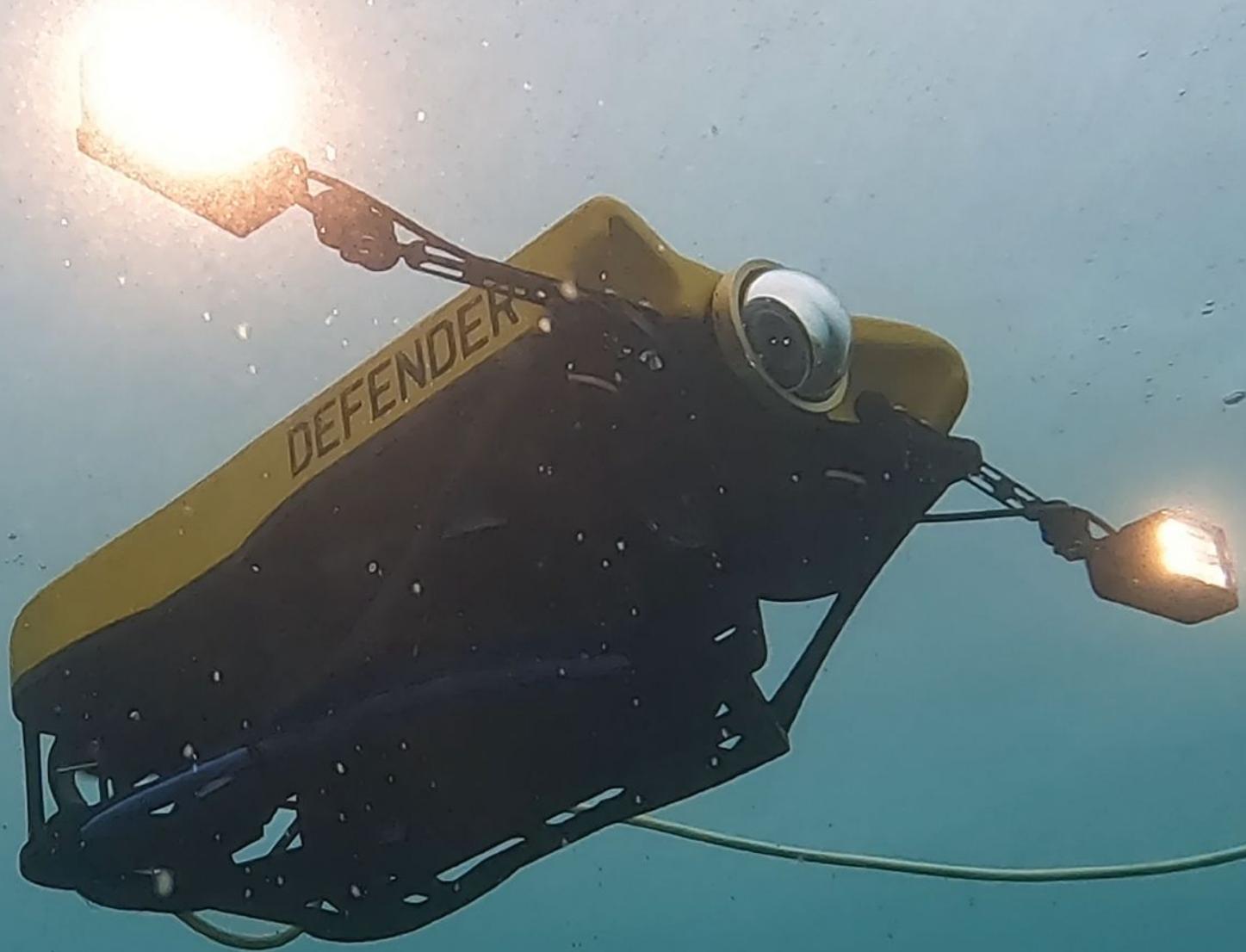


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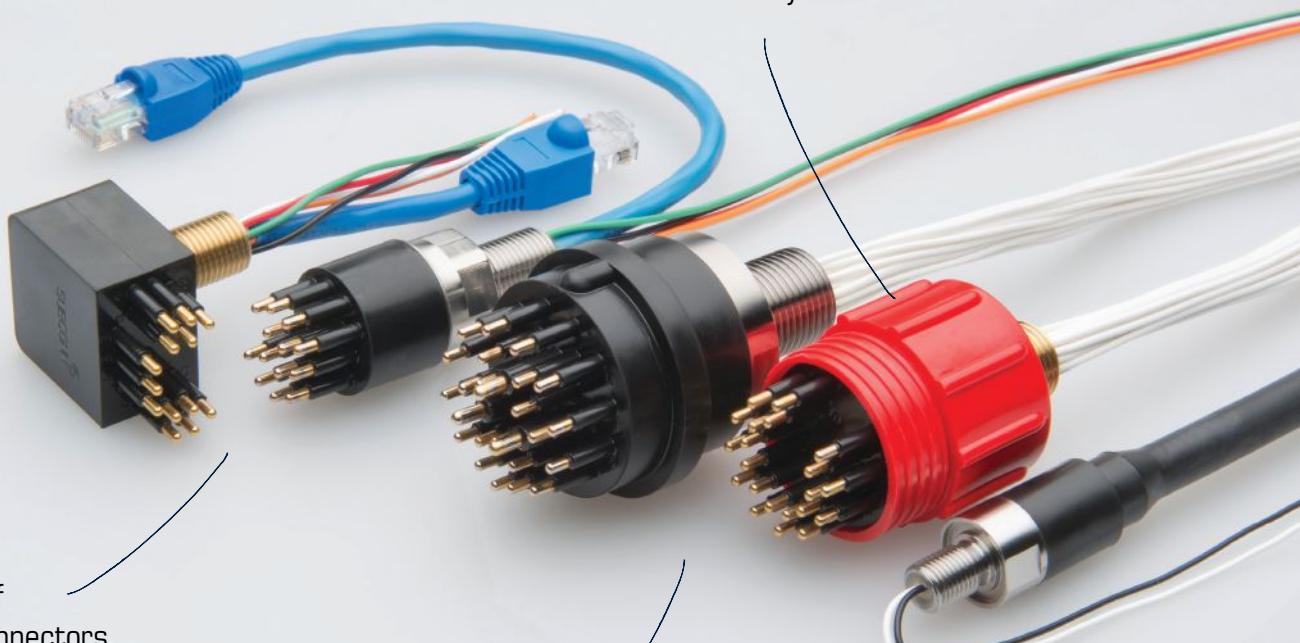


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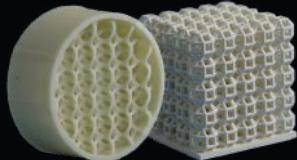
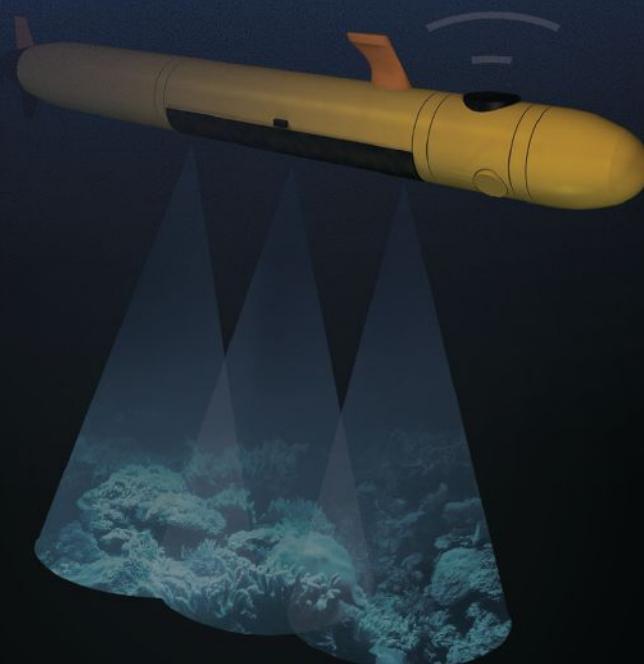


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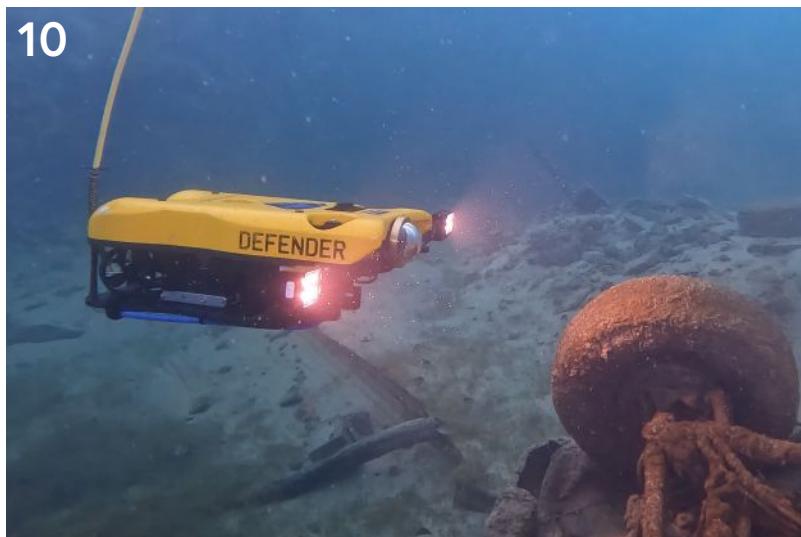


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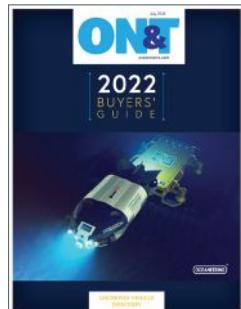
[WITH THANKS - Ed.]

This month we dive into the world of underwater sensor technology and imaging, taking our pointers from some of the leading developers and exponents of subsea innovation. Our thanks go to Voyis, Water Linked, NV5 Geospatial, Hydromea, and EGS.

Next up, in July, is ON&T's Uncrewed Vehicles Buyers' Guide (UVBG 2023), the ocean industry's one-stop-shop for ROVs, AUVs, USVs, gliders, crawlers, and towed vehicles.

Don't miss out on the last few advertising spots!

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ON THE COVER:

An ROV vision system without compromise: Voyis' Discovery Vision System leverages edge computing to capture low-latency, enhanced piloting video and high-quality image data. (Image credit: Voyis)

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KADESHA DSILVA

SeaState ON&T Podcast

seastate@oceannews.com

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Technology Systems Corporation

ADVERTISING SALES

LISA CHILIK

Tel: 574-261-4215

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ROBOTIC TECHNOLOGIES: GETTING WIND OF OPPORTUNITY

**By Josh Broussard**

Chief Technology Officer



Five seabed leases were granted at the end of 2022 by the Bureau of Ocean Energy Management (BOEM), representing the first-ever offshore wind lease sale on the US west coast and the first-ever US sale to support commercial-scale floating offshore wind.

Many offshore wind developers, like Equinor—which secured a 2 GW lease in the Morro Bay area offshore California—believe that up to two-thirds of America's offshore wind energy potential is in deep waters, which is what makes the Pacific seaboard, where the relatively narrow continental shelf rapidly drops to depths of 3,000 to 4,000 m, such an exciting prospect.

Buoyant Investment

And while floating wind installation costs are currently thought to be about five times those of fixed bottom wind farms, DNV has suggested that tech-led advancements are set to bring down the leveled cost of energy (LCOE) to below \$100/MW by 2025 and under \$40/MWh by 2050.

As a long-term investment, therefore, the appeal of floating offshore wind arguably overshadows that of traditional fixed wind farms, where prime locations (suitable water depths, seabed conditions, weather patterns, etc.) are not only limited in number but are also dogged by the challenges associated with heavy-duty seabed installation and the accompanying logistical hurdles. Floating installations, by contrast, can be constructed in port and towed to their location without too much disruption.

However, the deeper waters do require a different approach to site surveys. The North Sea, for example, has an average depth of 90 m and is, therefore, mapable by 'traditional' towed arrays to an acceptable level of detail for most windfarm pre-construction survey campaigns. At the depths found off the US west coast, autonomous underwater vehicles (AUVs) offer a more accurate and efficient means of data acquisition.

Fleet Expansion

Ocean Infinity's AUV fleet—comprising fourteen 6,000 m rated Kongsberg Hugin with a further six 3,000 m rated models in production—is primed to

support the exploration of suitable floating wind sites. The AUVs host a broad-spectrum geophysical sensor package including two types of side scan sonar, multibeam sub-bottom profilers, magnetometer, digital imaging system, and in some cases, a laser profiler. High-endurance batteries enable underwater missions of up to four days and power additional environmental, temperature, and depth sensors.

Operating at 6,000 m, this represents a unique sub-sea proposition—a USP, if you will—for underwater data analytics and is further complemented by our line-up of remotely operated vehicles (ROVs), hybrid AUV/ROVs, and autonomous surface vessels (ASVs).

Remote Operations

At Ocean Infinity, we consider the ongoing integration of remote vessel operations and uncrewed technologies as instrumental to the growth of the offshore renewable energy market and believe that our Armada fleet—the 'motherships' to our expanding portfolio of autonomous assets—offers the right package in terms of operational capacity and environmental profile.

These 78-m vessels, eight in total, are designed from the keel up to be completely tech-enabled and fully compatible with the latest breakthroughs in fuel cell propulsion, low earth orbit satellite communications, AUV deployment systems, electric work class ROVs, seabed drills and back deck equipment. The first Armada 78 arrived in Norway in January 2023 after its maiden voyage from Vietnam, closely followed by a second.

The entire Ocean Infinity uncrewed ecosystem has been built with our Remote Control Centers (RCCs) in mind. The first one of these state-of-the-art facilities will officially commence live operations in Southampton, UK, in the summer of 2023, following a year-long cycle of testing.

The RCC enables, for the first time, operators to remotely operate multipurpose vehicles—lean crewed or completely uncrewed—from anywhere in the world, in a range of maritime jurisdictions, to undertake complex tasks above and below the waterline via the latest communication technologies.



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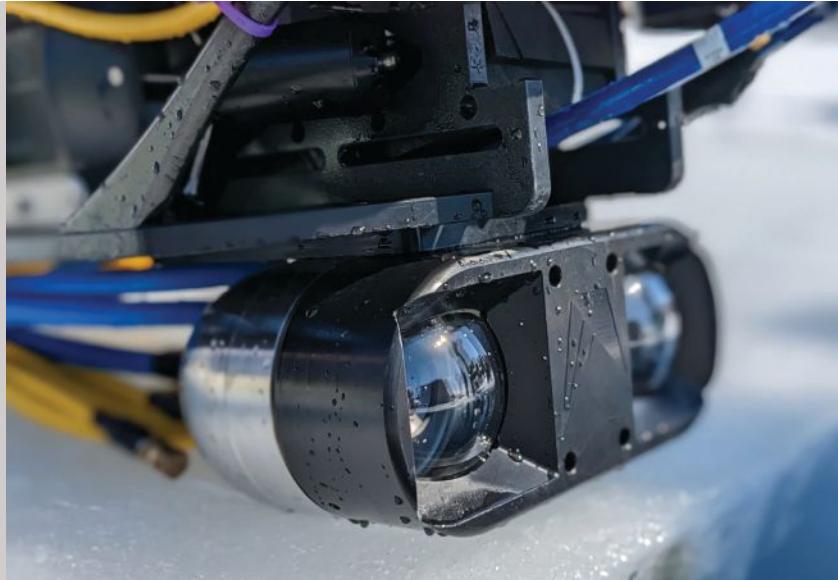
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A NEW ERA FOR ROV IMAGING



By Chris Gilson
CEO
VOYIS 



» *Discovery Stereo integrated with Inspection Class ROV. (Image credit: Voyis)*

The ocean is an enigmatic and uncharted realm that has long fascinated humanity. The emergence of autonomous underwater vehicles presents the opportunity to gain new insights and groundbreaking discoveries in this vast region, but getting there is just the first step. One of the core challenges is effective underwater vision, the ability of the subsea platform to perceive its surroundings.

Recent years have seen an increase in underwater exploration. From the RMS *Titanic* to Shackleton's *Endurance*, advances in Work Class ROVs and the popularity of small ROVs have made these endeavors attainable. However, camera technology for interacting with the surroundings has not kept pace. Two-dimen-

» *3D Model generated with data collected with Voyis Discovery Camera. (Image credits: Voyis)*

sional video streams with limited resolution remain the norm.

Cutting-edge vision systems can improve piloting and inspection effectiveness by enhancing situational awareness and spatial perception. Voyis' Discovery Vision System addresses the challenges of underwater vision head-on. The goal is to overcome the trade-off between piloting and 3D inspection cameras.

Discovery is a platform without compromise, leveraging edge computing to capture low-latency, enhanced piloting video and high-quality still image data for 3D machine vision. Voyis offers two versions: The Discovery Camera and the Discovery Stereo.

THE TRADE-OFF: STILLS OR VIDEO

An ROV survey operation requires a low-latency video stream for effective vehicle piloting, but conventional video cameras do not capture the high-quality stills images that are needed for 3D reconstruction. Conversely, inspection cameras capture stills images, but typically at a lower frame rate and higher latency than required for piloting. This trade-off is caused by limitations in the camera's computing architecture that prevent the recording of both compressed video and the original raw image frames.

A video camera acquires image frames at

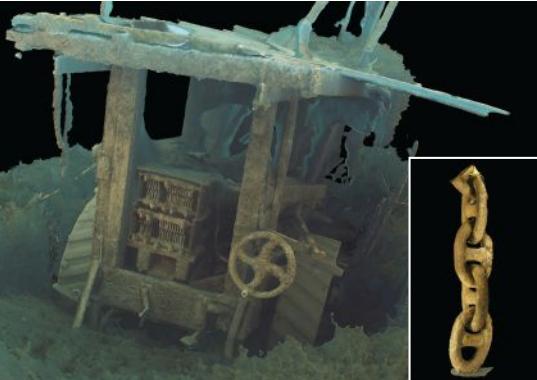
around 25 FPS, which are encoded into a video stream. The process of video encoding introduces artifacts that render the data ineffective for 3D modeling. Furthermore, each video frame typically uses long shutter speeds to overcome limited sensor sensitivity and low power lighting. To capture a target in motion shutter speeds must be sufficiently low to ensure the target does not move during the exposure.

To address this complex problem, the Discovery camera utilizes an approach that Voyis calls "Stills Driven Video." By utilizing machine vision cameras and a powerful onboard computing module, this trade-off between great video and images can be eliminated. Stills images are captured at 25 FPS with short exposure times, enhanced with edge-computing, and encoded to a low latency video stream. Then instead of discarding the original images, they are time tagged and saved for 3D reconstruction.

