risk for our customers on these complex projects defines our core business, and we appreciate the confidence our customers place in us to deliver for them."

SIEMENS ENERGY, SUMITOMO TO SUPPLY GREENLINK INTERCONNECTOR

Siemens Energy and its consortium partner Sumitomo Electric have signed a contract with Greenlink Interconnector Limited. Siemens Energy will deliver the high-voltage direct current (HVDC) converter technology for the 190 km electricity interconnector Greenlink.

The 500-megawatt HVDC link will connect the power grids of Ireland and Great Britain. As the power can flow in either direction, depending on supply and demand in each country, it allows both countries to benefit from increased grid stability, security of power supply and cost-effective growth and integration of low carbon energy. Work will begin at the start of 2022 following financial close.

HVDC technology offers the most efficient means of transmitting large amounts of power over long distances. Siemens Energy will be responsible for the overall system design and the construction of two converter stations located close to the Great Island transmission substation in County Wexford (Ireland) and the Pembroke transmission substation in Pembrokeshire (Wales). Both converter stations will use Siemens Energy's market leading HVDC PLUS technology with modular multi-level arrangement (VSC-MMC) to convert Alternating Current to Direct Current and vice versa. Linked via an HVDC XLPE (crosslinked polyethylene) cable system by Sumitomo, the stations will enable the low-loss transport of energy with a voltage of 320 kilovolts. Siemens Energy's scope of supply also includes a Service and Maintenance Agreement with an initial duration of seven years.

James O'Reilly, CEO of Greenlink, commented: "We are delighted to have reached another significant milestone in the delivery of the Greenlink project with the signing of the contract with Siemens Energy and Sumitomo Electric. Greenlink is one of Europe's most important energy infrastructure projects, contributing to energy security, regional investment, jobs and the cost-effective integration of low carbon energy, and we have chosen a consortium with exceptional experience, skill and standing in the energy and engineering sector for this major undertaking. We will be looking to maximize local supply chain benefits during the three-year construction period and we look forward to working with Siemens Energy and Sumitomo Electric towards successful commissioning in 2024."

Beatrix Natter, Executive Vice President Transmission at Siemens Energy, said: "Interconnectors like Greenlink play a critical role in strengthening the share of renewable sources in the European energy mix and bolstering energy security. We at Siemens Energy are very pleased that Greenlink chose our state-of-the-art HVDC technology, adding a new lighthouse project to our proven track record of ten HVDC projects in implementation and more than 59 successfully completed projects worldwide."

Greenlink has key strategic importance, as it will provide significant additional interconnection between Ireland and Great Britain, with onward connections to continental Europe. Leading to more import and export capacity in both countries, GreenLink will enable a diversified energy mix, bolster European energy security, and ultimately make the enhanced integration of renewable energy possible.

» *Siemens Energy will be responsible for the overall system design and the construction of two converter stations and a transmission substation. (Photo credit: Siemens Energy)*

EQUINOR AWARDS DEEPOCEAN SUBSEA CABLE REPAIR FRAME AGREEMENT

DeepOcean AS has been awarded a frame agreement contract by Equinor for provision of contingency equipment and services for handling of high voltage subsea cables

The contract has a duration of three years with options to extend the contract with up to four additional years.

The contract covers provision of handling equipment and personnel for subsea high voltage cable contingency operations, such as subsea cutting, retrieval, on deck cable handling for cable repair, and deployment /laying of subsea high voltage cable.

DeepOcean will also provide a core organization to manage the contract and ensure the readiness of the handling equipment. In addition, using DeepOcean's subsea base facilities at Killingøy to store the equipment is aimed to provide swift mobilization in a contingency situation.

Although the initial area of operations will focus on Northern Europe, there will be an option to extend operations worldwide dependent on Equinor's requirements for emergency cable repair preparedness across the globe. Equinor will manage and operate the contract on behalf of the Pipeline Repair and Subsea Intervention (PRSI) pool members who also may call upon services provided by the frame agreement. Various studies may also be provided under the contract.

"The renewables segment and associated electrification of offshore installations is a key focus area for Equinor and many other energy companies. DeepOcean has a clear ambition and strategy to support our clients in their quest for greener energy. We are pleased that Equinor trusts DeepOcean with this award, requiring an agile, flexible and quality-minded organization. We look forward to starting a 'new chapter' in our relationship with Equinor and we will do our utmost to ensure this relationship is a success," says DeepOcean's commercial director for subsea services, Rolf Ivar Sørdal.

GLOBAL MARINE COMPLETES CABLE ROUTE SURVEY FOR THE SCOTTISH GOVERNMENT

The Scottish Government-funded R100 project aspires to extend superfast broadband capabilities at speeds of at least 30Mbps to every premises in Scotland.

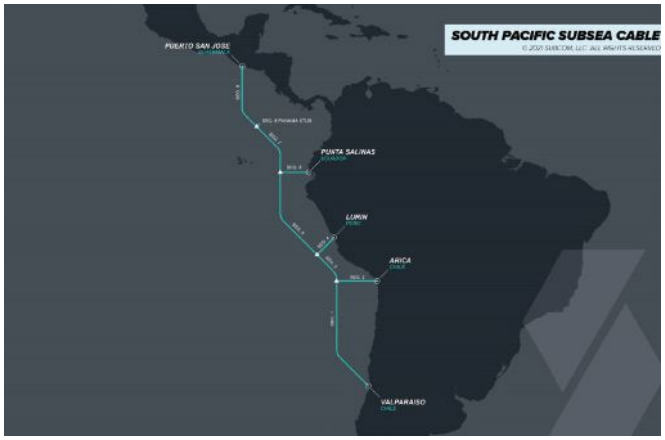
Utilizing the extensive subsea knowledge of our sister company OceanIQ, also part of the Global Marine Group, and specialist service provider Fugro, the cable route surveys are now complete, ahead of the 16-route cable lay. The fiber optic cable installation is scheduled to commence early in 2022 and will be delivered by Global Marine's multi-purpose vessel, Normand Clipper.

Three survey vessels were mobilized on the project to complete specific scopes of geophysical and geotechnical survey work along the different cable routes. The scope of work also included an Unexploded Ordinance (UXO) assessment. As well as land survey activities, an aerial lidar survey was conducted to acquire topographical and inter-tidal survey data and photogrammetry.

Bruce Neilson-Watts, Managing Director of Global Marine said: "We are pleased that this initial stage of the project is almost complete. The diverse elements of the subsea survey data will combine together to give a rich and detailed picture of the seabed environment and shallow soils regime, providing essential information to deliver this high-profile project safely and effectively for the long-term benefit of many of Scotland's residents."

Clive Downing, R100 Program Director, Scottish Government said: "As a result of the R100 North contract many homes and business will benefit from full fiber broadband, far exceeding our superfast commitment and providing future-proofed full fiber connectivity to some of the most rural and remote communities in Scotland. This is something that will make a huge difference to both residents and businesses as we continue to work, learn and access public services remotely."

"Fugro and Global Marine have successfully mapped out the subsea routes through complex underwater and overhead surveys and this work is the first step in connecting islanders to faster broadband. I look forward to hearing about subsea progress in the upcoming months."



SUBCOM COMPLETES INSTALLATION OF SPSC/MISTRAL UNDERSEA CABLE SYSTEM

SubCom has completed the deployment process for SPSC/Mistral and announced that the new undersea cable system is officially ready for service. Commissioned by Claro(América Móvil) and Telxius, the 7,300 km undersea cable runs along the Latin American Pacific coast, connecting Puerto San José (Guatemala) to Valparaíso (Chile), with additional landing points in Salinas (Ecuador), Lurín (Peru), and Arica (Chile).

