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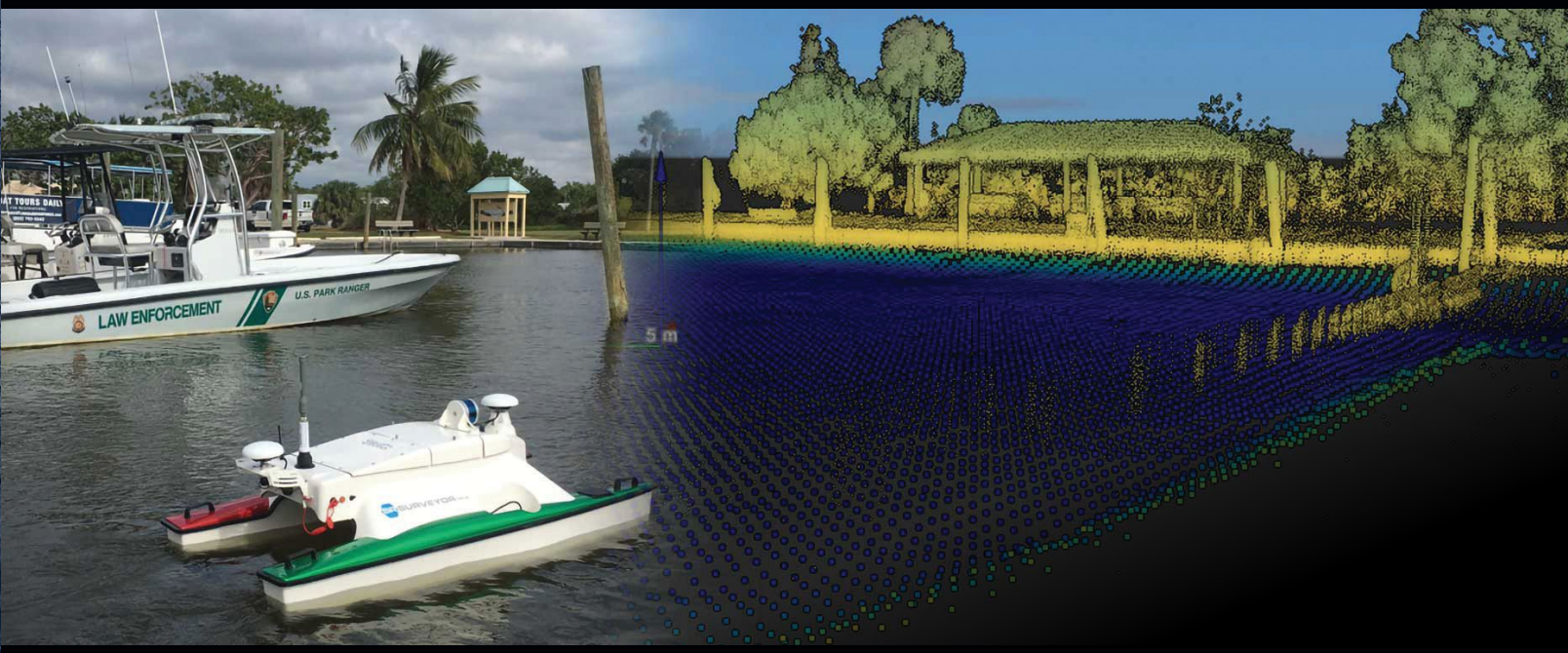

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FEATURES & SPOTLIGHTS

DEPARTMENTS

IN EVERY ISSUE

ON THE COVER:
Saipem's Hydrone program is developing intelligent, multipurpose subsea vehicles for reconnaissance, inspection, and intervention missions at depths of up to 3,000 meters. (Image credit: Saipem)

[WITH THANKS - Ed.]

Our November/December edition profiles some of the most exciting marine engineering projects and technologies driving the safe and sustainable development and expansion of subsea infrastructure. Our thanks to Saipem, DNV, CalWave, Swift Anchors, and Fugro for their exclusive editorial insights.

Next up is this year's Special Edition, The Future of Ocean Technology 2021, which will be distributed in late December. And so, the ON&T editorial team would like to take this opportunity to wish all readers, contributors, and advertising partners a safe and healthy end to the year and a very prosperous start to 2022.

editor@oceannews.com

Ed Keenan

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Technology Systems Corporation
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Ocean News & Technology ISSN# 1082-6106 is published 11 times a year in print and digital by Technology Systems Corporation, 8502 SW Kansas Ave, Stuart, FL 34997, telephone 772-221-7720.

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A NEW VISION FOR SUBSEA ASSET POSITIONING & CONSTRUCTION SUPPORT

BY SJOERD BUTTER,
Project Owner Vision Technology, Fugro

FUGRO

Subsea installation projects have traditionally always called for bulky, and battery dependent positioning equipment to be affixed to the asset in question. This was always a time-consuming and risky operation. But as we continue to harness new ocean technology in the name of faster, safer, and more reliable offshore operations, it is time to disrupt legacy thinking and revolutionize subsea installations. Vision technology, which uses cameras as sensors to perform measurements or visualise future assets using augmented reality (AR), offers a more efficient and safer way to install and position subsea assets.

BENEFITS OF VISION-BASED SOLUTIONS

As Geo-data specialists, much of our thinking at Fugro canters around new ways and means to help offshore developers make real-time decisions about complex and technically demanding projects. When it comes to subsea infrastructure, we believe that underwater vision-based solutions not only help optimize personnel safety, but they also minimize overall vessel time given that the need to install and remove sensing hardware is eliminated.

The convenience of real-time touchless inspection and monitoring significantly reduces a project's complexity, accelerates turnaround times, and widens the operational weather window for essential tasks. At Fugro, we have seen first-hand how vision-based solutions can significantly reduce the required construction vessel time on subsea projects, and so consequently, drastically curb a mission's overall carbon footprint.

PRODUCT DEVELOPMENT

In recent years, therefore, we have seen more and more clients look for an alternative to mounting beacons and gyros to their subsea structures. This pushed our engineers to assess various robust and reliable alternatives and conceive a product that would ultimately standardize schedule improvements, while completely mitigating the risks of using fixed sensors on seabed structures.

The result was QuickVision®, a solution that provides accurate subsea asset positioning during subsea drilling and construction support operations. QuickVision® accurately measures and positions subsea assets by using a smart camera system—easily mobilized on any remotely operated vessel (ROV)—to acquire high quality imagery with precise timestamps and combines them with the ROV inertial navigation system, attitude and heading reference system, and vessel navigation systems.

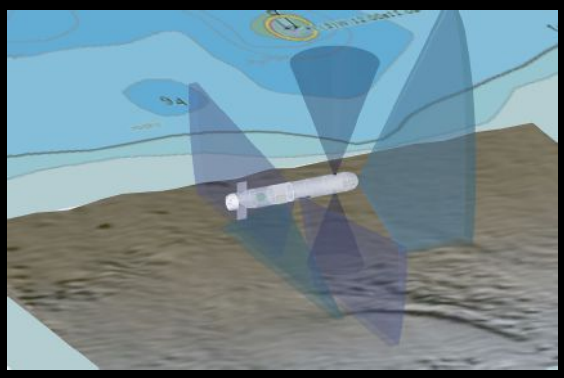
INTUITIVE PATTERN TRACKING & AR

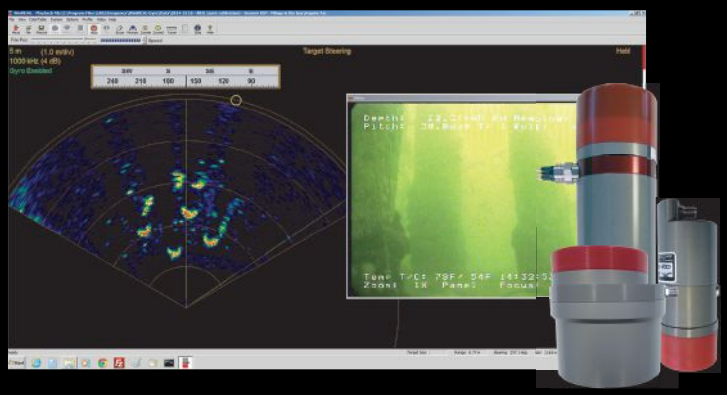
One area we have dedicated substantial resource to is developing a patented real-time pattern tracking feature. As an operational mode of QuickVision®, using these patterns only requires a dimensional control survey to provide the exact location of the pattern on the structure. The patterns are easy to produce, and multiple patterns can be used at the same time, introducing redundancy while also guaranteeing the structure can be tracked from all sides. These patterns enable a complete touchless approach and can stay on the structure once the project is finished.

We incorporated AR to enable the measurement of the subsea heading, attitude, depth, and position of structures without ROV intervention or additional equipment. The AR toolkit accurately mixes the reality of video with virtual measurement tools and enables users to replace physical marker buoys with virtual ones. This not only eliminates the risk of buoys detaching from the seafloor but removes the need for any physical installation in the first place.

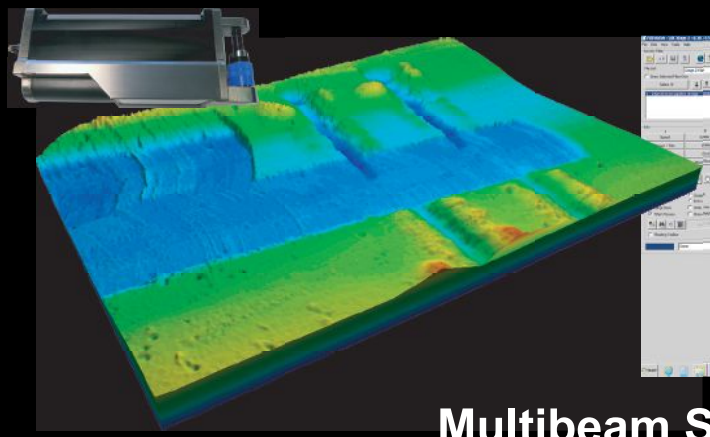
As the ocean industries set sights on expanding further offshore, and into ever deeper waters, a new vision for marine asset positioning, construction, and integrity will likely prove instrumental.

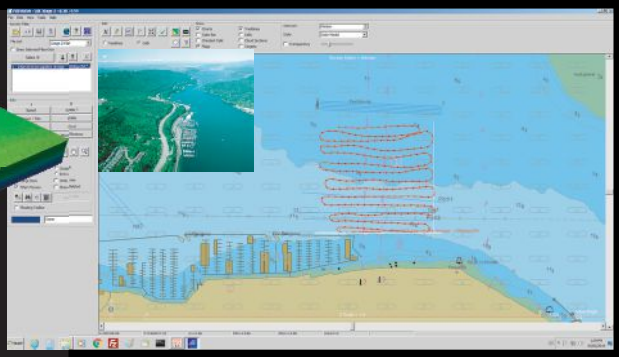
Affordable Solutions for
Sonar Systems



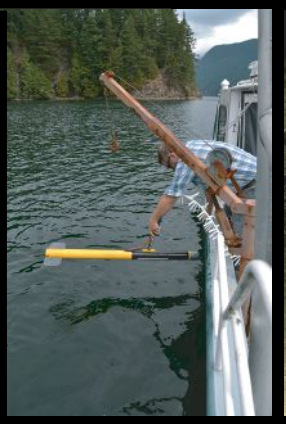


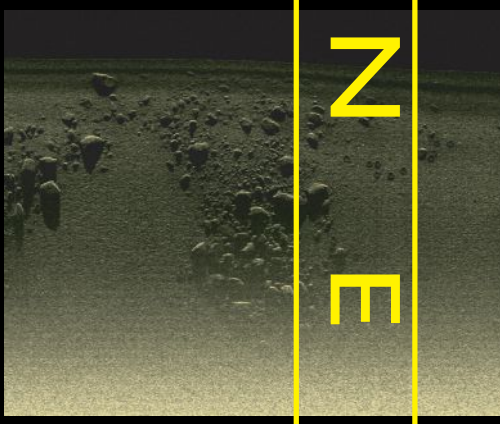
AUV & ROV Sensors





Multibeam Sonars





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REDEFINING THE FUTURE OF SUBSEA ROBOTICS

By Saipem

Saipem is an advanced technology and engineering platform for the design, construction and operation of safe and sustainable subsea projects and plants. With an unrelenting drive for innovation at its core, Saipem is fully committed, in partnership with its diverse range of clients, to a clear transition towards a futureproof energy mix, with the increasing integration of digitalized tools, technologies, and processes.

Saipem has a long and established track record in the offshore energy sector, operating in some of the most challenging environments on the planet—few can be as unpredictable as those associated with subsea activities. This extensive experience in the field, including the running of complex projects that have helped redefine traditional subsea infrastructure, has led to the development of several revolutionary and proprietary technologies, including the *Hydrone* underwater drone program. These intelligent, multipurpose subsea vehicles represent the latest frontier in the field of subsea robotics.

HYDRONE PROGRAM

This technological initiative was dubbed *Hydrone* to evoke both the natural environment in which these assets operate and a fundamental element of Saipem's DNA: water. The drones can reach depths of up to 3,000 meters unassisted by any surface cable link and can travel up to 100 km from a particular dive site. All *Hydrone* program operations are carried out by Sonsub—Saipem's center of excellence for the development of subsea technologies and equipment—which is headquartered in Venice and has several offices around the world, as well as an advanced testing facility in Trieste.

An underwater drone can execute reconnaissance, inspection, and intervention activities below the waterline. *Hydrone* was initially conceived, designed, and developed to meet the needs of the offshore energy sector, both in the traditional segment and the growing renewables market, and specifically for at-sea energy plants. However, *Hydrone* also provides the technological and practical solutions for other marine operations, for example, support and inspection activities of coastal and offshore fish farms, as well as the monitoring of public transportation infrastructure, such as submarine tunnels for fjord crossings or bridges.

ENABLING REMOTE OPERATIONS

Drone piloting operations are carried out at a remote command console, fully equipped with monitors and sophisticated systems for data processing. The control room is connected to a satellite or fiber optic communication network to guarantee a direct data link with each submarine drone. Thanks to the

» *Saipem's Hydrone underwater drone program, a unique family of intelligent, multipurpose subsea vehicles, represents the latest frontier in the field of subsea robotics. (Image credit: Saipem)*

» *Saipem's Hydrone-S, better known as FlatFish, is the company's most compact underwater drone and engineered for inspection activities. (Photo credit: Saipem)*

enhanced navigation tools, the drones are capable of operating entirely autonomously—that is, without the need for human piloting, intervention, or supervision. In other words, the drone can follow a predefined route, recognize objects, and classify them as obstacles or elements to be inspected. However, manual control is also possible, in which case the pilot is supported by a stereometric view of the surrounding environment thanks to the hi-res real-time images captured by the mounted cameras.

To date, Saipem has developed three models of drone for the *Hydrone* program: *Hydrone-S*, more affectionately known as *FlatFish*, is the most compact and primarily engineered for inspection activities; *Hydrone-R*, which is the mid-sized drone tasked to execute inspections and intervention activities with its robotic arms and multipurpose tools; and *Hydrone-W*, the most powerful of the family thanks to its 180kW capacity (approx. 240 hp).

The versatility of underwater drones cannot be overstated. They can be used for a broad range of subsea missions: they can inspect pipes, electrical cables, optical fibers, underwater tunnels, vessel hulls, and mooring lines; digitally reconstruct the morphology of the seabed; count and classify fish; monitor the quality of sea water; control port waterfronts; and perform repair and maintenance operations on critical subsea infrastructure.

SUSTAINABLE SUBSEA RESIDENCY

Compared to other contemporary underwater drones, Saipem's family of *Hydrones* share a distinctive and exclusive feature: each model is certified for continuous seafloor utilization, for deployments of up to twelve months. This "resident" configuration requires them to have fixed bases, or subsea garages, for recharging, data transfer, and mission profile upload. However, *Hydrone* units can also be launched and recovered using more conventional topside operations.

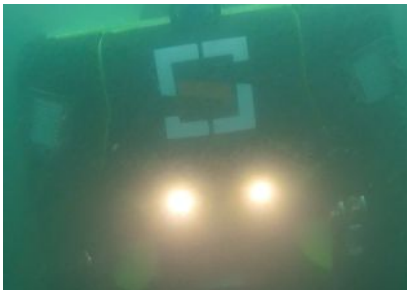
True to Saipem's commitment to green technologies, each *Hydrone* also has a very low environmental footprint. Today, for the most part, subsea inspection operations are reliant on support vessels to deploy tethered or tetherless marine robots but removing this topside dependency—given that these drones can just as easily be launched from an at-sea fixed platform or onshore jetty—not only helps reduce a developer's operational costs but also drastically curbs their associated carbon emission and HSSE risk exposure.

When in resident mode, Saipem's *Hydrones* can be deployed remotely at a moment's notice to inspect pipelines, monitor manifolds, detect leaks, and so on. In terms of aquaculture, the drones can also be used for cleaning fish farm tanks and to monitor the overall health of the fish through sample analysis of movement and behavior.

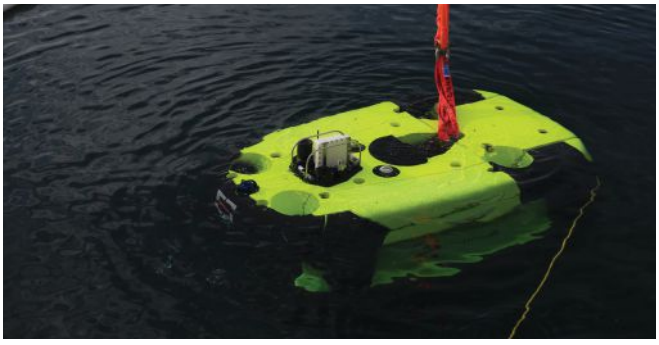
FUTURE INVESTMENTS

Saipem has several projects underway that will, over the next three years, enable the remote operation of drones in swarm formation for extensive hydrographic activities. As part of the same program, Saipem's subsea engineers are working on the miniaturization of drones for applications that demand greater accessibility and maneuverability in confined spaces. A plan for the development of far-reaching underwater Wi-Fi networks with wide coverage is also in the works and will ultimately be one of the prerequisites to establishing the future digitization of underwater infrastructures.

Saipem is also working on the concept of an exclusive fuel cell powered vessel that, in its initial phase, will be operable from land and, therefore, only require a minimal onboard crew. Phase two will introduce completely autonomous operations. Engineering of this nature is integral to Saipem's medium-to-long term strategy, the cornerstone of which is the universal automation of offshore systems in the name of optimizing the environmental and economic efficiency of at-sea activities, as well as the digitization of critical data and information.



» *Hydrone-R's robotic arms and multipurpose tools make it ideally suited for subsea intervention activities. (Photo credit: Saipem)*



» *Subsea Residency: Each Hydrone model (Hydrone-R pictured) is certified for uninterrupted deployments of up to twelve months and supported by fixed bases for recharging and data transfer. (Photo credit: Saipem)*

» *Bear Moored: Close up of Bear mooring to a pier showing her hull and sail rig. (Image courtesy of the U.S. Coast Guard)*

» *Maintenance: Joe Hoyt and John Bright conduct survey equipment maintenance. (Image courtesy of the Search for the U.S. Revenue Cutter Bear)*

CSA OCEAN SCIENCES' EXPEDITION WITH USCG AND NOAA LEADS TO THE DISCOVERY OF USRC *BEAR*

CSA Ocean Sciences Inc. (CSA) recently revealed details of a historic geophysical marine survey conducted in September 2019 off Nova Scotia, which resulted in the recently confirmed identification of the sunken US Revenue Cutter *Bear*. The two-week reconnaissance mission was carried out in partnership with the National Oceanic and Atmospheric Administration (NOAA) and the United States Coast Guard (USCG), with the primary objective of locating and cataloging acoustic targets that might pinpoint the final resting place of the fabled 190-foot vessel.

The data collected from the 2019 campaign identified two key targets, one of which the expedition team believed was almost certainly the USRC *Bear* based on the historical records of her sinking in 1963, in waters approximately 260 miles due east of Boston and 90 miles south of Cape Sable, Nova Scotia. Expert marine archeologists subsequently pored over the remote sensing data and, earlier this year, the USCG and NOAA researchers returned to the site of the 2019 discovery to deploy a remotely operated vehicle (ROV) equipped with high-resolution underwater video cameras to gather conclusive evidence. The USGC's announcement last week confirming that the 2019 sighting is the USRC *Bear* ends the agency's two-decade long search for the iconic patrol boat.

CSA not only provided the Lead Survey Technician, John Bright, but also much of the sophisticated instrumentation used to gather critical seafloor data, including a Klein 3900, an extremely high-resolution dual-frequency sonar system with 445 kHz for extended range and 900 kHz for enhanced clarity of identified targets. The sonar was towed behind the vessel via an armored coaxial towcable spooled onto a 10-horsepower self-contained hydraulic winch powered by 460 volts.

The survey covered more than 62 square nautical miles of the seabed, running a total of 558 linear miles at 4-5 knots. The research party, which in addition to Mr. Bright, included Mission Coordinator Brad Barr (NOAA), Operations Coordinator Joseph Hoyt (NOAA), and POA Beth Crumley (USCG), operated on 12-hour rotations, logging data (ensuring line files were recorded correctly), target logging, maintaining a manual event log, communicating with the bridge on speed and turns to ensure proper towfish altitude, and managing the tether/winch as required. CSA expertise greatly assisted the team with survey mobilization, online operations, and sonar data processing.

"The recent confirmation that the 2019 discovery is indeed the remains of the USRC *Bear* is a source of much pride for the team at CSA," commented Kevin Peterson. "This is an exciting time for the marine archaeology community, not just because we can now study the conditions of this elusive wreck site, but because we now operate in a technological age that promises to accelerate the rate of similar such discoveries in the future. Furthermore, this highly collaborative project amply showcases what's possible with focused cooperation across synergistic public agencies and commercial entities like CSA."

The USRC *Bear*, built as a sealer in 1874, was purchased by the United States in 1884 and served nearly 80 years in the US Revenue Cutter Service, the US Coast Guard, and the US Navy. The ship saw action in both World Wars, as well as famously patrolled the Arctic for 41 years performing search and rescue operations.