DESIGNED FOR MACHINE VISION

The core purpose of the Discovery platform is to enable effective underwater machine vision by acquiring the best possible input data. It seeks to address two core issues that limit standard cameras, a lack of depth of field and limited dynamic range.

Depth of field is the ability of the camera to focus simultaneously on near and far elements, producing a sharp image at both distances. Since 3D inspection cameras



must be calibrated to generate undistorted images, they must have a fixed focus to maintain this state. With this goal in mind, the Discovery camera employs a large glass dome, and a specialized 4K lens, to ensure that focus is maintained across the operating range.

Dynamic range is the ability of a camera to resolve both bright and dark targets simultaneously. This is critical in subsea surveys because the light that travels to the corners of the image undergoes more absorption across the longer distance, producing poor illumination at the edges of the field of view. Machine vision algorithms must utilize the entire field of view to effectively track and identify image features. To overcome this, a sensor was chosen that captures 12-bit HDR raw images, providing an extended dynamic range that can be utilized by edge-computing for lossless light leveling. Synchronized high power Nova Mini lights provide 125,000 lumens, either in short strobes or continuously on, which further improves the operating range and feature detection capabilities of the vision system.

These features ensure the pilot, and machine vision algorithms, can effectively utilize the entire ultra-wide 130°x130° field of view for situational awareness and tracking.

SITUATION & DEPTH PERCEPTION

The Discovery Stereo brings true depth perception and real-time 3D modeling to ROV platforms, while still maintaining a wide 75°x75° field of view and low latency video stream for piloting. This product employs a pair of calibrated cameras in a deep rated housing to deliver real-time, scaled 3D point clouds.

Images are accurately captured from both cameras simultaneously, with edge-computing enhancing, correcting, and analyzing the images to calculate 3D data in real time. A stereo point cloud is generated using feature matches between a pair of images at a single point in time and single perspective. It can be displayed in a real-time rotatable 3D video stream to observe the changing scene and visualize the build-up of data as the operator "paints" the structure during the survey. This provides quantitative insight to the survey team, as well as real-time quality control

on the survey coverage.

In addition to providing critical depth perception to ROV pilots, it also can help enable autonomous capabilities on newer robotic platforms. Since these depth maps can directly model the position of the vehicle and its manipulator relative to the target in real-time, it provides the needed feedback for manipulator autonomy, station keeping, or feature based navigation.

These point clouds are then refined and combined in post-processing to produce a complete and accurate colorized reconstruction of the underwater environment. The result has millimetric accuracy, delivering the potential to revolutionize methodologies for many underwater inspection applications.

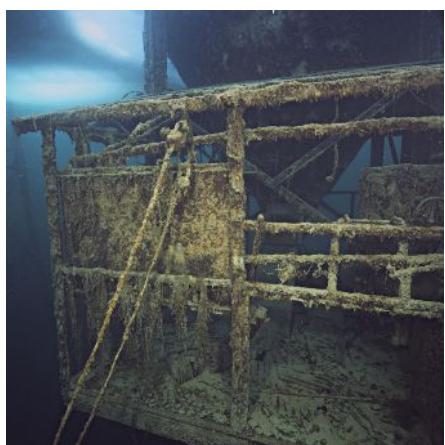
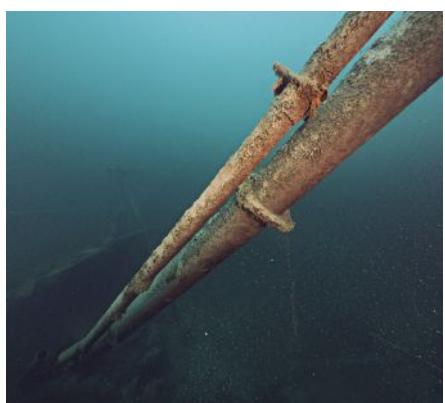
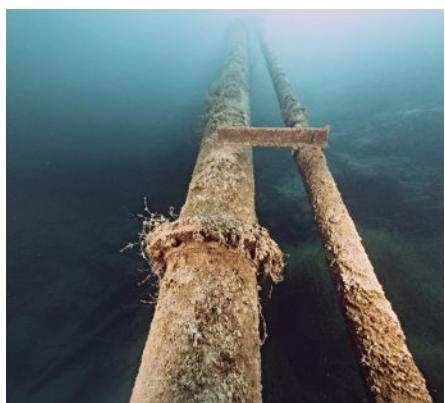
SIMPLIFIED INTEGRATION

The Data Distribution Service (DDS) standard defines a data centric architecture where data is the primary and permanent asset. The Discovery is the first underwater camera product that fully supports the DDS architecture, both externally and internally, using its onboard edge computing hardware. When combined with its ROS2 interface, the platform supports simplified and reliable sensor integrations by vehicle manufacturers.

The result is open communication of all product data streams to unlimited endpoints, a significant step forward in how sensors will enable autonomy. By connecting the Discovery camera to the vehicle network, it will broadcast specific data topics, such as Video, Raw Images, Corrected Stills Images, IMU Data, and Depth Maps, enabling any computer on the platform to access the live data and control the product.

The culmination of these innovations in vision system technology has made it possible for ROV operators to explore our oceans with complete situational awareness, real-time 3D data, and an improved visual experience. It is by deeply understanding these core challenges, both the scientific and practical considerations, that Voyis can push the limits of underwater vision and provide a robust solution for operators navigate their environments and enable future autonomy.

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



» Stills images captured with Discovery Camera. (Image credits: Voyis)

SONARDYNE UPGRADES INDIA'S NATIONAL TSUNAMI DETECTION NETWORK



» A Bottom Pressure Recorder (BPR) being prepared for deployment in the Indian Ocean. (Image credit: Sonardyne)

A network of deep-water acoustic sensors that provides India's coastal communities with an early warning of tsunami waves is being upgraded by marine technology company Sonardyne to extend both their endurance and capability.

Deployed at key locations in the Bay of Bengal and the Arabian Sea, the network of Sonardyne's Bottom Pressure Recorders (BPRs) is owned and operated by India's National Institute of Ocean Technology (NIOT) as part of the country's Tsunami Early Warning System (TEWS).

The BPRs were first installed in 2007, as part of NIOT's national tsunami detection system, which was conceived following the deadly Boxing Day Tsunami of 2004.

The BPRs detect the characteristic changes in water pressure (as little as 1 cm in 4,000 m depth) caused by an earthquake in the deep ocean. If a tsunami wave is detected, an alert message is transmitted up to a satellite buoy on the surface. From there, it is relayed to the national Tsunami Warning Centre onshore for comparison with recent seismic activity. If validated, a widespread alarm is raised to alert vulnerable communities.

» NIOT staff on a recent training visit to Sonardyne Headquarters as part of their ongoing support package. (Image credit: Sonardyne)

bandwidth by ten-fold (from 600 bps to 6,000 bps).

The first batch of upgraded BPRs arrived in India in 2022, with further batches planned for shipment in 2023. In addition, Sonardyne is also supplying a large pool of spares to maintain a continuously available TEWS capability. These include floats and fittings for the larger Maxi BPRs being supplied, as well as transceivers for the surface buoys to communicate with the BPRs. NIOT are planning to use the upgraded capability to extend the number of permanently occupied stations.

Each BPR is a customized version of Sonardyne's Compatt transponder—a versatile subsea instrument that has a wide range of autonomous monitoring and measuring applications within offshore energy, survey, and ocean science.

Sonardyne's BPRs benefit from being small and self-contained, with no cables, exterior sensors or batteries to interface, making them easy to deploy and more reliable. These features, alongside long battery life, reliable through-water communications and Sonardyne's expertise in long-endurance underwater monitoring applications, are the reasons why they were chosen for the Indian Ocean Tsunami Detection System back in 2007 and continue to protect their coastal communities 16 years later.



NOAA PREDICTS A NEAR-NORMAL 2023 ATLANTIC HURRICANE SEASON

NOAA forecasters with the Climate Prediction Center, a division of the National Weather Service, predict near-normal hurricane activity in the Atlantic this year. NOAA's outlook for the 2023 Atlantic hurricane season, which runs from June 1 to November 30, predicts a 40% chance of a near-normal season, a 30% chance of an above-normal season and a 30% chance of a below-normal season.

NOAA is forecasting a range of 12 to 17 total named storms (winds of 39 mph or higher). Of those, 5 to 9 could become hurricanes (winds of 74 mph or higher), including 1 to 4 major hurricanes (category 3, 4 or 5; with winds of 111 mph or higher). NOAA has a 70% confidence in these ranges.

The upcoming Atlantic hurricane season is expected to be less active than recent years, due to competing factors—some that suppress storm development and some that fuel it—driving this year's overall forecast for a near-normal season.

After three hurricane seasons with La Niña present, NOAA scientists predict a high potential for El Niño to develop this summer, which can suppress Atlantic hurricane activity. El Niño's potential influence on storm development could be offset by favorable conditions local to the tropical Atlantic Basin. Those conditions include the potential for an above-normal west African monsoon, which produces African easterly waves and seeds some of the stronger and longer-lived Atlantic storms, and warmer-than-normal sea surface temperatures in the tropical Atlantic Ocean and Caribbean Sea which creates more energy to fuel storm development. These factors are part of the longer-term variability in

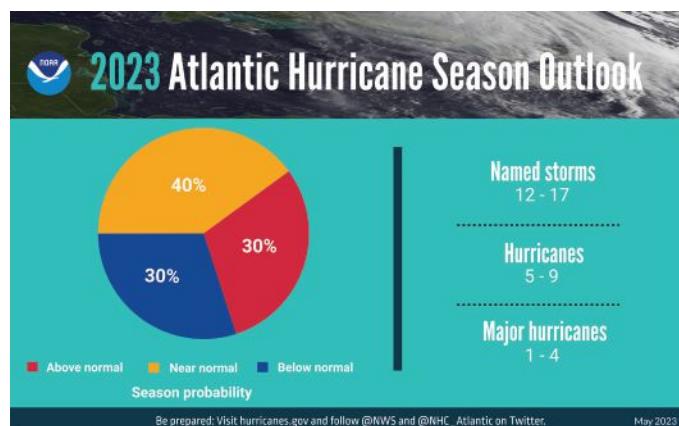


» NOAA GOES satellite captures Hurricane Ian as it made landfall on the barrier island of Cayo Costa in southwest Florida on September 28, 2022.

Atlantic atmospheric and oceanic conditions that are conducive to hurricane development—known as the high-activity era for Atlantic hurricanes—which have been producing more active Atlantic hurricane seasons since 1995.

This summer, NOAA will implement a series of upgrades and improvements. NOAA will expand the capacity of its operational supercomputing system by 20% and continue improving new and current observing systems critical

in understanding and forecasting hurricanes, including new small aircraft drone systems, the deployment of additional Saildrones and underwater gliders, and WindBorne global sounding balloons.



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LUMA WIRELESS MODEMS CERTIFIED FOR UNPRECEDENTED DEPTH IN THE OCEAN

Swiss-based autonomous underwater robotics company, Hydromea, has achieved a groundbreaking validation for its underwater optical modems, LUMA X-UV, in Germany's Nautilus lab. With a remarkable certification at 1,200 bar of pressure, equivalent to depth of 12,000 m in the ocean, Hydromea's LUMA X-UV modems have surpassed previous limits.

The Mariana Trench, the deepest point on Earth measuring 10,994 m, has been an immensely challenging destination to explore due to extreme pressure reaching 1,100 bar. Very few expeditions have dared to venture to these depths, limited by the scarcity of suitable equipment. Recognizing this need, one of Hydromea's customers, preparing for the upcoming Mariana Trench expedition, requested the company to pressure-test their LUMA X-UV wireless optical modems.

Igor Martin, the CEO of Hydromea, said: "At Hydromea, we are committed to changing that narrative by developing technology that thrives in the harshest underwater environments. Our LUMA X products enable unparalleled high-bandwidth near-range wireless connectivity underwater, extending to the full depths of Earth's oceans. By doing so, we provide research teams and the offshore energy industry with new means to communicate with sensors and collect data at lightning speed."

Hydromea's groundbreaking achievement marks a significant leap forward in the exploration and connectivity of the underwater world. With their rugged and cutting-edge technology, the company continues to redefine the limits of oceanic exploration, paving the way for new discoveries and advancements in various industries.



» LUMA X-UV. (Image credit: Hydromea)

MARISCOPE AND REACH ROBOTICS SIGN COLLABORATION AGREEMENT FOR LATAM



» Mariscope ROVs, such as the Diavolo model, will integrate Reach Robotics' multifunctional robotic arms. (Image credit: Mariscope/Reach Robotics)

Mariscope and Reach Robotics have signed an exclusive representation agreement for the Chilean and Argentine markets. Given that both companies have always specialized in the development of innovative and individualized solutions, this cooperation will provide the national market with ROV and multifunctional arm sys-

tems adapted to meet local realities and demands.

The agreement between both companies aims to identify underwater applications that cannot currently be performed with existing equipment and technology on the market, and which are often carried out by divers or, in instances where they are too deep, simply cannot be carried out at all. One example is the collection of marine organisms for scientific studies that are at depths which cannot be reached by divers and must be collected with great precision and delicacy to ensure they arrive intact at the surface for further study.

Reach Robotics offers a Master Arm control system for its robotic arms, enabling the operator to intuitively maneuver the manipulator with unparalleled precision. In this way, recovery operations of, for example, naval artifacts become extremely efficient, reducing the time lost in frustrated attempts to hook and recover them.

For the local aquaculture industry, future applications include repairing nets, manipulating cavitation systems for controlled cleaning of the systems installed in marine harvesting sites, among many others.

German ROV manufacturer Mariscope has been operating in the South American market for 24 years.

4SUBSEA LAUNCHES NEW DIGITAL TOOL TO OPTIMIZE VESSEL OPERABILITY

4Subsea, a leading provider of digital technology and services, has secured its first contract for a new digital solution that enhances the operability of any weather dependent marine vessel operation.

Marine Operations DynOps utilizes 4Subsea's 4Insight® data sharing platform to support decision-making based on analytics and reduces operational inefficiencies. It enables ship operators to use vessel sensors, motion sensors and GPS data in conjunction with weather forecasts to accurately predict how a ship will react to the environment up to a week in advance.

Having secured a first contract win, the service is now set to be used by a major shipping operator in its operations on the Norwegian Continental Shelf to mitigate challenges posed by the region's harsh environments.

DynOps combines live vessel response data and weather forecasts with advanced analytics to predict vessel operability with high accuracy and support decision making. DynOps has been found to reduce waiting on weather for marine operations by up to 30%, vastly reducing cost and time.

Peter Jenkins, 4Subsea CEO, said: "By providing both onshore and offshore personnel with the ability to safely prepare for operations

up to a week in advance, companies can not only make significant savings on the cost of their campaigns, but also ensure that they are done in a timely fashion. The future of marine operations will see an increasing focus on sustainability, automation, and digitalization. For the offshore wind sector, it will soon help streamline the installation process and, looking further ahead, will also smoothen maintenance procedures when operational."



» DynOps reduces time waiting on weather for marine operations by up to 30%. (Image credit: 4Subsea)

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REDEFINING UNDERWATER PERCEPTION: TEN YEARS AND JUST GETTING STARTED



By Scott McLay

Chief Commercial Officer – Navigation

WaterLinked

In 2013, a visionary named Torgeir Trøite established a revolutionary company in Trondheim, Norway, called Water Linked. Driven by a desire to disrupt the underwater industry, Water Linked set forth on a journey of innovation and invention, seeking to transform the sector with its product designs and the application of affordable technology. As the company responded to the market's demands, the dedicated team at Water Linked utilized their exclusive technology to develop solutions to substantially influence the burgeoning underwater market.

The company's first significant leap came with the unveiling of the Underwater GPS (UGPS) at the Oceanology International North America event in San Diego in 2017. This compact, Short BaseLine (SBL) acoustic positioning system was unique in its ability to precisely pinpoint the absolute

location of an underwater vehicle without the need for additional sensor inputs.

Packed into an affordable unit, the UGPS brought true disruptive innovation to the market, leading to a strategic alliance with Blue Robotics. This partnership, alongside collaborations with esteemed entities like Deep Trekker, greatly assisted Water Linked in the development and success of their pioneering underwater navigation offerings.

DVL INNOVATION

Fueled by the overwhelming success of the UGPS, Water Linked pursued an ambitious goal to cater to the industry's need for a versatile velocity log. In 2020, Water Linked introduced the A50 Doppler Velocity Log (DVL), a product designed to be suitable for vehicles with a limited payload capacity, without compromising on performance.

Engineered for meticulous navigation, the DVL is a pivotal piece of sonar technology. Its primary function lies in measuring the speed and direction of vehicles operating underwater, however it's also suitable for use by vehicles navigating on the water surface.

In environments where GPS signals are either unreliable or entirely absent, which is certainly the case underwater, the DVL emerges as a crucial navigational tool.



» Water Linked DVL A50, the world's smallest DVL. (Image credit: Water Linked)



» Water Linked CageSense™, wireless smart sensor. (Image credit: Water Linked)

The principle on which a DVL operates is rooted in the analysis of time differences between the emission of acoustic signals and their ensuing echoes. In this way, the DVL can determine the Doppler shift—a frequency alteration stemming from the relative motion between the signal-emitting transducer and the reflecting surface. This Doppler data facilitates pinpoint navigation and broadens the horizon for the automatic control of the vehicle, lending to precise maneuverability and improved efficiency.

Amplifying its usefulness, the DVL's exact measurement capabilities make it indispensable across a broad spectrum of applications. These include underwater research, marine exploration, and the operation of autonomous underwater vehicles (AUVs) and subsea robotics. Through its provision of exact speed and direction data, the DVL optimizes vehicle control and promotes a higher rate of mission success. In essence, the DVL constitutes an integral component in the exploration and understanding of our underwater world.



» Water Linked DVLs are designed to integrate with most ROVs, such as Blue ROV 2. (Image credit: Blue Robotics)

SUPPORTING MICRO AUVs

The launch of the DVL A50 exceeded industry expectations. It was a significantly smaller option than other DVLs in the market without compromising its capabilities. This development expanded the scope for smaller underwater vehicles, allowing them to take on roles previously exclusive to larger machines. Furthermore, the DVL A50 was crucial in developing micro autonomous underwater vehicles (AUVs) as its integration with the Inertial Navigation Systems dramatically improved their long-term position accuracy.