SPSC/Mistral will significantly expand capacity and redundancy throughout the region. Designed and built by SubCom, the four-fiber-pair system transmits at 18Tbps per fiber pair with a total system design capacity of 72Tbps. SPSC will enable both Claro and Telxius to meet increasing demand for Internet, data, and content services, as well as high-capacity applications.

Manufacture of the cable and equipment took place at SubCom's recently expanded manufacturing campus in Newington, NH, USA, and main lay installation operations were performed at the height of the global pandemic. Despite significant constraints imposed by the pandemic, SubCom, Claro, and Telxius were able to adapt to the extraordinary circumstances to ensure the system would be ready for service on-time.

In a recent press release, Mario Martín, Telxius CEO, noted: "With the rapid rise in cloud adoption and an increasing demand for higher capacity, lower latency and higher availability, this next generation submarine cable is ready for service at a pivotal time. Mistral means that Telxius effectively contributes with the highest standards of service, reliability and security in the region, creating opportunities for businesses and communities across Latin America and optimizing digital services for society at large."

"Our congratulations to Claro and Telxius on this tremendous achievement. We are always pleased to assist in fulfilling the vision of our customers become a reality, particularly when they are able to officially make a system available for service," said David Coughlan, CEO of SubCom. "Deploying undersea cable systems during the pandemic, as we did in this case, was a challenge that demonstrated the creativity and flexibility of our operations and our customers'. Having invested heavily in risk mitigation and preparedness in advance of the pandemic, SubCom was able to safely adapt to the circumstances with minimal disruption, and the completion of this project is a testament to both that advance work, and the ingenuity of our teams in the field."

PRECISION FIBER OPTIC SYSTEM TO AUGMENT STRUCTURAL STRESS MONITORING ON WORLD'S FIRST EXPOSED FISH FARM

» *Ocean Farm 1 is a full-scale pilot facility designed to verify the biological and technological aspects of offshore fish farming. (Photo credit: Light Structures)*

Light Structures AS, the world leading supplier of fiber optic condition monitoring systems for maritime applications, and SalMar ASA have entered into an agreement for delivery of a Fiber Bragg Grating technology (FBG)-based structural monitoring system for installation on the unique Ocean Farm 1 aquaculture facility, located in open water near Frohavet on Norway's west coast.

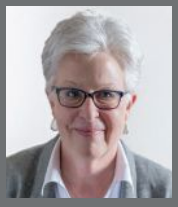
Making its debut as the first ever 'offshore fish farm' in 2017, Ocean Farm 1 is a full-scale pilot facility designed to verify the biological and technological aspects of offshore fish farming. The exposed fish farm concept introduces tangible benefits to the aquaculture workflow, not least with the ability to raise healthier fish due to the continuous flow of water an offshore location enables. Ocean Farm 1 features six huge nets arranged in a circular floating structure, with a total capacity for 1.6 million Salmon.

In order to provide more precise structural stress and fatigue data for lifecycle research conducted by Ocean Farm 1 technology partner DNV, SalMar tasked Light Structures to deliver a customized monitoring system using its SENSFIB™ technology in August 2021. The decision to use this unique alternative to traditional electro-mechanical monitoring was made based on the better accuracy, dependability, and adaptability of FBG, as well as DNV's positive work on ship hull stress and fatigue monitoring with Light Structures in the past.

"We have delivered tailored structural stress monitoring solutions using the FBG methodology to over 300 vessels of varying size and type," said Ernad Sehic, Senior International Sales Manager, Light Structures. "The custom project nature of our work with large ships and specialist vessels demonstrates our ability to adapt SENSFIB™ to unique structures like the Ocean Farm 1. The data will contribute to optimized condition-based maintenance and support further offshore aquaculture developments."

Light Structures' SENSFIB™ fiber optic stress and fatigue monitoring system will be delivered to Ocean Farm 1 at the end of September. Installation—without the need for any hot works—will start soon after and the system is expected to be operational early in October.

BUILDING AND SUSTAINING THE SUBMARINE SHIPBUILDING AND UNDERSEA TECHNOLOGY DEFENSE INDUSTRY ECOSYSTEM



By Molly Donohue Magee,
Executive Director, SENEDIA and UTIC

Southeastern New England is small but mighty, punching above its weight when it comes to the national security landscape. Our region contains an impressive collection of public sector defense entities, private sector defense manufacturing and technology firms, valued educational organizations, and relevant infrastructure assets. The strength and diversity of the sector is well represented in the region.

In other words, southeastern New England is the Silicon Valley of undersea technology.

This observation has been made by two Secretaries of Defense—both Hagel and Esper—and underscores the value of regional partners in protecting our nation and supporting our economy. Submarines and their underlying technology, onboard systems, capabilities, and operational concepts are developed here. An innovation ecosystem has developed, supported by key collaborative resources including research and development at the Naval Undersea Warfare Center, academic research and thought leadership at the Naval War College and other area universities, and a technology industry cluster representing large and small suppliers.

The Southeastern New England Defense Industry Alliance (SENEDIA) is laser focused on growing and strengthening this regional defense industry ecosystem. Our mission is to enable the development of innovative technology, foster thought leadership, and facilitate the nimble and responsive workforce development needed to support a strong talent pipeline. SENEDIA has 130 member companies, mostly in New England, but beyond as well. Key technology thrusts of the alliance members are submarine shipbuilding and undersea technology.

BRIDGING TALENT

SENEDIA connects defense companies, who often refer to themselves as 'competimates,' sometimes serving as competitors and other times as teammates. They rely on SENEDIA as a bridge to talent, meeting the industry's workforce needs for their current and future positions. In support of this, SENEDIA has a robust science, technology, engineering, and mathematics (STEM) internship program with a directed focus on veterans.

In August 2020, SENEDIA was awarded an $18.6 million contract from the Department of Defense Industrial Base Analysis and Sustainment Office focused on submarine shipbuilding workforce development, specifically related to trade and industrial skilled employees. These jobs are high-tech, high-demand, and high-wage.

In support of this effort, SENEDIA has established a New England region Next Gen Sector Industry Partnership. The partnership, comprised of companies in the submarine shipbuilding supply chain, meets quarterly to identify common challenges and is supported by a stakeholder group that consists of state workforce and training agencies and other training and related nonprofit organizations. The stakeholder group develops proposed solutions to the challenges of industry, prioritizing transparency and communications so that businesses know exactly how to access programs and supports. The website, BuildSubmarines.com, hosts resources for the industry partnership.

PARTNERSHIP INITIATIVES

SENEDIA partners across government, education, media, and defense businesses to develop and sustain the innovation ecosystem. We regularly convene defense leaders from government, Congress, and industry, providing a space to share best practices and collaborate to mutual benefit. Our signature event, Defense Innovation Days, was created in 2014 to bring together companies who are developing cutting-edge innovations with policymakers who are helping steer the nation's defense strategy. This event creates a community where policymakers and business leaders within the defense arena can engage with and learn from one another.

We just concluded our 2021 Defense Innovation Days and, though virtual, it provided an important venue for conversation and forward-thinking solutions across priority topics, including national security, climate change, cybersecurity, and foreign affairs. Key speakers included Senate Armed Services Committee Chairman Senator Jack Reed, Secretary of the Navy Carlos Del Toro, and White House National Cyber Director Chris Inglis among others.

» *SENEDIA's recent Tech Talk featured Electric Boat senior executives who discussed their growth trajectory and supply chain needs in support of the Columbia and Virginia-class submarine programs. (Photo credit: Electric Boat)*

Beyond our signature convening, SENEDIA also hosts monthly Tech Talks focused on more targeted technology discussions. A recent Tech Talk, for example, featured Electric Boat senior executives who discussed their growth trajectory and supply chain needs in support of the Columbia and Virginia-class submarine programs. This sustained growth is resulting in significant hiring of trade and industrial skilled employees and continued expansion at Electric Boat.