CSA
CSA Ocean Sciences Inc.

For more information, visit:
www.csaocean.com

3D AT DEPTH REALIZES A ONE-HOUR METROLOGY WITH NEXT-GENERATION SL4 SUBSEA LI-DAR TECHNOLOGY

The SL4 is 3D at Depth's next-generation step change in the future of the company's sensor platforms with compact onboard electronics designed in-house. The ultra-high-speed compact electronics enable more onboard processing and averaging resulting in single or multipoint Li-DAR pulsed returns which lower the range measurement to less than 1 mm or even lower depending on the operational environment with much faster scanning speeds.

To quantify this improvement for users of 3D at Depth's technology and service, the already market-leading SL3 collects data at scan speeds of 30-degree x 30-degree sector scans which comprised of over 2.1 million data points takes around 5 minutes to collect and process. Three years ago, this was impressive and is still considered the fastest way to collect larger areas of seabed and highly repeatable XYZ points complementing 3D at Depth's patented in-house index of refraction algorithms. After significant investment in the technology development, the SL4 scan 30-degree x 30-degree sector scans is reduced from 5 minutes to 52 seconds, or lower if there is a requirement for less resolution using our configuration point resolution too.

"Over 600 metrologies later using our Subsea LiDAR platforms the 4th generation performance enhancements allow operational subsea data collection times for a spool metrology that used to take 3D at Depth and its partners three hours of on bottom time comprising of two scan positions for the entire metrology to now be conducted in less than one hour with the same number of data points and both scan positions," stated Neil Manning, Chief Operating Officer, 3D at Depth.

Complementing the SL4 is 3D at Depth's own designed for a Pan and Tilt solution with performance and power reduction for battery-powered vehicles or remote deployment solutions as the requirement. The Pan and Tilt in conjunction with an SL4 together allows remote operations with risk-reducing user improved and simplistic diagnostics software tools for remote operations being able to identify any probable system damage or advise on which cable is the probable cause.

NEW REVERSE-GENDER BIRNS MILLENNIUM™ SERIES CONFIGURATIONS FROM BIRNS

BIRNS has announced unique new reverse-gender (RG) contact configurations in its 6 km-rated BIRNS Millennium™ connector series. These custom-engineered connectivity solutions provide flexibility and enhanced safety and security options for subsea system designers who prefer that a power source use sockets versus pins in the receptacle.

This can improve safety and further protect against mechanical damage or electrical shorts in specific application designs—an example of a subsea application for which this might be preferable could be Hydraulic Power Units (HPUs), which provide power to the thrusters on certain ROVs.

In most common electrical connections, it's considered optimal to specify a power source with recessed sockets or contacts. Therefore, in typical connector pairs, the Cable Plug (CP) incorporates sockets, and the receptacle has pins. However, in some systems the power comes from the receptacle, so BIRNS's innovative RG connector options offer an effective solution: recessed sockets in a flanged or other receptacle, with pins recessed within the mating CP.

These new solutions fit the same mounting footprints as non-RG receptacles, providing complete system backwards compatibility. They provide the same depth rating and electrical performance characteristics, as well. Also, RG inserts are backwards-compatible into existing receptacles. Thus, system designers have the option to change existing connectors to an RG configuration by simply replacing the inserts and re-wiring.

» *Typical FR and CP. Right: Reverse Gender CP with pins and FR with sockets. (Photo credit: BIRNS)*

» *The digital twin is a virtual image of an asset maintained throughout the lifecycle and easily accessible at any time. (Image credit: DNV)*

| FEATURE |

TROUBLESOME OR TRUSTWORTHY: HOW CAN DIGITAL TWINS TRULY DELIVER VALUE?

By Kjell Eriksson,
Vice President, Head of Digital Twin Assurance, Energy Systems, DNV

Energy assets are inherently built to perform to the highest standards and undergo rigorous assurance processes throughout their lifetime. Until now, there has been no requirement for their virtual replicas to be as thoroughly checked and maintained.

Energy companies are increasingly utilizing digital twin technology to bring asset information from multiple sources together in a single and secure place, connecting 3D models with real-time field data during the operation phase. Some digital twins are simple, covering a single component. Others are highly complex, spanning entire facilities. What they all have in common, regardless of size and scope, is that they must be trusted. Afterall, millions of decisions about the design, construction and operation of hundreds of thousands of real-world assets will be taken based on them.

In October 2019, Kongsberg Digital, a subsidiary of KONGSBERG, signed a NOK 100 million ($10.5 million) contract scope to digitalize the Nyhamna facility, a gas processing and export hub for Ormen Lange and other fields connected to the Polarled pipeline. It was developed in less than 100 days, and since January 2020, the Nyhamna Dynamic Digital Twin has been in operation and evolving continuously through monthly product releases, focusing on safe, effective and integrated work processes and optimization of production and energy use. The model has since been extended to cover the subsea facilities.

FutureOn is another pioneer of digital twin technology. Its FieldTwin™ builds a digital copy of the oil and gas field and uses advanced visualization to drive collaboration across application programming interfaces (API) platforms and break down silos. As information traditionally stored in databases and expert systems can often be difficult to harness due to size or file format, or is left unused, the technology gives teams instant access to the right information. This will enable better collaboration between different disciplines and parties and thereby, significantly speed up the early design phase, unlock savings, and improve de-carbonisation efforts. The company was recently been awarded a contract with Aker BP.

DIGITAL TWINS DEMAND CLOSE SUPERVISION

Today's digital twin goes beyond being a mirror image of an asset on a desktop. It can become a dynamic framework for advanced digitalization and analytics. While this heralds a new era of visually interacting with data and models, guidance on its use, management and maintenance is critical if it's to be trusted to deliver the value expected.

Rather than think of it as a single, all-encompassing virtual system, it should be seen as a collection of elements or components, of various levels of complexity, each with their own distinct role and function.

DNV, in partnership with TechnipFMC, has published the oil and gas industry's first recommended practice (RP) on how to build and quality-assure digital twins. DNV-RP-A204: Qualification and assurance of digital twins, sets a benchmark for the sector's varying approaches to building and operating the technology and builds upon the principles of DNV's RPs for data quality assessment and assurance of machine learning. It provides:

- Valuable guidance for digital twin developers
- Introduces a contractual reference between suppliers and users
- Acts as a framework for verification and validation of the technology.

The framework provides clarity on the definition of a digital twin; required data quality and algorithm performance; and requirements on the interaction between the digital twin and the operating system. This will create a level playing field to the sector's varying technical definitions of, and expectations of, digital twins.

The methodology is currently being used by leading operators and technology vendors such as Equinor, Aker BP, National Grid, VISCO and Cognite.

BUILDING DIGITAL TRUST AND EFFICIENCY

When buying solutions that offer digital twin capabilities, it is critical to consider the need, not the application itself. By falling into the trap of focussing on the features of the system rather than the decisions that a digital twin should support, one may end up paying two or three times for the same features as many vendors are extending the functionality of their solutions and offer overlapping capabilities.

The journey from data as 'raw materials' to where you serve the data for consumption can sometimes be very long and pass through several stakeholders. Therefore, the activity to monitor the condition of the data so that it is fit for use all the way to where it is needed, is often challenging. Hence, to have a digital twin that can be trusted at any one time often requires the operating procedures to be modified. For instance, by converting the component in the digital system before it is replaced physically, and then release the updated digital version in parallel with the modfication of the asset rather than the other way around, is one way to remain up-to-date at any one time.

For digital twins to be efficient they must work well with the existing IT infrastructure and asset information models as they need to ensure that the right quality of data is available for the decisions to be made. As the digital twin involves the integration of various IoT sensors and technologies for virtualizing the physical twin, with growing connectivity arises the risk of security, compliance and data protection, and regulations. Essentially, the digital twin may be used as a possible entry point for a cyber attack, an aspect that is also addressed in the RP from DNV.

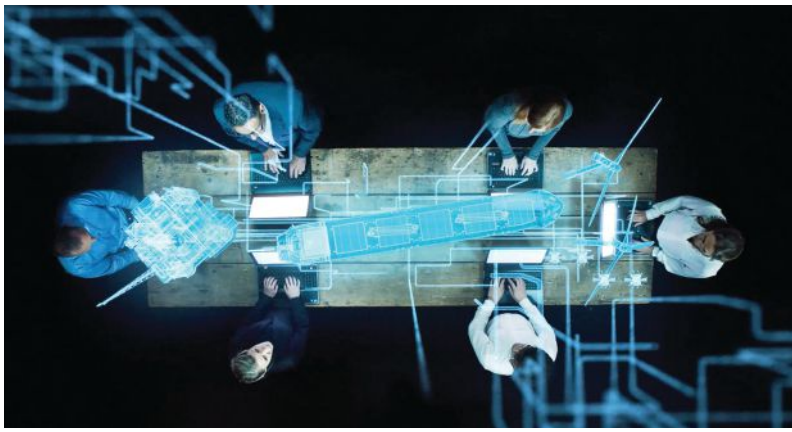
Inherently, all organizations have their own way of doing things. To get true value from a digital twin requires a new way of working, a different asset operating approach or model. Hence, acknowledging that change management and adapting the culture within a business is at the crux of this transition to a digital mindset is key to successful implementation of digital twins.

To realize the potential of digital twins, the sector must start treating digital transformation like any other vital business process. That means defining goals and strategies that create long-term value and help organizations to take the lead in a rapidly changing energy landscape.

HERE TO STAY

Digital technology and digitalization are key enablers for the safe and sustainable transition to a low-carbon energy system. Their potential transformative effects are massive provided that they can be trusted.

The size of the global market size rises exponentially year-on-year, with COVID-19 catapulting its adoption. In 2020, it was valued at $3.1 billion and is projected to reach $48.2 billion by 2026. As this technology evolves, it is vital to combine the criticality and the use cases of the digital twin to fully understand the quality and all the components in it.



» *The digital twin platform brings all the experts together, providing powerful analysis, insight and diagnostics. (Image credit: DNV)*

MARINE-I HELPS STL DEVELOP FUTURISTIC ROBOTIC ARM FOR OFFSHORE OPERATIONS

Marine-i has agreed to support the next stage of development for a futuristic robotic arm designed by Submarine Technology Limited (STL).

Part funded by the European Regional Development Fund, Marine-i is designed to help the marine technology sector in Cornwall and the Isles of Scilly grow through harnessing the full potential of research and innovation.

STL's innovation is a ship-based multi-axis robotic arm for autonomous operations. It will form an integral part of a new Autonomous Synchronized Stabilized Platform (ASSP) to enable intervention tasks to be carried from Autonomous Surface Vessels (ASV). Typical intervention tasks will include equipment transfer and payload management, survey and inspection, launch and recovery.

The aim of this next stage was to develop a Remote Sensing System to allow STL's hydraulically actuated robotic systems to achieve 'Synchronous-Stabilization' without the need for data communication between the moving target and the host vessel.

The Remote Sensing System will add Machine Vision to STL's sophisticated robotic control systems. This will enable the movement of objects to be tracked. Movement data will be fed back into the control system allowing robotic arms to synchronize with the object. These could include Autonomous Underwater Vehicles, Remote Operated Vehicles, and Floating Wind Turbines.

As well as grant funding, the Marine-i team created a bespoke RD&I program for STL's new technology which comprised:

- Evaluation of object tracking systems
- Design and build of an object tracking system, together with modifications to the ASSP robotic arm
- Trials in the Ocean Basin at University of Plymouth COAST Lab
- Sea trials at the FaBTest site in Falmouth Bay

Peter Back, Technical Director for STL, says:

"The structured RD&I program that Marine-i have worked on with us is helping us bring our pioneering innovation to market quicker than might otherwise be possible. It's also fantastic to have access to world-class testing facilities here in the South West, to help us refine and test our approach."

Prof Lars Johanning, Programme Director for Marine-i, says:

"This project by STL is at the cutting-edge of science. As far as we are aware, there is no directly comparable full system solution with identified innovative functions that is currently available. Our work with STL is helping to put Cornwall at the forefront of developing a new marine technology for the International offshore energy sector, as well as offering functions in a number of other offshore sectors, including oil and gas and aquaculture."

» *STL's innovation is a ship-based multi-axis robotic arm for autonomous operations. (Photo credit: STL/Marine-i)*

NEW MITRE BLUETECH LAB ANNOUNCED

The University of Rhode Island (URI) recently joined MITRE in its announcement of the new MITRE BlueTech Lab, a national resource for advancing undersea testing, innovation, and collaboration. URI also joins the Northeast BlueTech Science and Engineering Acceleration (BlueSEA) Coalition as a founding member, along with MITRE, Woods Hole Oceanographic Institution, MassChallenge, and the Naval Undersea Warfare Center, Division Newport.

The MITRE BlueTech Lab will be a state-of-the-art, all-weather maritime test facility in Bedford MA, and a national resource for advancing undersea testing, innovation, and collaboration.

The Northeast BlueSEA Coalition will work together to accelerate solutions to complex maritime challenges by combining complementary skills, assets, resources, equipment, and infrastructure.

"The MITRE BlueTech Lab will accelerate and provide a foundation for underwater research and innovation for positive impact and help make New England a global nexus of maritime research," said Douglas Robbins, MITRE Labs."

URI President Marc B. Parlange said: "URI is well positioned to train and educate the next generation workforce, and drive the creation of 'blue jobs' in this dynamic, emerging industry."

SAILDRONE CLOSES $100 MILLION SERIES C FUNDING ROUND TO ADVANCE OCEAN INTELLIGENCE PRODUCTS

Led by BOND, the round includes new investors XN, Standard Investments, Emerson Collective, and Crowley Maritime Corporation, as well as participation from previous investors, Capricorn's Technology Impact Fund, Lux Capital, Social Capital, and Tribe Capital. The new financing will be used to grow Saildrone's data insight teams and scale go-to-market functions to meet the rapidly growing demand for ocean domain intelligence.

Saildrone's products are based on data collected from a fleet of uncrewed surface vehicles (USVs) that are powered primarily by renewable wind and solar power. Saildrone USVs are the most reliable autonomous vehicles on the planet, sailing over 500,000 nautical miles and clocking more than 15,000 days at sea in some of the harshest conditions on the planet. From the ice edge in the high Arctic to the inhospitable Southern Ocean, Saildrone USVs have proven their exceptional endurance and ability to collect rich, high-precision data. Only recently, a Saildrone USV navigated to the heart of Hurricane Sam, in a world first, taking scientific measurements and HD video that stands to transform our understanding of hurricane forecasting.

Saildrone not only collects scientific data for climate intelligence and high-resolution bathymetric mapping of the ocean floor, it also uses proprietary machine learning to provide marine domain awareness (MDA/ISR) for law enforcement and homeland security applications such as policing IUU fishing, counter narcotics operations, and marine sanctuary protection.

"We're thrilled to partner with Saildrone as they build out the future of maritime intelligence, drawing on their unique technological differentiation and expansive mission history to serve customers across diverse industries," said Noah Knauf, general partner at BOND, who will join the company's Board of Directors.

An American owned and operated company founded in 2012, Saildrone's mission is to sustainably explore, map, and monitor the ocean to understand, protect, and preserve our world. Predominantly powered by renewable energy, Saildrone USVs have a minimal carbon footprint and are equipped with advanced sensors and embedded ML/AI technology to deliver critical insights from any ocean, at any time of year.

"We are honored to have the BOND team and our new investors join our journey," said Richard Jenkins, Saildrone founder and CEO. "The combination of the most tried and tested autonomous ocean technology with the partnership of some of the most experienced venture capitalists in the world consolidates our industry leadership and enables our rapid growth path to meet the needs of our customers."

SAILDRONE

» *Saildrone USVs have proven their exceptional endurance and ability to collect rich, high-precision data in the harshest of marine conditions. (Photo credit: Saildrone)*

EQUIPPING QYSEA'S ROV WITH CUTTING EDGE UNDERWATER POSITIONING SENSORS

QYSEA and Water Linked have partnered up to equip QYSEA's Remotely Operated Vehicles (ROV) with cutting edge underwater positioning sensors. The Water Linked A50 Doppler Velocity Log (DVL), the world's smallest DVL, will be the standard fit for QYSEA's FIFISH V6 EXPERT, PRO V6 PLUS and PRO W6 ROVs moving forward; an addition that is welcomed by a market demanding increased vehicle capabilities.

Following extensive evaluation of the A50 DVL, QYSEA placed an initial order for 10 units. However, to meet the growing demand for increased vehicle capability among their clients, QYSEA significantly increased this initial order prior to taking delivery.

Renowned for their entry level FIFISH V6 ROV, QYSEA have seen increased demand for more capable vehicles. The size, weight, and performance capabilities of the Water Linked A50 DVL made it the obvious choice to support accurate navigation.

Integrating the A50 into the control system of their ROVs has allowed QYSEA to offer advanced ROV station lock and control capabilities. These features allow operators of these smaller ROVs to undertake tasks that are typically undertaken by considerably larger vehicles.

Depth rated to 300 m, the A50 can be used on an extensive range of ROVs. Where there is a need to operate at greater depths, the Water Linked A125 DVL is available rated to 500 m or 3000 m.

Thanks to advances in technology allowing for the miniaturization of sensors, small ROVs can now be used for performing tasks that previously required larger vehicles. This results in a lower cost of operation and enhanced user experience.

Scott McLay, Chief Commercial Officer of Water Linked, stated: "This commitment by QYSEA to the Water Linked DVL, following extensive evaluation, is a great testimony to the ability of our engineers to develop high performance sensors that meet the needs of the industry, enabling small vehicles to operate in harsh environments."

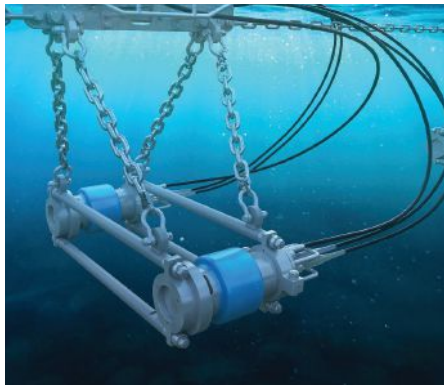
QYSEA's Marketing Director, Li Ping, added: "We at QYSEA have already successfully integrated the Water Linked Underwater GPS G2 system with a number of our current vehicles, providing users with additional navigation capability."

» *QYSEA's FIFISH PRO W6 ROV. (Photo credit: QYSEA)*

» *Water Linked A50 DVL. (Photo credit: QYSEA)*

SERCEL LAUNCHES NEW BLUEPULSE ACOUSTIC MARINE SOURCE FOR SEISMIC ACQUISITION IN SENSITIVE AREAS

Sercel has launched Bluepulse, an innovative marine acoustic source offering the most advanced frequency control technology on the market. Bluepulse is a purpose-built acoustic source designed to help protect marine wildlife from high-frequency emissions, while maintaining highly accurate and reliable results for seismic acquisition.



Bluepulse is compatible with all existing peripherals making it an easy choice for surveys requiring limited high frequency source emissions. Through intelligent engineering and design, existing G-Source and G-Source II units can be easily upgraded with Bluepulse technology, saving customers up to 40% on the cost of fleet conversions.

The new units offer available range options in three different casings, twenty-two different volumes and with two frequency limits (100Hz and 200Hz) to comply with regulatory environmental standards and restrictions. The source array can thus be configured and customized to meet exacting survey requirements.

Emmanuelle Dubu, Sercel CEO, said: "Bluepulse is a perfect example of our continued commitment to providing high-quality data combined with the highest level of environmental responsibility. The ability to upgrade existing units and the wide variety of options also offers the highest flexibility for marine surveys all over the world."

» *Bluepulse is a purpose-built acoustic source designed to help protect marine wildlife from high-frequency emissions. (Image credit: Sercel)*

OCEANGATE'S 2021 TITANIC SURVEY EXPEDITION CONNECTED BY INMARSAT SATELLITE COMMUNICATIONS

Inmarsat, the world leader in global, mobile satellite communications, kept the OceanGate Expeditions crew connected with team members and support services during the six-week expedition to document the Titanic heritage site, located over 400 miles off the coast of Newfoundland in the North Atlantic Ocean.

"The OceanGate Expeditions' Titanic Survey Expedition has taken Inmarsat full circle," said Eric Griffin, VP Offshore and High End Fishing, Inmarsat. "In response to the sinking of the Titanic and the appalling loss of life, the 1914 Safety of Life at Sea (SOLAS) Convention developed a radiotelegraphy requirement for vessels to be equipped with radio equipment for continuous communications. In 1979, the International Maritime Organization set up Inmarsat to provide reliable satellite communications to mariners as an extension of this original requirement. Today, we are proud to have worked with the team at OceanGate Expeditions to make these communications available at high speeds via Inmarsat's Fleet Xpress service for their operations and to have played a role in the important scientific and documentary work they are performing."

"In any expeditionary environment your crew needs to plan for and be prepared for the unexpected," said Stockton Rush, President, OceanGate Expeditions. "The ability to communicate with onshore crewmembers from the expedition support vessel makes a significant difference toward achieving mission success. Whether simply requesting parts and supplies we needed throughout the expedition, tracking our dive crews during hours-long dives in the OceanGate Inc. submersible, Titan, or ensuring the welfare of our crewmembers as they stayed in touch with family and friends back home, communications were essential for our operations. Our supporting Mission Specialists also appreciated the ability to maintain contact and share their experiences," added Rush.

» *Inmarsat kept the crewmembers connected during the six-week expedition to document the Titanic wrecksite. (Photo credit: Inmarsat)*

For more information, visit: *www.oceangateexpeditions.com.*

THE METALS COMPANY
SHOWCASES NODULE COLLECTION TECHNOLOGY

The Metals Company, an explorer of the world's largest estimated undeveloped source of battery metals for electric vehicles (EVs), announced the completion of their event in Rotterdam, Netherlands, '*Engineering the Future with Allseas*, co-hosted by the Company's strategic partner and shareholder, Allseas Group S.A. In partnership with TMC, Allseas is developing a deep-sea collection system to responsibly recover polymetallic nodules from the ocean floor and lift them to the surface for transportation to shore.