With unprecedented short-range capability, the Water Linked DVL is able to continue to operate at a range of only 5 cm, marking another milestone in the Water Linked innovative journey. This exceptional short-range capability enables the DVL to function even when a vehicle is in direct contact with the seabed, or when conducting intricate tasks like hull cleaning at close range. This level of versatility significantly broadened the realms of underwater exploration and applications.



Even though most micro vehicle manufacturers were satisfied with a DVL that had a depth rating of 300 m (600 m version also available) and a 50 m acoustic range, Water Linked continued to push boundaries by introducing the larger DVL A125. With an acoustic range of 125 m and the ability to operate at water depths of up to 3,000 m, the DVL A125 further diversified the scope of underwater operations.

WIRELESS MONITORING

In the summer of 2020, Water Linked achievements attracted the attention of major investors like Equinor and Investinor. This influx of external funding provided Water Linked with the financial stability required to bolster sales, fulfill customer demands, and propel research and development initiatives, including the development of aquaculture-specific products.

As a result, earlier this year, Water Linked proudly introduced CageSense™, a wireless environmental monitoring solution explicitly crafted for the fish farming industry. This state-of-the-art product enables fish farmers to increase productivity, enhance sustainability, and mitigate health and safety risks, thereby heralding a new era of smart sensor-based environmental monitoring systems.

Continual advancements are being made in the creation of products tailored for aquaculture. Interestingly, there is an increasing convergence between these innovations in

» The DVL-A50 is optimized for single-man portable AUVs. (Image credit: Seaber)

aquaculture related products and the products required to satisfy the needs of the navigation market.

Following two years of significant growth and exceeding expectations, Equinor and Investinor have considerably increased their investment, demonstrating their unwavering support for the ambitious product development strategy underway at Water Linked.

FUTURE UNDERWATER PERCEPTION

As Water Linked works towards the launch of a key new product later this year, one set to redefine underwater perception, it stays true to its mission of "redefining underwater perception." The company continues to challenge established beliefs and shape attitudes about what is truly achievable in underwater operations.

Although Water Linked has only been operating for a decade, it has achieved extraordinary feats. Driven by their steadfast commitment to innovation and disruptive technology, the company has left an indelible mark on the underwater industry. With an undying determination to push the boundaries of the possible, Water Linked existing success story promises to unfold even more captivating chapters in the future.

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

INMARSAT PUBLISHES DECARBONIZATION TOOLKIT FOR THE MARITIME INDUSTRY

Inmarsat Maritime, a Viasat business, and a world leader in global mobile satellite communications, has published its Decarbonization Toolkit, which outlines a practical blueprint for decarbonization in the maritime industry.

Compiled by maritime innovation consultancy Thetius, the report uses real life examples to set out a framework across three domains of energy transition: *Operation, Ship and Human Element*.

At the operational level, voyage optimization is a particularly effective means of decarbonization. In September 2022, Scandinavian shipping company Wallenius Wilhelmsen announced its intention to adopt an AI-based voyage optimization system across its 120-vessel fleet. The announcement followed the company's 18-month trial of a performance-routing solution that yielded a 6.9% increase in vessel efficiency, equating to a projected 170,000-tonne carbon dioxide equivalent (CO₂e) reduction in emissions with a fleet-wide roll-out.

Alongside voyage optimization, collaboration and data sharing could play a key role in lowering emissions. In February 2023, KCC Chartering and integrated energy company Raízen signed a three-year contract of affreightment targeting more energy-efficient operations through improved charterer-cargo owner com-



munications and data exchange. By minimizing legs in ballast and improving the efficiency of loading and discharge processes, the partnership is expected to result in a 40% reduction in the carbon intensity of its agreement.

Under *Ship*, other methods include port-call optimization and green corridor schemes, while tools available for decarbonizing the vessel itself include carbon capture and storage, optimized hull design, energy-saving coatings and devices, wind propulsion, future fuels and connectivity and data-exchange infrastructure.

For example, in the first quarter of 2023, ship management company Eastern Pacific announced the successful installation of carbon capture and filtering technology on board the chemical tanker *Pacific Cobalt*. Installed in the ship's stack, the system will capture up to 40% of the vessel's carbon dioxide emissions, filtering out sulphur and particulate matter from the exhaust gases.

The *Human Element*, meanwhile, relies on behavioral economics and change management in addition to skilled decarbonization teams. According to the report, crews should be trained in the new technology and processes that enable greener shipping operations, and they must be willing to embrace the changes that the maritime energy transition entails.

Ben Palmer, President, Inmarsat Maritime, said: "The key to a successful decarbonization strategy lies in implementing a practical, data-backed plan for the application of solutions that support greener, more efficient shipping companies today and for decades to come. As a long-standing technology partner to the international maritime industry, Inmarsat remains committed to supporting businesses in overcoming their challenges, seizing their opportunities, and achieving their decarbonization goals."

Matthew Kenney, Principal Research Consultant, Thetius, added: "It is overly simplistic to think of decarbonization as a compliance issue alone. Companies that have made proactive moves to seize the opportunities of decarbonization are already seeing return on their investments. Carbon footprints are being reduced at the voyage, vessel and fleet level, and fuel costs, time and effort are being saved as a result. This report examines some of these achievements and maps out a practical blueprint to success."

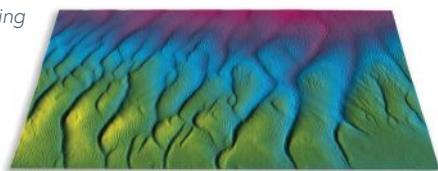
NEW SOFTWARE FOR AI-POWERED BATHYMETRIC DATA

Hydroacoustic technology specialist GeoAcoustics has released GS4 software v1.0.25 for GeoSwath bathymetric sonars, adding several upgrades including an Artificial Intelligence data processing system developed in collaboration with the University of East Anglia.

The new AI processing augments the existing automated filtering in the GS4 software by removing surplus and undesired data autonomously; during acquisition, the system is designed to log clean data, without any user intervention in the cleaning process, enabling better operational agility and decision support, while cutting the time to final data in post-processing.

GS4 software v1.0.25 adds further operational improvements including Survey Accuracy indication, and an auto mode for side scan data processing.

» Seafloor map showing sand waves created using AI-analyzed GeoSwath 4 data.
(Image credit: GeoAcoustics)



EXTERIOR CONSTRUCTION OF NEW RESEARCH VESSEL TAANI COMPLETED

The first of three new oceanographic research vessels dedicated to advancing marine science along US coasts was successfully launched in late May.

The ship, R/V *Taani*, is being constructed as part of a project, led by Oregon State University and funded by the US National Science Foundation, to provide scientists with valuable new tools to study critical issues such as rapidly changing ocean conditions and human impacts on the marine environment.

The Regional Class Research Vessel project, supported by more than \$390 million in grants, is charged with delivering three nearly identical ships to the US Academic Research Fleet. The ships are being built by Bollinger Shipyards in Houma, Louisiana with construction staggered about six months between each vessel. *Taani* will be operated by Oregon State University and based in Newport on the Oregon Coast.

The launch was led by Bollinger—which worked with LaShip, a subsidiary of Edison Chouest Offshore—and concludes the major exterior construction on the vessel. The shipbuilders will now complete wiring and finish installing equipment and other construction tasks; carry out weeks of operational testing; and conduct sea trials to ensure the vessel is ready for its mission.

The name *Taani*, a word used by the Siletz people meaning offshore, was chosen to recognize Oregon's Indigenous peoples and continues a university tradition of tying names of research vessels to regional Tribes and languages.



» R/V *Taani*. (Image credit: Oregon State University)

The second vessel, the R/V *Narragansett Dawn*, will be operated by the East Coast Oceanographic Consortium led by the University of Rhode Island. The third vessel, the R/V *Gilbert R. Mason*, will be based in the Gulf of Mexico. It will be managed by the Gulf-Caribbean Oceanographic Consortium, led by the Louisiana Universities Marine Consortium and the University of Southern Mississippi.

The 200-foot ships are unique, with new technologies and other features to enhance operational capabilities, improve safety and expand ocean-based research. Each ship is designed to operate with 13 crew and up to 20 scientists for missions extending up to three weeks at sea.

Construction of *Taani* is expected to be completed at some point in 2024.

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TGS TO LAUNCH WIND AND METOCEAN CAMPAIGN TO SUPPORT OFFSHORE WIND IN NORWAY

TGS, a global provider of energy data and intelligence, has announced the start of Norway's first-ever LiDAR buoy measurement campaign to support offshore wind development.

The campaign's first floating LiDAR buoy will be deployed in the Utsira-Nord zone and conduct wind, metocean, and environmental measurements to enhance decision-making for the three floating wind project areas to be awarded in Norway's first floating wind lease round.

TGS' multi-client approach, where multiple customers can subscribe to the same floating LiDAR data, provides a significant advantage for offshore wind developers by reducing development costs and timelines and providing a unique, early opportunity to minimize uncertainty in future energy generation.

The TGS buoy will deliver a comprehensive suite of data over a 12-month measurement campaign with the option to extend for an additional year. In addition to wind speed measurements, the data package includes critical metocean and environmental data such as significant wave heights, ocean current profiles, and acoustic monitoring of birds and bats.

Data will be continuously streamed, quality-controlled, and available to customers daily through the Wind AXIOM platform, TGS' comprehensive site evaluation and wind data analytics tool.

Wind AXIOM allows wind developers and stakeholders to constrain the most influential factors affecting the viability of offshore wind projects, improving the quality and speed of decisions.



» Floating LiDAR buoy. (Image credit: TGS)

PARTNERSHIP TO COMMERCIALIZE MARINE MAMMAL DETECTION AND CLASSIFICATION SYSTEM

SeaRobotics, CSA Ocean Sciences, and Woods Hole Oceanographic Institution (WHOI) have signed an MOU to collaborate on the commercialization of WHOI's infrared camera based marine mammal detection and classification technology.

WHOI's technology, developed under the leadership of Dr. Daniel Zitterbart, has been deployed on various vessels since 2009 to

help protect marine animals from being struck by ships by using thermal infrared (IR) cameras to monitor for the presence of whales in shipping lanes.

Installed on ships, the systems can automatically alert shipping captains to the presence of whales within a three kilometer (1.8 miles) radius to allow most vessels to slow down or change course. When

mounted high enough above sea level—such as on offshore wind turbines—these systems can detect whales at a distance of up to 10 kilometers (6.2 miles).

The ocean sector's transition toward safer, more efficient remote operations hinges on developing scalable automated technologies—hardware and software—to acquire, process, and validate real-time data and, in this case marine mammal monitoring, the professional training necessary to supervise and action certain interventions.

"The extensive data yielded by in-field testing of WHOI's marine mammal detection and classification system over the last decade serves as proof of concept for an automated system that safeguards marine mammals in increasingly busy waters; now it is a case of working with WHOI and CSA to better identify the precise applications across the broader ocean sector and, in doing so, frame a series of accessible product options to fit those specific requirements," said SeaRobotics President Don Darling.



ACUA OCEAN AND HYDROSURV ANNOUNCE MERGER



» HydroSurv's production facility. (Image credit: HydroSurv)

ACUA Ocean and HydroSurv, two UK-based companies specializing in maritime autonomous systems, have announced their intention to merge, combining extensive expertise in the development and operation of uncrewed surface vessels (USVs) and associated technologies for marine surveying and surveillance.

The new company, to be named Blue Ocean Autonomy, will deliver turnkey solutions across a broad spectrum of capabilities, covering the inland, nearshore, and offshore sectors.

David Hull, Founder and CEO of HydroSurv, said: "In an evolving market, customer demand is shifting towards a comprehensive solution for trusted and certified USV systems. In response to this trend, we are excited to announce the intent to merge our two companies with a shared focus on accelerating the availability of these solutions for widespread commercial use, expanding our market presence, and providing a better value offer to our customers."



» ACUA Ocean's hydrogen-powered H-USV.
(Image credit: ACUA Ocean)

Environmental Assessment Vessels (REAV) and ACUA Ocean's hydrogen-powered H-USV, being developed as part of the UK Department for Transport's flagship Clean Maritime Demonstration Competition (CMDC) program.

The merger will deliver a broad offering of both near-shore and long-endurance vessels, from 2.8 m to 13.5 m, for ocean data collection, hydrographic, geophysical, and environmental survey, and surveillance and monitoring of critical offshore infrastructure.

Neil Tinmouth, Founder and CEO of ACUA Ocean, added: "Our emphasis has always been on what is best for our customers. This merger represents a natural progression of our vision and values with a company that is a strong cultural, as well as technological, fit. The new entity will undoubtedly be greater than the sum of its parts, establishing one of the most experienced and talented teams in marine autonomy."

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VINEYARD WIND ANNOUNCES INVESTMENT IN US-BASED BUBBLE CURTAIN SUPPLIER

Vineyard Wind has announced a pilot program to deploy and test a secondary bubble curtain during foundation installation through a partnership with ThayerMahan, a firm that specializes in seabed surveys, acoustic mitigation and monitoring, and other maritime related services, with facilities in Connecticut and Massachusetts. The \$5 million in funding comes from Vineyard Wind's Industry Accelerator Fund, which is administered by the Massachusetts Clean Energy Center (MassCEC).

As a part of the agreement, ThayerMahan will move its headquarters for their bubble curtain acoustic mitigation product line to New Bedford, sharing part of the Foss Marine Terminal.

"Our agreement with ThayerMahan ensures that for the first time, a US-based company will perform the service of providing a bubble curtain mitigation system for an offshore wind project," said Vineyard Wind CEO Klaus S. Moeller. "We believe this is the first step of getting US firms experience in this new industry and sets the stage for rapid expansion in the coming years, particularly in our hometown of New Bedford."

A bubble curtain, which is comprised of large, perforated hoses and specialized air compressors, is designed to absorb and dampen sound during foundation installation. The hoses are placed on the seafloor around the monopile before being filled by compress air. Once the hoses are inflated, the air escapes through the perforations and creates a barrier of bubbles that reduce noise.

These operations will be conducted from the *Northstar Navigator*, a vessel that will be operated out of the Port of New Bedford.

"We are proud to support Vineyard Wind in the construction of the United States' first large scale offshore wind development," said ThayerMahan Chairman and CEO Michael Connor. "We appreciate the support of Massachusetts Clean Energy Center in establishing a world class noise mitigation capability in New Bedford that will serve construction efforts throughout the region."

Vineyard Wind recently submitted its first annual report to the state compiled by UMass Dartmouth and Springline Research Group that found Vineyard Wind more than doubled early estimates for the number of jobs created and dollars invested.

An 800-megawatt project located 15 miles off the coast of Martha's Vineyard, Vineyard Wind will generate electricity for more than 400,000 homes and businesses in the Commonwealth of Massachusetts, create 3,600 Full Time Equivalent (FTE) job years, save customers \$1.4 billion over the first 20 years of operation, and is expected to reduce carbon emissions by more than 1.6 million metric tons per year, the equivalent of taking 325,000 cars off the road annually.



» The bubble curtain's large, perforated hoses and specialized air compressors are designed to absorb and dampen sound during foundation installation. (Image credit: Vineyard Wind)

TOTALENERGIES AND CO-VENTURERS SIGN PRODUCTION SHARING CONTRACT OFFSHORE BRAZIL

TotalEnergies and its co-venturers Petrobras, QatarEnergy, and PETRONAS Petróleo Brasil Ltda (PPBL) have signed a Production Sharing Contract (PSC) for the Agua Marinha block, which was awarded in the Open Acreage under Production Sharing Regime—1st Cycle held by Brazil's National Petroleum Agency (ANP) in December 2022.

Agua Marinha is a 1,300 km² exploration block located in the pre-salt Campos Basin south of the Marlim Sul field and about 140 km from shore. The work program includes drilling one firm exploration well during the exploration period.

"The signature of the PSC for Agua Marinha expands our presence in this promising area of the pre-salt Campos Basin, alongside our three strategic partners, and we are looking forward looking to exploring the block and drilling the Touro prospect," said Kevin McLachlan, Senior Vice President, Exploration of TotalEnergies.

"Offshore Brazil, with its material low-cost, low-emission resources is a core area for the Company. This block, along with the two South Santos basin concessions obtained in 2022, further reinforces our exploration portfolio in this high potential area."

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» R/V Shackelford is optimized for site development and cable surveys for offshore wind. (Image credit: NV5-Geodynamics)

| FEATURE |

NOT ALL BOATS ARE CREATED EQUAL FOR OFFSHORE WIND SURVEYING



By **Mike Conn**

Senior Director of Offshore Wind Services

NV5 GEOSPATIAL

Activity is heating up along the nation's coastlines as the Biden Administration seeks to meet its goal of deploying 30,000 MW of offshore wind energy by 2030. Yet before these projects can become reality, a range of nearshore and offshore surveys are needed to assess site suitability, environmental impacts, and ensure regulatory compliance.

Vessels typically being used today for offshore wind surveys are, in large part, not ideally suited for such diverse project requirements. They're often too big and expensive, or repurposed from other industries without the expertise to take on such sophisticated work. But a new class of vessel is emerging; ones that are purpose-built to handle the distinctive demands of these projects and deliver accurate data from the deep sea, where turbines are located, to the cable landings on the shoreline.

ADDRESSING SURVEY CHALLENGES

Accurate, timely surveys are the foundation for offshore wind deployments. But surveys are not without significant challenges:

- Varying water depth—The transition from shallow nearshore to deep water; underwater terrain that includes rocky areas, uneven sediment, and other obstacles; water turbidity and limited visibility require surveyors to adapt their methods and equipment.
- Remote locations—These present logistical challenges, including the time and expense to transport survey equipment and personnel.
- Marine wildlife and habitats—Working in these protected areas requires compliance with environmental regulations and assessment of potential impacts on marine wildlife, including migratory

routes, feeding grounds, and breeding areas.

- Long project lifecycles—Surveys are typically conducted at various stages, from site selection and feasibility studies to ongoing monitoring, which can make it tricky to maintain data continuity and consistency over extended periods of time.
- Cost and time—Comprehensive surveys can be costly and time-consuming because of the scale and complexity of the projects, which leaves project developers trying to balance the need to stay on time and on budget.

Because they are so complex, offshore wind projects require specialized boats and survey technology. But too often, the vessels being used are not purpose built to specifically address these unique needs.



» Helm set up for vessel navigation and systems monitoring, with two dedicated screens fed from the survey lab. (Image credit: NV5-Geodynamics)



» Morgan crane for dockside survey mobilization and gear recovery while at sea. (Image credit: NV5-Geodynamics)



» View of the large stern A-frame with twin hydraulic winches for sensor deployment, with sonar strut support tower between the winches. (Image credit: NV5-Geodynamics)

Currently many surveys are done with large vessels operated by European companies and manned by independent, contracted crews. This poses many problems. Use of these vessels is very expensive and their access to certain areas is limited by water depth and international maritime laws. Large, important swaths are left unsurveyed, requiring other entities to complete the work, which potentially introduces inconsistencies to the overall data set.