UNDERSEA TECHNOLOGY INNOVATION CONSORTIUM

In 2016, driven by the growing ecosystem of regional and national undersea and maritime technology companies and the Department of Defense's parallel need for undersea technology innovation, SENEDIA worked to establish a partner organization, the Undersea Technology Innovation Consortium (UTIC). The UTIC mission is to facilitate collaborative rapid prototyping, development and testing of innovative undersea and maritime technology.

In June 2018, UTIC was awarded the Other Transaction Agreement (OTA), a special DoD contract for prototyping, for Undersea Technology Innovation by the Naval Undersea Warfare Center. An OTA is an "enterprise partnership" between the government and a consortium of technology developers and providers, allowing innovation through partnership and collaboration. The OTA, with up to a 10-year contracting horizon, allows for industry, academia, and the nonprofit sector to engage in a broad range of undersea and maritime prototyping activities in support of the Department of Navy's needs.

The UTIC OTA represents a unique opportunity to work collaboratively and leverage industry, academia, and government capabilities. It is an even greater opportunity to quickly deliver the innovative solutions the Navy needs. Prototypes developed through an OTA may include physical or virtual models to evaluate the technical or manufacturing feasibility or military utility of a technology, process, concept, end item, or system. Any commercial, nonprofit, or academic institution that is part of the consortium is eligible to receive an award. Barriers are minimized and support is provided for companies who have not previously worked with DoD to participate.

» *UTIC's mission is to facilitate the rapid prototyping, development and testing of innovative undersea and maritime technology, like minehunting sonars. (Photo credit: Raytheon)*

» *UTIC Other Transaction Agreement (OTA) enables critical innovation to get to the fleet faster. The Navy identifies technology needs, such as lightweight torpedoes, to UTIC members bi-annually. (Photo credit: U.S. Navy)*

The UTIC OTA is a game changer—enabling critical technology/innovation to get to the fleet faster. UTIC currently has 300 member organizations from 37 states. Over 70% percent of our membership are small businesses, ensuring broad outreach to innovative technology providers. With just over three years of operation, there have been over 60 UTIC OTA awards to provide prototype technology solutions, with a total value of over $300 million. The Department of Navy identifies technology needs to UTIC members bi-annually in the spring and fall. Urgent needs can be identified out-of-cycle. Members respond in turn with an enhanced white paper defining their proposed technology solutions. The government can choose to accept the white paper proposal and award, decline to award, or put the proposal in "the basket," allowing the government the opportunity, over the next three years, to make a future award.

Through workforce development, and support for innovative technologies, and by serving as a bridge between companies and talent, and industry and government, SENEDIA and UTIC are growing the innovation ecosystem. We bring people and ideas together, and the result is a deeper pool of talent and a greater network of solutions for undersea technology.

For more information, visit: *www.senedia.org*
www.underseatech.org • *www.buildsubmarines.org*

» *DNV releases new Naval Technical Assurance certification concept. (Photo credit: DNV)*

NEW DNV NAVAL TECHNICAL ASSURANCE CONCEPT OFFERS TAILORED SOLUTIONS FOR NAVAL VERIFICATION

Classification society DNV has released the new Naval Technical Assurance certification concept, as an alternative approach to the classification assurance process. The new concept is set down in the DNV-SE-0555 Naval technical assurance service document, published on August 25, 2021.

The regulation of naval and occasionally governmental vessels is significantly different from merchant vessels and requires more diversified and broader assurance processes. Combining DNV's competence in naval surface, subsurface and governmental vessels, Naval Technical Assurance is an overarching service for naval vessels, enabling DNV to adjust the assurance scope to provide customers a service tailored to their requirements.

Under the umbrella of Naval Technical Assurance, DNV offers verification according to a variety of different standards, may be flexibly combined with DNV's classification portfolio. These standards include:

- National legislation prescribing clear safety objectives and/or a regulatory system.
- Detailed navy proprietary regulatory systems, in some cases combining this with a clear safety objective.
- Regulatory systems mainly relying on Classification Society services.
- Regulatory systems applying NATO's ANEP-77 Naval Ship Code as the main means of material safety and seaworthiness control.
- This results in a customized service from the first concept of a new vessel, through design, newbuilding, operation, and end-of-life.

"Naval Technical Assurance enables us to address customer requests in a flexible way and handle their exact assurance needs in a tailored manner," said Christian von Oldershausen, DNV Maritime Segment Director for Navy. "With Naval Technical Assurance's structured processes, we can compile different services and support facilities to address the needs of our customers and now have a second path for verification services alongside our classification services."

The relevant assurance scope is defined by establishing a standards plan consisting of all design elements, components and systems and the respective standard(s) to be verified against. The "Certification Matrix" is a complementary document that defines the body that will certify each part, component, or system, according to the standards plan.

Together with DNV's Naval rule set, as the entry point for naval customers, Naval Technical Assurance provides the flexibility to engage with both existing and future technical assurance seaworthiness safety frameworks.

BAE SYSTEMS AND DELL TECHNOLOGIES INNOVATE FOR UK NAVAL DEFENSE

BAE Systems is working with Dell Technologies on delivering innovative digital capability for the new City Class Type 26 frigates.

The first three frigates in this class include HMS Glasgow, a cutting-edge UK-designed ship currently being built on the Clyde in Glasgow.

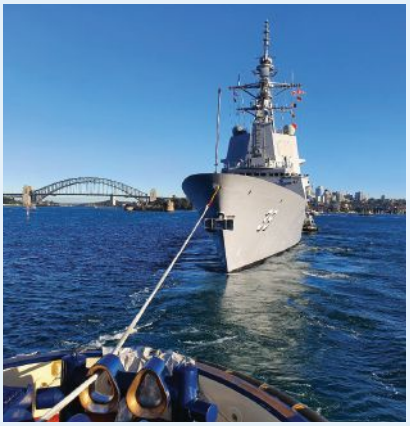
The collaboration will deliver a Shared Infrastructure to host the ship's essential systems, including a number provided by third parties, on a single, reliable digital platform. It will take full advantage of scalable, open, and coherent technology while providing enhanced durability, state-of-the-art security, and data protection. Additionally, the reduced footprint of the solution will provide environmental benefits.

The integrative approach of these two industry leaders builds on the successful deployment of a Shared Infrastructure solution across numerous other front-line naval platforms, including the Queen Elizabeth Class aircraft carriers. It has already demonstrated exceptional operational reliability and reduced through-life costs, helping to future-proof the fleet and allow rapid capability deployment.

Amelia Gould, Naval Ships Combat Systems Director at BAE Systems, said: "We're delighted to continue our work with Dell Technologies. Our combined solutions provide the Digital Backbone to the Carrier Strike Group and Type 26. The collaboration reinforces our digital capability and provides mutual benefit by allowing us to have first-look access to the latest digital technologies and provides Dell with useful insights on complex uses for their solutions."

Dayne Turbitt, senior vice president and general manager at Dell Technologies for the UK said: "Our collaborative development approach with BAE Systems on the next generation of world-class naval ships reflects the strength of our successful and long-standing relationship and reinforces our mission to provide a vital advantage in protecting what matters. Together we're driving leading-edge, secure technology that can be deployed and integrated fast and delivered in the most demanding environments—ultimately supporting BAE customers to make faster and better decisions and improve Defense outcomes."