At the event, key stakeholders were given the opportunity to tour the pilot polymetallic nodule collection vessel, the Hidden Gem, and the facility where the prototype of a nodule collector vehicle is being built. The Hidden Gem is a 228-meter-long former drill ship and is currently undergoing key modifications to enable at-sea deployment through its existing moonpool of a 4.3-kilometer-long riser that would bring polymetallic nodules up from the seafloor. The Hidden Gem is expected to become the world's first ship classed as a subsea mining vessel by the American Bureau of Shipping. Allseas engineers have also integrated a launch and recovery system for the twelve-meter-long nodule collector vehicle that would enable it to be deployed over the side of the vessel.

Both the Hidden Gem and the nodule collector vehicle are key components of the partnership's efforts to responsibly recover polymetallic nodules from the ocean floor and lift them to the surface for transportation to shore for processing. Allseas current schedule has the Hidden Gem being deployed in the Clarion Clipperton Zone (CCZ) to undertake collection tests in mid-2022.

The estimated in situ resource on the seafloor in the exploration contract areas held by TMC's subsidiaries is sufficient for 280 million EVs – roughly the entire U.S. passenger vehicle fleet. The development of this resource offers an abundant, low-cost supply of critical raw materials for EV batteries and wiring including nickel, cobalt, copper and manganese, with an expected lower lifecycle ESG impact than conventional land-based mining.

"One of the great opportunities we have in getting this industry started is the conversion of assets from the oil and gas industry, which enables us to reach our milestones with significantly less capital expense," said Gerard Barron, Chairman and CEO of The Metals Company. "It was an honor to be able to showcase the incredible ingenuity of Allseas engineering for our key stakeholders, to see the collector coming to life and to stand onboard the Hidden Gem and witness her transformation firsthand. The fact that she will be ready for trials next year and for production in what we anticipate will be 2024 is tremendously exciting."

Edward Heerema, Founder and President of Allseas, said: "We've studied this industry very carefully for many years and when we gained the certainty as engineers that this can work, we really went for it. There is no better solution than the conversion of the Hidden Gem for the first nodule production ship and the development of the collector vehicle and vertical transportation system are currently in a stage that we are very comfortable with."

For more information, visit: *www.metals.co.*

» *The collector vehicle is a key component of the partnership's efforts to responsibly recover polymetallic nodules from the ocean floor. (Photo credit: TMC)*

» *The Hidden Gem is a 228-meter-long former drill ship undergoing key modifications. (Photo credit: TMC)*

NOC AND SUBSEA 7 LAUNCHES
BORA BLUE OCEAN RESEARCH ALLIANCE™

The UK's National Oceanography Centre (NOC) is partnering with Subsea 7, a global leader in the delivery of offshore projects for the energy sector, to create BORA Blue Ocean Research Alliance™.

The alliance represents a significant step towards gaining a better understanding of the world's oceans and seas for a sustainable marine future.

Until now, it has not been possible for researchers to assess deep waters at the frequencies or range needed to better understand global ocean processes. BORA Blue Ocean Research Alliance™ will accelerate this knowledge through a number of projects which will utilize the NOC's world-class scientific research and expertise in technology development, combined with Subsea 7's ability to reach areas of deep marine waters on a global scale and established track record in innovative marine technology and project management.

BORA Blue Ocean Research Alliance™ will help bridge the gap between industry and science to support sustainable research and development, providing researchers access to hard-to-reach areas and sharing open access scientific data and knowledge at every step of the way.

BORA Blue Ocean Research Alliance's™ initial projects will include measuring Essential Ocean Variables in usually inaccessible areas through the use of sensor boxes. Fitted to Subsea 7's global fleet of vessels and Remote Operating Vehicles (ROVs), they will enhance the global scale of ocean observations. The alliance will help accelerate the development of critical ocean sensing technologies aimed at addressing global issues such as climate change. Open data gathered by the suites of sensors can then be analyzed by scientists worldwide or used to support wider observing initiatives and datasets shaping major global ocean health assessments.

Other key projects involve using ROV technology to search for and obtain footage of undiscovered sea creatures that inhabit remote locations and unexplored ocean depths. Subsea 7's unique operational access to unchartered waters enables the close monitoring of different ocean characteristics which will then be analyzed by scientists at the NOC.

Huw Gullick, Associate Director Strategic Business Development at the NOC, said: "BORA Blue Ocean Research Alliance™ will bring together ground-breaking global projects under one umbrella to ultimately provide open access data to scientists across the world to address the complex challenges associated with our oceans. Facing these ocean and societal challenges requires experts throughout the ocean economy to work together to ensure access to large volumes of high-quality information about ocean health in near real-time and at a low cost.

"With innovation at its heart, BORA Blue Ocean Research Alliance™ will help push the limits of scientific knowledge, setting the standard for collaboration between the industrial and scientific communities and delivering meaningful research on a global scale that will provide benefits for all communities."

Emma Stephen, Director of Sustainability at Subsea 7, added: "It is the responsibility of all of us to contribute and ensure the preservation of this most valuable natural resource. Our relationship with BORA Blue Ocean Research Alliance™ supports Subsea 7's value of sustainability, where we will use our global reach and technology to collect and share data to understand more about protecting our seas and marine ecosystems for future generations. We look forward to working with organizations, and businesses to support scientific projects that will make a real impact on our oceans for a sustainable future."

XPRIZE AND WORLD OCEAN COUNCIL COLLABORATE
TO ADVANCE OCEAN CO2 REMOVAL

World Ocean Council and XPRIZE recently co-hosted a webinar to discuss how ocean CO2 removal (CDR) projects can compete in the XPRIZE $100-million Carbon Removal Competition. The XPRIZE Carbon Removal team outlined requirements of the competition and participated in a Q&A with ocean entrepreneurs.

"Our objective is to try and inspire as many shapes and sizes of carbon dioxide removal technology that we can," said XPRIZE Technical Lead Michael Leitch.

The application process involves building a working demonstration, making a case for a project's scalability, and providing a scaled-up calculation of cost, which is the final piece that judges consider. "If teams have stepped over the first two barriers and proven to the judges that the technology works and that it's scalable, then the solutions are going to be ranked by cost in selection of the ultimate winners," explained Mr. Leitch.

During the webinar, CEO Paul Holthus spoke on WOC's efforts to ensure that ocean CDR efforts to sequester CO2, and their potential effects on surrounding ecosystems, are measured: "We're at the stage of both catalyzing a business association for the ocean CO2 removal community, and also very soon to begin convening a working group on the monitoring, reporting, verification technologies and protocols that need to be developed to support the XRPIZE process and its winners—but also that broader community and effort of ocean carbon dioxide removal."

HARNESSING ENERGY BELOW THE WATER

By Marcus Lehmann
CEO and Co-Founder, CalWave

Julie Mai
Communications Manager, CalWave

Unlocking the power of the ocean has undoubtedly faced several fundamental challenges. It's not too difficult to imagine: the ocean can be as unforgiving and treacherous as it is resource-abundant and life-sustaining.

From a technical perspective, the complexity of harnessing wave power as an energy source lies in the design, performance, and cost of operating devices in the open ocean—a corrosive, volatile, and sometimes violent environment.

While the evolution of the marine energy industry has led to a host of designs ranging from floating buoys to snake-like attenuators to address these pain points, CalWave has developed a novel solution that seeks to work with the ocean rather than against it.

xWAVE: SUBSEA INNOVATION

CalWave's xWave product family is built on a promising architecture that serves as a scalable solution for tapping into the renewable energy of ocean waves. Unlike past approaches, CalWave's xWave technology breaks through fundamental industry challenges by being lightweight, efficient, durable, and cost-effective.

Many wave energy developers have relied on building devices out of heavy steel to survive aggressive seas and storms, but xWave designs use a far lighter, less expensive technique based on the principles of submersion. Instead of bobbing on the ocean's surface, xWave devices operate fully submerged and, therefore, are able to shelter from aggressive swells. As a result, the easily deployable technology achieves high performance through extracting energy from all degrees of freedom while being able to control structural loads in any event. As a bonus, our subsea design keeps devices hidden, eliminating any concerns of visual pollution.

CURRENT TESTING IN CALIFORNIA

In September 2021, CalWave deployed its xWave pilot unit, x1, off the Scripps Institution of Oceangraphy's research pier in San Diego, California. For the next six months, the device will be tested with the goal of validating its performance and reliability in open ocean.

In this sea trial funded by the US Department of Energy, the x1 wave energy converter (WEC) is operating at a 26-meter water depth and the submerged 15-foot buoy is anchored at the test area. But all these numbers are negotiable for the next iterations: xWave devices can be smaller or larger to suit a customer's needs and can work in a variety of depths and distances from shore.

» *CalWave successful commission of x1, California's first fully submerged wave energy pilot. (Photo credit: CalWave)*

Further, CalWave is collaborating with PNNL & Integral Consulting, Inc. for observation of the device using three different monitoring tools: a noise spotter buoy, a drifting hydrophone, and three long-term bottom-mounted hydrophones. These instruments will allow scientists to collect data on how the machines impact the marine ecosystem through noise, collisions, or ecosystem changes.

FUTURE DEVELOPMENTS

Following the pilot demonstration, CalWave plans to deploy a larger unit at PacWave, the first commercial-scale, utility grid-connected wave energy test site in the US, rated for 20 MW.

CalWave's technology is also well suited for the power needs of end-users of the blue economy with applications in aquaculture, security and defense, ocean science, disaster recovery, and others that require access to power and data in remote offshore locations.

CalWave's xNode is another product offering specifically designed to enable the Ocean Internet of Things by providing access to power and data offshore. The xNode utilizes the proven x1 drive train technology. This versatile, adaptable, and resilient ocean observing platform features a standard baseline ocean science sensor suite that maximizes data collection and cross-functional interest for any offshore mission, as well as a standard payload interface enabling capability for multiple sensors and payloads to be added. In addition to providing remote power and data offshore, the xNode stands out through innovative features such as a digital twin, autonomous shelter/survival functions, on-board edge computing, and a compact size enabled by an inflatable hull. Similar to xWave designs, it is lightweight, low cost, resilient for storm survivability, and easily stores, ships, and deploys.

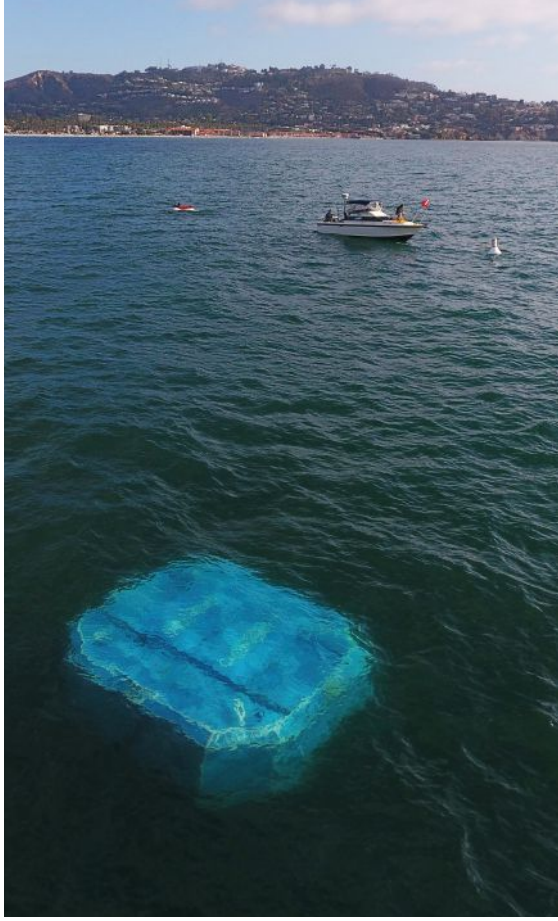
THE OPPORTUNITIES

The wave energy industry is at an inflection point and CalWave is taking a leading role in unlocking the vast and steady carbon-free power from ocean waves worldwide. The Department of Energy recently published a study including an updated resource assessment and found that wave power can provide up to 30% of the 2019 energy consumption in the US, representing the technically feasible resource potential and not just the theoretical. Additionally, it has one of the lowest lifecycle emissions at 17 gCO2e/kWh, and forecasts project that ocean energy has the ability to displace up to 1.38 - 1.9 GtCO2e emissions annually.

As several governments aim to transition to 100% clean energy, such as California through the passage of Senate Bill 100 in 2018, CalWave's scalable technology has the potential to complement existing renewable energy forms to provide reliable power when no other renewables are available. Like wind turbines, wave energy converters (WECs) are scalable in power rating and CalWave plans to offer product lines with different power ratings in the coming years. Utility-scale units can be colocated with offshore wind farms using the same electrical export infrastructure and achieve a 90% joint capacity factor due to the complementary production profile of wind and wave power.

CalWave sees an opportunity to work closely with small island developing states (SIDS). SIDS are the ideal benefactors of our technology, as they are located near subsea wind resources, face high diesel fuel imports, and are often affected by hurricanes. Tourism is one of their biggest industries, so having a renewable resource that works completely underwater and doesn't take up space while providing power close to baseload is a great opportunity for these communities.

As an active member of the National Hydropower Association's Marine Energy Council, we call for domestic marine energy to reach at least 50 MW by 2025, 500 by 2030, and 1 GW—approximately what 3 million solar panels can produce—by 2035.

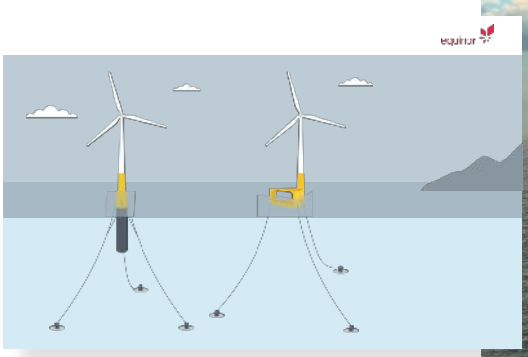


» *CalWave's xWave pilot unit is operating at a 26-meter water depth and the submerged 15-foot buoy is anchored at the test area. (Photo credit: CalWave)*

» *CalWave team viewing the x1 pilot unit device prior to open-ocean deployment. (Photo credit: CalWave)*

CALWAVE

www.calwave.energy



EQUINOR PLANS TO LAUNCH GW-SIZE FLOATING WIND CONCEPT IN SCOTLAND

Equinor has designed a new floating wind concept that will enable industrial standardization and maximize opportunities for local supply chains.

Having reaffirmed its commitment to Scotland earlier this year, the offshore energy company has now revealed its preferred floating wind foundation design for full-scale gigawatt (GW) commercial floating offshore wind, if successful in ScotWind. The Wind Semi, a semisubmersible wind turbine foundation, has been designed with flexibility, specifically to allow for fabrication and assembly based on local supply chain capabilities.

"We are ready to develop the next generation, large-scale commercial floating offshore wind farm in Scotland. By leveraging our twenty years of floating offshore wind experience and innovations, we plan to develop GW-size floating projects in one single phase. Implementing large scale projects will accelerate Scotland's energy transition to net zero. At 1 GW, this project would be over 30 times bigger than Hywind Scotland, the UK's and Equinor's first floating project and have the potential to not only position Scotland as a leader in deep water technology, but also create opportunities for both existing suppliers and new entrants to the offshore wind sector," said Sonja C. Indrebø, Equinor's vice president of Floating Offshore Wind.

To ensure that the technology can be deployed cost effectively whilst maximizing local benefits, Equinor has developed a set of design principles and solutions that are applicable across floating concepts.

Equinor installed the first ever floating offshore wind turbine in 2009, and operates Hywind Scotland (30 MW), the world's first floating wind farm. Since it began production in 2017, Hywind Scotland has consistently achieved a higher capacity factor than other UK wind farms, demonstrating the true potential of floating offshore wind.

"Hywind Scotland proved that the floating concept works, and as we move to the next generation floating offshore wind projects, we need to demonstrate that floating offshore wind is deployable at scale, in different geographies cost effectively whilst bringing local benefits. We have seen the journey of fixed bottom offshore wind, and combined with our long experience in floating, we can take learnings into account as we design and innovate the concepts for full-scale GW floating wind farms," says Indrebø.

The Wind Semi has several features making it particularly suited for harsh waters, and solutions that can maximize the opportunities for the Scottish supply chain:

• Increased dependability: By introducing a passive ballast system, the Wind Semi has a simple substructure design, reducing the risk of system failure and the amount of maintenance needed

• Simpler, more robust design: A flat plate design that is free from bracings, heave plates and complicated nodes that are prone to fatigue cracking

• Flexibility towards the supply chain: With a harbor draught of less than 10 m, the Wind Semi's turbine integration can be assembled at most industrialized ports. The Wind Semi's simpler flat plate design enables the substructure to be built in blocks that can either be fabricated locally and/or shipped from other locations.

"Scotland can be in the forefront of this exciting technology. We asked ourselves how we can achieve industrial standardization and maximize local content opportunities to create additional and sustainable long-term value from floating offshore wind projects. With a design-based approach we've used our experience and gone right back to basics to incorporate this focus in the initial concept design," said Indrebø.

Equinor will select the best suited floating wind concept for its projects. Water depths, conditions around shipyards and ports, and the specializations and capacity of the local supply chain are primary drivers for selecting a given design.

Selecting the most cost-efficient concept design and achieving optimal fabrication efficiency is key to competitive full-scale floating wind parks. In Scotland, Equinor will actively work to develop a broader and more competitive supply chain that can efficiently and effectively deliver a ScotWind floating projects safely, on time, and on budget. In particular, Equinor will work closely with the domestic supply chains in Scotland and rest of the UK to maximize the opportunities for local suppliers and local communities.

SIEMENS GAMESA LAUNCHES FIRST OFFSHORE WIND BLADE FACILITY IN US

Siemens Gamesa Renewable Energy held a launch ceremony on October 25 with representatives from state and local government authorities and wind industry partners in Virginia for what will be the first offshore wind turbine blade facility in the United States. This is also the first commitment by a global offshore wind turbine manufacturer in a US-based supply chain. This milestone solidifies Siemens Gamesa's presence in the US Offshore Wind market and position as the world's leading offshore wind turbine manufacturer.

Siemens Gamesa will develop more than 80 acres/32 hectares at the Portsmouth Marine Terminal in Portsmouth, Virginia upon execution of a firm order for the 2.6-GW Coastal Virginia Offshore Wind Commercial Project with Dominion Energy. Representing a cost of more than $200 million dollars, the facility would perform finishing of patented Siemens Gamesa Offshore IntegralBlades. Approximately 260 jobs at the facility are expected to be created when fully operational. Also, Siemens Gamesa intends to create around 50 service jobs to provide operations and maintenance services for the Coastal Virginia Offshore Wind Commercial Project.

Furthermore, to enable the blade facility, Siemens Gamesa entered a land lease agreement with the Virginia Port Authority, supported by Virginia state incentives for site improvements. When operational, the facility is immediately intended to support deliveries to the Coastal Virginia Offshore Wind Commercial Project.

The Siemens Gamesa blade facility represents another step to develop the Portsmouth Marine Terminal into an offshore wind hub. Siemens Gamesa will look to potentially expand the facility if awarded future projects in the region, creating additional jobs in the future.

"As Congress considers taking historic action on climate, this facility evidences that offshore wind can create significant new manufacturing activity and quality jobs to American communities," said Steve Dayney, Siemens Gamesa's Head of Offshore North America. "We are hopeful this commitment will lead to further action by federal and state policy makers to establish policies to provide long term certainty and help sustain the competitiveness of this facility in the global marketplace for decades to come."

NEW PARTNERSHIP TO ACHIEVE A WORLD FIRST IN OCEAN THERMAL ENERGY CONVERSION

Marine-i has welcomed the news that Global OTEC Resources has entered into a partnership for the deployment of the world's first commercial floating OTEC platform, which will be located in the Democratic Republic of São Tomé and Príncipe.

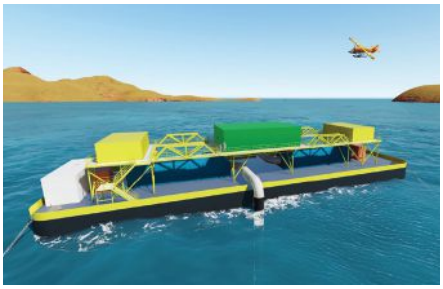
OTEC (Ocean Thermal Energy Conversion) is a process where solar heat energy stored in our oceans is extracted and turned into useful energy, such as electricity.

The Marine-i project provided grants and business development support to Global OTEC Resources to help accelerate the commercialisation of their technology. Part funded by the European Regional Development Fund, Marine-i is designed to help the marine technology sector in Cornwall and the Isles of Scilly grow through harnessing the full potential of research and innovation.

Global OTEC Resources, which is based in Newquay in Cornwall, plans to use OTEC technology to provide green energy to 'off-grid' islands across the tropics. Dan Grech, Director of Global OTEC Resources said: "São Tomé and Príncipe is a small island nation off the equatorial coast of Africa. Our technology has been developed with these smaller communities in mind. It is the perfect way to provide them with clean, affordable energy and reduce their dependency on fossil fuels. This project will be delivered via a Public Private Partnership between our company and SIDS DOCK, the Small Island Developing States (SIDS) Sustainable Energy and Climate Resilient Organization.

"Our breakthrough floating OTEC plant design stems from focusing efforts on small scale projects. Previous developers have attempted going the route of, 'too fast, too soon,' before having an operational grasp of the fundamentals of the cold-water pipe. Collaborating with leading riser manufacturers and scientists on the cutting-edge of subsea riser designs, we have a concept that reduces the technological and financial risk in deploying floating OTEC plants."

The next stage in the project will be a prefeasibility study, which will be part-funded by the United Nations Industrial Development Organization.



» *The floating OTEC plant design stems from focusing efforts on small scale projects. (Image credit: Global OTEC Resources)*

Prof Lars Johanning, Programme Director for Marine-i, added: "This is a really exciting development. Ocean Thermal Energy Conversion technology is based on converting incoming solar radiation into electricity, and is continuously available in almost all ocean locations between the tropics. It therefore represents an unlimited source of baseload electricity for the blue-green economy. As a result, it could provide a major boost to the economies of small island states for generations to come."