In other cases, vessels—such as old fishing trawlers, industrial barges, and cargo ships—are being repurposed and leased out to handle survey work, despite their lack of scientific background. These types of boats are not ideal for nearshore work since they must remain a certain depth above the sea floor for surveys. Plus retrofitting them with the mounts and various sensors needed for surveys without careful attention to offset measurements can result in inaccurate data. This will delay projects if the survey does not meet Bureau of Ocean Energy Management (BOEM) specifications.

RIGHT TOOLS FOR THE JOB

Offshore wind involves finding both a suitable siting location and a cabling route that travels to a shore-based landing area. The ability to conduct accurate, cost-effective surveys from deep sea to nearshore is a critical component to any successful project.

NV5-Geodynamics is a rare partner that can do both hydrographic and shallow water bathymetric lidar surveys. Rising to the challenge of meeting offshore wind developers' needs, Geodynamics' fleet includes state-of-the-art boats specially designed to survey all depths, from the deep sea to shore. And the company employs an American-based crew who has unmatched scientific expertise and understands the full capabilities of the vessels.

The NV5-Geodynamics team offers a blend of marine geology, coastal science, and remote sensing expertise unmatched in the industry.

The company also continues to invest in state-of-the-art survey technologies. The most recent is the *Shackleford*, a purpose-built vessel that takes a new approach to high-resolution surveys for offshore wind.

The 72.5-foot *Shackleford* is capable of supporting surveys at any depth. Designed on a semi-displacement catamaran hull, the vessel dampens wave action for improved survey conditions, while the hydrofoil design offers quick transit with a 21-knot cruise speed and a 24-knot top speed to and from survey sites. The interior supports numerous scientific and vessel crew safely for extended 12-hour and limited 24-hour operations. It houses five dedicated computer stations, two bunk rooms and a full galley.

To reduce survey mobilization costs, the *Shackleford* is outfitted with fully dedicated and redundant survey systems including:

- Multibeam sonar
- Sidescan sonar
- Sub-bottom sonar (parametric)
- Seismic profiling
- Magnetometer/gradiometer
- Sediment sampler
- Video/ROV inspection

Multibeam sonar is deployed through the retractable moonpool, while the other sensors are fixed mounted on the port and

» Central retractable strut designed around the Kongsberg EM2040 dual head sonar moonpool sensor deployment. (Image credit: NV5-Geodynamics)

starboard sides via USM mounting poles. Sensors can also be deployed from the large stern A-frame with twin hydraulic winches, which allow alternative and additional equipment to be easily integrated.

The *Shackleford* is the seventh vessel in NV5-Geodynamics' versatile owned and operated fleet, which also can also be utilized for telecommunications cable landing surveys, benthic habitat surveys and more. Other vessels include the *Bogue*, a 58-foot third generation Kvichak foil-assisted planning catamaran; and the *Substantial*, a 59-foot research vessel that bridges the gap between survey launches and extended offshore vessels; and nearshore survey vessels, *Benthos*, *Chinook*, *4 Points*, *Sounder*, and *Echo*.

To learn more about how NV5-Geodynamics can support accurate and cost-effective offshore wind surveys, contact Mike Conn at mike.conn@nv5.com or visit www.geodynamicsgroup.com.



JOHAN SVERDRUP FIELD PERFORMS CAPACITY TEST

During a capacity test at Johan Sverdrup, the field reached a record-high production level of 755,000 barrels of oil per day. This equals 6–7% of the daily European oil consumption.

"This process capacity test at Johan Sverdrup confirms technically very robust facilities and was safely performed with no unwanted incidents. This is an important milestone, and the result of systematic and targeted efforts," said Marianne Bjelland, VP Exploration and Production for Johan Sverdrup in Equinor.

Equinor and partners Aker BP, Petoro, and TotalEnergies aim to maintain production levels of oil from the field up towards this level going forward.

In addition, Johan Sverdrup produces 31,500 barrels of oil equivalents of gas per day.

Johan Sverdrup has reserves of 2.7 billion barrels of oil equivalents. Phase one opened in October 2019, phase two started producing in December 2022.

The field is located in the area of Utsirahøyden in the North Sea, 160 kilometers west of Stavanger, at depths of 110–120 meters,



» The Johan Sverdrup field in the North Sea. (Image credit: Arne Reidar Mortensen/Equinor)

covering an acreage of 200 square kilometers. It was originally expected to produce 720,000 barrels of oil per day at plateau, about a fourth of Norwegian oil production at the current level.

Johan Sverdrup produces at some of the lowest CO₂ emissions of any oil field in the world, at 80–90% lower than the global average.

IKM TESTING UK SECURES DRONE-BASED METHANE EMISSIONS SURVEY WITH BUMI ARMADA

Independent integrated solutions provider IKM Testing UK has secured a second contract with Bumi Armada to deliver a drone-based methane emissions survey on the Kraken Floating Production Storage and Offloading (FPSO) vessel in the North Sea.

The project follows a successful aerial survey in November 2022 as a first stage in establishing baseline methane emissions from the Kraken FPSO.

» Results from the drone survey will inform Bumi Armada's Methane Action Plan. (Image credit: Bumi Armada)



IKM delivered a breakdown of the methane emissions measured during the first project, including an overall asset methane value and localization of methane emissions hot spots. By performing multiple drone surveys, IKM was also able to provide an efficiency assessment of the Kraken's flare.

The second drone survey is due to commence in Q3 of this year and will see IKM build on the results from the initial work. Bumi Armada will use the results to inform its Methane Action Plan, with the overall aim of reducing methane emissions from the Kraken FPSO.

Drone-based surveys is one method of IKM's Methane Emissions Quantification (M-E-Q) service which delivers full top-to-bottom methane measurement solutions that encompass data collection and reporting, delivering actionable insights to drive real change for emissions reduction.

Methane (CH₄) is the second most prevalent greenhouse gas (GHG) caused by human activities, following carbon dioxide (CO₂). In comparison to CO₂, CH₄ is a significantly more potent GHG, with 84 times the global warming potential over a 20-year period. However, due to its relatively short lifespan in the atmosphere, reducing CH₄ emissions can have a rapid and substantial impact on preventing the worst global warming effects in the near term, providing additional time to address our carbon emissions more effectively.

TUGDOCK AND CROWLEY PARTNER TO INNOVATE SOLUTIONS FOR FLOATING OFFSHORE WIND ENERGY

Crowley has made a new investment in Tugdock, a UK-based developer of the world's first road-transportable floating dry dock known as the Tugdock Submersible Platform (TSP), to help advance offshore wind energy in the US.

Crowley, a US-based supply chain solutions company serving the offshore wind sector, and Tugdock will explore potential use of the platforms in locations, such as the US West Coast, where depth and conventional dry docks may be ill-suited for the logistics required.

Crowley Wind Services is developing and planning wind terminals in California, Louisiana and Massachusetts. At the California Port of Humboldt Bay, Crowley is progressing on an agreement to build and operate a terminal for manufacturing, installation and operation of offshore wind floating platforms, use of large heavy cargo vessels and provide crewing and marshalling services for the Pacific waters recently approved for leases for wind energy. Humboldt and other West Coast installations will rely upon floating offshore wind turbines.

Tugdock's award-winning, patented TSP technology offers a cost-effective solution for developers and ports in the floating off-



» *Tugdock Submersible Platform. (Image credit: Tugdock)*

shore wind industry. TSPs were developed to be launched in ports that lack the sufficient water depth and assembly space required to build and loadout the massive floating substructures required to support offshore wind turbines. The technology allows floating dry docks to be delivered by road in modular form and assembled at the port to dimensions far wider than most of the world's existing dry docks. Once loaded, the platform is then towed to deeper water for launching and transporting the turbines.

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TGS AND KONGSBERG PARTNER TO DEVELOP DATA-DRIVEN OFFSHORE WIND SOLUTIONS

TGS and KONGSBERG have announced a strategic collaboration to jointly develop integrated data and digital solutions for the offshore wind industry. The aim of the partnership is more efficient use of data and digitalization to drive faster scaling of offshore wind.

According to forecasts, the offshore wind installed base worldwide is expected to more than quadruple between 2023 and 2030. To support and enable this growth, TGS and KONGSBERG have signed a Memorandum of Understanding agreeing to collaborate on developing solutions that meet offshore wind client needs and jointly engage leading offshore wind developers.

The offshore wind industry holds potential for exponential growth and is widely viewed as being crucial for increasing the production and share of renewable energy needed to reduce emissions in line with global goals set for 2030 and 2050. To enable the scaling speed required to achieve this ambition, the process

of prospecting, site assessment, and field development needs to be more efficient. Responding to this need, TGS and KONGSBERG aim to combine high-quality data with digital solutions that are accessible, modular, scalable, and support an open ecosystem.



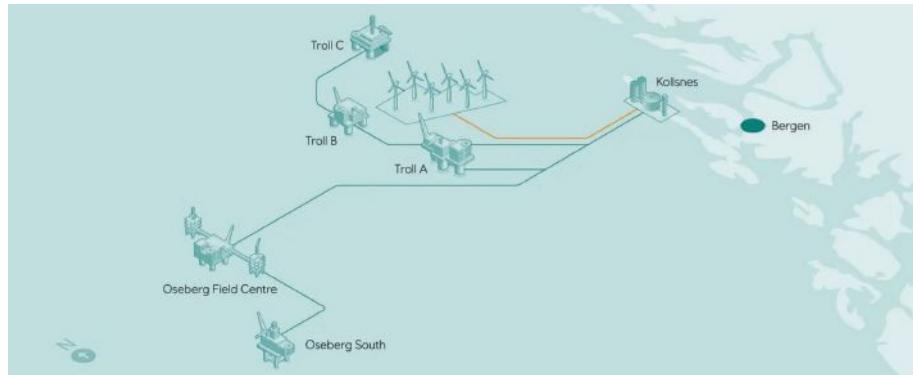
TGS and KONGSBERG are among the leaders in their respective domains related to offshore wind, with TGS specializing in energy data acquisition, asset management, high-power computing and data analytics. At the same time, KONGSBERG excels in sensors, marine robotics, automation, industrial digital twins, and collaboration tools.

"Together, TGS and KONGSBERG are uniquely positioned to provide reduced development and installation costs, shorter cycle times, and better operational performance for the entire offshore wind project life cycle from site assessment to operations," said Kristian Johansen, CEO at TGS.

EQUINOR POSTPONES TROLLVIND OFFSHORE WIND PROJECT IN NORWAY

Equinor will postpone a further development of the Trollwind offshore wind initiative indefinitely. This decision is based on several challenges facing the project, including technology availability, rising cost and a strained timetable to deliver on the original concept. The authorities have been informed about the decision.

» Knowledge from Trollwind will be applied to other projects in the region. (Image credit: Equinor)



Equinor has previously announced reduced activity in the project due to technical, regulatory, and commercial challenges to the project.

Behind the decision of putting Trollwind on hold are several challenges facing the broader offshore wind industry. Rising costs

have challenged the original concept that Trollwind would not require any financial support and it is no longer a commercially sustainable project.

Furthermore, changes in the technical solutions due to preferred technology not being available has made the concept less viable. Finally, time was always going to be a challenge with the proposed timeline, and despite the big effort it has not been possible to mature Trollwind to the level needed to go forward at this time.

As Equinor has taken this decision the company is also looking forward. The company's ambition is still to lead in building an offshore wind industry in Norway. The knowledge and learning from working on Trollwind will be applied to other projects as Equinor remains committed to developing floating offshore wind power at Utsira Nord and outside Norway.

SINGLE-LIFT SOLUTION SELECTED FOR TENNET'S AMBITIOUS OFFSHORE WIND PROJECT



» Pioneering Spirit. (Image credit: Allseas)

Allseas' superior single-lift technology has been selected to install supersized offshore wind converter stations for TenneT's ambitious 2 GW Program and play a key role in Europe's energy transition.

The companies signed a multi-year framework agreement for the transportation and installation (T&I) of topsides and jackets for at least eight Dutch and six German 2 gigawatt (GW) offshore wind projects in the North Sea.

Allseas has been awarded 15 "slots" for T&I of a supporting jacket or high voltage direct current (HVDC) converter topsides for the transmission of wind-generated power to shore. Allseas will deploy

its revolutionary single-lift vessel *Pioneering Spirit* for the works.

The agreement continues the strong collaboration between TenneT and Allseas, following earlier offshore wind installation awards for transformer stations (700 MW) in the Dutch North Sea.

Pieter Heerema, Allseas' President, said: "*Pioneering Spirit*'s unique transport and installation capability has been used to great effect to deliver critical assets for offshore energy and wind developments across Europe. *Pioneering Spirit*'s large lift capacity and high workability ensure that the installations can be safely performed all year round, creating maximum flexibility in the vast and complex building schedules."

Nine European countries including the Netherlands have pledged to boost their combined North Sea offshore wind capacity by at least 120 GW by 2030. To meet these ambitious goals, operators are advancing plans for next generation offshore grid systems supported by 2 GW converter stations.

"The next generation converter stations are substantial structures, similar in size to a football pitch and weighing up to 30,000 tonnes. The housing complex and delicate HVDC technology makes them a good match for our industry-leading installation capabilities," added Mr. Heerema.

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OIL AND GAS PRICES CHALLENGE LONG-TERM BULLISH CASE



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

CRUDE OIL:

During the month of May, WTI oil prices slumped 11 percent. That month, oil prices fluctuated widely but on average were amazingly stable, contradicting the impression left by the magnitude of May's price drop. At the start of May, WTI was above \$74 a barrel but it ended the month at \$68. Such a decline suggests a disaster for the oil industry. However, when we analyzed WTI's price movement during the 22 trading days in May, surprisingly WTI spent only four days below \$70. Equally surprising, WTI spent just two days above \$74. The other 16 days saw WTI trade between \$70 and \$74, a stable and profitable range for oil producers. The price drop prompted Saudi Arabia to engineer another OPEC+ supply cut by shouldering the bulk of the reduction, at least for a month starting in July.

When you pick points in time to measure oil price performance, you are at risk of unusual events distorting views about the health of the oil market. Our accompanying oil price charts show the volatility of WTI prices for May and so far in 2023. The year-to-date price chart ends on May 31, which misses oil price changes during the first two days of June that closed out that week. When trading ended on Friday, June 2, WTI was \$3.65 a barrel higher, up 5.4 percent. That jump put WTI at nearly \$72—well within the price range for most of May. While the June 2 price was below the 2023 year-to-date average of \$75.69 a barrel, it is a healthy price for producers, and tolerable for consumers.

Recently, Robert McNally, the head of Radian Energy Group, a Washington, D.C. consulting company, laid out the long-term bullish case for oil. The thesis is simple:

price-inelastic demand growth will exceed price-inelastic net supply by a large margin and oil prices will need to rise sharply to ration the available supply. The oil boom McNally foresees will only come after we deal with the macroeconomic headwinds buffeting oil markets currently and likely will continue for the next 3–6 months. The primary headwind is the question of a recession. When and how deep are unknown. The latest strong labor market data has some strategists believing we are headed for a "soft-landing" or no recession at all. Those possible scenarios would be good for oil demand and continue the growth that defies the doom-and-gloom forecasts of oil's impending demise.

McNally discussed the challenge of Russian oil production within the global oil market. The West's sanctions on Russian oil due to the Ukraine war have had less impact on global oil supplies than predicted. Once beyond the recession headwind, McNally foresees the Russian oil production issue becoming a non-event as global demand overwhelms supply, especially as drilling remains weaker from the lack of industry spending.

McNally's greatest worry is our growing debt, exacerbated by rising entitlement and pension spending that he believes will cause governments to target the profitable oil industry for additional tax revenues. This threat, in his opinion, is greater than concerns over climate change leaving the oil industry with stranded assets. In McNally's view, we must taste the bitter before the sweet.





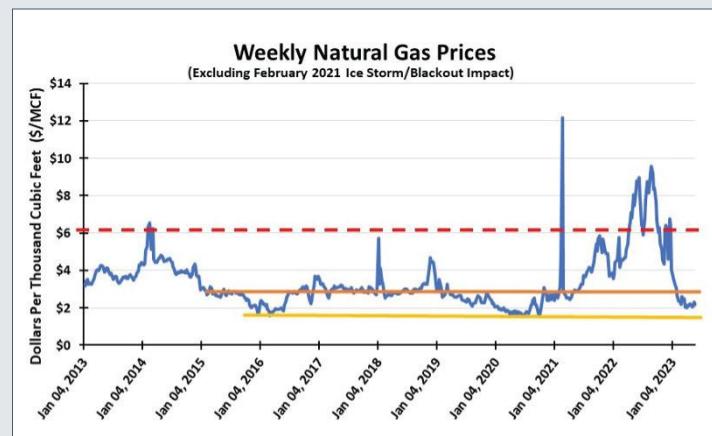
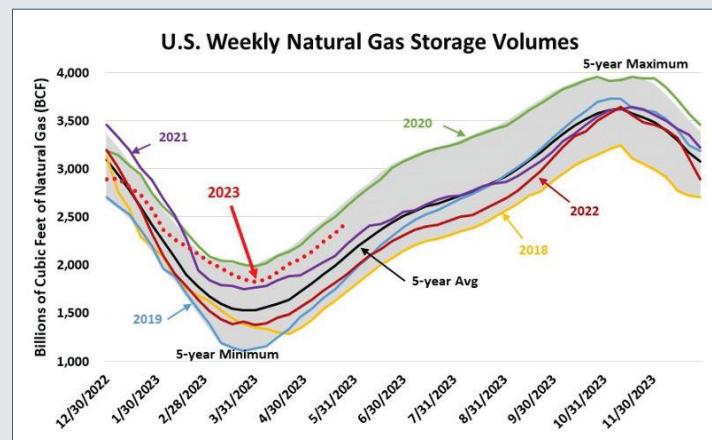
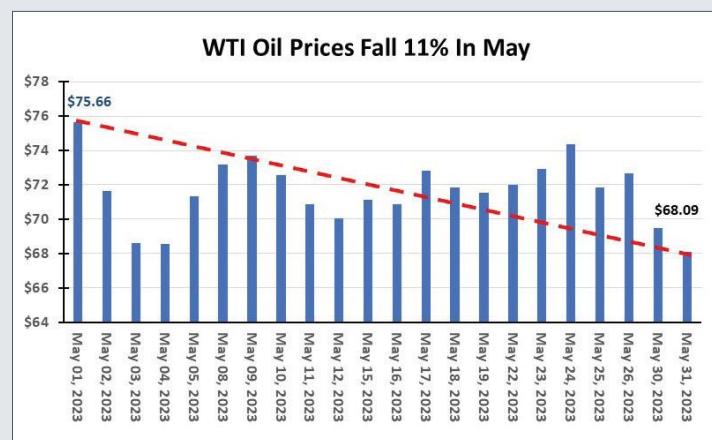
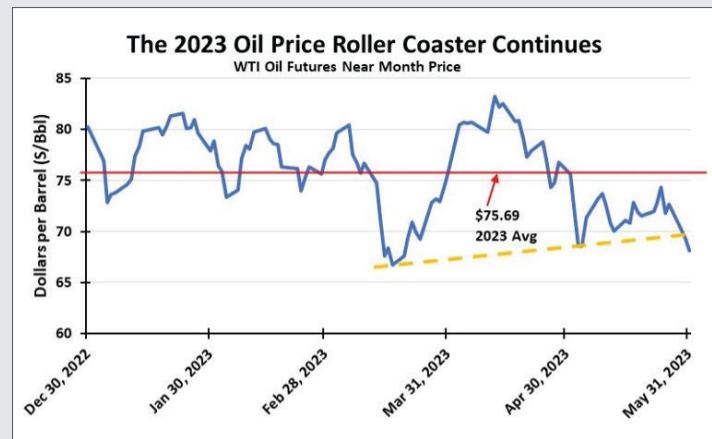
NATURAL GAS:

With the natural gas storage injection season well underway, weekly builds are growing. From 75 billion cubic feet injected into storage during the first week in May, by the end of the month, it was at 110 bcf. Because last winter was so mild, gas storage volumes began rebounding well before the end of the withdrawal season. At the end of May, gas storage was 17 percent above the five-year average and 29 percent above 2022's level. The rapid storage build explains why natural gas prices remain weak.