» *HMS Glasgow. (Image credit: BAE Systems)*



» *Svitzer will provide towage services for Australia's naval fleet. (Photo credit: Svitzer)*

SVITZER AUSTRALIA AWARDED TOWAGE CONTRACT FOR ROYAL AUSTRALIAN NAVY

Svitzer Australia, Australia's leading towage provider, has been announced as the successful tenderer for a long-term contract to provide towage services for the Australian Department of Defense, servicing the Royal Australian Navy.

As the winner of the Defense Marine Support Services Package 3 tender, Svitzer will provide towage services for Australia's naval fleet, the management of Navy towage assets, and the development of naval personnel training in major ports around Australia.

With a network of over 20 ports nationally and as the largest employer of Australian seafarers, Svitzer Australia will continue to promote and support Australian and local maritime industries and jobs as part of this long-term contract.

Svitzer Australia Managing Director, Nicolaj Noes, said: "We are honored to be chosen as the trusted partner to provide essential towage services to the Royal Australian Navy as they undertake their vital duty to serve Australia at sea. With our network of ports around Australia, fleet capability and experienced crews, we are well placed to provide a safe, reliable and efficient service for the Navy's operational and strategic needs."

RE2 ROBOTICS TO DEVELOP UNDERWATER AUTONOMOUS SYSTEM FOR THE U.S. NAVY

RE2 Robotics, a leader in intelligent mobile manipulation systems, has received a $9.5 million contract from the Office of Naval Research to create an underwater robotic system for the autonomous neutralization of underwater mines for the U.S. Navy. The program, called Maritime Mine Neutralization System (M2NS), will utilize the RE2 Sapien™ Sea Class system to precisely place and attach neutralization devices to underwater mines and water-borne improvised explosive devices (WBIEDs).

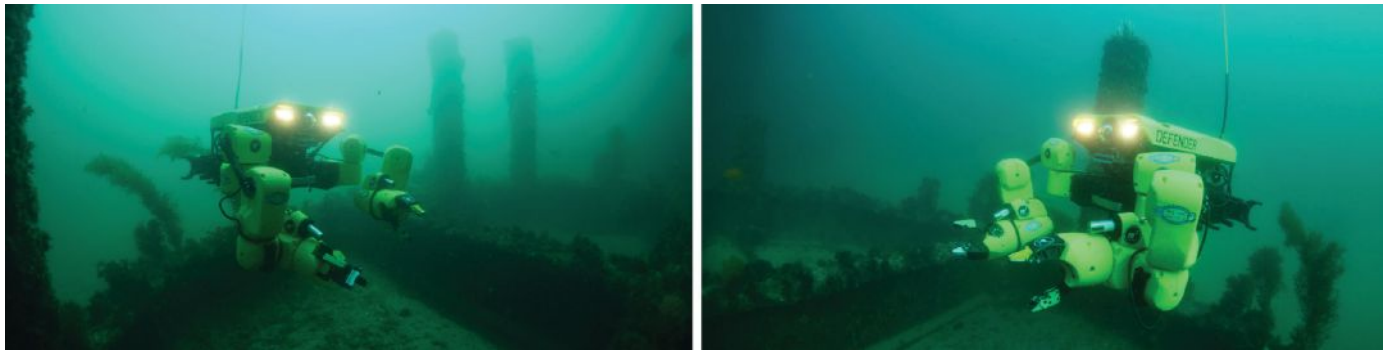
RE2 will serve as the systems integrator for this program. In addition to RE2 Sapien Sea Class, the M2NS will use components, including RE2's advanced computer vision and autonomy software, RE2 Detect™ and RE2 Intellect™, to enable the precise, autonomous, and clandestine neutralization of a target.

"The detection and neutralization of WBIEDs and other underwater explosives is a critically dangerous task for Navy divers. Consistent with our mission of improving worker safety, the M2NS will enable the Navy to find and autonomously neutralize targets in deep ocean waters, while experienced divers supervise from a safe distance," said Jorgen Pedersen, president and CEO of RE2 Robotics."

The M2NS comprises best-in-class technologies such as RE2's Sapien Sea Class arms and VideoRay's Defender remotely operated vehicle (ROV), which both exhibit unprecedented power density. In particular, RE2 Sapien Sea Class arms, which were originally designed and developed for the ONR, feature a compact, strong, electromechanical design with human-like dexterity (7-function per arm) that is neutrally buoyant. The fusion of these key technologies provides superior strength and precision while manipulating neutralization devices.

"The M2NS will use RE2 Detect computer vision software to locate targets underwater, and RE2 Intellect to autonomously and precisely place devices on those targets," said Dr. Amanda Sgroi, director of computer vision and autonomy at RE2. "We also will integrate new sensors to provide situational awareness and aid autonomy, allowing the system to potentially navigate to extended depths in the ocean."

In addition to defense tasks, the human-like capability of the M2NS allows it to be used for complex offshore infrastructure and maintenance applications in the oil and gas and renewable wind industries. For example, M2NS can be used for weld inspection of rig piles, ships and FPSO (Floating Production Storage and Offloading) systems; mooring inspection and measurement; and valve inspection and manipulation.



» *The M2NS comprises best-in-class technologies such as RE2's Sapien Sea Class arms and VideoRay's Defender ROV. (Photo credit: RE2 Robotics)*

COMMTACT UNVEILS A NEW COMMUNICATIONS NETWORK SOLUTION FOR FIRST RESPONDERS & SPECIAL FORCES

Commtact Ltd., a leading provider of advanced wireless communications solutions for first responder teams and robotics platforms, is unveiling CommNet—a new real-time communications network solution for first responders, large events, and command and control center teams.

Being the first on the scene of catastrophes and natural disasters, first responders have a growing need for an independent, reliable, real-time mobile communications network that facilitates data sharing alongside constant situational awareness. CommNet provides exactly this. Based on Commtact's proven operational performance, the new system enhances real-time situational awareness in a variety of missions, supporting ongoing real-time communications between multiple users operating diverse platforms. Even with a large number of users, the system provides consistently high quality of service (QoS).

Incorporating high-performance software-defined radios (SDRs) within ruggedized body-worn components, the solution provides reliable, low-latency video, voice, and data connectivity. It ensures consistently high QoS for large numbers of end users, including first responder teams and rugged multi-domain platforms. The agile, flexible solution easily adjusts to a variety of customer needs.

Leveraging proprietary wireless technologies, the system supports point-to-point (PTP), point-to-multi point (PTMP) and MESH topologies and a wide range of radio frequencies and channel width, while delivering high throughput over a secure private network.

SEEBYTE AND RAYTHEON COMBINE AN/AQS-20C SONAR WITH SEETRACK C2 SOFTWARE FOR REAL-TIME CONTACT ANALYSIS

SeeByte and Raytheon Technologies are working together to bring Raytheon's AN/AQS-20C advanced minehunting sonar system data into SeeByte's SeeTrack v4, multi-domain command and control system.

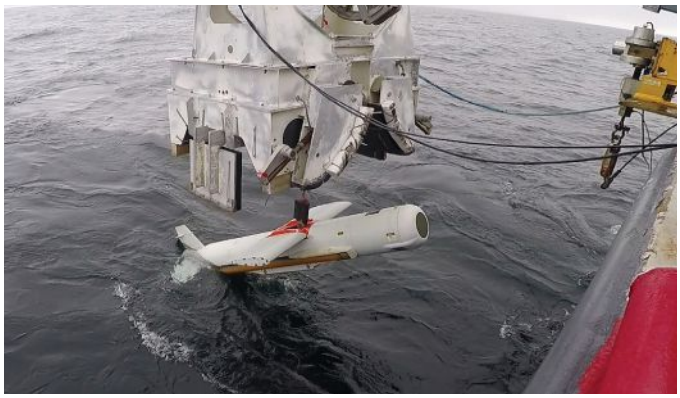
The AN/AQS-20C's combination of sidescan, forward-looking, and gap-filler sonars enables the sonar to detect and classify mine-like objects from the seafloor to the near surface in a single pass.