CALIFORNIA PILOT PROJECT PROGRESSING TOWARDS ENVIRONMENTAL IMPACT REPORT

BW Ideol recently announced that its planned offshore floating wind pilot-project in California has progressed to the environmental assessment stage, representing the next milestone in a permitting process for what may become one of the first wind farms off the coast of California.

The 40 MW+ pre-commercial floating wind project based on BW Ideol's Damping Pool® technology, will be installed off Vandenberg Space Force Base (formerly Vandenberg Air Force Base), located in Santa Barbara County, California. On 21 October, the California State Lands Commission formally authorized the solicitation of Statements of Interest for consultant services for the preparation of environmental documentation and mitigation monitoring for the proposed wind farm.

» *BW Ideol's offshore floating wind pilot-project has reached the next milestone in a permitting process. (Photo credit: BW Ideol)*

"We are pleased with the progress on the project at a time when both the Biden Administration and the State of California have made strong statements in favour of offshore wind development in California. We are convinced that our unique, proven technology with high local content may create thousands of local jobs when commercial-scale arrays are deployed. This pilot project will provide local stakeholders with exposure to and reassurance of the impacts and benefits of floating offshore wind," said Paul de la Guérivière, the CEO of BW Ideol.

The upcoming environmental assessment comes just over two years after BW Ideol's initial lease application submittal. It is a key element of a standard approval process and the result of extensive collaboration with the California State Lands Commission's staff as well as extensive stakeholder outreach by the Commission.

The project development plan is leveraging BW Ideol's cost competitive concrete hulls while also minimizing long-distance shipping and logistics, using local labour, supply-chain and infrastructure in California to reduce the carbon footprint and maximize local content contribution.

In 2019, BW Ideol conducted an in-depth review of all major California ports and identified at least five suitable sites for construction and launch of concrete hulls for commercial-scale windfarms (50 units or more). Two of these were considered immediately suitable without any upgrades. In addition, the review singled-out four sites suitable for wind turbine assembly and eight harbors capable of storing mooring lines as well as hosting operation and maintenance bases.

NEW OIL DISCOVERY IN THE NORWEGIAN SEA

Equinor, with partners PGNiG Upstream Norway and Longboat Energy Norway, has found oil in exploration well 6407 / 1-9 - Egyptian Vulture. Preliminary estimates show that between 3 and 10 million standard cubic meters of recoverable oil equivalents have been proven in the well, corresponding to 19-62 million barrels.

"Our ambition is to transform the shelf from an oil and gas province to a broad energy province that will ensure value creation from the shelf in the decades to come. In this ambition, our exploration activities are central," said Kristin Westvik, area director for Exploration and Production North.

She added that future value creation will largely come from increased recovery from existing fields, and connection of new discoveries close to existing infrastructure. Such near-field discoveries are not only profitable and robust against fluctuations in oil and gas prices, but they typically have a short payback period and low emissions.

The discovery is the sixth Equinor has made on the Norwegian shelf so far this year.

The well was drilled about 10 kilometers north of the Tyrihans field and 23 kilometers east of the Kristin field in the Norwegian Sea. The aim of the well was to detect hydrocarbons in sandstone reservoirs of the late Cretaceous age in the Lange Formation.

Well 6407 / 1-9 was drilled vertically to a measured depth of 3,883 meters below sea level and encountered an estimated 36 meters of oil column in sandstone in the Lange Formation, of which 13 meters are sandstones with poor to moderate reservoir quality. Oil down to 3,719.5 meters below sea level was detected in the well. The oil-water contact was not encountered. Water depth at the site is 301 meters.

Extensive data collection and sampling has been performed and the preliminary analysis of the MDT samples indicates a light oil.

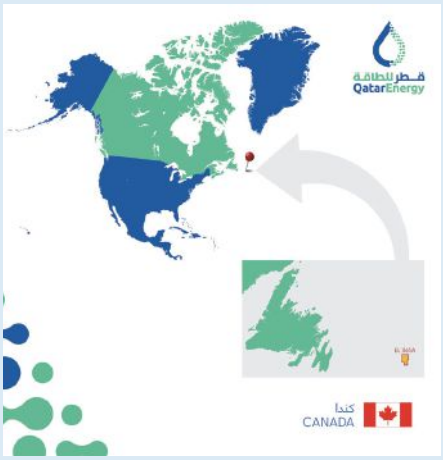
This is the first exploration well in production license 939. The license was awarded in APA 2017.

The discovery will be evaluated for further appraisal and assessed for tie back to existing fields in the area.

The well will be permanently plugged and abandoned.

Well 6407 / 1-9 was drilled by the drilling facility West Hercules, which will now drill exploration well 35 / 10-7 S Toppand in production license 630 in the North Sea, where Equinor is the operator.

» *West Hercules in the Barents Sea (Photo Credit: Ole Jørgen Bratland, Equinor)*



QATARENERGY SIGNS AGREEMENT WITH EXXONMOBIL FOR OFFSHORE ATLANTIC EXPLORATION

QatarEnergy has signed an agreement with ExxonMobil Canada to farm into an exploration license offshore the province of Newfoundland and Labrador in Canada.

The transaction has received all necessary consents from the Canada—Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB).

According to the agreement, QatarEnergy will hold a 40% participating interest in license EL 1165A, where the Hampden exploration well activities are planned. The remaining interest is held by ExxonMobil Canada.

Commenting on this occasion, His Excellency Mr. Saad Sherida Al-Kaabi, the Minister of State for Energy Affairs, the President and CEO of QatarEnergy, said: "We are pleased to conclude this agreement which represents our first entry into Offshore Canada, in an established producing basin with the leading producer in the area. This builds on our strong partnership with ExxonMobil and is an important addition to our growing international exploration portfolio."

His Excellency Minister Al-Kaabi added: "I would like to take this opportunity to thank the C-NLOPB for supporting the transaction, and to thank ExxonMobil, our strategic partner, for their cooperation and efforts to conclude this agreement."

The block covered by this license is located approximately 450 km east of the city of St. John's in Newfoundland and Labrador, in water depths of approximately 1,100 meters.

ACTEON: THE BALTIC IS POISED TO BECOME A SEA OF OPPORTUNITY FOR THE OFFSHORE WIND SECTOR

How to make this ambition a reality was one of the topics discussed during the 7th DISE Energy Congress, which took place in Wroclaw, Poland on September 29-30.

The theme chosen for this year's Congress was Sector Coupling, recognizing the fact that to deliver the energy transition and the EU carbon emission targets, a comprehensive transformation of the European energy systems will be required. As such, any future projects will need to be developed with the integration of the three key sectors (electricity, heat and transport) in mind.

Offshore wind has a fundamental role to play in this process, especially in Poland, a country that is still very much dependent on coal for its electricity generation. The Polish exclusive economic zone in the Baltic Sea has prime conditions for windfarm operations—strong and steady winds as well as shallow water depths. The Polish government is aiming for at least 12 GW to come from offshore wind by 2040.

That is why offshore wind majors have already teamed up with Polish energy companies and secured contract-for-difference (CfD) awards for a combined capacity of 6 GW (all to come onstream by 2030).

The participants of the DISE offshore wind panel (which included representatives of the major developers) agreed that for this ambitious program to come to fruition two key things are required:

- A stable regulatory environment (including, a clear and transparent permitting regime) that gives the developers and investors peace of mind
- Sufficient investment in critical infrastructure such as the transmission grid and local port facilities

Rafal Libera, who represented Acteon on the panel, explained that in the next decade we will see unprecedented growth in the volume of offshore wind farm projects globally.

It is estimated that, on average, 26 GW will be installed every year, which represents a sevenfold increase in comparison with the previous decade. Most of these projects will be developed based on a new generation of 12 MW+ turbines supported by larger and heavier foundations, which will, in turn, require larger installation vessels as well as more powerful drills and hammers. Acteon has responded to the challenges associated with larger foundations by introducing the world's largest hammer to date, which has been working successfully in the market since early 2021.

Predictability of project schedules (particularly in a new market like Poland) is vital for a global services provider like Acteon to plan, manage the allocation of its spread and, at the end of the day, enable the developers to deliver the projects on time and budget.

Moreover, the whole supply chain will have to work together to solve the challenges that come with the significant growth in scale of the offshore wind structures. Libera explained that Acteon is looking to work together with the Polish supply chain who can provide not only the necessary local knowledge but the experience that would be attractive to developers across the Baltic Sea and globally.

When it comes to reaching carbon neutrality, this much is clearer: cross-sectoral collaboration and a coordinated approach is of paramount importance. This is the case of the Baltic basin, where the Polish Phase I windfarms are a prelude to future transnational projects that will aim to export electricity across borders and incorporate green hydrogen production.

ADC ENERGY IDENTIFIES UPGRADE TO REDUCE RIG EMISSIONS BY ALMOST 5,000 TONNES/YEAR

ADC Energy, a specialist provider of integrated rig inspections, has completed a project with a major rig owner which identified that an upgrade to Dynamically Positioned (DP) rigs power systems can reduce carbon emissions by almost 5,000 tonnes per year.

Typical DP drilling units operate in HV split-bus, or open-bus, configuration with the power management switchboards operating in silos, using an independent island philosophy. However, this mode from a redundancy perspective requires more engines to be online than may be required for the total operational loads, creating a potentially greater emission output.

By upgrading existing rig power management systems to allow for closed-bus mode, which ties the switchboards together, this allows the power plant to run with less engines and optimal loads, therefore delivering a more efficient power source.

ADC's recent project highlighted that DP rigs operating in closed-bus configuration can successfully reduce annual CO2 emissions by 4,800 tonnes per year—delivering a fuel saving of $620,000 per year—while reducing engine running hours by 20%.

With the number of engines required to be online at one time lowered, the enhancement also provides operators with greater maintenance schedule flexibility, which can create potential maintenance savings of up to $150,000 per annum.

Austin Hay, Director at ADC Energy said: "There is significant pressure on the oil and gas industry to decarbonize current assets and the findings of our recent project effectively highlight how upgrades to existing systems can actively reduce the carbon footprint of operations.

"We recognize this enhancement requires considerable investment from rig owners and operators but as the sector continues its efforts to deliver more sustainable operations, this capital is essential to support net zero goals. Existing rigs and vessel are critical components in the energy transition, and we are already working with a number of clients to advise them through this process to ensure that assets continue to operate safely and efficiently with minimal environmental impact."

» *DP rigs operating in closed-bus mode can reduce engine running hours by 20%. (Photo credit: ADC Energy)*

A GREEN REVOLUTION FOR MARINE ENERGY DEPLOYMENT

By David Ainsworth,
Managing Director, Swift Anchors

Marine energy pioneer Sustainable Marine, located in the 'Everest' of the tidal energy world in the Bay of Fundy, Canada has developed a range of products in a bid to deliver the world's 'greenest' anchoring solutions for marine energy devices. Delivered under the 'Swift Anchors' brand, the technology—which has been under development for a decade—has potential to revolutionize traditional anchoring systems including clump weighs and gravity anchors, with a more streamlined and environmentally friendly solution.

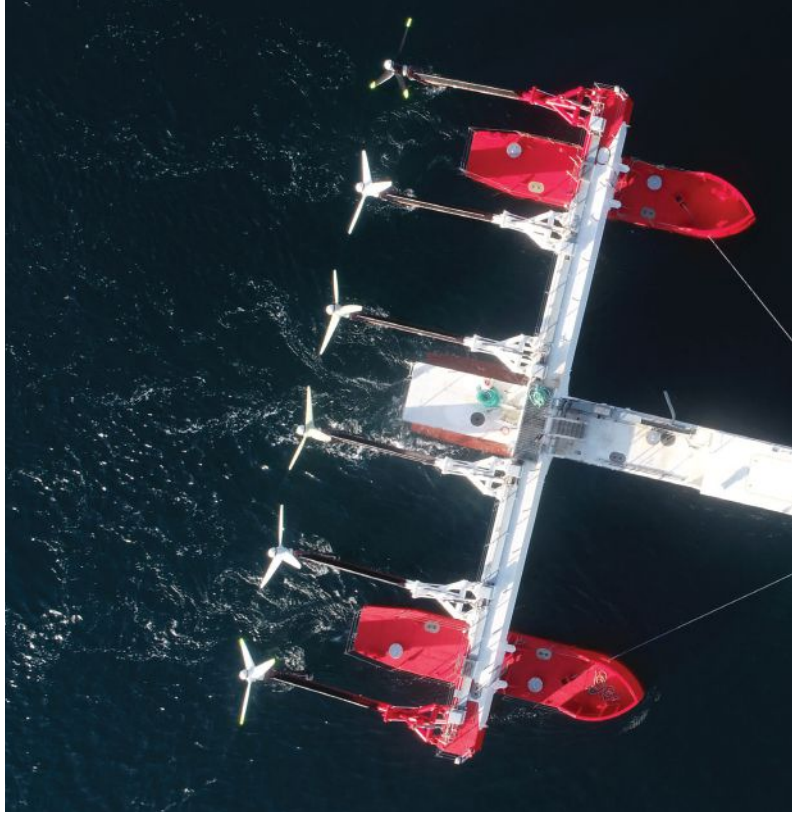
Key to Swift Anchors' approach is the use of low-cost, long-life, high-strength technology. This dramatically reduces seabed impact and speeds up installations using smaller vessels, leading to massive carbon savings. The portfolio, which has been developed carefully over many years, now includes Groutless Rock Anchors, Screw Anchor Piles, Drag Embedment Anchors and Grouted Self-Drilling Piles.

Early adoption dates back as far as 2013, when Sustainable Marine successfully developed and installed high-load helical screw piles to test a prototype tidal energy platform in the Solent. This was followed by several high-profile installations including 25 screw anchors for Cromarty Mussels in 2017, and rock anchor installations to support the testing of Sustainable Marine's tidal energy systems in Scotland at EMEC's (European Marine Energy Centre) Falls of Warness site, and below the Falls of Lora, in Connel Sound, near Oban.

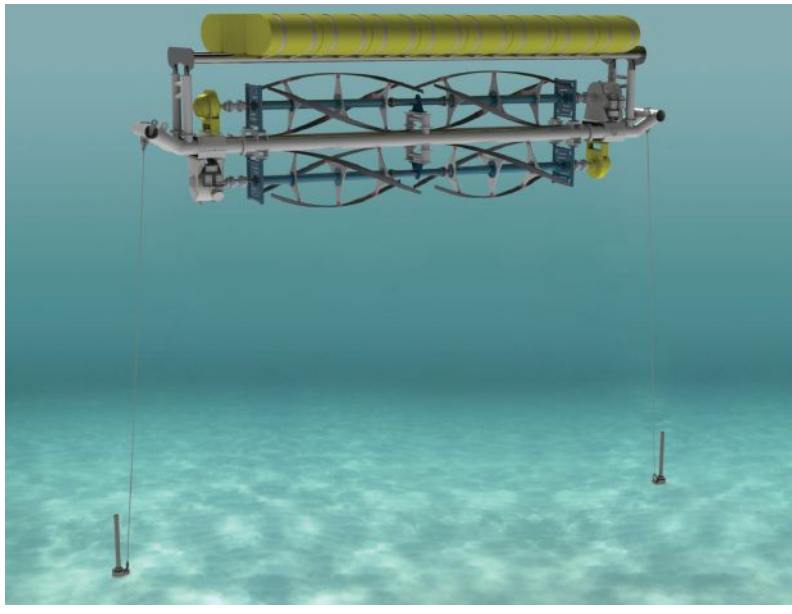
TIDGEN SYSTEM, EASTPORT MAINE, US

More recently, Swift Anchors secured a deal to supply a rock anchoring system for US tidal energy developer ORPC, to support the deployment of the next generation TidGen system, in Cobscook, Eastport Maine, US. This will deliver many environmental benefits, including a significant carbon footprint reduction—equivalent to 50 tonnes of CO_2, or the emissions of a Boeing 737-400 flying 10 times around the equator.

Due to the scale of the infrastructure, the rock anchor only requires light-touch logistics, meaning it can be easily installed from a Multi cat style vessel, further reducing cost and carbon emissions. Furthermore, the initial commercial offering includes a high strength 'rock bolt' with a holding capacity equivalent to 750 tonnes of concrete, opening up rocky areas where traditional anchors are not commercially or technically feasible. The scalable technology ultimately creates greater opportunities in higher-energy and more geotechnically challenging sites for marine renewables including floating offshore wind.



» *The launch of PLAT-I 6.40 Tidal Power Platform in Nova Scotia, Canada. (Photo credit: Sustainable Marine)*



» *Animation of ORPC's Advanced TidGen® marine energy device with Sustainable Marine's Swift Anchor anchoring system. (Image credit: ORPC)*

» *Innovative, multi-turbine design to be used to build 9 MW Pempa'q project in Bay of Fundy. (Photo credit: Sustainable Marine)*

» *Construction of the new tidal platform took place in Meteghan Nova Scotia, in November 2020. (Photo credit: Sustainable Marine)*

Accurate positioning on the seabed also reduces the cost of moorings and extends their life as well as reducing the environmental impact on the seabed.

PEMPAQ PROJECT, NOVA SCOTIA, CANADA

Moreover, Swift Anchors' technology continues to play an integral role in supporting Sustainable Marine's own tidal energy developments. Earlier in 2021, the firm successfully deployed its next-generation PLAT-I 6.40 floating tidal energy platform in the Bay of Fundy, Nova Scotia, Canada. This is set to form part of the world's first floating tidal energy array, in the pioneering Pempa'q Project, delivering up to 9 MW of electricity.

The legendary Bay of Fundy is home to one of the world's greatest and most dramatic tidal ranges, officially listed in the Guinness Book of Records. Here the mighty tides move at walking pace. A seismic aquatic shift sees more than 100 billion tons of water filling and emptying the Bay of Fundy twice daily. It's a mind-boggling volume equating to more than forty million Olympic-sized swimming pools.

The subsequent water force generated at the Minas Passage is equal to 8,000 locomotives or 25 million horses. So extreme is this natural phenomenon, that the surrounding land is known to dip under the load.

In order to provide a suitable anchoring and mooring system, Swift Anchors has teamed up with Norwegian specialist Seasystems, part of Scana ASA, to design a unique hybrid mooring connector and anchor solution. This involves the integration of Seasystems' adjustable mooring tensioners with Swift Anchors' anchor technology, significantly easing the installation process and increasing flexibility in the mooring system design.

The Pempa'q Project is receiving support from the Canadian Government with a $28.5 million investment—one of the nation's largest-ever investment in tidal energy. It will deliver up to 9 MW of electricity to the Nova Scotia grid, reducing greenhouse gas emissions by 17,000 tonnes of carbon dioxide a year and power approximately 3,000 homes. In addition to driving greater energy independence with a greener more sustainable economy, it will also boost creation across the region.

"STAGE-WISE" APPROACH

The Pempa'q Project is the result a gradual and carefully orchestrated 'step-by-step' process, with prototypes being tested in increasingly challenging environments over many years. This has maximized learning opportunities, and provided necessary time to finetune technology, not only to withstand greater natural forces but also ensure proven power output.

Early-stage testing saw deployments across various other sites in the UK, Indonesia, and Singapore, before more intensive programs to advance the PLAT-I concept in Connel, Scotland and in Nova Scotia, Canada in recent years. This sustained effort led to the creation of the PLAT-I 6.40 model which produces 50 percent more power than its predecessor.

Vital information has been gleaned at each small stage of the decade-long journey, translating to constant modifications and improvements, driving greater efficiency, reliability, and power generation. Sustainable Marine's model of steady, incremental growth combined with large volumes of time spent on the platform has helped shape the firm it is today and will further influence the future architecture of the company's third platform, currently on the drawing board.

FUTURE MARKETS

The broader Swift Anchors division is positioning itself as a 'one-stop-anchor-shop' for all marine applications. Its wide range of solutions have been carefully refined over many years to adapt to all forms of seabed conditions, including overburden, and soft sediments. The technology is highly versatile for use across multiple marine sectors, including offshore wind, wave, tidal and solar power, as well as aquaculture, ocean flow, marine civil engineering, ocean thermal energy conversion and all other high load mooring applications.

And the timing couldn't be more relevant, with the World Bank recently indicating up to 2,000 GW of offshore wind will be required by 2050. A substantial portion of this will be in floating offshore wind segment, where Swift Anchors' technology can offer a viable low cost, low emission solution. This is particularly pertinent for emerging markets where new offshore wind entrants may even leapfrog fixed wind systems in favor of floating solutions. Swift Anchors is firmly positioned to support the development of these opportunities, especially closer to home floating wind projects in Europe and North America.

INTERVENTEK LAUNCHES API 17G QUALIFIED 'REVOLUTION-7' SUBSEA LANDING STRING

Aberdeen-based, subsea well intervention technology specialist, Interventek, has announced the commercial launch of a new API 17G qualified, in-riser subsea landing string system. The Revolution-7 landing string is an advanced, 7-inch nominal, 10,000psi rated system incorporating Interventek's unique Revolution safety valve, which is proven to provide superior shear-and-seal performance. The system also includes Interventek's PowerPlus technology, which is a unique arrangement of a locally integrated, gas-accumulated power source, providing the fastest, failsafe valve actuation in less than a second.

The landing string incorporates lower and upper subsea test tree valves, a latch, a retainer valve and lubricator valve. A slick joint, shear sub and project specific adaptors enable space out in the BOP and interface with the tubing hanger running tool and landing string tubulars. The system components are integrated via pre-loaded connections which provide high operational performance and fatigue resistance.

Interventek's new Revolution-7 landing string is market-ready and the first systems were dispatched to a customer earlier this month. The technology has been designed, engineered and fully qualified by Interventek, with rigorous testing to meet the latest API 17G 3rd edition industry specifications.

The company believes the system is a stand-out solution, offering industry qualification to the highest standard, combined with advanced shear-seal valve technology, rapid failsafe gas-accumulated actuation, plus a range of technical, functional and cost benefits. The valve performs both cutting and sealing functions, using separate internal components, in a single rotation, reducing the need for the usual secondary valve to provide a post-cut seal. With fewer, simpler components, the landing string system is compact and lightweight, but stronger and more fit-for-purpose. Supply lead time, redress and maintenance are faster, which in turn reduce project and lifetime costs. The system is suitable for deployment in all BOPs and its modular nature allows additional or alternative valve functions to be incorporated.