At the end of May, Henry Hub gas prices were \$2.26 per thousand cubic feet, which is up from the \$2 level seen at the end of March. To better appreciate the warm winter's impact on US and global natural gas markets, one only needs to note that today's gas price is just 28 percent of the \$8.15/mcf price on May 31, 2022. Global gas prices are down substantially due to the warm winter, which allowed Europe to refill its storage caverns and end its furious pursuit of liquefied natural gas cargos. Asia also consumed less gas last winter, so its LNG demand has moderated.

To say the natural gas market has been a huge disappointment would be an understatement. The disappointment has played out not only in prices realized but in drilling activity, too. Since the beginning of the year, the Baker Hughes drilling rig count has seen 19 fewer gas-oriented rigs and 66 fewer oil-oriented rigs working. Combined, the 85 drilling rig decline represents 11% fewer active rigs than at the start of 2023. People might wonder why the oil rig count declined this year, but it was a combination of the volatility in oil prices discussed above and the impact of low gas prices on the associated gas output from oil wells that made drilling them marginally profitable. With the petroleum industry focused on financial discipline in its capital spending, the collapse in natural gas prices has curtailed drilling activity.

Drilling fewer gas wells, coupled with the natural 4–5 percent annual output decline from producing wells, will eventually restore the balance between supply and demand. A hotter summer, a hurricane destroying some of the US gas industry infrastructure, and prospects for a colder-than-normal winter could all tighten the gas market and boost gas prices, but none is a certainty. Regardless, the world will continue consuming more gas because it is a cleaner alternative to dirty coal. Currently, gas market headwinds are strong, but they too will eventually shift to tailwinds. Patience is the key.



VARD AWARDED DESIGN AND CONSTRUCTION CONTRACT FOR TWO CSOVs FOR PURUS WIND

VARD, one of the major global designers and shipbuilders of specialized vessels, has signed a contract for the design and construction of two Commissioning Service Operation Vessels (CSOVs) for UK-based offshore wind services provider Purus Wind. The agreement also has an option for two additional vessels.

Purus Wind has committed to contribute to the next generation battery hybrid service, operation, and transfer vessels to the sector.

The two CSOVs are of VARD 4 19 design, developed by Vard Design in Ålesund, Norway.

The battery hybrid system allows the vessels to run with zero emissions for periods. The vessels can be charged at sea by connecting to an offshore power source—hence removing any need to return to shore. The project has been awarded funding from the Norwegian Government's Green Platform Initiative.

The vessels have also been engineered to run on methanol in the future, bringing further versatility and sustainability to at-sea operations.

Tom Nevin, Business Head of Purus Wind, said: "These vessels will support a path-

way for our clients to decarbonize their operations and to maintain our position as a leader with the lowest carbon offshore wind support fleet. We are also very excited about the potential of what will be the next generation of a very successful design with the ability convert to methanol with the flexibility of hybrid and zero emission mode."

The CSOVs offer a highly flexible and comprehensive platform for all offshore wind support operations, with a focus on optimizing onboard logistics, comfort, storage capacity, and superior operability.

The vessels will be equipped with a SEA-ONICS' Electric Controlled Motion Compensated (ECMC) crane. This system allows operators to always keep the load close to the crane tip from the deck level to the TP platform.

The stepless walk-to-work-system offers stepless access in a range from 15 to 30 meters above sea and is suitable for both personnel and cargo transfer.

CEO of VARD, Alberto Maestrini, added: "VARD has a high focus on utilizing our innovation power to meet the world's changing needs. This innovation and development are only possible in close collaboration with our customers and partners seeking

sustainable solutions. We highly appreciate the reception our priority on the offshore wind segment has had in the market and will continue to develop our designs and tailor-made specialized vessels in accordance with our goal to enable sustainable business at sea."

The hull of the first vessel will be built in VARD in Romania for outfitting, commissioning, and delivery from one of VARD's yards in Norway. The second vessel will be built at VARD Vung Tau in Vietnam.

The first vessel will be delivered in Q2 2025, the second in Q2 2026.

Technical information:

- Length of approximately 87 meters and a beam of about 19.5 meters.
- Stepless walk to work system capable of working from 15 to 30 meters above sea.
- State-of-the-art DP2 positioning and sea-keeping systems.
- Maximum transit speed of 13 knots.
- Hybrid power generation, prepared for charging at sea.
- 85 cabins for 120 persons on board
- Prepared for methanol.
- SEAONICS' 5 tons motion compensated crane.

» VARD 4 19 CSOVs with accommodation for 120 POB. (Image credit: VARD)



FUGRO TO DEPLOY SEAWATCH WIND LIDAR BUOYS FOR DANISH OFFSHORE WIND PROJECTS

Energinet has awarded Fugro a new contract to provide floating wind lidar measurements for five offshore wind projects in Denmark.

Fugro will install and operate 10 SEA-WATCH® Wind Lidar Buoys across three main locations, namely the Kattegat Sea, Baltic Sea, and North Sea. These buoys will provide real-time metocean and environmental monitoring data to support investment decisions for offshore wind farms. This will help the Danish government achieve its goal of deploying 12.9 GW of offshore wind capacity by 2030.

Starting in summer 2023, Fugro's SEA-WATCH® Wind Lidar Buoys will be deployed to record continuous measurements of wind, waves, and currents for a minimum of one year. This critical data will be used to support the development and design process of offshore wind projects, including energy yield calculations, site

assessments, and the selection and design of foundations, grid connections, and cable corridors.

The SEAWATCH® Wind Lidar Buoy has a globally proven track record and is capable of recording wind measurements up to 250 meters above sea level, as well as wave measurements and current profiles down to the seabed.

Jørn Erik Norangshol, Fugro's Service Line Director for Monitoring and Forecasting Norway, said: "For Energinet, it is essential to gain an understanding of the natural forces that impact offshore wind farm development. With our SEAWATCH® Wind Lidar Buoys, we will provide highly accurate wind and metocean data, supporting the planning and development of future offshore wind farms."

This contract builds upon Fugro's 2021 engagements with Energinet for Denmark's

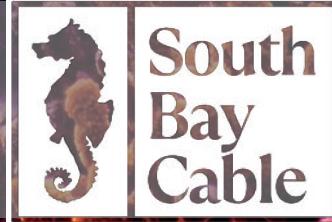
proposed Energy Island project, including two geotechnical site investigation contracts, a geophysical and unexploded ordnance (UXO) magnetometry survey, and a floating wind lidar measurement campaign.



» SEAWATCH can record wind measurements up to 250 meters above sea level, as well as wave measurements down to the seabed. (Image credit: Fugro)

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OCEAN VENTUS LAUNCHES END-TO-END SOLUTION FOR FLOATING WIND

As the world looks to expand offshore wind capacity to meet ambitious targets, Ocean Ventus AS is launching a new end-to-end solution to deliver cost-competitive power from floating wind.

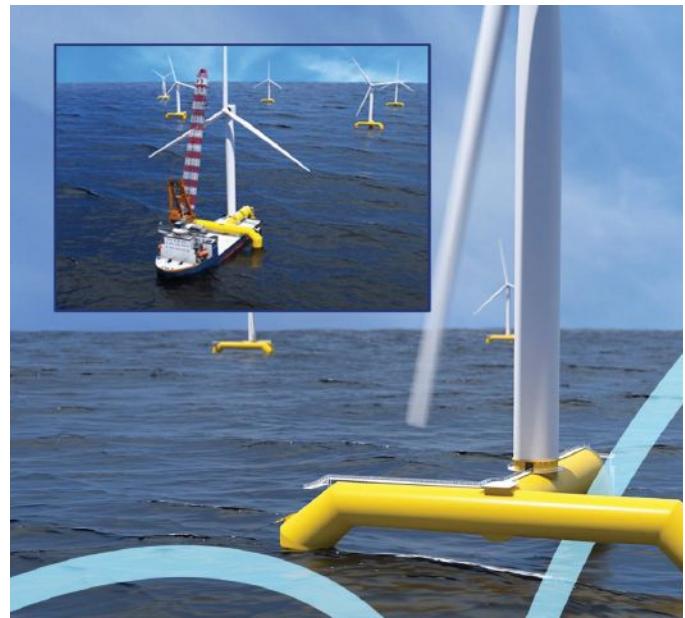
Offshore wind targets imply an 8x increase in installed capacity to 2030, with 32 GW of floating wind expected to be developed in the next decade. Floating wind is moving from the North Sea to global markets to serve the growing demand for renewable energy in areas with waters deeper than 60 meters.

However, foundations remain a bottleneck for the build-out of large-scale floating wind farms. Existing floating wind foundations are heavy, complicated, difficult to produce, and challenged by constrained supply chain capacity.

Ocean Ventus offers an end-to-end solution at low-cost for the floating wind market, from foundation production to transportation, assembly, and maintenance. The company's efficient design, which saves up to 40% on steel costs and CO₂ emissions, has now received Approval in Principle from DNV.

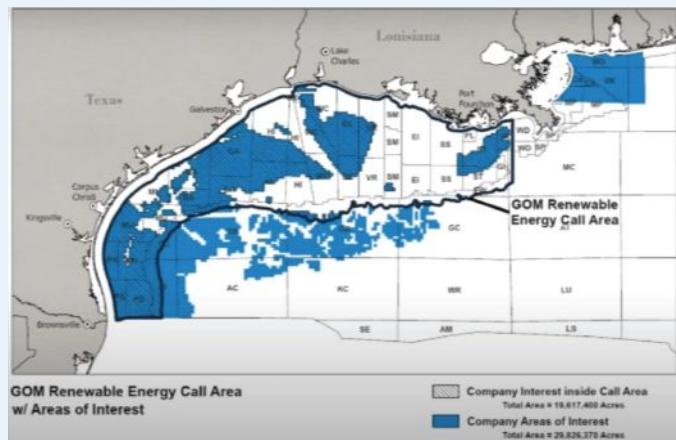
The Ocean Ventus floater can be mass manufactured using similar methods employed for monopile production, while modular construction allows for simplified transport on low-cost vessels. Assembly utilizes two purpose-built barges that can complete 50 floating units per location annually, minimizing use of quay space. Finally, the foundation is designed to work seamlessly with a pat-

ent-pending service vessel, enabling turbine maintenance offshore and eliminating the need to tow to shore.



» The floater's design saves up to 40% on steel costs and CO₂ emissions. (Image credit: Ocean Ventus)

NO SIGNIFICANT IMPACTS FOR OFFSHORE WIND LEASING IN GULF OF MEXICO



The Bureau of Ocean Energy Management (BOEM) has issued a final environmental assessment (EA) on potential impacts from offshore wind leasing on the US Outer Continental Shelf in the Gulf of Mexico, a key milestone towards the potential first-ever offshore wind lease sale in the Gulf. Based on the analysis in the EA, BOEM has issued a finding of no significant impacts to environmental resources.

"The completion of our environmental review is an important step forward to advance clean energy development in a responsible manner while promoting economic vitality and well-paying jobs in the Gulf of Mexico region," said BOEM Director Liz Klein.

On Oct. 31, 2022, BOEM announced two Wind Energy Areas (WEAs) offshore Texas and Louisiana that total about 682,000 acres—a subset of the 30-million-acre Call Area announced in November 2021. The WEAs represent offshore areas that appear to be the most suitable for wind energy development. On Feb. 22, 2023, BOEM announced its proposal for the first offshore wind lease sale in the Gulf of Mexico for areas within the WEAs.

BOEM prepared the EA on the entire 30-million-acre Call Area to allow greater flexibility for possible identification of additional WEAs and to provide NEPA coverage in the event that non-competitive and research leases were proposed in the Call Area. The EA considered potential environmental consequences of site characterization activities (i.e., biological, archeological, geological, and geophysical surveys and core samples) and site assessment activities (i.e., installation of meteorological buoys) associated with the possibility of issuing wind energy leases in the Gulf of Mexico.

US GULF OF MEXICO OIL PRODUCTION LEADS WITH LOWER GREENHOUSE GAS EMISSIONS INTENSITY



» Erik Milito,
NOIA President

The National Ocean Industries Association (NOIA) has released a comprehensive study on global oil production emissions completed by ICF, the GHG Emission Intensity of Crude Oil and Condensate Production. The report reveals that the greenhouse gas intensity of US oil production, particularly in the US Gulf of Mexico, is significantly lower compared to most other regions around the world.

- Total US oil production has a carbon intensity 23% lower than the international average outside of the US and Canada.
- The US Gulf of Mexico has a carbon intensity 46% lower than the global average outside of the US and Canada, outperforming other nations like Russia, China, Brazil, Iran, Iraq, and Nigeria.
- Using the largest crude category from the Gulf of Mexico (API Gravity 37.5), instead of similar crudes from outside the US and Canada, could result in a 50% reduction in the average international carbon intensity.
- The report includes a sensitivity analysis of global methane emissions, indicating that US production, especially in the Gulf

of Mexico, performs much better relative to the global average in terms of emissions intensity even when measured using other methane estimation methodologies.

This report highlights the record of the US and the Gulf of Mexico in reducing greenhouse gas emissions while maintaining a robust energy production system.

NOIA President Erik Milito said: "The US Gulf of Mexico energy production sets the standard for oil and gas production worldwide. The world needs both climate solutions and a growing amount of energy, and we don't have to choose between the two."

"Thanks to the remarkable efforts of the women and men producing energy in the Gulf of Mexico, we have an incredible source of reliable and responsibly produced energy. The Gulf of Mexico produces a massive amount of energy with a remarkably small footprint, and its continued success is critical for our energy security, national security, and energy affordability.

"This study validates the importance of the US Gulf of Mexico as a source of energy with demonstrably lower carbon intensity barrels."

AKER SOLUTIONS WINS UMBILICAL CONTRACT OFFSHORE GUYANA FOR UARU PROJECT



» Project scope includes delivery of three dynamic and seven static umbilicals. (Image credit: Aker Solutions)

Aker Solutions has been awarded a sizable contract from ExxonMobil's Guyana affiliate to provide dynamic and static subsea umbilical for the Uaru project offshore Guyana.

The contract includes delivery of three dynamic and seven static umbilicals totaling over 52 km

in length. Project execution, engineering, and manufacturing will take place at the Aker Solutions facility in Mobile, Alabama. The work will begin immediately, and delivery is planned for the first quarter of 2026.

The Uaru field is part of ExxonMobil Guyana's Stabroek project and is expected to add approximately 250,000 barrels of daily capacity after targeted start-up in 2026.

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NAUTICUS ROBOTICS AND LEIDOS EXECUTE \$2.7 M CONTRACT EXTENSION

Nauticus Robotics, Inc., a developer of autonomous robots using artificial intelligence for data collection and intervention services for the ocean economies, has been awarded an additional \$2.7 million under its current contract with Leidos Holdings, Inc., a FORTUNE 500® science and technology leader. The funded extension allows continued development of an Aquanaut-deriv-

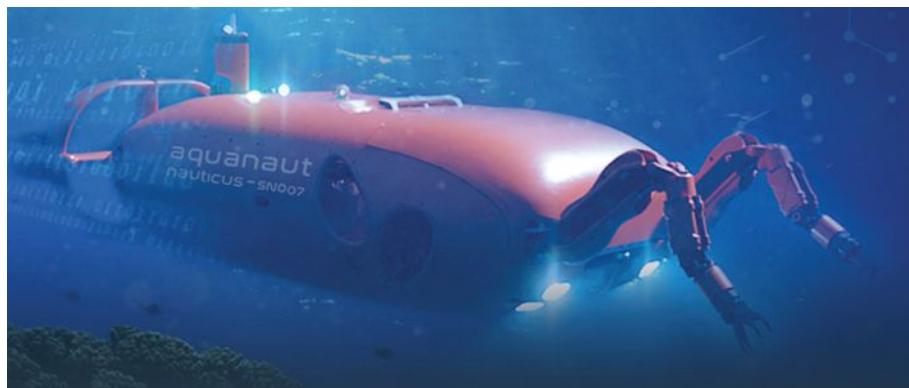
ative in preparation for customer adoption decisions and government opportunities expected later this year.

The state-of-the-art subsea platform, an unmanned underwater vehicle (UUV) with advanced artificial intelligence, sensing capabilities, and more can perform a growing number of jobs without hazarding

human divers. This program has received \$14.5 million in funding from Leidos since 2022, and the technology developed is expected to underpin major future government opportunities.

Like Nauticus' commercial UUV platform, Aquanaut, this derivative robot features technology to support security activities and is advancing to complete longer and more challenging missions. In addition, this award allows further autonomous behavior and operational capability enhancements to toolKITT, Nauticus' proprietary software package developed to enable an ecosystem of autonomous actions for subsea vehicles and serves as the foundation for this work.