This data can now be brought into SeeByte's SeeTrack for mission analysis. The AN/AQS-20C has built in Automated Target recognition (ATR) and identification level contacts can now be displayed in SeeTrack in near-real time.

The AN/AQS-20C is an advanced minehunting sonar system that has been designated as the minehunting sonar for the U.S. Navy. It is the most advanced and capable mine warfare sensor system, fully integrated with and effectively operated from the Littoral Combat Ship.

SeeTrack's post-mission analysis tools provide an intuitive user interface and streamlined workflow for ease of use in operational situations and its open architecture means it can be integrated with different sonars, sensors, or behaviors for specific operational needs.

"The AN/AQS-20C provides safety and efficiency in expansive mine-sweeping operations. Combining this with SeeTrack will allow naval customers to make informed decisions from the ATR data, improving mission tempo even further," said Robert Johnson, Business Development Manager for SeeByte.



» *Raytheon's AN/AQS-20C. (Photo credit: Raytheon)*

CONTROP ANNOUNCES DELIVERY OF ISEA25HD SYSTEMS TO A EUROPEAN COAST GUARD

CONTROP Precision Technologies, a company specializing in the field of electro-optics and IR defence and homeland security solutions, has announced the delivery of iSea25HD Systems to a European Coast Guard, thereby expanding its maritime activity in Europe, bringing operational value to border and coastal security and safety in the EU.

Together with a European partner, CONTROP has delivered successfully to the first of many programs to equip Coast Guard vessels with todays' most advanced miniature maritime payload, the iSea25HD. The iSea25HD has the best of its class gyro stabilization, coupled with powerful continuous optical zoom in both day and thermal imager cameras and a laser range finder (LRF). The iSea25HD operates covertly at a safe distance from its targets, while maintaining "eyes on target" day and night, even in harsh weather conditions. The smooth HMI (Human Machine Inter-face) and the high performance make the iSea25HD a trusted companion in protecting the EU exposed Southern flank

"We are pleased to continue our cooperation with a strong European partner, which is responsi-ble, among other things, for SAR activities in the area," said Hagay Azani, president and CEO of CONTROP. "CONTROP facilitates an innovative technological solution covering both sea and land, day and night, and is proud to be playing a key role in contributing to the saving of lives."

» *The iSea25HD operates covertly at a safe distance from its targets, day and night. (Photo credit: CONTROP)*

COMMODITY PRICES SOAR—WHAT'S NEXT?

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

Crude Oil:

WTI oil prices have revved up and climbed back into the mid-$70s per barrel range. Across the pond, Brent futures prices are over $80. Not surprisingly, talk about a new bull market in commodities has reemerged, and some forecasters say it may last for years! Why are prices rallying?

A combination of the economic revival from the pandemic, despite the recurring outbreaks of the Delta variant of COVID-19, and tightening supply are why. Like the original COVID-19 virus, the Delta variant has a cycle of virus cases, hospitalizations, and deaths climbing to a peak but then rapidly declining. This pattern means economic activity revives as variant cases decline, pushing up energy use. At the same time, supply disruptions from Hurricane Ida have cut crude oil and refined product output. OPEC's measured restoration of its supply cutbacks and production issues for certain OPEC producers have limited global oil supply growth. The result? Higher oil prices.

Incremental oil demand has appeared in response to problems within the global energy market. The failure of renewable energy to deliver the anticipated electricity in Europe due to stillness forced utilities to scramble to find alternative power supplies. The easiest move was to step up the burning of natural gas, and then restarting recently retired coal-fired power plants.

In Asia where developing economies are responding to population growth and robust economic activity, countries are straining to meet power needs. Natural gas has become very expensive, pushing governments to turn to local and imported coal, but those prices are soaring, too. As a result, some utilities are resorting to burning crude oil for power generation, adding to global oil demand.

The oil producing infrastructure in the Gulf of Mexico and onshore in Louisiana was damaged and kept offline for most of September due to Hurricane Ida. With the United States one of the world's three largest global oil producers, such a supply disruption has an impact on the world's supply. OPEC+ is planning each month to only add 400,000 barrels per day into the global supply. By adhering to that schedule, OPEC is not positioned to ramp up supply quicker when demand rises faster than anticipated.

Underlying higher global oil prices is the new DNA of the E&P industry. After years of losses caused by aggressive oil drilling during a low-price environment, executives are now exercising financial discipline in managing capital. Money for drilling new wells is restricted, with excess capital being returned to investors via dividends and share repurchases. This new corporate DNA suggests a restrained oil supply growth future, which means a tighter supply/demand balance and higher sustained oil prices. It is this prospect, despite near-term volatility, that will drive oil prices in the future.

Natural Gas:

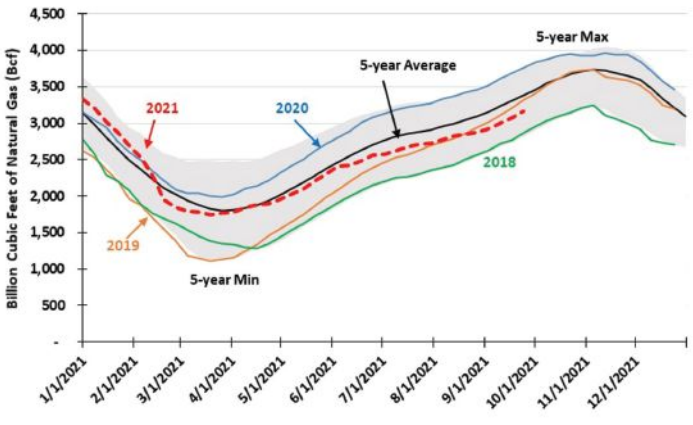
Wow! The $5 per thousand cubic foot barrier presented little resistance for natural gas prices. Now, we have broken through the $6 barrier, although the price subsequently fell back. The rapidity with which gas prices have climbed from $4 to these elevated levels underscores the turmoil in the global natural gas industry. That turmoil will last for as long as gas supply concerns linger.

Global gas markets are still reacting to the colder than expected winter of 2020-21 that drained gas storage volumes in Asia, Europe, and the United States. Gas use was also boosted by the underperformance of renewable energy in Europe. As electricity from wind and solar fell below anticipated amounts, utilities had to turn to coal- and gas-fired power for backup supplies. Keeping the lights on drove increased gas consumption, but as summer progressed and rebuilding storage for the upcoming winter lagged, gas prices rose as demand had to be restrained and new supplies secured.

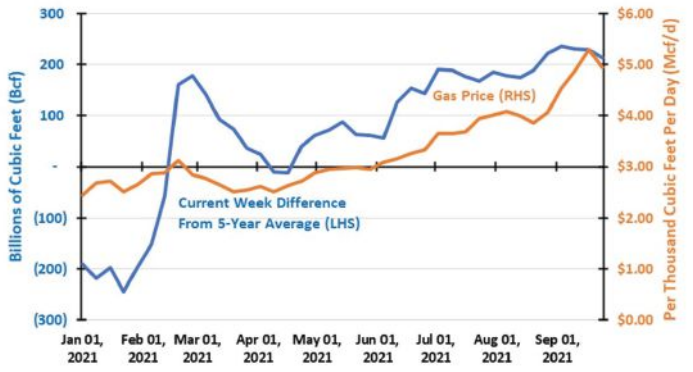
Not only was Europe struggling with gas supplies and prices, so too was Asia, driven largely by China's need for increased energy, and more energy from lower carbon fuels. China's current energy crunch is due to its reluctance to pay high current LNG prices and its political dispute with Australia that has cut the supply of coal and LNG. This has forced China to curb certain energy-intensive industries activity. While a temporary solution, this is not a long-term solution. How China meets its future energy needs may be bad news for the climate change movement. Given its large number of coal-fired power plants, and its building many more, China will disrupt climate activists' push for net zero emissions by 2050.