» *Gavin Cowie, Managing Director (L) and John Sangster, Technical Director (R) at Interventek, pictured with the company's newly launched, API-17G qualified, subsea landing string. (Photo credit: Interventek)*

Gavin Cowie, Managing Director at Interventek, explained: "Historically, operators requiring subsea landing string services have relied on a handful of tier one, integrated service companies that have their own fleet of proprietary systems. We work with both the operators and service companies to supply our advanced safety valves as system upgrades, where enhanced performance and functionality is demanded. In developing our offering, we are now delighted to be able to supply a complete subsea landing string system to a variety of customers in this market. We see a large and collaborative opportunity in providing cost-competitive and technically advanced solutions, to improve safety and operational efficiency for the wider industry.

"Our technology is modular and universal, allowing it to be scaled up or down in its configuration and capability, and integrated with other third-party equipment. We can offer simplified landing string systems, spanner joint systems, ultra-deep water systems and high-pressure, high-temperature systems depending on the field application."

For subsea well completion, intervention, workover or decommissioning operations, a landing string is deployed from a floating vessel, via a marine riser, to enable safe and environmentally secure operations. The landing string system includes a subsea test tree which provides the capability to close in the well, cut any medium in the bore and disconnect in the event of an emergency.

The shear-and-seal Revolution valve technology used in the in-riser system is also compatible with open water, tree-on-tree abandonment and surface applications. Interventek is also working towards the provision of a subsea control system to complement their advanced landing string package.

» *Interventek's new API 17G qualified subsea landing string. (Photo credit: Interventek)*

FUGRO WINS TWO ENERGINET SITE INVESTIGATION CONTRACTS FOR DENMARK'S ENERGY ISLAND

» *Fugro Scout, one of the dedicated geotechnical drilling vessels working on the project, is equipped with innovative in-situ testing technology to perform complex offshore operations. (Photo credit: Fugro)*

Fugro has secured two geotechnical site investigation contracts with Energinet for Denmark's proposed Energy Island project. A global first, this purpose-built artificial island will be situated 80 km offshore in the North Sea and act as a hub connecting hundreds of surrounding wind turbines. Fugro will perform the preliminary geotechnical site investigation for the Energy Island and the adjacent offshore wind farm zone. The resulting Geo-data will be used to prepare an integrated geological and geotechnical soil model on which wind farm developers will base future tenders.

The fieldwork will run from February to May 2022 and up to four dedicated geotechnical vessels will work on the project. These operations will include the use of Fugro's SEACALF® Mk V Deepdrive system for seabed cone penetration tests (CPTs), as well as the WISON® Mk V Ecodrive for the downhole testing. Following the fieldwork, an extensive laboratory testing program will be delivered by various laboratories, including Fugro's newly certified and accredited laboratory in Belgium.

Commenting on the award Jens Kenneth Larsen, Project Manager for Energinet's site investigations on the future Energy Islands, said: "Energinet is pleased to see Fugro among the suppliers for the Energy Island site investigation project. Reliable geotechnical site investigations are very important for future tenders and therefore a very important part of the foundation when realizing the Energy Island and surrounding offshore wind farms."

Sven Plasman, Fugro's Principal Commercial Manager, said: "We are proud to be involved in this European offshore wind megaproject. Fugro is uniquely positioned to provide the vessels, equipment, experienced engineers and geoconsultants required for successful geotechnical data acquisition, and our advanced laboratory testing will provide critical high-quality Geo-data that helps derisk the project's future development phases and support Denmark's energy transition."

This Energy Island contract follows on from the geophysical and unexploded ordnance (UXO) magnetometry survey awarded to Fugro earlier this year and the floating wind lidar measurement campaign that started in October.

ECA GROUP LAUNCHES THE R7

The R7, the latest addition to ECA GROUP's family of ROVs (Remotely Operated Vehicles), combines the compactness and ease of deployment of mini-ROVs with the performance, speed and payload carrying capacity of professional observation-class ROVs.

Fast, modular and easy to deploy, the R7 is designed for oceanographers, hydrographers, fish farmers and operators of submerged structures for all their underwater missions up to a depth of 300 m, including inspection, observation, surveillance, maintenance and object recovery. The R7 incorporates the expertise accumulated by ECA GROUP over more than 40 years as a supplier of autonomous underwater vehicles for civilian and military applications.

A 100% DIGITAL AND CONNECTED ROV

The R7 incorporates the latest developments in digital technology for some of the highest quality images on the market, thanks to a full HD video chain going from the camera sensors to the display screens.

» *The R7 is designed for underwater missions up to a depth of 300 m. (Photo credit: ECA GROUP)*

To facilitate navigation even in difficult visibility conditions, the R7's navigation camera is equipped with a very high sensitivity wide-angle video sensor. This camera is combined with high performance LED lighting to provide an exceptional level of rendering. The FHD observation camera with 4x optical zoom and vertical rotation movement ensures that the R7 offers optimum comfort during inspection. The plug-and-play connection of payloads is facilitated by the 100% digital architecture, giving the R7 its scalable character.

GREAT EASE OF USE

The R7 also stands out in terms of ergonomics: its highly intuitive Human Machine Interface and ease of use outperforms previous generation ROVs.

The 15-inch touch screen of the control unit and a second screen enabling the display of several data sources simultaneously. A USBL beacon and/or DVL are also available, enabling them to accurately track the ROV's position in real time.

R7 COMBINES POWER, STABILITY AND SERVICEABILITY

The R7 can also be equipped with a manipulator arm with up to five functions, making it extremely maneuverable. It can easily handle or recover objects up to 2 kg.

The R7's maneuverability and power make the operator's job easier even in harsh environments. The four horizontal vectored thrusters give the ROV exceptional dexterity in flight mode. The latest generation inertial measurement unit (IMU) coupled with the three vertical thrusters manages the attitude and provides the ROV with high horizontal stability in all directions.

The R7 can be maintained by a non-expert, who will have quick access to the sub-assemblies. These can be exchanged very quickly and easily, even during the mission.

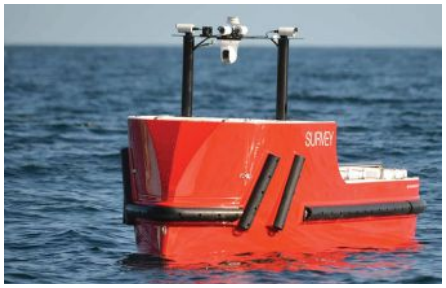
UNMANNED SURVEY SOLUTIONS FINALISTS IN THE 'HEROES OF NET ZERO' COMPETITION

As the engineers at Unmanned Survey Solutions continue to reassess and develop their Unmanned Surface Vessel (USV) design, they are constantly reviewing their commitment to Net Zero. From humble beginnings, the vessel design has changed dramatically to focus on using better energy sources to become more energy efficient.

The newest vessel in the USS fleet has been installed with both solar panels and a smart power monitoring system. This system has been designed to maximise efficiency and only operate when the system calculates that it will run at maximum efficiency to charge the electric batteries onboard. Once the batteries are charged, the generator switches off and operations will continue in electric mode. For shorter survey distances the USV is operated in solely electric mode.

Survey operations have also improved, wherever safe and possible—surveys are now remotely operated from home, meaning reduced manpower going to site and reduced emissions through transport and distribution.

This commitment to help reduce climate change saw USS become finalists in the Heroes of Net Zero competition, created by The Department for Business Energy and Industrial Strategy (BEIS) as part of the UK Government's 'Together for our Planet' campaign.



SONARDYNE, WAVEFRONT DEMONSTRATE OBSTACLE AVOIDANCE XLUUV

Underwater obstacle avoidance technology from maritime defense technology companies, Sonardyne and Wavefront, has been successfully demonstrated on board an extra-large, uncrewed, underwater vehicle (XLUUV) built and operated by Plymouth-based MSubs Ltd.

The demonstration of the Vigilant forward looking sonar was part of the first phase of the UK's Defence and Security Accelerator's (DASA) 'Uncrewed Underwater Vehicle Testbed—Opportunity to Integrate' competition, run jointly with the Royal Navy and the Defence Science and Technology Laboratory (Dstl).

The DASA competition is focused on testing and validating commercial-off-the-shelf technologies (COTS) sensors and payloads, like Vigilant, to help the Royal Navy understand the future roles for XLUUVS for surveillance, reconnaissance and anti-submarine warfare, and deliver new capabilities to the Royal Navy years earlier than otherwise be possible.

Vigilant, developed by Wavefront and manufactured and commercialized by Sonardyne, is a navigation and obstacle avoidance sonar for ships, uncrewed surface vessels (USVs) and underwater vehicles. It provides crews with automated long-range detection of objects in the water column, showing them where it is safe to navigate and alerting them to potential underwater dangers that could result in a collision or grounding.

The system has two operating modes. In 3D mode, Vigilant produces accurate 3D bathymetry and color-coded depth imagery out to 600 m and to depths down to 100 m. In Sonar mode, Vigilant processes the intensity of the acoustic data to extract long-range positional data out to 1.5 km and over a 120-degree field of view. The sonar returns are used to generate alerts highlighting the presence of a navigationally relevant obstacle.

For the trial, the system's sonar projector and receiver array were mounted in the bow of the 9 m-long MSubs' S201 XLUUV. At just 31 cm-wide and weighing only 14 kg in air, Vigilant is easy to retrofit on a wide range of platforms including ships, USVs or, as in this case, an XLUUV.

As part of the demonstration, the XLUUV was programmed to travel beyond the breakwater outside Plymouth sound. Vigilant was used to create a bathymetric map that was used by the XLUUV to navigate. The data was also overlaid over existing charts of the area, demonstrating the higher resolution provided by Vigilant.

Ioseba Tena, Head of Defence at Sonardyne, said: "We're delighted to be playing a role in helping the Royal Navy and program partners to test and evaluate technologies that will help the UK stay ahead of her adversaries in the underwater battlespace.

"Seaborne collision avoidance is a vital consideration for autonomous and uncrewed naval platforms. Vigilant can be integrated into these ocean robots to provide essential information to autopilots and command and control systems, to aid safe navigation and maneuvers around hazardous obstacles."

Bret Phaneuff, Managing Director at MSubs, said: "The data from Vigilant is truly impressive and transformative. It provides our XLUUV with instant situational awareness, which will help it avoid obstacles and, with some further integration, help optimize navigation trajectories to improve our performance and increase our endurance."

USV COMPLETES FIRST UNCREWED SURVEY OF FISH POPULATIONS AROUND OFFSHORE OIL PLATFORMS

An Uncrewed Surface Vehicle (USV) has been used for the first time to survey fish populations around oil platforms in the North Sea.

The survey was part of a project led by the University of Aberdeen, looking at the effects of decommissioning oil and gas structures on marine ecosystems. The USV, owned and operated by ocean data company XOCEAN, used sonar to collect data on fish numbers around several oil platforms off Scotland's north-east coast.

XOCEAN's USVs operate 'over the horizon' transiting unaccompanied hundreds of kilometers from shore, without the need for a mothership. Fitted with high end commercial fisheries sensors, the USVs perform the same task as a crewed vessel but without the need to send a single person offshore. Instead, XOCEAN's innovative platform brings the surveyor online in real time to collect and validate the data from anywhere in the world.

XOCEAN's XO-450 USVs are around the size of an average car (4.5 meters), allowing it to get within 10 m of a platform—significantly closer than a conventional ship. The project, part of the UKRI-funded INSITE (Influence of Man-made Structures in the Ecosystem) program, aims to better understand the influences offshore structures have on commercial fish populations in the North Sea.

The survey was led by Dr Joshua Lawrence, from the University of Aberdeen. He said: "The survey was a great success. After months of planning and working closely with XOCEAN and the platform operators, it was great to finally see the Uncrewed Surface Vehicle collecting data. It's amazing how this sort of technology reveals new opportunities to advance our understanding of these structures and their influences on the North Sea ecosystem. Previous work has suggested that fish aggregate up to several kilometers away from some of these structures, so we designed the survey to make approaches to the structures from 10 km away in each direction.'

The next stage of the project will see Dr Dougie Speirs and Prof Mike Heath from the University of Strathclyde use the survey data to model the expected effects of a range of decommissioning strategies on the surveyed fish populations.

Dr Speirs said: "The data coming out of this survey is providing us with an exceptional high-resolution picture of what is happening to fish distributions around marine installations. It was fascinating to see real-time online images from the USV, and the resulting data will be invaluable as we construct our fish population models."

James Ives, CEO of XOCEAN, said: "Conducting survey campaigns using USVs not only enables the collection of the highest possible resolution data, but it allows that to happen in a way that is safe, carbon neutral and economical for our clients."

The project, and the INSITE program, will run until 2023, and the team will be running similar surveys of more oil platforms using the USV next summer.

» *XOCEAN's USVs are 4.5 meters in length and can deliver real-time to operators anywhere in the world. (Photo credit: XOCEAN)*

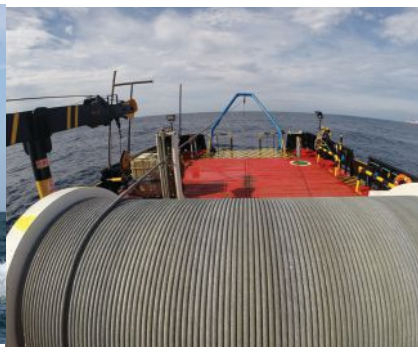
SHEARWATER GEOSERVICES AWARDED MAJOR 3D SEISMIC SURVEY

Shearwater GeoServices Holding AS recently announced the award of 3D seismic survey contract for acquisition in South Africa. The survey will acquire over 6,000 square kilometers of 3D seismic data, to be collected by the seismic acquisition vessel, the *Amazon Warrior*. The vessel will provide a stable platform for seismic acquisition in challenging seas and are ideally suited for the conditions offshore South Africa.

» *The Amazon Warrior. (Photo credit: Shearwater Geoservices)*

OKEANUS SCIENCE & TECHNOLOGY

ENGINEERING THE FUTURE

» *(Left) Okeanus designs, develops, and installs cutting-edge deck handling equipment. (Center) Autonomous systems deploying autonomous systems are set to rewrite the playbook for offshore operators and defense agencies. (Right) Okeanus specializes in fit-for-purpose turnkey solutions, whatever the mission. (Photo credits: Okeanus)*

Okeanus was founded in 2013 with a clear goal: to equip the ocean professional with the tools needed to complete projects on time and on budget, no matter the depth or location. In less than a decade, bolstered by acquisitions of Sound Ocean Systems, Inc. in 2016 and DT Marine Products, Inc. in 2017, Okeanus has established an industry-leading reputation for delivering fit-for-purpose turnkey solutions for complex marine operations from surface to seafloor.

The expansion of Okeanus' product portfolio—which today comprises deck equipment (A-frames, LARs, cranes, winches, HPUs, and sheaves), cutting-edge research technologies (including ASVs, buoys and towfish), and essential marine survey instrumentation—is reflective of the offshore industries' surging ambition to push the boundaries of subsea exploration.

"Our clients are constantly looking to harness breakthrough technology as a way of bridging new frontiers, and we see our role at Okeanus as an enabler—we are a one-stop-shop for ocean hardware, whatever the brief," says COO Don Brockett.

A CUSTOM-FIT APPROACH

While Okeanus offers a growing range of standardized products—available for both purchase and rental—the team also understands that some projects solicit a more customized, partnered approach to problem solving, governed by a phased process from conceptual design through to field deployment and rigorous testing and evaluation.

Although headquartered in Houma, Louisiana, and with several regional offices in the US and overseas, these specialized custom engineering services are managed out of Okeanus' state-of-the-art engineering and testing facility in Houston, Texas, where onsite fabrication is supported by the latest prototyping materials and machinery.

These resources and a very pragmatic approach to fusing scientific expertise, subsea engineering experience, and in-field know-how have helped Okeanus forge long-standing relationships with key defense contractors, oil and gas operators, and offshore renewable energy developers around the world, most of which tend to share a healthy appetite for technological disruption.

"We built our business around the ability to respond with practical solutions, but we are also motivated to challenge convention where technology permits," according to Brockett. "Every customer request is an opportunity to innovate and apply fresh thinking to unfolding operational opportunities."

HANDLING THE FUTURE

One such opportunity is the automation of systems designed to enable remote operations, often from shore-based command centers. Whether for commercial, scientific, or defense applications, the drive for increased automation is fueled by the promise of heightened operational efficiencies and HSSE standards.

Recent advances in subsea engineering and communication have accelerated the real-world orchestration of autonomous systems, with Artificial Intelligence (AI)—powered by machine learning (ML) and the Internet of Things (IoTs)—as the grand conductor. Okeanus is currently working with several private and government entities to further the potential of next-generation uncrewed systems—in particular ASVs/USVs and AUVs.

Naturally, an ocean technology ecosystem less reliant on crewed topside support places increased emphasis on failproof handing systems for these ever-smarter vehicles. But for Okeanus it also means examining how to make these autonomous assets even more autonomous.

"The practical implementation of crewless technologies hinges on the close cross-stitching of automated hardware—the mechanics of an ASV winch, for example—and autonomy software, that is a system's ability to make real-time critical decisions about the winch's deployment," explains Brockett.

Which begs the question: How "autonomous" can we make an autonomous system? That will be one for Machine Learning architects to unravel, but any such vision will be entirely reliant on the collaborative capacity of companies like Okeanus to design, develop and deliver the true nuts and bolts.

For more information, please visit: *www.okeanus.com*.

HULLWIPER TEAMS UP WITH WORLD SUBSEA SERVICES TO BRING HULL CLEANING OPERATIONS TO SRI LANKA

In-water hull cleaning specialist HullWiper Ltd has formed a partnership with leading underwater and related services company World Subsea Services Pvt Ltd to bring sustainable and affordable hull cleaning solutions to vessels calling at the Port of Colombo in Sri Lanka.

Strategically located in the Indian Ocean, Colombo Port is one of the country's largest and busiest ports, particularly for container vessels.

HullWiper's Remotely Operated Vehicle (ROV) provides an eco-friendly, safe alternative to traditional methods of hull cleaning using divers with brushes or karts. With HullWiper's advanced onboard filter unit technology, hull cleaning operations can be performed while the vessel is in port, day, or night, in most weather conditions and whilst cargo operations are underway. Vessels do not need to be off-hired or experience delays to their tight schedules.

"The shipping industry has moved into an era of performing eco-conscious operations, and with this comes the responsibility of ship owners and operators to use green solutions," said Lalindu Jayawickrama, World Subsea Services CEO. "We are preparing now for the inevitable possibility that the option to clean hulls using traditional methods may become extremely limited by offering a service that will not disrupt business continuity for vessels."

World Subsea Services joins HullWiper's expanding family of partners around the world operating under their lease agreement introduced in 2017. The global network of hubs provides cost-effective, safe underwater hull cleaning solutions that protects both vessel's expensive anti-fouling coatings and the marine ecosystem. HullWiper's ROV is 100% environmentally friendly and uses adjustable seawater jets as the cleaning medium instead of brushes or abrasives, to minimize the risk of damage to coatings. Removing fouling from vessels' hulls results in optimal performance, energy efficiency and reduced CO2 emissions, and avoids the expense of re-coating in case of damage. No divers are used, so there is no risk to human life.

"With our industry focusing more and more on efficient, sustainable operations, HullWiper's cleaning solution is an effective tool to improve a vessel's fuel economy and carbon footprint," says Simon Doran, HullWiper's Managing Director. "Colombo's strategic location in the Indian Ocean makes it a key hub, with vessels sailing to and from Europe, East Africa, the Persian Gulf, East Asia and elsewhere in South Asia. Having access to advanced hull cleaning technology services at this key port will be beneficial both for ship owners' and operators' bottom lines, and the marine environment."

Since its launch in late 2013, HullWiper has expanded from its first base in Dubai to key locations across the Middle East, as well as ports in Australia, Denmark, Egypt, Gibraltar, Mauritius, Namibia, Norway, Panama, South Korea, Singapore, and Sweden. HullWiper has performed more than 1,400 hull cleans for vessels worldwide.

» *HullWiper's ROV provides an eco-friendly, safe alternative to traditional methods of hull cleaning using divers with brushes or karts. (Photo credit: HullWiper)*

» *Atle Gran, Kongsberg Maritime; Trond Crantz, Argeo; Thomas Nygaard, Kongsberg Maritime; Morten Bjerkholt, Eelume*

ARGEO CHOOSES KONGSBERG MARITIME-SUPPORTED EELUME AUTONOMOUS UNDERWATER INSPECTION SOLUTION

Argeo AS, a survey and inspection company focused on subsea data acquisition and visualization, has selected Eelume's autonomous 'snake robot' to assist in their operations in the first commercial contract to be signed for this innovative technology. Eelume's advanced robotic solutions have been developed with the assistance of Kongsberg Maritime, who remain a majority shareholder in the venture.

Argeo's stated aim is to transform the ocean space inspection industry through robotics, sensors, and data analytics technology. By enabling more efficient acquisition of data with higher accuracy using technologies such as Eelume, the company can construct advanced and highly accurate digital models based on geophysical, hydrographic, and geological data. This enables organizations in the Infrastructure, Offshore Wind, Oil & Gas and Marine Minerals industries to significantly reduce their operational carbon footprint, since large surface vessels are no longer needed.

"We believe that this is just the beginning of a major shift in how the industry conducts underwater operations. There is a need in the market for this type of solution, and we anticipate a significant requirement for more robots of this type in the long term," said Trond Crantz, CEO, Argeo. "In addition to lowering carbon footprint and increasing efficiency, Eelume technology will enable Argeo to significantly reduce the costs related to inspection, light intervention and monitoring (IMR) of subsea assets and infrastructure. Currently, 90% of these costs are vessel-related. Implementing Eelume as a resident inspection tool for Offshore Wind and Oil & Gas will replace up to 70% of vessel activities."