"I am very proud of our team's performance resulting in this follow on award, further cementing our partnership with Leidos," said Nicolaus Radford, Founder and CEO of Nauticus. "This very important work combines great attributes from each company to deploy a truly novel subsea capability."



» Aquanaut is a multipurpose UUV. (Image credit: Nauticus Robotics)

AQUATERRA ENERGY INKS MULTI-MILLION SUBSEA RISER CONTRACT WITH BP

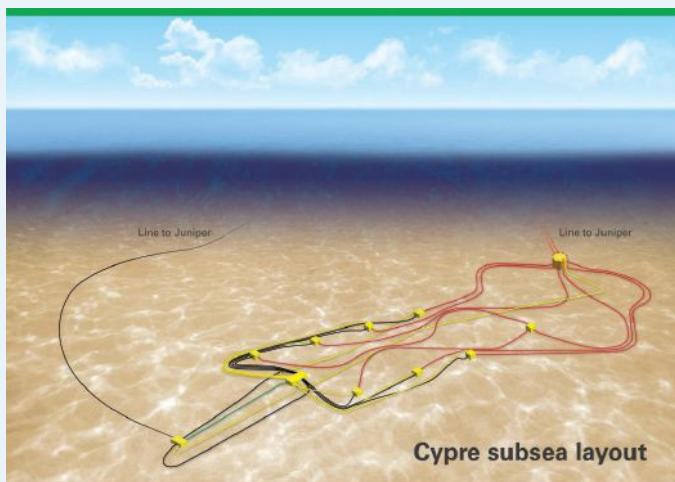
Aquaterra Energy, a leader in global offshore engineering solutions, has secured a multi-million subsea riser contract through a competitive tender with bp for a subsea well development project located in Trinidad and Tobago. Aquaterra Energy will provide a complete end-to-end managed service as a fully independent riser system and connector OEM.

The contract will see Aquaterra Energy deliver a subsea riser system to bp's Cypre Project, off the southeast coast of Trinidad and Tobago. The system will be operated from a jack-up rig, supporting gas exploration from seven development wells in a water depth of around 80 m. As part of the project, Aquaterra Energy will be providing local in country content, working alongside local fabricators, and transferring knowledge to teams. Drilling activities are expected to commence in 2023 with gas production to begin in 2025.

James Larnder, Managing Director of Aquaterra Energy, said: "This contract cements our position as one of the leading riser system specialists globally. We're proud to say we won our first riser contract with bp back in 2010, and 13 years on we continue to work together. bp chose us because we could deliver a fully integrated approach with access to solution driven engineers. This is one of the reasons why our riser project experience continues to grow,

and I am looking forward to the next part of that journey."

Aquaterra Energy will provide an integrated package of equipment, including rig modifications and personnel for full end-to-end delivery, focusing on enhanced offshore efficiency and improved safety.



» Subsea layout for bp's Cypre Project. (Image credit: bp)

SARCOS AND VIDEORAY PARTNER TO OFFER INTEGRATED ROBOTIC SYSTEMS

Sarcos Technology and Robotics Corporation, a leader in the design, development, and manufacture of advanced robotic systems, and VideoRay, the world's leading manufacturer of underwater robotic systems, has announced that the companies have signed an agreement to offer integrated underwater robotic systems combining VideoRay remotely operated vehicles (ROVs) with the Sarcos Guardian® Sea Class robotic system including its power-efficient dexterous arms.

Under the terms of the agreement, Sarcos and VideoRay will each be able to sell an integrated underwater robotic system, as well as their respective individual products, and provide replacement parts and repair services and support.

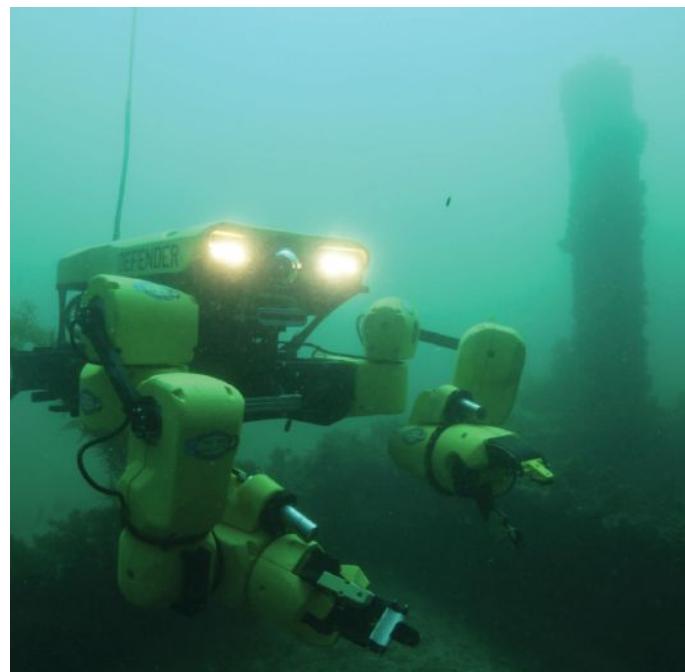
"This collaboration is significant for the industry as it will enable Sarcos and VideoRay customers to easily purchase a pre-integrated system combining VideoRay's best-in-class remotely operated vehicles with our advanced one- or two-armed Sea Class system," said Kiva Allgood, President and CEO, Sarcos. "Through this relationship we aim to make it easy for customers to acquire and deploy complete underwater systems and we look forward to continuing working closely with VideoRay moving forward."

Sarcos Guardian Sea Class robotic system has a modular design that will easily integrate with VideoRay's portfolio of one-person portable ROVs. VideoRay systems deliver exceptional power and maneuverability, enabling operations in currents up to four knots. In August 2022, VideoRay announced that the US Navy had standardized on the use of the VideoRay Defender system and had placed a large order of the remotely operated vehicles, due to its superior capabilities, flexibility and upgradability.

The Guardian Sea Class system can be operated with one or two six-degree-of-freedom arms and performs in depths of up to one kilometer (1,000 meters) for up to two hours at a time. It can be teleoperated or operated via supervised autonomy. As the system is electronically driven, the Guardian Sea Class eliminates the

added weight, size, and expense of hydraulic power unit systems, lowers maintenance costs, and reduces the risk of system downtime due to failure.

"VideoRay has designed our remotely operated vehicles to perform critical jobs in the harshest environments," said Chris Gibson, CEO, VideoRay. "Our ROVs are a natural fit with the Guardian Sea Class system and, when combined, we believe that the packaged solution offers the most advanced underwater inspection capability on the market today."



» Guardian Sea Class Robotic System. (Image credit: Sarcos)

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SAAB

CAN REMOTELY OPERATED VEHICLES GO WIRELESS?

By HYDROMEÀ



» EXRAY, the world's first wireless portable ROV seeks to redefine the underwater inspection market. (Image credit: Hydromeà)

Today's underwater robotic technology is firmly divided into two distinct product segments: remotely operated vehicles (ROVs) and autonomous underwater vehicles (AUVs).

The key difference between the two is whether there is a human in the loop or not.

AUVs are traveling underwater on a fully pre-programmed mission. Generally, these are torpedo-shaped vehicles that cannot hover and are carrying a sensor payload which is collecting data along the way. There is a new trend emerging in large intervention AUVs from the likes of Oceaneering, Saipem, Saab, and Nauticus. These are much more complex robotic systems with an array of sensors and manipulators,

although their full autonomy capabilities are still being developed. Naturally, an AUV is a fully detached vehicle and relies on on-board intelligence to complete a mission. This means that a pilot cannot have immediate access to the AUV to control it.

ROVs, on the other hand, typically always have a human in the loop. And both are connected to each other through a tether—a physical cable carrying data and sometimes power. This allows for immediate control of the vehicle, but it carries a number of disadvantages. Firstly, as the tether gets ever longer to follow the ROV, it increasingly creates more drag and requires the ROV to spend additional energy to pull it. Secondly, tethers restrict the maneuverability of an ROV, especially the thicker kind of tethers which also carry power. Finally, a

tether is an entanglement risk. In complex underwater environments, tether management becomes challenging and can significantly slow down the inspection process.

THE SPEED OF LIGHT

While power demand can be addressed with internal batteries, exchanging data wirelessly through water is harder to achieve. Radio waves don't work underwater, and the data rate of acoustic communication is low. The only option is to use light. And this is what a Swiss-based underwater robotics company Hydromeà did. They developed a proprietary high-bandwidth wireless communication system they call LUMA. LUMA uses blue or UV light to wirelessly exchange data with low latency and at high bandwidth. LUMA devices are



» EXRAY flyout performing vertical inspection of a pole. (Image credit: Hydromea)

already being used in several subsea applications for short-range wireless communication, such as data harvesting from sensors and wireless data exchange between ROVs and other subsea infrastructure.

GOING WIRELESS

When it comes to de-tethering an ROV, LUMA enables fast wireless connectivity between an ROV pilot and the ROV.

Within a range of 30–50 meters, in reasonably clear waters, the pilot can remotely control the vehicle and get instant HD video feedback just like aerial drones do in the air—wirelessly.

Hydromea calls this new ROV system EXRAY and claims it to be the world's first portable wireless ROV. Today EXRAY is already performing limited inspections on assets in the North Sea and is scheduled to be unveiled for full commercial availability at SPE Offshore Europe in Scotland in September. The EXRAY system has just received a class certification from DNV for inspections of ballast water tanks on Floating Production Storage and Offloading (FPSO) platforms in the offshore oil & gas industry.

LEARNING TO FLY

So how exactly does the EXRAY system work? EXRAY has two slim ROVs docked to each other. One ROV is tethered to the pilot station and the second ROV (a flyout)

is docked to the first one. As long as these two are connected, the system behaves as one ROV. The pilot can switch between control of the ROV and the flyout instantly with a single switch.

The pilot always has camera feeds from both vehicles which is an added benefit as it provides much better global awareness for the pilot. With the tethered ROV holding position, the pilot can fly the flyout around pipes, anodes, staircases and other submerged furniture—all without any concern of tether entanglement and all the while receiving full-HD video feedback, having the possibility to take 4K images—even in a macro mode, measuring metal thickness using a fully integrated Ultrasonic Thickness (UT) probe which provides a live A-scan to instantly verify the thickness reading. The pilot can move both vehicles independently while they are not docked. Once the inspection is finished, the pilot docks the flyout into the tethered ROV and it is one system again.

EXRAY is extremely slim and easy to control in all orientations thanks to its six degrees of freedom. Four hours of battery life is ample time for the pilot to finish a job that would usually take eight hours or more. While the initial focus is on confined space inspections with relatively clear water, such as water and storage tanks, industrial water basins, hydropower installations and nuclear pools, the next frontier are open water environments with limited visibility where Hydromea intends to further exploit the best of both worlds between a traditional ROV and a traditional AUV.

SUCCESS IN THE FIELD

What is the real benefit of having a wireless flyout system like that? Hydromea's first service partner in the North Sea, Air

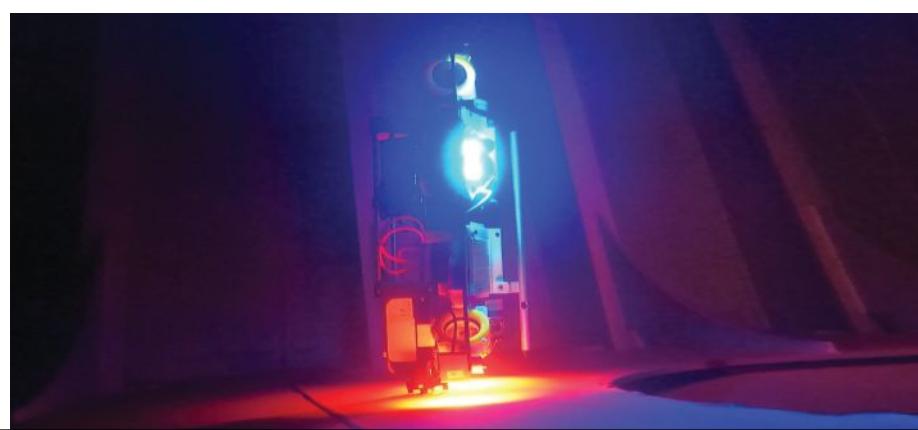


» EXRAY performs a tank inspection. (Image credit: Hydromea)

Control Entech (ACE), has been using the system since the beginning of 2023 on several inspection jobs. Kieran Hope, ACE's COO, says about the system: "EXRAY is an intuitive and flexible system that our pilots quickly got a handle on, and they are excited to perform inspections jobs with it. Not only is it easy to work with, but the system also significantly cuts the time it takes to inspect an asset. From our initial experience, we are already 50% more efficient with this system than what we were with a traditional ROV."

He adds: "The tethered ROV itself is already a top-of-the-line vehicle that can do more than most other ROVs. And coupled with a flyout, EXRAY is an exceptional piece of kit that is redefining the underwater inspection market. From the intuitive controls to the autonomous features to the data management, this system puts most other players to shame. We have an increasing demand for class inspections with this system from the operators and we clearly feel that we are setting a new standard in the inspection market together with Hydromea."

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



» EXRAY takes UT measurement. (Image credit: Hydromea)

C-INNOVATION COMPLETES WELL INTERVENTION NUMBER 46 IN THE GULF OF MEXICO

C-Innovation (C-I), an affiliate of Edison Chouest Offshore (ECO) and its family of companies, has announced the completion of its 46th well intervention in the Gulf of Mexico.

C-I, a leader in providing turnkey intervention services for the global subsea industry, also successfully completed three new riserless zone perforations, an industry first in both deepwater and high-pressure operations. The well intervention program provides increased efficiency along with faster response times for emergent situations through the quick mobilization and deployment of a vessel. C-I specializes in downhole operations, including production injection and integrity logging, caliper measurements, and setting water shut-off and zone bypass plugs. With more well intervention operations planned for 2023, C-I has played a pivotal role in increasing output for operators in the Gulf of Mexico.

George Wilson, Project Manager with C-I, said, "We are very proud to be a part of increasing oil production in this challenging geo-political climate. Riserless interventions on vessels offer both time and cost advantages over riser interventions. C-I's program offers the added benefit of dedicated dock space with advanced fluid tracking for faster between-well maintenance."

C-I's well intervention program, which made its debut in 2017, has performed 31 hydraulic interventions and 15 mechanical interventions. The mechanical interventions included a total of 85 successful wireline runs, both e-line and slickline. C-I recently completed its longest mechanical intervention on board the vessel, *Island Venture*. With 79 days offshore, the operation included 22 e-line and slickline runs, as well as 22,205 barrels of fluid pumped into the well.



» Riserless light well intervention. (Image credit: C-Innovation)

SUBSEA7 SECURES MAJOR CONTRACT FROM TURKISH PETROLEUM



» The second phase of the Sakarya field is slated for 2024. (Image credit: Subsea7)

Subsea7 S.A. has confirmed the award of a major contract by Turkish Petroleum for the second phase of the Sakarya field development offshore Türkiye in the Black Sea.

The award for this two-phase subsea development was announced in redacted form on May 12, 2023. The first phase has been recorded in the backlog in the second quarter of 2023 and the second phase, expected in 2024, remains subject to sanc-

tion by the client.

The contract is awarded to a consortium including Subsea7 and its partner in Subsea Integration Alliance, OneSubsea®, as well as SLB and Saipem. The integrated project scope of the engineering, procurement, construction, and installation (EPCI) contract will cover the subsurface solutions including subsea production systems (SPS), subsea umbilicals, and flowlines (SURF).

The scope of work to be executed by Subsea7 comprises the EPCI of approximately 37 km of infield flowlines, 47 km of control umbilicals, and associated subsea equipment in water depths of 2,000 m. The contract also includes additional FEED studies and options to further extend the scope of work.

Project management and engineering will be managed from the Subsea7 office in Istanbul, Türkiye and offshore activities are expected between Q2 2025 and Q3 2025, with optional scope between Q4 2026 and Q4 2027 subject to final investment decision by the client.

Franck Louvety, Africa, Middle East & Caspian Vice President, said: "Through the close collaboration of Subsea7, OneSubsea and Turkish Petroleum, first gas from Sakarya Phase 1 was delivered just 30 months after discovery. Subsea7 looks forward to extending this relationship for Phase 2 and continuing our contribution to the development of the energy industry in Türkiye."

EXXONMOBIL GUYANA CHOOSES TRENDSETTER CONNECTION SYSTEM

Trendsetter Engineering Inc. has been awarded a contract to provide Esso Exploration and Production Guyana Limited with an order of TC11 Connection Systems. ExxonMobil Guyana plans to use Trendsetter's innovative clamp connectors on their Gas-to-Energy project in Guyana.

"We're delighted to continue our long-standing relationship with ExxonMobil and expand it into the Guyana market," said Tony Matson, Vice President of Trendsetter Engineering. "Gas-to-Energy is a truly transformational project for the country and people of Guyana and we're proud to be a part of it."

The contract includes Trendsetter's TCS subsea connectors, hubs, and an assortment of pressure caps and tooling. The contract also includes subsea valves, sourced from Advanced Technology Valve (ATV) in Colico, Italy. The equipment is slated for delivery in mid-2023.

The Trendsetter Connection System (TCS) is a family of subsea connector solutions developed to meet industry needs for reliable, innovative connector products. The heart of the TCS is Trendsetter's proprietary TEX metal-to-metal (MTM) gasket system. Trendsetter first introduced its subsea connector and TEX gas-



» The Trendsetter Connection System (TCS) is a family of subsea connector solutions. (Image credit: Trendsetter)

ket technology to the industry in 2013. These include size options from 2–20 inches, as well as multi-bore, 400°F and 20,000 psi capabilities.

Trendsetter Engineering, Inc. is a privately owned oil and gas service company based in Houston, Texas which provides specialized subsea hardware and offshore service solutions globally, from exploration drilling through abandonment.