The global natural gas industry has gone through an interesting transition. The U.S. has emerged as one of the three top global suppliers of natural gas crossing borders, joining Russia and Qatar. In the U.S., natural gas supply has grown, but domestic consumption lagged, allowing LNG exporters to ship more gas into the global market. Although the LNG industry was hurt by Hurricane Ida that shut down the Gulf of Mexico and export terminals, both are recovering. LNG shipments are at a peak given the $20/Mcf arbitrage with international gas markets. Expanding LNG export volumes will not happen until 2023. Therefore, continued growth in domestic gas production will likely cap gas futures prices in the $5.50-$6.50/Mcf range. Near-term futures prices will move on weather news. Longer-term gas prices will be driven by new well drilling activity and price competition between coal and gas for power generation. Ultimately, growing LNG export capacity will drive gas prices from the second half of next year onward. Given the tightness of the global gas market, be prepared for unexpected events to impact futures prices.

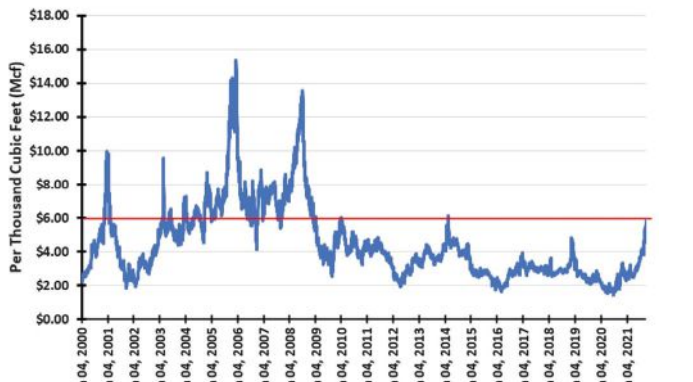
Gas Storage Falling Further Below 5-Year Average Driving Prices Higher



How Gas Prices Reacted To Greater Shortfall From 5-year Average Storage Volumes



Natural Gas Futures Prices Are In Rare Territory



Daily Oil Futures Prices During 2021

AMERICAS

Offshore Well Intervention GoM
Houston, TX » November 8-9
www.offsnet.com/owi-gom

BlueTech Week
Virtual » November 15-19
www.tmabluetech.org/bluetech-week

WorkBoat
New Orleans, LA » December 1-3
www.workboatshow.com

US Offshore Wind Risk Management
Virtual » December 9
https://reutersevents.com/events/offshore-wind/content-risk.php

PTC
Honolulu, Hawaii » January 16-19, 2022
www.ptc.org

Blue Innovation Symposium
Rhode Island » February 22-24, 2022
https://blueinnovationsymposium.com/

Floating Wind Solutions
Houston, TX » March 1-3, 2022
https://floatingwindsolutions.com/fws-22/

US Offshore Wind
Boston, MA » March 16-17, 2022
https://reutersevents.com/events/offshore-wind/content-boston.php

Canadian Underwater Conference & Exhibition
Halifax, Canada » March 27-29, 2022
www.underwaterconference.ca

International Partnering Forum (IPF)
Atlantic City, NJ » April 26-28, 2022
https://www.offshorewindus.org/2022ipf/

EUROPE

Eastern Mediterranean Conference
Cyprus » November 10-12
www.emc-cyprus.com

Ocean Energy Europe
Brussels, Belgium » December 6-7
www.oceanenergy-europe.eu/annual-event/oee2021

Windpower Finance & Investment Summit
London, UK » December 7-8
https://windfinancesummit.com

Undersea Defence Technology (UDT)
Rostock, Germany » December 15-17
www.udt-global.com

Subsea Expo
Aberdeen, UK » February 22-24, 2022
www.subseaexpo.com

EEEGR Southern North Sea
Norwich, UK » March 2-3, 2022
www.eeegr.com/events/sns2022/

Seabed Mapping & Inspection
Geilo, Norway » March 9-11, 2022
https://www.tekna.no/en/events/seabed-mapping-and-inspection-2022-42041/

Oceanology International
London, UK » March 15-17, 2022
www.oceanologyinternational.com

OTHER REGIONS

ADIPEC
Abu Dhabi » November 15-18
www.adipec.com

Telecoms World Asia
Virtual » November 16-17
www.terrapinn.com/conference/telecoms-world-asia/index.stm

Offshore Well Intervention Australia
Perth, Australia » November 23-24
https://offsnet.com/owi-aus

Asia-Pacific Deep Sea Mining Summit
Singapore » December 8-9
www.asia.deepsea-mining-summit.com

OTC Asia
Kuala Lumpur, Malaysia » March 22-25, 2022
https://2022.otcasia.org/

Mediterranean Offshore Conference
Alexandria, Egypt » October 18-19, 2022
www.moc-egypt.com

MONTH & DEADLINES	EDITORIAL FOCUS & SHOW DISTRIBUTION	TECHNOLOGY & INDUSTRY FOCUS	2021 EDITORIAL CALENDAR
JANUARY Editorial: Dec. 28 Ad: Jan. 14	» **The Essential 2021 Offshore Toolkit**	**Technologies:** ROV tooling & control, Subsea cables, Remote inspection, Supply vessels, turbines, tethers, and more. **Industry Focus:** Offshore Energy & Renewables, Marine Survey, Scientific, Defense	
FEBRUARY Editorial: Jan. 25 Ad: Feb. 11	» **Ocean Observation**	**Technologies:** Buoys, ADCP, Data Software, Sensors, Drifters, Gliders, and more. **Industry Focus:** Marine Survey, Scientific, Offshore Energy & Renewables	
MARCH Editorial: Feb. 22 Ad: Mar. 11	» **Unmanned Vehicles & Marine Robotics** » **Distribution:** GIPEX 💻 / June 28-30	**Technologies:** USVs, AUVs, ROVs, Aerial drones, Control systems, Seafloor residency, and more. **Industry Focus:** Offshore Energy, Marine Survey, Defense, Academic, Subsea Infrastructure	
APRIL Editorial: Mar. 22 Ad: Apr. 08	» **Defense & Security**	**Technologies:** Autonomous Navigation, Comms & Telemetry, Magnetometers, GIS, Sonar, and more. **Industry Focus:** Subsea Defense, Government, Offshore Energy, Subsea Infrastructure	
MAY Editorial: Apr. 19 Ad: May 06	» **Marine Renewables** » **Distribution:** SIPEX 💻 / June 1-3 Floating Wind Solutions / June 28-29 Int'l Partnering Forum / Aug. 24-26 H2O Conference 💻 / June 7-10	**Technologies:** Turbines, Subsea Cables, Inspection Drones, Subsea Batteries, Grid Integration, Connectors, and more. **Industry Focus:** Offshore Wind, Wave Energy, Tidal Energy, Alternative Offshore Energy	
JUNE Editorial: May 17 Ad: June 03	» **Bathymetric Mapping & Hydrographic Survey** Marine Tech Expo 💻 / July 12-13	**Technologies:** Oceanographic Equipment & Instrumentation, Sensor Suites, ADCP, Buoys, ROVs, and more. **Industry Focus:** Marine Survey, Academic, Geotechnical Services	
JULY Editorial: July 01 Ad: July 15	» **Unmanned Vehicles Buyers' Guide** 💻	**Technologies:** ROVs, AUVs, USVs, Towed & Bottom Crawling Vehicles, and Gliders. **Company Focus:** Exclusive company/product spotlights and editorial features available	
AUGUST Editorial: July. 26 Ad: Aug. 12	» **Deep-Sea Exploration** » **Distribution:** Global OCEANS / Sept. 20-23 Seanergy 💻 / Sept. 21-24 US Hydro 💻 / Sept. 13-16	**Technologies:** Seabed samplers, Mining machines, Geotechnical tooling, Seafloor imaging equipment, and more. **Industry Focus:** Offshore Energy, Marine Mining, Scientific	
SEPTEMBER Editorial: Aug. 23 Ad: Sep. 09	» **Offshore Build, Inspection & Maintenance** » **Distribution:** Ocean Business / Oct. 12-14 Offshore Energy / Oct. 26-27 ACP Offshore Windpower / Oct. 13-15	**Technologies:** Inspection drones, Turbines, Subsea cables, Power substations, Battery technology, Grid integration, Connectors, and more. **Industry Focus:** Offshore Operations & Maintenance, Offshore Energy & Renewables	
OCTOBER Editorial: Sep. 20 Ad: Oct. 07	» **Submersibles** » **Distribution:** Ocean Energy Europe / Dec. 6-7 UDT / Dec. 14-16	**Technologies:** Manned submersibles, Navigation systems, ROVs, Submarines, Resident Subsea Vehicles, and more. **Industry Focus:** Offshore Energy, Defense, Academic, Marine Mining	
NOV./DEC. Editorial: Oct. 18 Ad: Nov. 11	» **Subsea Engineering & Infrastructure**	**Technologies:** Subsea drills, Prospecting tools, Deck handling equipment, and more. **Industry Focus:** Offshore Energy, Defense, Marine Mining, Government	
SPECIAL ISSUE Editorial: Nov. 18 Ad: Dec. 1	» **The Future of Ocean Technology**	**Tech and Industry Focus:** Our Special Edition unites an exclusive roll call of industry thought leaders to discuss the innovative breakthroughs set to redefine how we work in marine environments over the coming decade.	