In operation, one Eelume robot can typically provide a serviceable footprint of 50-75 km2. Argeo propose matching the technology with their Unmanned Surface Vessels (USV), making the Eelume an effective mobile survey solution complete with deployment and recovery system.

Both Eelume and Argeo's aims are wholly in accord with Kongsberg Maritime's focus on sustainable and autonomous technologies. "Argeo has shown itself to be a forward-thinking and innovative company that will use unmanned solutions to save both carbon emissions and costs," concluded Nygaard. "Furthermore, such solutions will increase safety in the offshore industry, by allowing more of the operations that are currently performed offshore to be moved safely to land through robotics and autonomy."

OPTIMISM AND ENTHUSIAM ABOUND AT OFFSHORE WIND CONFERENCE

By John Manock,
Submarine Cable Expert and ON&T Contributor

The American Clean Power (ACP) Offshore WINDPOWER Conference & Exhibition 2021 was held in Boston in October and ON&T was there to cover all the latest from the offshore wind industry. And the optimism, especially the prospects for the US offshore wind market, was palpable. The overwhelming feeling among delegates was that, finally, there is a clear path forward and that the state and federal governments have found common ground to create a powerhouse industry.

This sentiment was captured by one of the conference's keynote speakers, Secretary of the Interior Deb Haaland. In her address, she emphasized certainty and transparency as key to delivering the Biden-Harris administration's goal of 30 GW of offshore wind by 2030. She also announced that the Bureau of Ocean Energy Management (BOEM), part of the Department of the Interior, would hold up to seven new lease sales by 2025. These would include leases for already designated wind energy areas (WEA) for New York Bight and Carolina Long Bay, as well as for new WEAs to be designated for Northern and Central California, the Gulf of Mexico, the Central Atlantic, Oregon and the Gulf of Maine.

The Secretary also noted that the Construction and Operations Plan (COP) for the first commercial-scale offshore wind farm, Vineyard Wind-1, has been approved. The agency is reviewing another nine COPs and expects to complete the review of an additional five by 2025. These 16 COPs will total 19 GW, not including the seven new lease sales noted above.

One of the wind energy developers whose COP is moving towards BOEM approval is Atlantic Shores. ON&T had the pleasure of speaking with two of the company's executives—Jennifer Daniels, Development Director, and Rain Byars, Technical and Delivery Director—who offered an exclusive update.

ATLANTIC SHORES

Atlantic Shores is a 50:50 partnership between Shell New Energies US and EDF Renewables North America. It holds a lease area off the coast of New Jersey and has been awarded an Offshore Renewable Energy Certificate (OREC) by the New Jersey Board of Public Utilities (BPU) for 1,510 MW. Atlantic Shores' COP is one of those being reviewed by BOEM and covers the southern portion of the lease area that extends from Barnegat Light to Atlantic City. The COP covers not only the area to be used for the OREC, but also an area of the WEA that could be used for a second award in the future.

The OREC order includes 111 turbines. The export cable will land in Atlantic City and a turbine nacelle assembly facility will be built at the New Jersey Wind Port. Atlantic Shores Project 1 also has a unique feature—a 10 MW green hydrogen pilot project.

"The hydrogen project will take green electricity and run it through an electrolyzer to produce hydrogen," explained Ms. Byars. "The hydrogen will be blended with natural gas and put into the natural gas distribution network. It's a demonstrator project to look at the feasibility of combining offshore wind with hydrogen production in order to contribute to decarbonization of the sectors in New Jersey that are really difficult to get electrified."

"It's very encouraging to see New Jersey, through its Wind Port and other initiatives, wanting to mobilize the supply chain in the Mid-Atlantic," added Ms. Daniels. They have strong aspirations to be a hub and building the supply chain is critical to this. Atlantic Shores plans to play a major role in this, committing over $840 million to supply chain and workforce development in New Jersey."

"New York and New Jersey have set the most significant targets right now in the country. We now have targets from BOEM indicating how they're going to move the permitting progress forward for New York Bight and the other WEAs. One of the things that's been hard in the US offshore wind market is the timing of when to apply and when to make major investments. The actions by the states and by BOEM now give us a clear line of sight moving forward."

CRP SUBSEA'S BEND STIFFENER PROLONGS THE FATIGUE LIFE OF A POWER CABLE

CRP Subsea and Hellenic Cables have completed dynamic cable testing at the University of Exeter, as part of the EU-funded MaRINET2 research program. The results show that when tested with a CRP Subsea Bend Stiffener (protecting it against overbending) the power cable survived 3.7 times as many cycles and was on average 72.5% stiffer than the power cable alone. These results highlight the importance of a Bend Stiffener's presence to extend the fatigue life of the system to be used in future Floating Offshore Wind (FOW) applications.

CRP Subsea and Hellenic Cables collaborated to jointly apply for the MaRINET2 program, as both companies are looking to increase the lifespan of dynamic subsea cables. The testing at the University of Exeter used a dynamic cable designed and manufactured by Hellenic Cables and a Bend Stiffener designed and manufactured by CRP Subsea. The power cable (only) and power cable with Bend Stiffener were individually tested to compare both performance and fatigue.

John Duggan, Principal Design Engineer at CRP Subsea, stated: "These results are encouraging but expected and explain why the use of a CRP Subsea Bend Stiffener in such a system is critical. The CRP Subsea Bend Stiffener material has undergone an extensive and rigorous material qualification. This along with the comprehensive design methodology, manufacturing, and quality systems have been fully reviewed and approved by Lloyds Register. Our Bend Stiffener is designed to maintain a cable or flexible pipe above a given minimum bend radius in a dynamic application. This, in turn, increases the life of the product by protecting it against damage and fatigue, which can result due to over bending." John Duggan, added, "It is imperative that we use our 25+ years' experience of supplying Bend Stiffeners to all the major oil and gas manufacturers, without any failures in service, to support dynamic cable protection for FOW."

George Georgallis, Head of R&D and Cable Engineering for Hellenic Cables commented: "At Hellenic Cables we are always looking forward in collaborating with industrial and academic partners involved in the offshore industry to promote and validate innovative concepts. The positive outcome of the fatigue test of a dynamic power cable coupled with a bend stiffener at the Exeter DMaC facility is very encouraging."

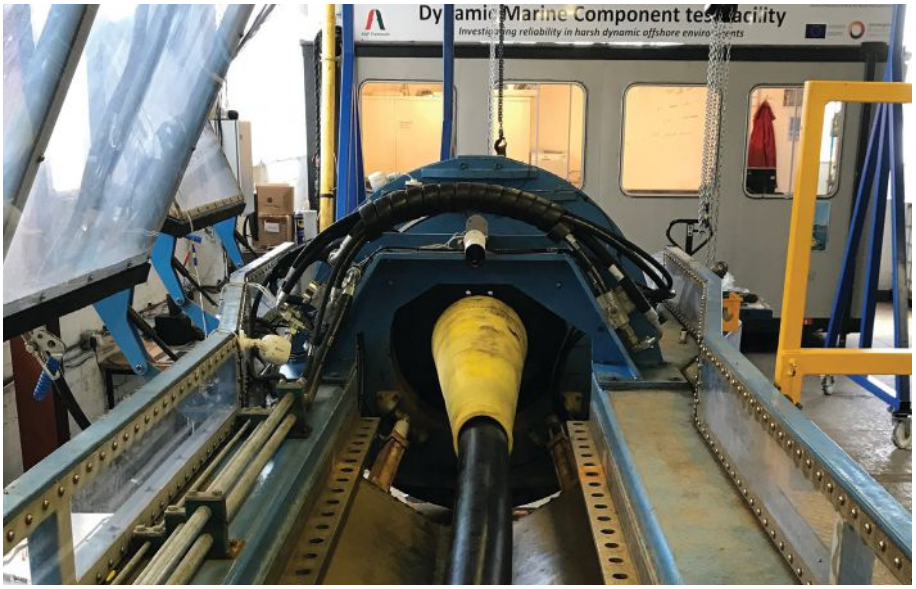
The study is related to one of the key challenges for Floating Offshore Wind (FOW) developers, which is to ensure the long-term integrity of the dynamic cable, connecting the floating platform to the Offshore Sub-Station. Whilst dynamic cable assemblies are recognized as a key technical risk, the sector is not at a commercial scale yet, this funded research and development support is required to demonstrate and enhance dynamic cable solutions for FOW.

Professor Lars Johanning, Project Lead at the University of Exeter, explained: "Floating offshore wind power will be a vital component in achieving global Net Zero targets. It will also have a profound effect on the economy in Europe and globally, creating new jobs in the supply chain and providing a key component for the post-pandemic green recovery. We are extremely excited working with innovative companies in the development of subsystems for the floating offshore industry."

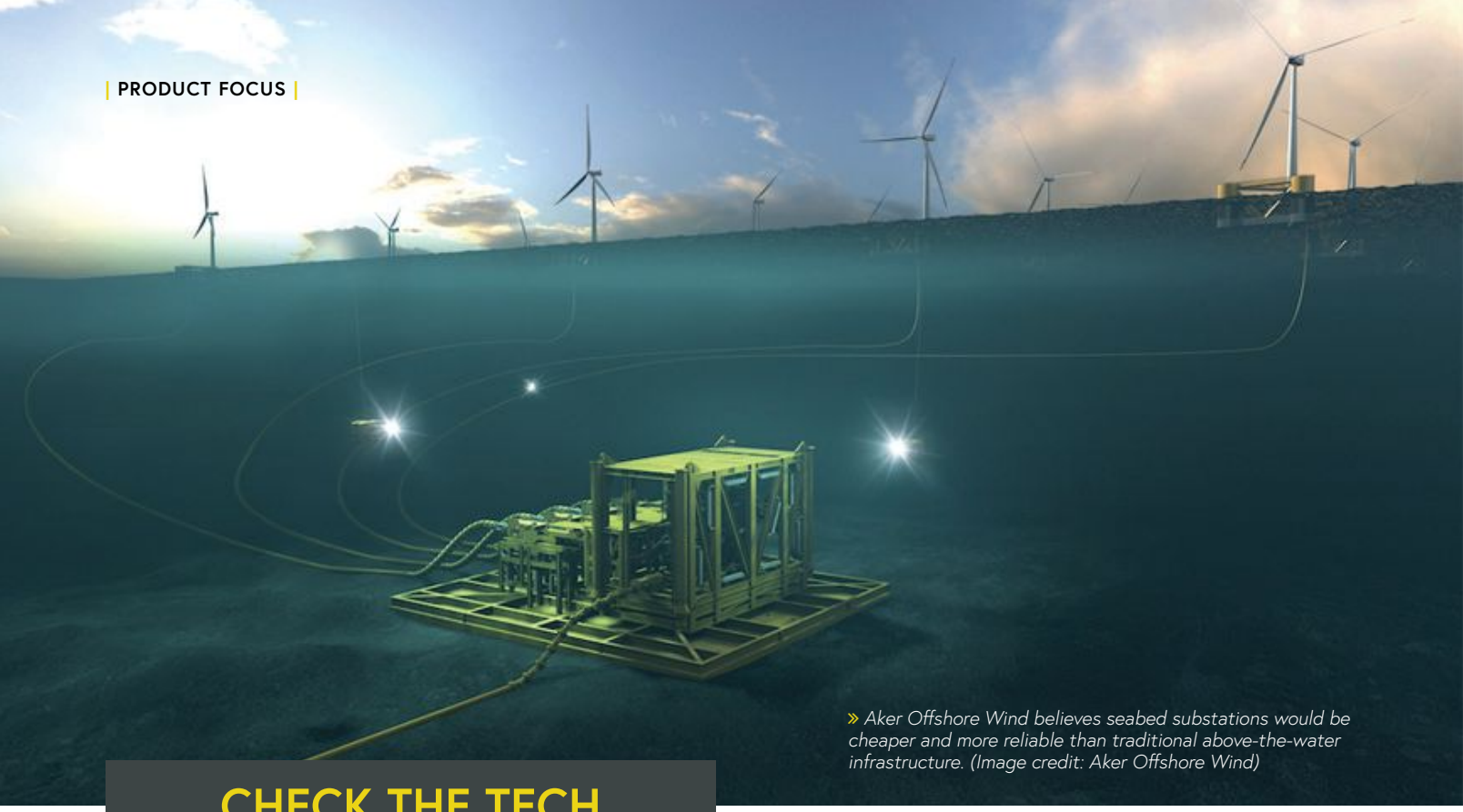
The University of Exeter performed two tests. Firstly, the performance characterization tests that involved bending the cable to a 3.7° angle at the headstock whilst holding a constant force of 40 kN, 60 kN and 80 kN at the tailstock at a 10s cycle period. Secondly, the fatigue testing involved bending the cable to 4° whilst holding a constant force of 80 kN. The cycle period was steadily decreased from 10s to 1s (to minimize overall test duration). The test plan was identical between the power cable (only) and the power cable with bend stiffener combination (including the change in cycle period).

Bend Stiffeners are used to protect cables and flexible pipelines from over bending at the termination point. Manufactured from an elastomeric material, the Bend Stiffener is suited to the constant wave and current-induced motion of dynamic installations and can also be used for static applications. The conical shape of the Bend Stiffener provides a gradual increase in the overall stiffness between the flexible pipe, umbilical or cable, and the termination in order to prevent over bending at the termination point.

This work was supported and funded through the MaRINET2 program (*www.marinet2.eu*) from the European Union Horizon 2020 Framework Program (H2020).



» *Results highlight the importance of Bend Stiffeners to future Floating Offshore Wind (FOW) plans. (Photo credit: CRP Subsea)*



» *Aker Offshore Wind believes seabed substations would be cheaper and more reliable than traditional above-the-water infrastructure. (Image credit: Aker Offshore Wind)*

CHECK THE TECH

SUBSEA SUBSTATIONS FLOAT NEW THINKING FOR OFFSHORE WIND

The future development of offshore substations—power distribution systems that export energy generated by turbines to shore via submarine cables—will play a critical role in the ongoing integration of offshore renewable energy sources to power grids around the globe. Offshore substations are traditionally installed above the waterline but relocating them to the seabed may be a way to unlocking previously unimagined operational efficiency.

This is certainly the view of Aker Offshore Wind. In October, the company outlined plans to develop, manufacture, and supply Scotland's first offshore wind underwater substation under the Scotwind licensing program. Installing substations on the seafloor, according to Aker Offshore Wind, could bring considerable advantages to offshore operations. Notably, seawater could be used as a natural cooling system—stable temperatures ultimately mean greater reliability and reduced maintenance costs—and undersea substations would require fewer components and rotating parts.

Aker Offshore Wind has teamed up with Ocean Winds to submit a series of floating bids which could deliver up to 6,000 MW—enough energy to power millions of homes—in the Outer Moray Firth, in the North Sea. The substations would be produced by Aker Solutions, a sister company of Aker Offshore Wind and a key supplier to UK wind projects.

THE FLOATING FRONTIER

Floating wind technology is still in its infancy, but its potential is staggering. Most offshore wind turbines have fixed foundations and so, due to lateral loads and other environmental factors, can only be installed in depths of up to approximately 50 meters. Floating turbines, however, are tethered to the seabed by mooring lines and so can exploit deeper waters, where winds tend to be stronger and more abundant. Estimates suggest that 80% of potential offshore wind is found in deeper waters.

So, with falling technology costs and the fact that positioning floating turbines further offshore mitigates the NIMBY (Not-In-My-Back-Yard) sentiment, it is little wonder why offshore developers are so interested in technological breakthroughs like Aker's proposed subsea substation.

Technologies that essentially champion the scalability of floating offshore wind will be of huge interest to investors in the US energy mix. The current Administration's pledge to deliver more than 30 GW of offshore wind by 2030 will hinge somewhat on the viability of floating wind infrastructure. In fact, The Department of Energy has reportedly already invested more than $100m in researching and developing floating offshore wind technology in an attempt to establish itself as a leader in the sector.

SCALING UP

Back in Scotland, the hope is that Aker Offshore Wind and Ocean Winds can bring world-leading innovation to scale:

"Both the Aker group and Ocean Winds have the necessary heritage and experience to deliver this at scale. We know the benefit is there—it will revolutionize how energy is produced and present Scotland with the opportunity to export genuinely innovative technology to the rest of the world," said Sian Lloyd-Rees, managing director of Aker Offshore Wind UK.

"Through innovation, we have the opportunity to implement new technology in the ScotWind leasing round, making Scotland and the UK a global leader in subsea solutions for floating offshore wind and exporting the technology around the world."

THE INTERNATIONAL CABLE PROTECTION COMMITTEE APPOINTS NEW PROJECT MANAGER

In May 2021, The International Cable Protection Committee (ICPC) launched a campaign to hire a UK-based Project Manager, and after a thorough review process of qualified candidates, the ICPC has selected Mr. John Wrottesley to fill this new role and they are pleased to announce his contract with the organization commenced on September 14, 2021. Mr. Wrottesley joins the team from Red Penguin (an Associate Member company of the ICPC).

As Project Manager, Mr. Wrottesley will coordinate and oversee the organization's sponsored projects and additional research initiatives as well as ICPC Recommendations, which are document guides to aid the submarine cable industry in promoting the highest goals of reliability and safety in the submarine cable environment. The new Project Manager will work under the oversight of the ICPC General Manager, Mr. Ryan Wopschall, and will collaborate closely with the Secretariat, the Executive Committee, International Cable Law Adviser, Marine Environmental Adviser, and UN Observer Representative.

Mr. Wrottesley has been working in the submarine cable industry for 13 years, primarily in permitting for cables relating to the telecommunications, energy (offshore wind and interconnectors) and oil and gas industries around the globe. He has been involved in submarine cable industry bodies for many years and was the Chairman of the Technical and Regulatory Subgroup within European Subsea Cables Association (ESCA). Presently, he is the Liaison Officer for ESCA in addition to his work for the ICPC.

"Having already being very familiar with the ICPC over the years, I am honored to now be involved in the significant day-to-day activities of the ICPC and grateful to operate more closely on their achievements for the worldwide submarine cable community," said Mr. Wrottesley. "I look forward to working with the ICPC General Manager, Secretariat, EC and Advisers, and contributing to the continued great work undertaken by the ICPC."

» *John Wrottesley*

NEXANS' DYNAMIC CABLE PAVES WAY FOR FUTURE INNOVATION

Nexans has been awarded a significant turnkey contract to supply and install a groundbreaking deep-water high voltage dynamic cable solution for the Jansz-Io Compression (J-IC) project operated by Chevron Australia.

The Jansz-Io gas field is part of the wider Chevron-operated Gorgon development, which has been operational since 2016 and delivers natural gas to customers across Asia and Australia. The Gorgon Project is a joint venture between the Australian subsidiaries of Chevron (47.333 percent), ExxonMobil (25 percent), Shell (25 percent), Osaka Gas (1.25 percent), Tokyo Gas (1 percent) and JERA (0.417 percent).

The J-IC project will use world-leading subsea compression technology to maintain long-term natural gas supplies to the Gorgon liquefied natural gas (LNG) and domestic gas facilities on Barrow Island. As part of this, Nexans will deploy a power and communication transmission system from the shore to the offshore compression facilities, which will sit at a water depth of 1,400 m. A 145kV deep-water dynamic cable will provide power from shore to an offshore floating facility that will subsequently power and control the subsea compression.

"While innovative on its own terms, the high voltage dynamic subsea cables for J-IC will be a major strategic reference and enabler for future projects in floating offshore wind and the electrification of floating offshore facilities," said Ragnhild Katteland, Nexans' VP Subsea and Land Systems Business Group.

Nexans will use its new cable-laying vessel, the Aurora, to install the cables for J-IC. The new vessel's carousel capabilities are specifically designed for laying cables in complex, deep-water deployments like the Jansz-Io field. The 135-km long high voltage subsea power cable will also be manufactured, tested and installed in one continuous length.

To date, Nexans has invested more than €500 million in high voltage state-of-the-art manufacturing and installation assets, firmly establishing the company as a world leader in cabling solutions for offshore developments.

www.nexans.com

» *Aurora, Nexans' state-of-the-art cable-laying vessel, will be used to install the cables for J-IC. (Photo credit: Nexans)*

NATIONAL GRID POWERS UP NSL BETWEEN THE UK AND NORWAY

The UK and Norway are now able to share renewable energy for the first time following the commissioning of the world's longest subsea electricity interconnector. National Grid's €1.6 billion North Sea Link (NSL), a joint venture with Norwegian system operator Statnett, will start commercial operations today, marking a major milestone in the UK's journey to net zero. By enabling the trade of renewable energy between the two countries, North Sea Link will help reduce the burning of fossil fuels in the UK and avoid 23 million tonnes of carbon emissions by 2030.

The 450-mile cable, which connects Blyth in Northumberland with the Norwegian village of Kvilldal, near Stavanger, will start with a maximum capacity of 700 MW and gradually increase to the link's full capacity of 1400 MW over a three-month period. The gradual increase in capacity follows the Norwegian system operator's standard approach for integrating new interconnectors. Once at full capacity, NSL will provide enough clean electricity to power 1.4 million homes.

North Sea Link will be the fifth interconnector for National Grid, which also operates links to Belgium, France and the Netherlands. By 2030, 90% of electricity imported via National Grid's interconnectors will be from zero carbon sources saving 100 million tonnes of carbon—equivalent to taking two million cars off the road. NSL has taken six years to build. Laying of the undersea cables began in 2018 and more than four million working hours have been spent on the project, including 5,880 working days at sea.

» *One of the specialist barges used to construct North Sea Link, which connects Blyth, Northumberland, to the Norwegian village of Kvilldal. (Photo credit: National Grid)*

Norwegian power generation is sourced from hydropower plants connected to large reservoirs, which can respond faster to fluctuations in demand compared to other major generation technologies. However, as the water level in reservoirs is subject to weather conditions, production varies throughout seasons and years.

When wind generation is high and electricity demand low in Britain, NSL will enable renewable power to be exported from the UK, conserving water in Norway's reservoirs. When demand is high in Britain and there is low wind generation, hydro power can be imported from Norway, helping to ensure secure, affordable and sustainable electricity supplies for UK consumers.