Ocean Sensor Systems

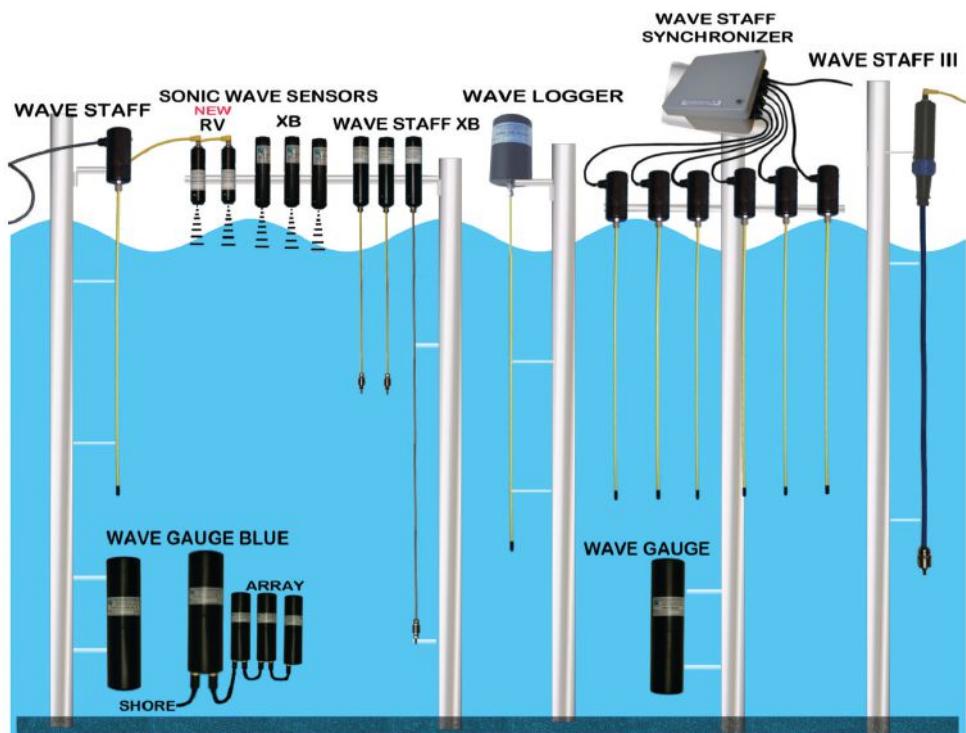
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CHECK THE TECH: IN THE FIELD

EGS AUSTRALIA COMPLETE MULTIDISCIPLINARY SURVEY FOR PAPAU LNG PROJECT



» Survey Vessel *Riverside Guardian* towing geophysical survey equipment. (Image credit: EGS Australia)

EGS Australia recently completed a 7-month high resolution geophysical, UXO, and geotechnical survey campaign offshore Papua New Guinea for the Papua LNG project, which intends to install a pipeline and CALM buoy in Caution Bay, near Port Moresby.

Survey operations were conducted from the 34-m survey vessel *Riverside Guardian* and comprised analogue high resolution geophysical survey, UXO search, digital seismic reflection with multichannel analysis of surface waves (MASW), and geotechnical investigations including onshore mobile laboratory testing.

OCEAN TECH TOOLKIT

The geophysical component involved the acquisition and processing of high resolution MBES data (Kongsberg 2040), side scan sonar data (Edgetech 4200), and shallow geology data using both an Innomar sub-bottom profiler (SBP) and an Applied Acoustics 400 TIP Sparker. OmniStar G4+ corrections, tightly coupled POS MV INS, and Sonardyne Ranger 2 USBL tracking ensured the best-in-industry quality positioning on all sensors.

The UXO survey was undertaken using an EIVA Scanfish Katria 3D ROTV to tow a 4x Geometrics G-882 magnetometer array at 5-m line spacing. The MBES data from the geophysical survey was used to plan the UXO survey so that the ROTV could be flown within 4 m of the seabed and the 3D option with USBL tracking allowed steering precise lines to achieve full coverage.

In areas too shallow for the *Riverside Guardian*, the 8-m aluminum EGS Indepen-

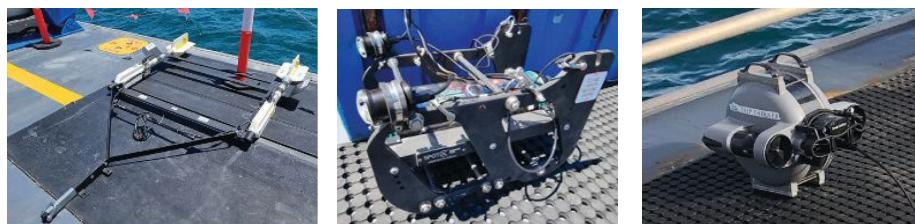
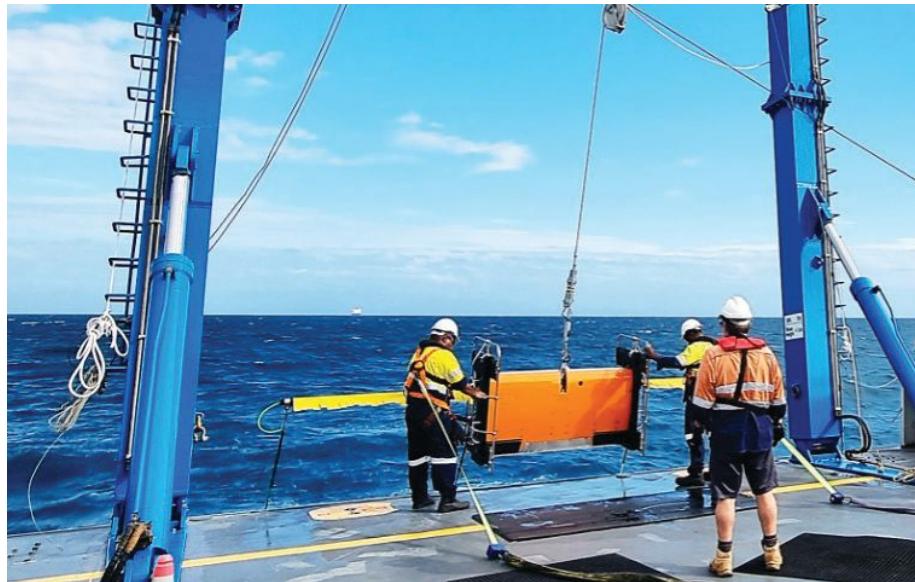
dence survey launch was used to tow a TVG gradiometer using a GNSS tail buoy to survey over the shallow reef line up to the shoreline. Potential ferrous targets were then investigated using a mini ROV for visual confirmation on magnetic anomalies of interest.

The multichannel seismic work (refraction) was carried out to complement the high-resolution marine seismic survey. Seismic source included mini airguns and acquisition with Geometrics Geode seis-

mograph, deploying streamers using both towed and static modes with a mix of 24 x 1 m/2 m/4 m, and 48 x 1 m arrays.

SEABED SITE INVESTIGATION

Geotechnical investigations were conducted utilizing a 6-m vibrocoring system and a Datem Neptune Seabed CPT unit. A box corer was also used for some locations and a grab sampler in the very shallow areas where only the small boat could access. After cutting core samples to 1 m



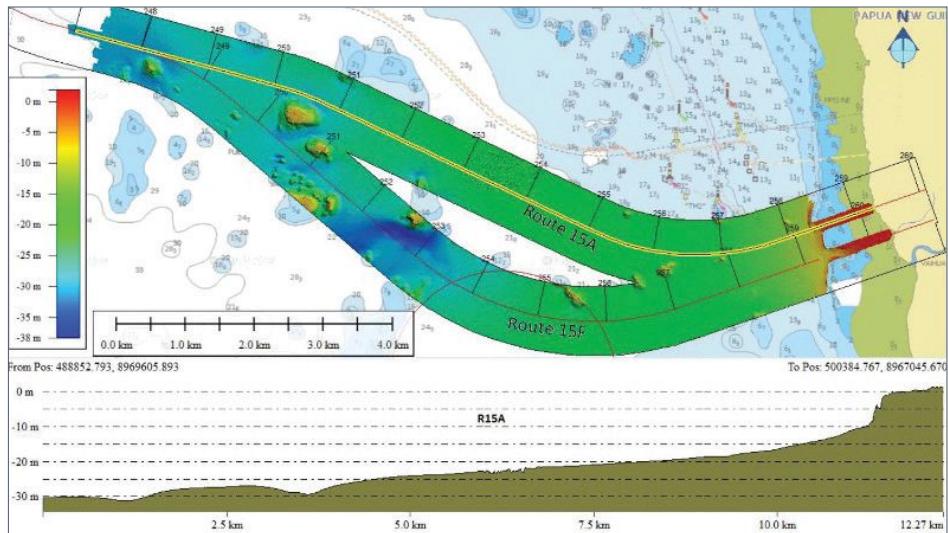
» EIVA Scanfish, EGS Geometrics TVG, drop camera, and mini ROV. (Image credits: EGS Australia)

lengths and initial offshore tests the cores were stored onboard in a 20-ft reefer container prior to transferring onshore for further lab testing.

EGS mobilized its containerized geo-technical processing laboratory to Port Moresby and a 2-month onshore testing campaign followed the offshore sampling.

This extensive multidisciplinary survey project demonstrates EGS capabilities in a diverse range of operations using largely EGS owned technologies. The operations were conducted safely, without any lost time injury, and the data is of excellent quality.

To find out more, visit:
www.egssurvey.com.au.



» Example of MBES data—1 km corridor over 2x route options. (Image credit: EGS Australia)

If you have a project or technology that you wish to profile in ON&T's
CHECK THE TECH: IN THE FIELD, contact: editor@oceannews.com.



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EXPRO WINS WORK FOR WELL ABANDONMENT CAMPAIGN OFFSHORE UK

Energy services provider Expro, has secured a new contract with Harbour Energy for a well abandonment campaign as part of the decommissioning project for the Balmoral area, in the UK Continental Shelf.

The multi-year contract, valued at more than \$20 million, will utilize Expro's Subsea Well Access technology with a combination of open-water and in-riser applications deployed from a semi-submersible rig.

Wells that require abandonment tend to suffer from loading and fatigue issues on the wellhead and Xmas trees. Expro's ability to supply a lightweight open-water system will help to mitigate these loading issues during the subsea well access intervention part of the overall abandonment campaign.

Expro's open-water and in-riser bore selector technology, which eliminates the use of a dual bore riser for the entire abandonment campaign, is designed to deliver significantly reduced system deployment and retrieval times and with lower maintenance costs.

To overcome key technical requirements from the customer, Expro devised an innovative technological solution based on a new build lightweight intervention system, incorporating its unique subsea ball valve technologies. Expro's existing API 17G standard high debris ball valve was recently qualified to provide a single ball cut and seal on coil tubing. This ball valve technology will be re-packaged into bespoke open water riser housings to provide the lightweight solution required.

The solution developed for this award expands Expro's subsea well access portfolio and allows Expro to now supply the client with all the subsea well access tooling required for the abandonment campaign on the Balmoral area, for horizontal and vertical Xmas Trees.



CALEDONIA OFFSHORE WIND FARM FOCUSED ON DATA COLLECTION IN MORAY FIRTH

Caledonia offshore wind farm is on track to contribute to government green energy targets following an advanced two-year site survey campaign which included analysis of birds and marine mammal species in the area.

Caledonia is a 2 GW project being developed in the Moray Firth, and one of the few ScotWind sites scheduled to be operational by 2030.

Developer, Ocean Winds, is laying the groundwork for its comprehensive Environmental Impact Assessment (EIA), a key element in the consenting process, following the project's survey program across the 429 km² site.

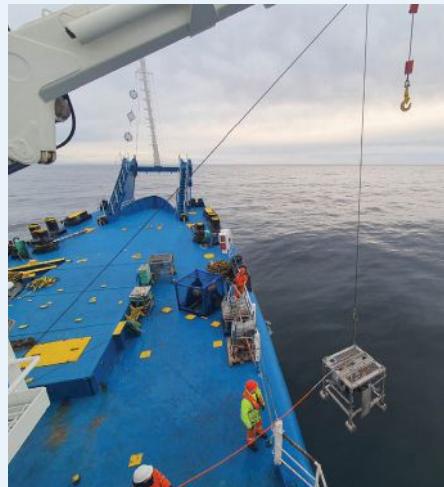
A pair of floating Lidar devices are to be deployed at the project site—where water depths range between 40 and 100 m—by contractor Fugro. The units are fitted with a range of sensors and equipment

designed to acquire marine environmental data including wind, wave, and current conditions, among other factors. This adds to Ocean Winds' extensive site data already acquired over twelve years of development in the Moray Firth.

Data will be transmitted to shore in near real time, while raw data will be stored and downloaded during maintenance visits. In addition to informing the EIA, results will support engineering design for Caledonia.

Additional geophysical surveys are also ramping up, building on work already completed in 2022. Gardline vessel *Ocean Endeavour* was mobilized at the start of March 2023 to conduct full surveys of the offshore export cable route in addition to further reconnaissance in the wind farm array area.

The workscope includes benthic sub-tidal environmental surveys and sampling. A



» The multidisciplinary survey workscope covers 429 km². (Image credit: Caledonia)

separate vessel, the *Titan Discovery*, will carry out geophysical and benthic sub-tidal surveys of the nearshore cable route area.

PRYSMIAN GROUP TO CREATE POWER TRANSMISSION CABLE TECHNOLOGY HUB

Prysmian Group is launching a new investment of around €120 million in its strategic plant in Pikkala, Finland. The investment—in addition to the €100 million already provided in 2022—is aimed at further increasing the production capacity of the 525 kV HVDC submarine cable systems, supporting the growing market demand driven by the need to develop and upgrade power transmission grids for the energy transition.

The global power transmission cable market is expected to grow to €15 billion by 2030 from around €8 billion reported in 2022.

The new Vertical Continuous Vulcanization (VCV) lines will more than double the Pikkala plant's existing production capacity of 525 kV extruded submarine cables and 400 kV AC cables by 2026.

"This investment confirms the strategic importance of the Pikkala plant, which is already considered the Group's energy transition flagship factory. Thanks to its switch to green energy sources, this plant is to date the first cable plant in the world to have achieved the net-zero goal," stated Ferdinando Quartuccio, CEO at Prysmian Group Finland.

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AUTONOMOUS OPERATIONS AND MAINTENANCE PILOT AT DEUTSCHE BUCHT OFFSHORE WIND FARM

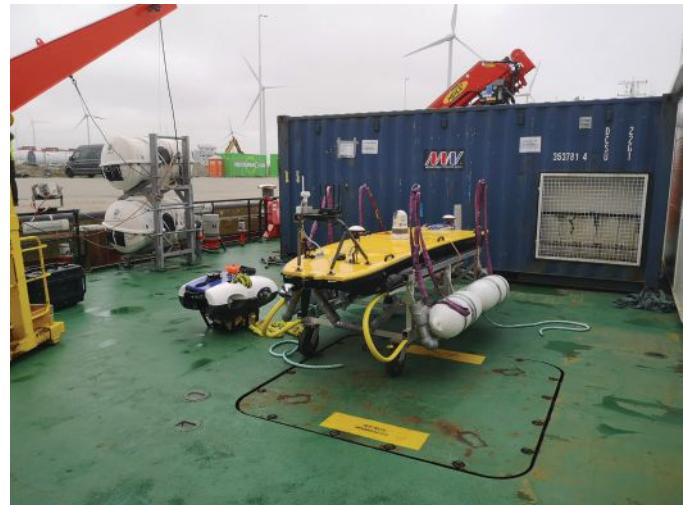
Pioneering global offshore wind farm owner Northland Power has selected Subsea Europe Services as its partner for a ground-breaking pilot project in Summer 2023 at the Deutsche Bucht Offshore Wind Farm that will place autonomous marine survey and underwater inspection at the heart of its Operations & Maintenance (O&M) programs.

The greenlight for the project, which starts this July, follows the successful harbor testing of Subsea Europe Services' Autonomous Surveyor uncrewed surface vessel (USV) and A.IKANBILIS hovering autonomous underwater vehicle (HAUV), which took place in May on the Albert Betz service operation vessel (SOV) in Eemshaven, the Netherlands.

Northland Power will task Subsea Europe Services' Autonomous Surveyor and A.IKANBILIS to deliver the complete offshore wind foundation survey and inspection scope. While the Autonomous Surveyor USV will conduct multibeam echosounder surveys to monitor the Inter-Array Cable routes and potential scouring at the foundations, the A.IKANBILIS HAUVE will conduct general visual inspections of the foundations, from water level all the way down to the seabed. All survey and inspection work will be carried out with only minimal human involvement.

Uniquely, both autonomous platforms will remain resident at the wind farm for the duration of the pilot project, using the SOV for the safe and efficient launch, recovery and storage of the Autonomous Surveyor and A.IKANBILIS. The SOV will become the mothership and center of operations for autonomous survey and underwater inspection operations within a highly automated project workflow: from planning and execution to reporting and data delivery. This approach significantly reduces the number of personnel and vessels required offshore, making the wind farm a safer, greener, and even more efficient workplace.

"New technologies including autonomous platforms are integral to optimising our O&M strategies," said Jan Schmökel, Balance



» A.IKANBILIS HAUVE (left) alongside Autonomous Surveyor. (Image credit: Subsea Europe Services)

of Plant Engineer, Northland Power. "We're impressed with the Subsea Europe Services autonomous vessel fleet and their expert team so far, and as a company dedicated to innovation in pursuit of safe and efficient marine operations, we can't wait to see the difference they make at Deutsche Bucht during the forthcoming pilot project."

"This project is a fantastic opportunity to demonstrate the power of True Autonomy when applied to both surface and underwater tasks at an operating wind farm," said Sören Themann, CEO, Subsea Europe Services. "Our approach makes it possible to significantly reduce the number of personnel and vessels required on-site, which unlocks HSE, environmental and economic benefits while optimizing workflows for faster acquisition of higher quality data using fewer resources."

ITALY'S DEEP SEA TECHNOLOGY SELECTS SAAB SEAEDGE FALCON DR ROV



» Divers working on the wreck of a Spanish galleon off the Sardinian west coast. (Image credit: DST)

Italy's DST (Deep Sea Technology) has chosen a Saab Seaeye Falcon DR, depth rated to 1,000 m, to support archaeological research and offshore energy activities.

The Seaeye Falcon DR was selected by Naples-based DST to support subsea operations in both shallow and deep waters. The Falcon package includes a Tritech Super SeaPrince sonar and skid-mounted five function manipulator and rope cutter.

"The Falcon DR will extend our operational capabilities," said Alessandro Scuotto, CEO of DST. "It will operate in both single configuration and for diver support and we plan to further enhance the vehicle with new system options in the future."

STROHM'S PIPELINE TECHNOLOGY INSTALLED OFFSHORE BRAZIL

The world's leading composite pipe technology company Strohm was awarded a contract with independent E&P operator PRIO (formerly known as PetroRio) to provide its composite pipe solutions to support operations at its Frade field.

This contract with PRIO marks the first time Thermoplastic Composite Pipe (TCP) is used for permanent subsea operations in the region, following its increased adoption by other operators across the globe.

The Frade subsea development is located in the deepwater Northern Campos Basin off the coast of Brazil, with wells tied back to a floating production, storage, and offloading (FPSO) vessel.