SEABED 2030 PROJECT AND WHOI ENTER PARTNERSHIP TO MAP THE WORLD'S OCEAN

The Nippon Foundation-GEBCO Seabed 2030 Project and Woods Hole Oceanographic Institution (WHOI) have signed a Memorandum of Understanding in recognition of both organizations' work to advance our understanding of ocean bathymetry. This will complement the goals of the United Nations Decade of Ocean Science for Sustainable Development.

Seabed 2030 is a collaborative project between The Nippon Foundation and GEBCO to inspire the complete mapping of the world's oceans by 2030, and to compile all bathymetric data into the freely available GEBCO Ocean Map. GEBCO is a joint project of the International Hydrographic Organization (IHO) and the Intergovernmental Oceanographic Commission (IOC), and is the only organization with a mandate to map the entire ocean floor.

Woods Hole Oceanographic Institution is a private, non-profit institution dedicated to advancing knowledge of the ocean and its connection with the Earth system through a sustained commitment to excellence in science, engineering, and education, and to the application of this knowledge to problems facing society. The ocean is a defining feature of the planet and crucial to life on Earth, yet it remains one of the planet's last unexplored frontiers.

WHOI scientists and engineers are committed to understanding all facets of the ocean as well as its complex connections with Earth's atmosphere, land, ice, seafloor, and life—including humanity. This is essential not only to advance knowledge about the planet, but also to ensure society's long-term welfare and to help guide human stewardship of the environment. WHOI researchers are also dedicated to training future generations of ocean science leaders, to providing unbiased information that informs public policy and decision-making, and to expanding public awareness about the importance of the global ocean and its resources.

"It is invaluable to count upon Woods Hole Oceanographic Institution's support in our quest for bathymetric data," said Jamie McMichael-Phillips, Director of the Seabed 2030 Project.

"WHOI's commitment to researching and understanding the ocean matches Seabed 2030's sustainability goals, and we are confident that our collaborative work will bring us closer to achieving our aims and ultimately allow for a fairer, more sustainable world."

Commenting on the new agreement, Kilaparti Ramakrishna, Chair of the newly-formed Seabed 2030 Strategic Advisory Group, said: "It is highly promising to witness top international organizations such as WHOI and Seabed 2030 combining resources and working together to step up the pace of research in the name of sustainability. I look forward to seeing the results of this collaboration."

Peter B. de Menocal, WHOI President and Director said: "Despite its size and impact on the entire planet, 80 per cent of the global ocean hasn't been mapped or explored. WHOI is uniquely qualified to provide expertise in exploration of the ocean floor, which is crucial for understanding our global climate puzzle."

All data collected and shared with the Seabed 2030 Project is included in the GEBCO global grid, which is free and publicly available.

KONGSBERG DIGITAL APPOINTS NEW VP OF STRATEGY

Kongsberg Digital recently announced the appointment of Benedicte Willumsen Grieg as Vice President, Strategy. She will work to support the company's future growth plans, with a special focus on strategy projects and operationalization.

Willumsen Grieg previously held the post of VP Business Development in Kongsberg Digital's parent company, the Kongsberg Group, where she led and supported acquisition and strategy processes across the group's business areas. She will take up the new position on October 1, 2021.

"We have many strong technology clusters in Norway and the Kongsberg Group is a leader in many areas," said Benedicte Willumsen Grieg. "Kongsberg Digital is based on domain knowledge, market positions and many years of investments in this market, and with the Kongsberg Group as an important partner, we have a solid position to realize our growth ambitions."

Kongsberg Digital's vision is to digitalize the world's industries. The company delivers cloud-based, dynamic, and scalable products to complex markets, including the maritime sector, oil and gas, processing, and renewable energy. To ensure growth in these industries, as well as explore new market positions, the company is dependent on a proactive strategy where both partnerships and acquisitions will be considered. Willumsen Grieg will be responsible for much of this work.

"Kongsberg Digital is growing rapidly, and we are on an exciting journey. It will be extra valuable for us to have Benedicte on the team in the growth phase we are in," said Hege Skryseth, President, Kongsberg Digital.

» *Benedicte Willumsen Grieg*

TELEDYNE ANNOUNCES LAUNCH OF NEW GEOSPATIAL BUSINESS

Teledyne has announced the launch of a geospatial group with the unification of its Optech and CARIS businesses. The new Teledyne Geospatial group will offer holistic solutions to seamlessly map land and sea through the integration of industry-leading lidar sensors combined with world-renowned software workflows.

Teledyne Optech has been a world leader in the design, development and manufacture of advanced lidar instruments for more than 45 years. And for over four decades, Teledyne CARIS has developed market-dominating software for the marine GIS community.

This collaboration provides customers with a competitive edge in mapping and delivering data products inside of one complete workflow. Ease of collection and processing, through to final product, is enhanced with efficiency-driving AI algorithms and real time quality control. Ongoing collaborations with other Teledyne businesses extends the geospatial capabilities even further.

The CZMIL SuperNova, the first product from Teledyne Geospatial, integrates Optech's bathymetric lidar with CARIS' comprehensive processing software providing the highest performing bathymetric lidar system in the world.

Andy Hoggarth, Vice President, Sales and Marketing at Teledyne Geospatial said: "Businesses today are increasingly expected to offer a more comprehensive suite of services. Bringing Optech and CARIS together allows us to leverage the world-leading expertise of both companies, ensuring customers can fully realize the competitive advantages provided by our ability to deliver holistic solutions for land and sea."

» *CZMIL SuperNova, the first product from Teledyne's newly formed Geospatial group. (Photo credit: Teledyne)*

MTS ANNOUNCES ITS 2021 AWARD RECIPIENTS

The Marine Technology Society recently announced its 2021 Award Winners, a diverse field of individual recipients that have distinguished themselves in their work, through technological accomplishment, volunteer service, or mentorship. Among this year's accolades was the Ocean News and Technology Young Professional Award, presented to Mathew Biddle for his exceptional work of supporting the integration and management of marine life data for the United States Integrated Ocean Observing System (IOOS®).