UK Energy, Clean Growth and Climate Change Minister Greg Hands, said: "The UK has a strong energy bond with Norway that goes back decades. North Sea Link is strengthening that bond and enabling both nations to benefit from the flexibility and energy security that interconnectors provide.

Cordi O'Hara, President of National Grid Ventures, said: "This is an exciting day for National Grid and an important step as we look to diversify and decarbonise the UK's electricity supply. North Sea Link is a truly remarkable feat of engineering. We had to go through mountains, fjords and across the North Sea to make this happen. We are delighted to have been able to work together with our Norwegian partners Statnett to deliver a world record asset that will make a positive impact on the lives of citizens on both sides of the North Sea."

Hilde Tonne, CEO of Statnett, said: "The sharing of renewable energy between countries and regions is a prerequisite for delivering a net zero future for everyone. As North Sea Link goes into trial operations, I am proud of the engineering feat produced by our joint team. North Sea Link brings the power systems on both sides of the North Sea closer to the future." *www.nationalgrid.com*

GCS, XTERA LAUNCH CONSTRUCTION OF THE GALAPAGOS CABLE SYSTEM

Galapagos Cable Systems Pte. Ltd. (GCS) and Xtera, Inc., recently announced that the Engineering, Procurement, and Construction (EPC) contract has been signed for the turnkey build of the Galapagos Cable System between the west coast of Ecuador and the Galapagos Islands. The 1,280 km system has been developed to date by GCS, a Singapore based digital infrastructure company working in close cooperation with CNT (Corporación Nacional de Telecomunicaciones) the national telecommunications operator of Ecuador.

This contract triggers the project execution which starts with the permitting and design phase, and the marine survey which is already scheduled to follow in early 2022. The system will connect Continental Ecuador with Galapagos Islands, enabling the development of scientific research, commerce, tourism and education.

The new cable, which will go live in Q2 2023, will initially boost bandwidth to the Galapagos Islands by over ten times. President Lasso has increased confidence in the Ecuadorean economy, encouraging the international business community's inbound direct investment. The Minister of Telecommunications, Vianna Maino, and CNT's General Manager, Ralph Suástegui, have cleared all of the obstacles to allow this major infrastructure project to proceed. A key benefit of the system is to provide the Galapagos archipelago with high capacity and high quality national

and international telecommunications services, both fixed and mobile, fiber optic broadband internet, and 4G mobile services with 5G in the future. With a design capacity of 20 terabits per second, the state-of-the-art submarine system will ultimately increase the regional bandwidth more than 2,500 times.

Xtera will perform the design and construction works on a turnkey basis utilizing their next generation SDM repeater, with cable supplied by Prysmian/NSW and marine installation activities performed by IT International Telecom. Xtera's subsea implementation combines project management and system integration expertise with solid industry partnerships.

Alexandria Donoghue, Managing Director Galapagos Cable Systems Pte. Ltd., stated that, "GCS' decision to invest in this project was based on the company's opportunity to make a strategic investment in Ecuador that would enable the digital connectivity of the Galapagos Islands to the mainland. This new system allows for unique possibilities; connected services and the IoT will be available to the entire community, bringing with them a wealth of new opportunities, increased scientific research capabilities, and a boost of revenues for existing businesses."

John Hibbard, Chairman of Galapagos Cable Systems Pte. Ltd., an industry veteran with extensive experience consulting with Pacific Island Governments, noted: "With the wealth of comprehensive research institutions on the Galapagos Islands, this submarine cable system will enable real-time collaboration between the scientists on the islands and their colleagues in their home base."

Keith Henderson, Chief Executive Officer of Xtera, added: "It is our privilege to deliver this environmentally important, state-of-the-art undersea system. Xtera's agile approach to supply enables GCS to benefit from a turnkey solution which utilizes the best products and services for their requirements. We are living in a time of unprecedented bandwidth demand and Xtera's expert team will continue to drive important connectivity projects, such as this one, to successful completion."

www.xtera.com

| FEATURE |

SEABED MINING: THE COAST GUARD'S DEEP FUTURE

Lieutenant Kyle Cregge,
Via CIMSEC

What if the final frontier is much closer to home? From SpaceX to Space Force, many groups are seeking to dominate space in an era of Great Power Competition and commercialization. Yet for all the time humans have looked up, a far murkier domain below remains largely unexplored. The deep-sea and seabed remain less understood than our near abroad in space and yet contain myriad natural resources which have yet to be tapped. Beyond the familiar reserves of hydrocarbons, there are metallic nodules and crusts spread across the seabed, resting beneath national exclusive economic zones (EEZs) and claimed continental shelves, as well as below the high seas.

China, meanwhile, maintains a near-monopoly on the rare-earth metals that sustain the modern global economy and regularly leverages these key resources through coercive bilateral sanctions. Amidst these challenges, the private sector and public investment of many other nations will likely turn to the seabed to diversify their supply chains. Environmental risks, scientific opportunities, and assent to untested international law remain open questions in these extractive ventures, but seabed mining is coming regardless. The US Coast Guard's similar and enduring missions around maritime resource extraction make it well-suited to enforce domestic and international law in this expanding industry. The service should prepare for seabed mining by engaging with allies and partners and by supporting scientific research and environmental protection.

» *Deep-sea polymetallic nodules, potato-sized concretions, were first recorded by the HMS Challenger Expedition of 1872-1876. (Photo credit: The Metals Company)*

THE OPPORTUNITY OF SEABED MINING

Deep seabed mining is generally defined as extracting resources below a depth of 200 meters, such as the deep-sea polymetallic nodules first recorded by the HMS Challenger Expedition of 1872-1876. Private citizens and companies have intermittently attempted to capitalize on the potato-sized concretions over the past 150 years. These ambitions even served as the elaborate cover story between Howard Hughes and the CIA for the ship Glomar Explorer and the plan to recover the sunken Soviet submarine K-129 off the coast of Hawaii in 1974. More recently, the multinational firm Nautilus Minerals went bankrupt in 2019 following a decade's worth of planning and investment to drill off the coast of Papua New Guinea for copper, gold, silver, and zinc contained within seafloor massive sulfide (SMS) deposits. Despite the legal and financial trouble Nautilus Minerals encountered, the bounty from mining the seabed will continue to encourage innovation and investment. While estimates vary, proposals have put the potential annual contributions of the deep-sea mining industry to the US economy at up to $1 trillion, and the value of all gold deposits alone worth up to $150 trillion. Compared to the value of US commercial fisheries—$5.6 billion in 2018—seabed mining could be orders of magnitude more profitable.

As part of its coercive economic diplomacy, China has selectively complicated foreign supply chains through export restrictions on rare earth metals. Long a recognized strength for China, former leader Deng Xiaoping stated in 1992, "The Middle East has oil. China has rare earths," and his assessment has only continued to bear out to today. The communist nation currently supplies 95% of the global rare earths output and has used its virtual monopoly as a thinly-veiled economic weapon

during diplomatic disputes with Japan, South Korea, and the Philippines in the last decade. The US imports up to 80% of its rare earths from China. Those resources feed into critical defense systems like guided missiles, lasers, and fighters like the F-35 Lightning II, which requires up to 920 pounds of rare earths during the production of each aircraft. The F-35 is currently in use or on order by fifteen countries that are currently European or Indo-Pacific partners or allies of the United States. Expanding beyond the single aircraft system, deliberately reduced rare earth exports could threaten each of these nation's military modernizations. Whether for profit or supply chain preservation, America and its allies will likely look to the seabed to help meet these demands.

WHY THE COAST GUARD?

Seabed mining requires a coordinated surface support infrastructure akin to hydrocarbon exploration and extraction, which is an oversight role the Coast Guard knows well. Robot tractors, unmanned underwater vehicles (UUVs), and other seafloor collectors will mine from seamounts or collect nodules deep below, feeding those resources up through a flexible riser pipe for refinement and processing, while a return pipe feeds the non-desired sediment and waste back to the seafloor. Barges and bulk carriers will then receive the collected seabed resources from the production support vessel and transfer them back to a port of call for further use. Additional remotely-operated vehicles (ROVs) will be launched from commercial ships on the surface to provide seabed surveillance, conduct scientific research, and monitor environmental impacts as part of the broader operation.

Just like the Coast Guard's presence missions for domestic fisheries, cutters will represent US mining interests within and beyond the nation's exclusive economic zone (EEZ), though some national rights to seabed resources reach out to the extended continental shelf (ECS). As the Vision to Combat Illegal, Unregulated, or Unlawful (IUU) Fishing states:

The U.S. Coast Guard has been the lead agency in the United States for at-sea enforcement of living marine resource laws for more than 150 years. As the only agency with the infrastructure and authority to project a law enforcement presence throughout the 3.36 million square mile U.S. EEZ and in key areas of the high seas, the U.S. Coast Guard is uniquely positioned to combat IUU fishing and uphold the rule of law at sea.

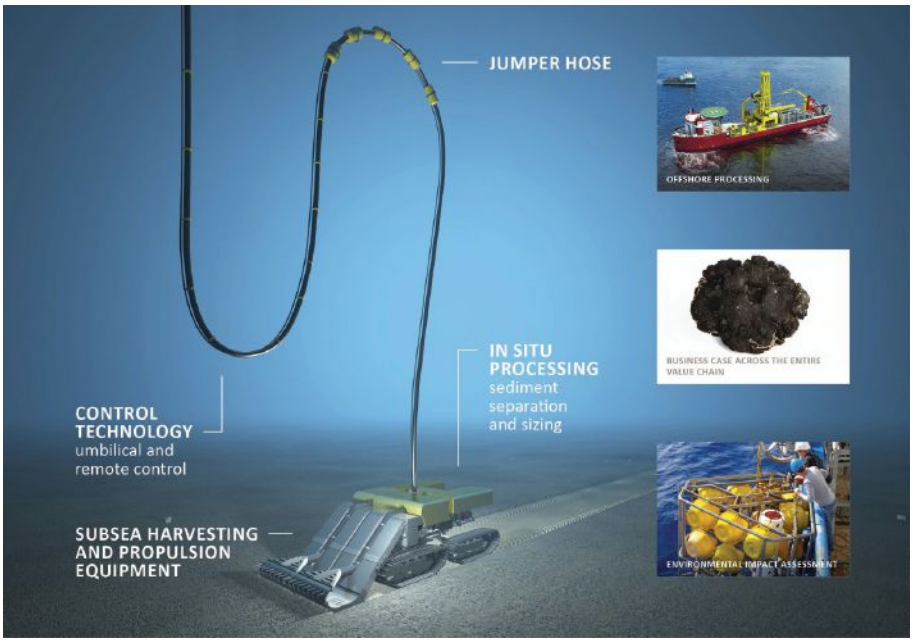
While seabed resources are not living, domestic and international law similarly govern their extraction— and mining will require the same sort of maritime regulation. American domestic justification follows from the 1980 Deep Seabed Hard Mineral Resource Act (DSHMRA), which claimed the right of the US to mine the seabed in international waters, and specifically identifies the Coast Guard as responsible for enforcement.

INTERNATIONAL LAW AND ENGAGEMENT

Internationally, the Coast Guard will face the same problem the US Navy does with its freedom of navigation operations in places like the South China Sea. Through the presence of its surface vessels, the services seek to reinforce the United Nations Convention on the Law of the Sea (UNCLOS) as reflecting customary international law, while the US is not itself a party to the treaty. The US Senate has thus far avoided treaty ratification to avoid potentially surrendering sovereignty around seabed mining regulation to the International Seabed Authority (ISA), based in Kingston, Jamaica.

Formed in 1994, the organization retains responsibility under the United Nations for administering "The Area," of the seabed beyond any nation's EEZ. Because the US is a non-party state to UNCLOS and an observer, vice member, of the ISA, US companies must either pursue mining operations through another sponsor state under the ISA regime or operate outside the ISA's purview based on US domestic law interpreted within the framework of UNCLOS. These complications are not the Coast Guard's fault, nor is the service responsible to necessarily fix them. But given the intersection of maritime law enforcement, commercial resource extraction, and the desire for non-military engagement, the Coast Guard is far better suited than the US Navy in a "seabed maritime presence" role.

The seabed is likely the next domain for competition over a "free and open Indo-Pacific," and a "rules-based international order." Among the most challenging in a future seabed competition would be China and Russia, states that have already used lawfare in the South China Sea and Arctic regions respectively to pursue their territorial gains. The two great powers may



» *Seabed mining requires a coordinated seabed to surface support infrastructure. (Image credit: Blue Nodules)*

» *Unmanned underwater vehicles (UUVs) and other seafloor collectors, like GSR's Patania II, will collect nodules from the deep. (Photo credit: GSR)*

use the same playbook in the deep sea both in practice and through the ISA. The ISA has authorized 30 total contracts for exploration in The Area, and 16 are within the Clarion-Clipperton Zone (CCZ). The CCZ is a vast plain spanning over 3,000 miles of the central Pacific Ocean southeast of Hawaii which contains a vast supply of polymetallic nodules. Two separate Chinese and Russian companies have each received 15-year contracts from the ISA for 75,000 square kilometer areas for future exploration, in addition to areas on the Southwest Indian Ridge and Western Pacific for China specifically. No nation has yet indicated a serious move to begin commercial exploitation in The Area, but as the technology matures, China may seek to extend its rare earths monopoly and start mining throughout the Indo-Pacific.

While the US has claimed four tracks within the CCZ under its domestic law, it too has not yet begun commercial exploration. Yet there are numerous opportunities for theater engagement and for ensuring seabed mining practices are in accordance with international regulations. The Coast Guard's enduring support to allies and partners for fisheries enforcement should naturally be mirrored to the seabed—particularly for Pacific nations. Many of the same island nations and territories working on IUU fishing are evaluating deep-sea mining ventures to stimulate their economies within their EEZs and out into the CCZ.

The Pacific island nations Nauru, Papua New Guinea, Tonga, Fiji, Vanuatu, the Solomon Islands, and the Cook Islands all have active seabed licenses to explore within their EEZs. For US allies and partners, six of the top nine largest national EEZs are western or democratic nations, with a total area larger than the continent of Asia. This presents a vast potential bounty for seabed mining. With its long history working with international coastal forces, the Coast Guard remains the most capable service to demonstrate American commitment to a rules-based international order across various future seabed mining ventures.

PRESERVING THE SEABED ENVIRONMENT

The Coast Guard's responsibility to support and enforce proper seabed mining will also be a natural outgrowth of its other enduring missions to support scientific research and environmental protection. As it has done with polar icebreaker missions, the Coast Guard routinely explores new domains with scientists and experts on board. The seabed requires further study, as a mere 20% of the global ocean has been mapped at better than a kilometer grid resolution, and the previous administration specifically directed the White House's Ocean Policy Committee to develop a strategy to map the remaining 60% of unmapped American EEZ. From what has been mapped, the seabed's biodiversity is immense. Of the estimated 0.01% of the explored area of the CCZ, scientists have collected more than 1,000 animal species, of which 90% are believed to be new or undescribed. This tally does not account for over 100,000 potential microbe species. The Coast Guard can both support this research from its cutters and support its enduring statutory mission of Environmental Protection as well.

Early studies have proposed immense risks to seabed environments from mining. Habitat loss, sediment smothering of seabed animals following resource processing, and issues of light, noise, or other vibrations are all significant concerns for unique resources and animals which have evolved over millions of years. If calls for an international moratorium on mining are ultimately ignored, the US should not leave China or Russia to shape the best practices for seabed mining. The US Coast Guard can be present and use its cutters or even onboard UUVs to monitor that mining practices are in accord with any standing international agreements to best preserve the environment.

A DEEP FUTURE FOR THE COAST GUARD

The Coast Guard has time to critically analyze its role in future seabed mining ventures but must consider the development of new service capabilities and build interagency bridges. Force structure assessments could partner with the Navy on multiple capability areas. UUVs operating at various depths could serve ongoing submarine force objectives while supporting Coast Guard mining monitoring requirements. If the Coast Guard determined it needed a larger platform for sustained presence and multi-helo or UUV deployment at a mining site, the Expeditionary Staging Base (ESB) could serve as a cheaper, known option from which to iterate. Regardless of platform, operations in the CCZ or broader Pacific would present a taxing operational requirement, given its distance from Hawaii and the necessary logistics train, compared to the service's more common littoral missions.

To meet this demand signal, civilian policymakers must ensure that any profits associated with domestic commercial seabed mining would be taxed with a sufficient funding line to support the shipbuilding, logistics, command and control, and research and development in support of the Coast Guard seabed presence mission.

The Coast Guard must also strive to build its interagency relationships around seabed mining. The service is already a member of the State Department's Extended Continental Shelf (ECS) Task Force, an inter-agency government body that already focuses on seabed issues. But the ECS Task Force is primarily focused on identifying the limits of the US Continental Shelf through geological survey and legal analysis; projections of national seabed mining objectives must go further. Beyond the interagency and joint force, the Coast Guard should liaise with academia, non-governmental and international organizations, and the private sector to contextualize the service's future role. Each will have their initiatives and interests, but collectively they will better prepare the Coast Guard to engage with the seabed.

The Coast Guard has yet to be tasked to support presence, international maritime law enforcement, scientific research, or environmental protection with respect to seabed mining. Yet it has done those same types of missions on the surface for hundreds of years. While the commercial industry is developing its technologies and processes, the Coast Guard should project its role into the deep domain given its historic missions and requirements. Challenges abound, from international economic drivers to future science and environmental research. Working collaboratively, the Coast Guard can lead a network of partners to strengthen economic and maritime security around seabed mining, thereby promoting the rules-based international order and a free and open Indo-Pacific. Looking forward, the Coast Guard must look deeper to win on the seabed and in the future.

Lieutenant Kyle Cregge is a surface warfare officer. He served on a destroyer, cruiser, and aircraft carrier as an air defense liaison officer. He was selected by Carrier Strike Group 9 for the 2019 Junior Officer Award for Excellence in Tactics. He currently is a master's degree candidate at the University of California San Diego's School of Global Policy and Strategy.

» *The US Coast Guard can use its at-sea resources to monitor that mining practices are in accord with any standing international agreements to best preserve the environment. (Photo credit: U.S. Coast Guard)*

CIMSEC

COMMODITY MARKET VOLATILITY SPARKS FEAR OF WINTER DESPAIR

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

Crude Oil:

The accompanying chart highlights recent crude oil price volatility and how prices have climbed to levels not seen in years. This raises a question: Will prices stay at this high level, or is this merely transitory? The concept of transitory is very popular, as economists, bankers, and politicians debate whether exploding consumer prices, with their burden on family, business, and government budgets, is temporary or will last for much longer. Yes, rising consumer prices are partially driven by higher gasoline and diesel prices, but they are also being driven by more expensive electricity due to soaring natural gas and coal prices. Moreover, higher energy prices are imbedded in the cost of the food and products we buy, and the services we use. Currently, energy is an inflationary force in our economies. Thus, what happens to crude oil prices will impact future global inflation.

Why are oil prices rising? Demand in 2021 is rebounding in concert with the pandemic-depressed economy of 2020. Greater demand is running up against limited oil supply growth, resulting in higher prices. OPEC+ has elected to retain its plan for modest monthly oil supply additions into 2022. The producer group is adhering to this plan out of fear of adding too much supply just as economies weaken from another wave of COVID-19 cases and economic lockdowns. The result is a tight oil supply/demand balance and high prices.

United States oil supply growth has been constrained by environmental, social and governance (ESG) concerns that have caused bankers and shareholders to demand producers live within their cash flows and return any excess funds to investors. This newly embraced financial discipline has caused producers to abandon their traditional response to higher oil prices: Drill baby, drill! With a slowly rising drilling rig count, U.S. oil supply growth is constrained. Producers are also hampered by a federal government pursing an anti-fossil fuel agenda. This agenda limits access to federal lands for drilling and imposes activity-harming regulations, resulting in restricted output and higher costs.

The current world energy crisis emerged from last year's colder winter that drained global gas inventories amid rebounding energy demand. Soaring natural gas and coal prices have driven several Asian countries to switch to burning cheaper oil, further adding to global oil demand. These switches have come despite global oil prices climbing above $80 per barrel.

How high might oil prices go? Speculators have been piling into oil futures contracts expecting oil prices will climb to the $100 per barrel range. Several prominent financial firms are forecasting such a price next year. However, there are concerns that high oil, gas and coal prices will cause world economies to slow. A recession in our future? Possibly. People and economies always adjust to higher or lower energy prices. They will again if current high energy prices are sustained. The under-investment in energy – oil, gas, and coal—for the past decade will limit future supply growth. Therefore, energy demand will determine global energy prices. With renewable energy proving incapable of meeting global power needs, we likely are looking at a new multi-year commodity cycle that will make energy an attractive sector for investment and employment.

Natural Gas:

Volatility has been the watchword for natural gas this year. Futures prices recently exceeded $6 per thousand cubic feet. The adjacent chart shows near-month natural gas futures prices for September through October 26. As the chart shows, gas prices started at $4.61/Mcf but merely eight days later crossed the $5 marker for the first time in years. Prices remained above $5 through September 20 before dipping lower. On October 5 the gas price soared above $6, only to fall below $5/Mcf less than two weeks later. By October 25th, prices were again flirting with $6.

Why the price volatility? It was all about weekly gas storage injections and weather forecasts. As the chart showing the status of gas storage volumes demonstrates, at the beginning of September, the gap between this year's storage and the 5-year average inventory was wide, as we headed into the final weeks of the gas injection season. Given the short time to refill storage, traders reacted to every colder or warmer winter weather forecast by bidding up or selling gas futures contracts.

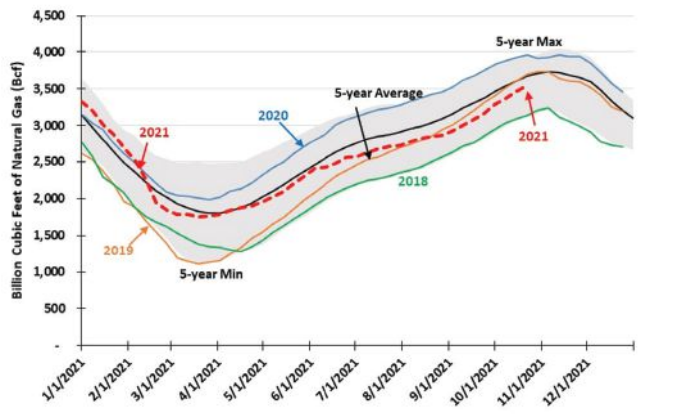
The gas market did what was needed to coax more supply for storage—it ultimately raised prices. The result was that between early September and late October, the shortfall between current storage and last year's volume shrank by 200 billion cubic feet, a one-third reduction. The storage gap with the 5-year average volume declined from 235 to only 126 Bcf, with several weeks remaining before winter arrives.

The upcoming U.S. winter forecast offers a mixed bag for energy demand. Parts of the country are projected to experience warmer and drier conditions for December through February, while elsewhere is expected to see colder and wetter weather. Winter weather forecasts are influenced by meteorologists' views of the possibility that La Niña weather conditions might develop in the South Pacific Ocean. This uncertainty reduces confidence in the winter forecasts, adding further confusion to projected gas storage needs.

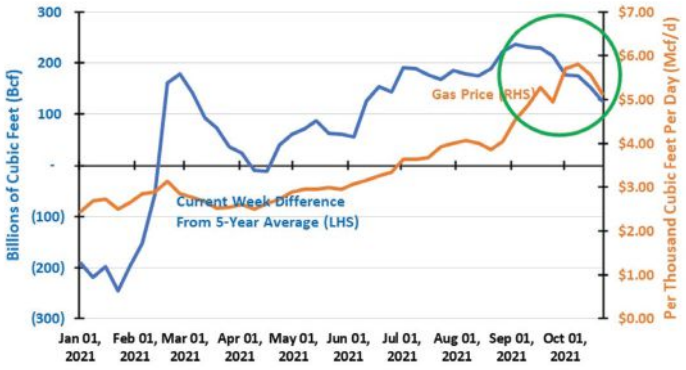
Natural gas prices will remain volatile. Uncertainty over gas production, LNG exports, domestic demand, international gas prices, global economic activity, winter weather, and geopolitical considerations will drive this volatility. Predicting gas prices is impossible. Expecting volatility is certain.

Recent Oil Prices And How High They May Go

Storage Still Below 5-Year Average Boosting Prices



How Gas Prices Reacted To Shrinking Shortfall
From 5-Year Average Storage Volumes



Natural Gas Prices:
Two Steps Forward; One Step Back In A Raising Market



AMERICAS

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

AUVSI XPONENTIAL
Orlando, FL » April 25-28, 2022
https://www.auvsi.org/events/xponential/auvsi-xponential-2022

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

Offshore Technology Conference (OTC)
Houston, TX » May 2-5, 2022
https://2022.otcnet.org/

US Floating Wind
San Francisco, CA » June 7-8, 2022
https://reutersevents.com/events/offshore-wind/content-san-francisco.php

H2O Conference
Halifax, Nova Scotia » June 14-16, 2022
https://www.h2oconference.ca/

EUROPE

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

SPE Offshore Europe
Aberdeen, Scotland » February 1-4, 2022
https://www.offshore-europe.co.uk/

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

Offshore Pipeline Technology Conference
Amsterdam, The Netherlands » February 28 - March 2, 2022
https://informaconnect.com/offshore-pipeline-technology/

WindEurope
Bilbao, Spain » April 5-7, 2022
https://windeurope.org/annual2022

MCE Deepwater Development
London, UK » April 12-14, 2022
https://mcedd.com/

OTHER REGIONS

OCEANS Chennai
Chennai, India » February 21-24, 2022
https://chennai22.oceansconference.org/

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

Telecoms World Middle East
Dubai » May 24-25, 2022
https://www.terrapinn.com/conference/telecoms-world-middle-east/index.stm

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

Submarine Networks World
Singapore » September 7-8, 2022
https://www.terrapinn.com/conference/submarine-networks-world/index.stm

Oceanology International Middle East
Abu Dhabi » September 18-20, 2022
www.oceanologyinternationalmiddleeast.com

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

💻 Digital Issue

FUGRO BOOSTS LABORATORY CAPACITY BY 50% TO MEET INDUSTRY DEMANDS

Fugro's advanced geotechnical testing laboratory capacity is set to increase by over 50% across Europe and America by the end of 2021. This development across three key laboratories—Wallingford, Houston and Brussels—will significantly reduce the turnaround time of test Geo-data and ensure a rapid response to the growing demands of the energy and infrastructure sectors.

All laboratories feature newly customized equipment that has been designed in collaboration with suppliers, allowing Fugro to offer project-specific and research-level testing on a commercial scale. The total expansion includes over 100 cyclic and static simple shear and triaxial testing devices to ensure representative results across all soil types, including stiff clays, sand and soft rocks. A third of these devices are capable of measuring soil small strain stiffness parameters, which are critical for offshore wind farm foundation design.

Amin Rismanchian, Fugro's Global Director of Geotechnical Laboratory Services, said: "Our laboratories provide unprecedented capability for advanced geotechnical testing worldwide, answering the call from clients for increased testing capacity. We're not just receiving and analyzing samples; with this investment in people, equipment and technology, we're providing an all-in-one solution for clients that delivers high-quality testing results on time and within budget to reduce project risks."

The laboratories have similar scopes of accreditation, quality management systems and procedures, guaranteeing harmonized and reproducible results throughout the regions.

» *Dr Arsène Mango, laboratory engineer at Fugro, sets up a cyclic triaxial test to measure critical soil parameters for offshore wind farm foundation design. (Photo credit: Fugro)*

OSI APPOINTS PERRY WRIGHT VICE PRESIDENT AND GENERAL MANAGER

Ocean Specialists, Inc. (OSI), a global provider of specialized subsea technical services and marine operations, recently announced the appointment of Perry Wright to the position of Vice President and General Manager. Mr. Wright's immediate focus will be to build upon OSI's 20-year track record of delivering over 200 international projects for clients in the telecom and offshore energy markets by extending OSI's engineering and project management capabilities to several new key target sectors in the ocean industries.

The announcement is in line with OSI's continued strategic growth enabling OSI to offer an integrated approach to marine operations and custom subsea engineering.

"We are delighted to announce the appointment of Perry to the position of Vice President and General Manager of OSI," said OSI President Jim Byous. "Over the past 12 years, Perry has played a foundational role in many of OSI's most important projects and has led by example in terms of delivering technical expertise and disciplined project management to OSI partners and customers alike. We look forward to Perry's leadership as OSI moves into new markets and technical developments in the coming years."

Perry joined OSI in 2009 and has a proven track record of developing long-term relationships with global oil and gas and telecom operators. Perry's management specifically focused on the design, planning, installation, and delivery of critical subsea infrastructure, in particular submarine fiber optic networks, resulting in additional value for the owner. His new role, based out of OSI's global headquarters in Stuart, FL, will see him manage a growing number of multi-stakeholders, cross-border initiatives designed to field turnkey solutions for more complex subsea products and services.

Speaking of his appointment, Mr. Wright commented: "This is an exciting time for the team at OSI as we look to galvanize a fully integrated approach to subsea engineering, fabrication, and deployment services, offering our customers a turnkey solution. OSI's experience of working on major subsea technology and installation projects over the past two decades has enabled the company to accrue a unique technical skillset, one focused on developing reliable, discreet and purpose-driven responses for fast-evolving requirements of at-sea operations."

» *Perry Wright, Vice President & General Manager*

OSI
Ocean Specialists Inc.

PROSEP WINS BEST TECHNOLOGY WITH ITS INNOVATIVE MIXER TECHNOLOGY

ProSep, a global environmentally friendly solutions provider, was the recent recipient of the prestigious title of Best Gas Processing/LNG Technology at this year's Hydrocarbon Processing awards for its innovative Annular Injection Mixer (AIM).

Hydrocarbon Processing is a globally recognized technical publication for the downstream sector, one of which petroleum refining, gas processing, petrochemical/chemical and engineer/constructor companies have turned to for high quality technical and operating information and each year its awards highlight the best technology developments in the industry.

Established in 2005, ProSep has continued to build on innovative solutions to assist global industries lower their chemical and water consumption, clean their water, and reduce their Greenhouse gas emissions footprint. The revised and proprietary AIM design was the brainchild of John Sabey, CTO and Terry Lou, Senior Process Engineer based on dynamic feedback from a consortium of blue-chip clients. The concept to commercial deployment of this design was achieved in less than 18 months with the help of computational fluid dynamic (CFD) studies. The demand for this design continues to grow with several enquiries from Asia Pacific and Americas currently in progress.

John Sabey, ProSep's CTO, said: "We were extremely proud to be named as a finalist in the awards so to have now walked away a winner we are beyond grateful for. This reaffirms our commitment to helping the global industry value chain use less harmful chemicals, save water, and clean water.

"Our technologies offer clients sustainable solutions, which align with their strategic objectives and we have a proven track record having installed more than 200 high-efficiency mixers globally, saving thousands of tonnes of GHG emissions, and we continue to work with some of the world's largest companies and operators, providing them with a rapid Return on Investment (ROI)."

» *ProSep's CTO, John Sabey*

HELIX ENERGY SOLUTIONS PARTNERS WITH TRENDSETTER ENGINEERING

Helix Energy Solutions Group, Inc. has joined Trendsetter Engineering, Inc. in a global partnership to provide integrated hydraulic intervention services for subsea wells and flowlines.

The new partnership will integrate Trendsetter's 15,0000psi Subsea Tree Injection Manifold (15K STIM) and experienced personnel into Helix's state-of-the-art fleet of well intervention vessels and equipment used to perform well services globally. Helix's well intervention vessels include the *Q4000*, the *Q5000*, the *Q7000*, the *Seawell*, the *Well Enhancer*, and two chartered monohull vessels, the *Siem Helix 1* and the *Siem Helix 2*.

TRANSOCEAN SETS 40% REDUCTION TARGET FOR GREEN-HOUSE GAS EMISSIONS INTENSITY BY 2030

Transocean Ltd. has committed to reducing operating Scope 1 and Scope 2 greenhouse gas emissions intensity by 40% from 2019 levels by 2030.

This critical initiative is consistent with the technical leadership that Transocean has demonstrated over the years. Indeed, the company has proactively implemented numerous innovations to improve the performance of its rigs, and enhance safety, reliability, operational execution, and efficiency. Importantly, Transocean will achieve the reduced emissions intensity target without diminishing its record of safety and operational integrity.

"Globally, almost one billion people lack access to electricity, and all of us desire reliable and affordable sources of energy that help improve our daily lives. As such, we believe that demand for hydrocarbons and, therefore, for Transocean's assets and services, will remain strong," said Transocean President and Chief Executive Officer, Jeremy Thigpen. "Our responsibility as the industry leader extends beyond providing superior results for our customers. We must continue to deliver our services in a manner that minimizes our impact to the environment and, in this context, supports the interests of all our stakeholders, including employees, customers, investors, and for the broader public good.

"Currently, nearly all energy used to power Transocean's global fleet of high-capability drilling rigs is generated through the conversion of diesel fuel to electricity. Therefore, we commit to reduce emissions across our fleet through fuel reductions and other initiatives that can be achieved by developing and implementing new processes and technologies that enable us to optimize our power management capabilities."

Transocean is also committed to utilizing its assets and expertise in support of its customers' lower-carbon energy projects including, potentially, carbon capture and sequestration.

Transocean

OKEANUS SCIENCE & TECHNOLOGY APPOINTS ENGINEERING MANAGER

Okeanus Science & Technology, LLC (Okeanus), an established provider of marine equipment and engineering services, recently announced the appointment of Justin Tyra to the position of Engineering Manager.

In this newly created role, Mr. Tyra will be responsible for the overall operational performance of the firm's design and engineering division, with a particular focus on leveraging Okeanus' reputation for delivering industry-leading turnkey equipment to drive increased awareness and efficiency of Okeanus' customized product development services.

Tyra, an industry veteran, brings over 17 years' hands-on design, engineering, and operational management experience to Okeanus, over a decade of which was spent as a lead subsea engineer for various offshore operators.

"We are thrilled to bring Justin aboard to lead Okeanus' engineering team through this exciting period of company growth," said Okeanus COO Don Brockett. "Our commitment to innovation and continuous product improvement requires a talented engineering staff with strong leadership, and we are sure that Justin's unique skillset and rich industry experience will help propel us toward our goals."

Speaking of the announcement, Mr. Tyra added: "I am very much looking forward to working with this team of talented engineers and contributing to the Okeanus' continued growth and success in this the fast paced, ever evolving industry."

» *Justin Tyra*

OCEAN BUSINESS 2021 REUNITES THE OCEAN TECH INDUSTRY

Ocean Business 2021, which took place on the quayside of the National Oceanography Centre in Southampton, welcomed thousands of delegates from 52 countries from 12-14 October. Visitors were there to meet with over 250 of the world's leading ocean science and technology manufacturers and service providers, demoing their latest equipment and services—all helping to explore, monitor and survey the ocean.

James Williams, Director, Unmanned Survey Solutions said: "Ocean Business is the most important show in our calendar. It offers the right mix of workshops, training, presentations, and one-to-one business opportunities. It's great to be back!"

Ocean Business' Event Director, Cheri Arvonio, commented: "To have been able to deliver a successful show after the 18 months we've all had is a huge achievement for the Diversified team. The amazing feedback from both exhibitors and visitors so far has made all of our efforts worthwhile and we couldn't be more appreciative of the support from the industry."

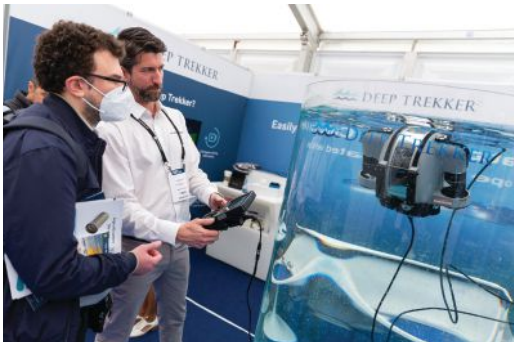
In true Ocean Business style, the dockside waters had a constant fleet of ocean robots displaying their capabilities and payloads. Maritime Robotics in collaboration with Kongsberg Maritime, Norbit and Teledyne Marine had 3 of their Otter-Pro USV's out on the water, Nortek showcased their new Nortek Fusion DVL1000 from their hospitality suite and Sonardyne were demoing their new Sprint-Nav Mini and Ranger 2 USBL onboard the University of Southampton and HydroSurv USV's.

David Brown, Head of Marketing at Sonardyne International states: "Live events underpin our lead generation and business intelligence gathering activities, so after 20 months without one, I can't recall a more eagerly anticipated show than this year's OB. And it didn't disappoint. With busy and buzzing exhibition stands and aisles, it was in every sense 'business as normal' and we look forward to being back in 2023."

Ocean Business exceeded expectations when it came to networking and co-located events. A brand new free-to-attend keynote programme, with talks that covered hot topics in the industry including sustainability and new innovations, welcomed David Boyne Aitken, CEO/Managing Director, Maricuda Special Projects Ltd (Renewable Energy) saying: "Ocean Business is an event to see the latest innovations, re-connect with suppliers and network, and a great opportunity to get an overview of our industry and its future."

Ocean Careers once again proved a valuable opportunity for students seeking a career in marine technologies, with presentations from industry trailblazers and one-to-one sessions providing the chance to explore careers in detail.

The next Ocean Business will place on 18-20 April, 2023. For more details, visit: *www.oceanbusiness.com*.



SeaState

THE ON&T PODCAST

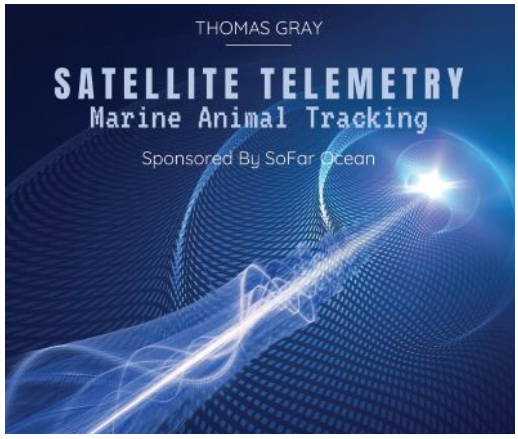
SEASON 2 / EPISODE 10

SATELLITE TELEMETRY – MARINE ANIMAL TRACKING

In this month's podcast we talk to Thomas Gray about Satellite Telemetry and Marine Animal Tracking.

Thomas joined the Environmental Monitoring team at the Woods Hole Group (WHGRP) in early 2016 where is currently responsible for business development with satellite telemetry systems (Argos and Iridium) primarily for wildlife and oceanographic applications.

Before joining the team at the WHGRP he worked for an underwater electronics manufacturer, Desert Star Systems where he helped design, market, and sell underwater technologies, such as tracking systems, acoustic releases, and Argos satellite tags.



» *Thomas Gray*

AQUATERRA ENERGY SECURES $4.4 MILLION CONDUCTOR TENSIONING CONTRACT

Aquaterra Energy has been awarded a $4.4 million contract with BW Energy to provide procurement, engineering, manufacture, installation, and commissioning support of multiple conductor tensioning units for the repurposing of the Hibiscus Alpha jack-up rig to an offshore installation (OI), located offshore Gabon, West Africa.

Aquaterra Energy will provide its new digital tensioning monitoring system, which will remotely monitor the tension applied via an app. The technology will monitor the tension being exerted on each riser, sending real-time data about the tension tolerance to BW Energy engineers off and onshore. Reduced human error and instant alerting create major safety improvements, while the long-term benefit of the data will enable operators to monitor asset fatigue over time, resulting in safer and more cost-efficient operations.

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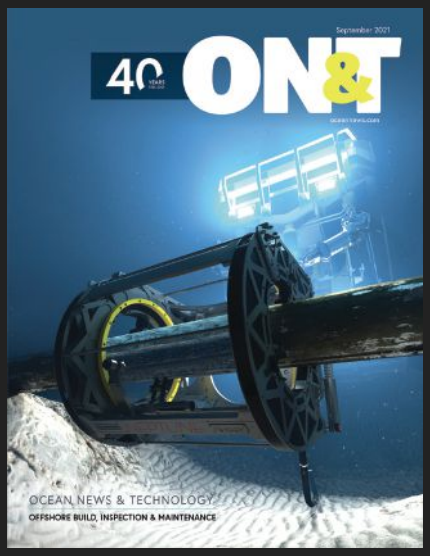

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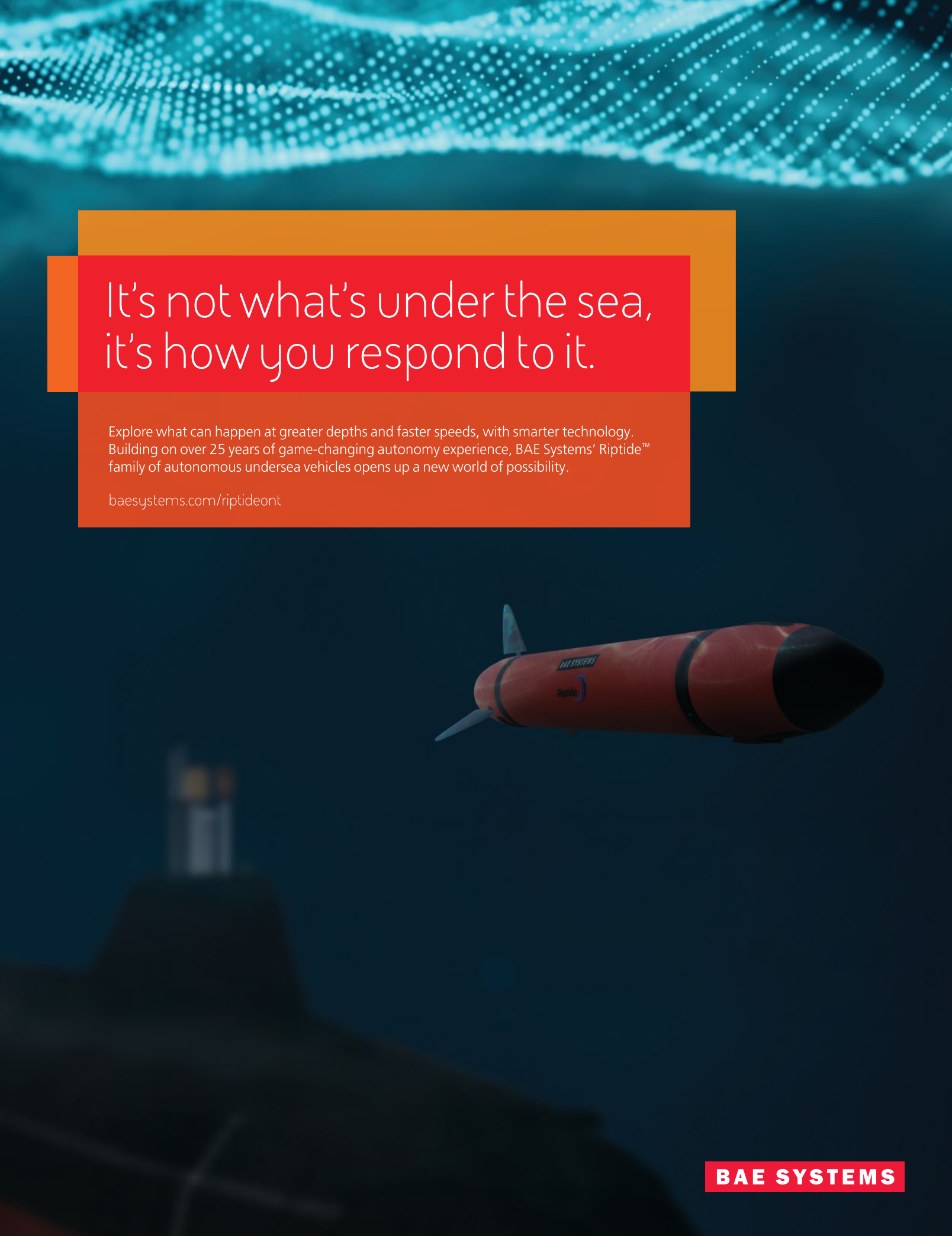

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