"Marine technology impacts our global society in a multitude of ways and these award recipients represent the top of their field. They are helping advance the Blue Economy and their contributions to advancing marine technology are notable and inspiring. We congratulate them and look forward to seeing their continued successes," said MTS President Zdenka Willis.

For more information, visit: *www.mtsociety.org/awards-honors*

» *Will Cotta*

MAYFLOWER WIND APPOINTS WILL COTTA TO SUPPLY CHAIN MANAGER

Mayflower Wind has appointed Will Cotta Supply Chain Manager. Cotta, who has experience working with the Mass Clean Energy Center and the offshore wind industry, is charged with growing Mayflower's supply chain in the New Bedford and Fall River area as well as across Massachusetts.

Cotta served nine years as an officer in the US Coast Guard where he specialized in maritime safety and disaster recovery. In 2018, he was recognized as the Coast Guard Engineer of the Year and nominated for the Federal Engineer of the Year in recognition of his work on marine salvage and expanding the use of alternative fuels in the maritime industry.

Michael Brown, CEO of Mayflower Wind said: "Will has the knowledge, insights, and experience that enables him to make sure that offshore wind development is done in a manner that is fully compatible with existing ocean uses and with environmental stewardship in mind. These important skills along with his supply chain expertise, make him a welcome and wonderful addition to the Mayflower Wind team."

Cotta comes to Mayflower Wind from the Rhode Island Commerce Corporation where he served as the Offshore Wind Supply Chain Director. He holds an MS in Mechanical Engineering from the Massachusetts Institute of Technology, a BS in Naval Architecture and Marine Engineering from the US Coast Guard Academy and completed the Naval Command and Staff online program at the US Naval War College.

JAN DE NUL AND KEPPEL FELS: WINNERS OF THE IADC SAFETY AWARDS 2021

During the virtual IADC Annual General Meeting, IADC President Frank Verhoeven revealed the winners of the Safety Awards 2021. As of this year, IADC presents two safety awards: one to a dredging contractor and one to a supply chain organization active in the dredging or offshore industry. The first award was granted to Jan De Nul Group for its Bollard Step. The second award went to Keppel FELS, a wholly-owned subsidiary of Keppel Offshore & Marine, with its Safety Plus Program and National WSH Vision 2028.

Dredging Contractor Award

Jan De Nul's bollard step was designed by crew, creating a solution that is both easy and quick to use and requires little maintenance. The bollard step transforms mooring equipment into a safe and secure step for making maritime transfers. There are several step designs to deal with different locations and scenarios, all of which can be used on a variety of vessels. The simple and smart solution is adaptable to different types of bollards and creates a stable platform in places where a transfer zone would not normally be possible.

Supply Chain Organization Award

Anchored in Keppel Offshore & Marine's Safety Plus Program and Singapore's National WSH Vision 2028, Keppel FELS continues to consistently improve and enhance its existing Health, Safety and Environment (HSE) management systems. The company invests in building HSE competence and capabilities through training, outreach activities and empowerment of every employee to intervene and stop unsafe acts. Keppel FELS adopts a set of ten lifesaving rules and carries out an assessment of high impact risk activities (HIRA) prior to the execution of works.

Annual Awards Promote Safety Innovation

"At IADC, we realize that suppliers and dredging contractors play an important role in increasing safety. Sometimes the simplest idea can make a major contribution to improving safety, as is the case of the Bollard Step. This nomination, designed by crew, showed once again that an idea doesn't always have to be rocket science, but innovation can be found in the simplest of things," says René Kolman, Secretary General of IADC. "Our Safety Awards are designed to encourage the development of safety skills in the workplace and to reward people and companies who demonstrate a commitment to safety awareness in the course of their profession. The awards, presented each year, recognize the exceptional safety performance demonstrated by a particular project, program, procedure, product, vessel, team or employee(s)."

» *Jan De Nul's bollard step. (Photo credit: Jan De Nul)*

» *Keppel FELS Safety Plus Program and National WSH Vision 2028. (Photo credit: Keppel FELS)*

ARMADA DPC SOFTWARE SUITE TO BE DEVELOPED ON OPENSEA IN COLLABORATION WITH GREENSEA

Greensea Systems have agreed to partner with Ocean Infinity to provide OPENSEA as the open architecture platform that the Armada Dynamic Payloads Control (DPC) will be built upon. The two companies will collaborate on creating advanced robotic control and supervision capabilities for the Armada fleet's payloads. The DPC will provide a framework for supervising and controlling an ROV system, including the deck gear and launch and recovery systems, by operators located at any of Ocean Infinity's re-mote control centers. Through the OPENSEA API and OPENSEA SDK interfaces, Greensea, Ocean Infinity, or any of its partners can easily plug into the Armada DPC to add functionality to the fleet through the open architecture interfaces provided by OPENSEA.

Greensea will provide the engineering services supporting the integration of Armada DPC on the OPENSEA platform. Armada will be implementing Greensea's over-the-horizon command and control suite, SafeC2, as the backbone for Dynamic Payloads Control.

SeaState

THE ON&T PODCAST

SEASON 2 / EPISODE 9

MANNED SUBMERSIBLES – A DEEP DIVE WITH SEAMAGINE HYDROSPACE

The latest episode of SeaState highlights the unique story of SEAmagine Hydrospace Corporation, a California-based manufacturer of personal submarines. SeaState host Rhonda Moniz is joined by three members of the company's management team, co-founders Will and Charlie Kohnen, and CTO Ian Sheard.

The trio started SEAmagine in 1995 with, according to Will, "*no preconceived notion—we really started with a blank sheet of paper.*" The eventful journey since has taken the team across the globe, working with partners and customers to engineer some of the world's most sophisticated manned submersibles.

The SEAmagine product portfolio has evolved over the decades, from the early years when form and function eclipsed all else, to SEAmagine's *Aurora* product line, a range of models with 2 – 9 passenger capacity and depth ratings varying from 100 – 2,500 meters. The company's existing fleet of has accumulated over 12,000 dives around the world.

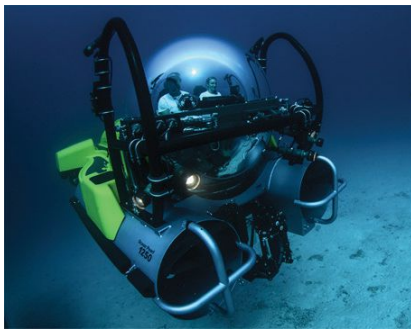
"*Uncompromising*" is the one word, Ian points out, that reflects their collective approach to product development. And it is this unwavering commitment to the highest standards of subsea engineering and safety that promises passengers such inspiring and immersive underwater experiences.

Throughout the podcast, our guests recount personal stories and insights about the past, present, and future of submersible technology and how this buoyant industry bridges several distinct customer segments, from tourism operators to documentary makers to superyacht owners.

As listeners will discover, SEAmagine's dedication to bringing manned submersibles to market over the last 27 years has triggered a new dawn of subsea exploration. Next-generation underwater vehicles will continue to change the way we perceive the ocean and, ultimately, shape our attitudes towards it. Manned submersibles, Will believes, are instrumental to the future of subsea exploration:

"*Hydrospace is a big white canvas waiting for imagination, and there is so much room for the next generation to explore and take our adventures to the unknown—to apply human imagination to the ocean—and submarines is an integral part of that future.*"

Catch the full episode at *www.oceannews.com/seastate.*



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