Under this award, Strohm has already delivered two sets of TCP Jumpers for gas lift service, one 1,300 m long and the second 900 m long, both delivered onto transportation and installation reels.

The TCP Jumpers feature a weight coating designed for sustained on-bottom stability whilst maintaining maximum weight benefit.

Both lines were successfully installed by PRIO in Q2 2023, at approximately 1,200-m water depth, where the *Normand Pioneer* vessel was deployed for the offshore installation campaign.

As a result of TCPs lightweight properties, unlike alternatives,

it could be transported and installed by a small, multi-purpose vessel greatly reducing costs and carbon emissions.

TCP can be used for a wide spectrum of applications such as supporting the mature fields in Brazil currently being revamped and re-developed by independent operators such as PRIO. It is also suited to ultradeep waters with high CO₂ contents, typical of the pre-salt province.

Renato Bastos, VP Brazil with Strohm, said: "It is a testament to Strohm's ability to efficiently serve both the brownfield and greenfield segments with our TCP portfolio and its lightweight, corrosion free and low CO₂ benefits."



» Strohm's pipeline technology installed across PRIO's Frade field in offshore Brazil. (Image credit: Strohm)

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GENERAL DYNAMICS NASSCO AWARDED \$736 MILLION TO BUILD T-AO 213

General Dynamics NASSCO, a subsidiary of General Dynamics, has been awarded a \$736 million modification to the existing T-AO contract for construction of a ninth ship (T-AO 213) in the John Lewis-class fleet oiler program. The exercised option comes in addition to the earlier awarded eight ships, bringing the total contract value to approximately \$5.5 billion for construction of nine ships.

"NASSCO is proud of our ongoing dedication to deliver these ships to the fleet," said Dave Carver, President of General Dynamics NASSCO. "We are committed to working with our Navy partners to ensure the continued success of the John Lewis-class fleet oiler program."

Construction of T-AO 213 is scheduled to begin in the third quarter of 2025.

In 2016, the US Navy awarded NASSCO with a contract to design and build the first six ships in the next generation of fleet oilers, the John Lewis-class (T-AO 205), previously known as the TAO(X). Designed to transfer fuel to US Navy carrier strike group ships operating at sea, the 742-feet vessels have a full load displacement of 49,850 tons, with the capacity to carry 157,000 barrels of

oil, a significant dry cargo capacity, aviation capability and up to a speed of 20 knots.

The first ship, the future USNS *John Lewis* (T-AO 205), was delivered to the Navy last year. The future USNS *Harvey Milk* (T-AO 206), the future USNS *Earl Warren* (T-AO 207), the future USNS *Robert F. Kennedy* (T-AO 208), the future USNS *Lucy Stone* (T-AO 209), and the future USNS *Sojourner Truth* (T-AO 210) are currently under construction.



» T-AO sea trials. (Image credit: General Dynamics NASSCO)

VESTADAVIT INKS REPEAT ORDER FROM CROATIAN NAVY FOR MODULAR DAVIT



» PLAR-4500 deploying a launch craft. (Image credit: Vestdavit)

The Croatian Navy has returned to Vestdavit for a repeat order of the latter's PLAR-4000 davit for retrofitting on an offshore patrol vessel (OPV) after seeing its proven reliability on a range of operational missions.

The PLAR-4000 davit, with boat-handling capacity of 4,000 kg, is designed with an aluminum frame that makes it 30% lighter than

steel-structured equivalents to enhance vessel stability, while also minimizing corrosion.

Reduced weight of onboard equipment also results in better energy efficiency with lower fuel consumption that enables an OPV to operate farther from shore and remain longer at sea, as well as improved speed responsiveness and maneuverability.

Consequently, the lightweight PLAR system has been preferred for fast patrol boats being used by the Royal Australian Navy's Cape Class Vessels, the Royal New Zealand Navy, the Danish Navy, the Swedish Navy, the US Coast Guard, and others.

The modular davit is delivered pre-assembled and skid-mounted for ease of installation, while its compact size makes it adaptable for retrofitting on an existing vessel with limited space availability, which was a key requirement with the latest Croatian naval order.

The Croatian Navy's davit, with lifting capacity of between 2,000 kg and 7,000 kg, will be capable of high-frequency launch-and-recovery operations in up to sea state 5 for fast rescue craft, RHIBs used for boarding other vessels, and surveillance boats used for security purposes, control of maritime borders and fisheries inspection, among other missions.

TEXAS A&M MARITIME ACADEMY PREPARES NEXT GENERATION OF MARITIME PROFESSIONALS

Over 500 cadets, faculty, and staff have departed from Texas A&M University at Galveston to participate in the Texas A&M Maritime Academy's 60-day summer sea term to earn their US Coast Guard license. This required at-sea training prepares future mariners and maritime professionals to support our national security and drive the state economy.

"Over 90 percent of everything you eat, wear or use travels to you through our nation's ports and inland waterways," said Texas A&M Maritime Academy Superintendent Rear Admiral Michael E. Fossum. "Our nation's workforce of skilled mariners is aging and retiring. Educating and training maritime professionals to continue to drive the blue economy here in the Gulf Coast region and around the globe is critical in meeting the needs of our citizens."

The academy is sailing aboard the TS Kennedy, the first large training vessel assigned to Texas A&M in 18 years. The ship serves as a living laboratory where cadets earn hands-on experience in ship navigation, marine engineering systems, maintenance, safety and security, and attend classes onboard.

"The hands-on experience that we gain during summer sea term is vital for our success as mariners," explained Texas A&M



» TS Kennedy arrives at the Galveston Campus dock. (Image credit: Texas A&M University Galveston)

Maritime Academy cadet Gunnar Pierson '24. "The experience someone has can save lives and dollar signs in our industry."

Successful legislative efforts in Washington, D.C. secured the transfer of the TS Kennedy to the Galveston Campus this year and a new, state-of-the-art National Security Multi-Mission Vessel, NSMV Lone Star State, in 2025. These ships have 12 times the capacity of the maritime academy's former training ship, the TS General Rudder.

"It is truly surreal to be able to call the TS Kennedy ours and be the first class in 18 years to have a training ship that fits the needs of everyone at this academy," said Pierson, who is also the Summer Sea Term Corps Commander, the highest-ranking

cadet on the ship. "I am incredibly honored to lead such a motivated group of mariners striving to gain their own experience."

The summer sea term includes port stops in Curacao, Florida, Puerto Rico and Louisiana, where cadets will have two days in each port to explore and participate in academy-organized activities.

The campus also hosts ship tours for the community to highlight the importance of the maritime industry. They will return to Galveston, TX, in August before the start of the fall 2023 semester. Cadets from California Maritime Academy, Massachusetts Maritime Academy, Maine Maritime Academy, and State University of New York Maritime College will sail with the academy this year.

KRAKEN TO SUPPLY A NAVY IN ASIA-PACIFIC WITH SEABED MAPPING SONAR EQUIPMENT

Kraken Robotics Inc. has announced a \$9.5 million contract to supply high-resolution seabed mapping sonar equipment to a navy in Asia-Pacific. Under the scope of the contract, Kraken will deliver its KATFISH™ high-speed minehunting solution. The contract also includes a variety of support and sustainment options, including training, spares and operational support.

Under the acquisition contract, Kraken will deliver its KATFISH towed Synthetic Aperture Sonar, Tentacle® Winch and Autonomous Launch and Recovery System (ALARS) in Q2 2023. Kraken's equipment will be integrated onboard a vessel of opportunity selected by the customer. Continuing to build off successful KATFISH deliveries with various NATO navies, this represents Kraken's first KATFISH system sale in the Asia-Pacific region.



» KATFISH recovery. (Image credit: Kraken)

COMMERCIAL COLLABORATION IS KEY TO REALIZING THE NAVY'S UNMANNED AMBITIONS



By Captain George Galdorisi

USN – retired

While it will take years to unpack all the lessons learned from the ongoing war in Ukraine, one tactical deployment of note—until now mostly hypothetical in practice—has been the use of uncrewed surface vessels (USVs) to safeguard the marine domain and, when required, attack naval vessels with explosive devices.

Consider how naval analyst H.I. Sutton described the impact of drone attacks in late 2022 and what they portend for the future of maritime warfare: "Ukraine's attack on Sevastopol on October 29, 2022, will go down in history as the first major example of what many believe is a new era of drone warfare. The Russian Navy Black Sea Fleet found itself defending against both surface and aerial drones. Seven USVs were involved, along with nine uncrewed air vehicles (UAVs).

"Individually, they may pose only a limited danger, but their low cost and the low risk associated with their use likely will lead to them becoming a persistent threat. They may shape future wars just as their aerial counterparts are already doing. But will leading navies accept the obvious lessons and initiate similar low-cost armed USVs?"

Like their air and ground counterparts, unmanned maritime systems are valued because of their ability to reduce the risk to human life in high-threat environments; offer options for more aggressive and

risk-worthy strategies; and deliver persistent surveillance over areas of interest.

MULTILATERAL NAVAL EXERCISES

The US Navy is far from being the only navy interested in USVs, as demonstrated by an unprecedented number of international exercises in 2022, including the International Maritime Exercise 2022 (IMX 22) in the Middle East, the Exercise Autonomous Warrior 2022 (AW 22) in Australia, RIMPAC 2022 (Rim of the Pacific Exercise) off Hawaii, and REPMUS-22 (Robotic Experimentation and Prototyping with Maritime Unmanned Systems) in Portugal. A busy 2022 calendar was crowned by the US Navy-led Digital Horizon 2022, a three-week exercise in Bahrain that focused on employing artificial intelligence and 15 different unmanned systems.

The strategic importance of these events cannot be understated. These live demonstrations provide US Navy officials with ample evidence to convince lawmakers about the fast-evolving role of unmanned maritime systems in defense and security operations—this is the future, and the time to invest is now, being the underlying message.

PRIVATE SECTOR INTEGRATION

To reconcile this need with the usual budgetary pressures, world navies are keen to integrate commercial-off-the-shelf (COTS) unmanned maritime systems from the private sector. And so, these international

events are critical windows for developers and manufacturers of unmanned vehicles to demonstrate their latest innovations—2022's roll call included entries from Saildrone, MARTAC, Atlas Elektronik, Elbit Systems, Exail, and Ocius Robotics, to name but a few.

But more than the opportunity to showcase the latest applications for unmanned technologies, naval exercises of this nature give oxygen to meaningful collaboration. Today, with a broadening range of unmanned assets performing autonomous functions above, on, and below the waterline, branches of the armed forces and private companies can collectively envisage new ways of working at sea and prioritize actions to turn these opportunities into strategic advantages in the combat zone.



» Fast response cutter USCGC *Glen Harris* (WPC 1144) sails near a US sail drone explorer in the Gulf of Aqaba during the International Maritime Exercise/Cutlass Express (IMX) on February 13, 2022. (Image credit: Cpl. DeAndre Dawkins)

THREE CROWLEY-MANAGED TANKERS AWARDED ROLES IN DEFENSE FLEET WITH STENA BULK

Three Crowley-managed tankers have been selected by the US Maritime Administration (MARAD) to serve in its Tanker Security Program. The program ensures a commercial fleet can readily transport liquid fuel supplies in times of need for the US Department of Defense.

The selected medium-range tankers are part of a joint venture between Crowley and Stena Bulk USA awarded TSP participation. The vessels—*Stena Immaculate*, *Stena Imperative*, and *Stena Impeccable*—will be reflagged as US registered vessels with US crews. The tankers will continue international commercial operations but can be chartered on a short-term basis to serve the US government's operations.

A federal law requires the US Department of Transportation, which includes MARAD, work with the Defense Department to establish a fleet of active, commercially via-

ble, militarily useful, and privately-owned product tank vessels to meet national defense and other security requirements. The initial fleet size is ten, and companies receive a stipend for each ship enrolled in support of the nation's defense forces.

Crowley and Stena Bulk partnered before to serve the energy needs of the govern-

ment and military. For example, Crowley won the Military Sealift Command charter contract in 2022 to run the *Stena Polaris*, an Ice Class tanker serving bulk fuel needs of the US Department of Defense in the Arctic and Antarctic regions as well as transporting fuel in the Mediterranean Sea region.



» Stena Immaculate and Stena Imperative. (Image credit: Stena Bulk)

Intelligent Marine Robotics
Solutions that put you in control

This section features a large image of a white and green autonomous surface vehicle (ASV) in the water, positioned next to a U.S. Park Ranger boat. Below the main image is a dark banner with the text "Intelligent Marine Robotics" and "Solutions that put you in control".



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MARTAC LAUNCHES DEVIL RAY T24

Maritime Tactical Systems, Inc. (MARTAC) has unveiled its Devil Ray T24 (7 m) ASV from their Devil Ray Production Facility. The base configuration Devil Ray T24 is designed as a high performance ASV capable of burst speeds up to 50 kts, open ocean cruising ranges up to 600 nautical miles, and a payload capacity up to 1,800 pounds. The T24 was designed and developed from concept to empower operators to execute missions with multiple advanced above and below-surface sensors over both line of sight and satellite datalinks.

The T24's use of advanced automation and Collision Avoidance Systems (CAS) provides the level of trust necessary to conduct missions with significantly reduced human intervention or oversight. In addition to its inherent autonomy, the T24 is built on an agile technology stack which is Interoperable and Interchangeable (I2I) allowing easy adoption of emerging Artificial Intelligence (AI) capabilities.

The T24 is the only ASV with native marsupial hosting capabilities with platforms such as MARTAC's MANTAS T-series (T8/T12) ASVs, unmanned aerial vehicles (UAVs), unmanned underwater vehicles (UUVs), and remote operated vehicles (ROVs).



» The Devil Ray T24 delivers burst speeds of up to 50 knots. (Image credit: MARTAC)

Bruce Hanson, MARTAC's CEO, said: "We are excited about the launch of our Devil Ray T24 with its ability to change how ASVs are utilized to augment operations and manned systems. This is our first Devil Ray ASV designed from the ground up to meet specific multi-role mission requirements. It is capable of autonomous operation at high speeds, and we will continue to advance our technology to address the needs of our military, scientific and commercial customers' missions, and applications."

SAHIL GANDHI TAKES OVER AS NEW CEO AT UNIQUE GROUP



» (L-R) Sahil Gandhi, CEO and Harry Gandhi, Chairman at Unique Group.

Unique Group has announced the appointment of Sahil Gandhi to the position of CEO, succeeding Himanshu (Harry) Gandhi, who will now assume the position of Chairman of the Group.

Acting as Unique Group's COO since 2017, Sahil has previously held Executive Director and Group Sales Manager roles. Under his

leadership, the company has experienced rapid growth, diversifying its portfolio into unmanned survey technology and initiating digitization that led the business to operational excellence, as well as renewing its commitment towards the United Nations Sustainable Development Goals (UNSDG).

Harry Gandhi, Chairman of Unique Group, founded the company in 1993 with three employees, turning it into a thriving multinational organization with over 500 employees today. Harry Gandhi expressed his confidence in Sahil's ability to lead the company into the future, stating: "Over the years, Sahil has been instrumental in shaping Unique Group to become a leader in providing comprehensive technical and digital solutions for the subsea, renewable, and wider energy industries, with a continued focus on sustainability. Sahil's appointment heralds the beginning of a new era for Unique Group, and I'm confident that his expertise, passion, and ambition will steer the company towards new heights."

Upon assuming his new role, Sahil Gandhi expressed his commitment to building on the company's legacy and positioning Unique Group as a frontrunner in providing subsea innovation for clients.

Unique Group is set to launch key products under its unmanned surface vessel (USV) portfolio, expand its global facilities, and introduce new divisions throughout the second quarter and the remainder of the year.

GN ROPE FITTINGS SETS NEW WORLD RECORD FOR LARGEST FORGED SHACKLE

GN Rope Fittings, a leading manufacturer of ROV, mooring, heavy lifting and rigging connections to the global oil and gas and offshore wind industries, has made the world's largest forged shackle, surpassing its own previous record.

The latest product, built in 14 weeks, is a bespoke wide-body shackle with the world's heaviest load-bearing capacity. The forged shackle has a working load limit of 3,000 tons (WLL3000T)—equivalent to lifting 13 Statues of Liberty.

Commissioned by IQIP, the shackle will be part of a system for the monopile installation of offshore wind turbines. It was forged and produced at GN Rope Fittings' sole manufacturing facility in Nieuwkoop, the Netherlands, using raw materials from Western Europe to ensure the highest quality of craftsmanship.

At the client's request, the bow was designed in a D-shape—not the conventional omega shape. The bow radius and the jaw opening are larger than for standard shackles, demonstrating GN Rope Fittings' ability to modify any product range to deliver bespoke solutions. Additional features include a shaft for the installation of the pin.

The shackle was load tested to DNV lifting standards, followed by a non-destructive testing inspection. The company has its own in-house WLL6000T test bench in the Netherlands and all testing was done there.

Bart Vossenberg JR, Director, GN Rope Fittings, said: "We're witnessing an increasing demand in larger capacity equipment for renewable energy projects and we're grateful for the opportunity to contribute to the growth of this industry."



» L-R: GN Rope Fittings Director Bart Vossenberg JR, Vera Vossenberg, Head Administrator, and Bart Vossenberg SR, CEO.

A dark blue advertisement for the 10th edition of Ocean Energy Europe. The text '2023 OCEAN ENERGY EUROPE' is prominently displayed in white, along with the date '25-26 OCTOBER, THE HAGUE, NETHERLANDS'. Below this, '10TH EDITION' is written in gold. A circular logo featuring a stylized wave is positioned next to the text. At the bottom left, the word 'REGISTER NOW' is enclosed in a gold-bordered box. The bottom right corner features the logo for 'DMEC DUTCH MARINE ENERGY CENTRE' in white. The word 'Platinum Sponsor' is also present in white text.





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Dredging Summit & Expo

Las Vegas, NV » July 17–20
<https://dredging-expo.com/>

SPE Subsea Well Intervention Symposium

Galveston, TX » August 8–10
<https://www.spe.org/events/en/2023/symposium/23ssi/subsea-well-intervention.html>

South America Offshore Wind 2023

Rio de Janeiro, Brazil » September 18–20
<https://fwssouthamerica.com/>

OCEANS Gulf Coast

Biloxi, MS » September 25–28
<https://gulfcoast23.oceansconference.org/>

ACP Offshore WINDPOWER

Boston, MA » October 3–4
<https://cleanpower.org/offshore-windpower/>

Hydrogen North America 2023

Houston, TX » October 11–12
<https://events.reutersevents.com/renewable-energy/hydrogen-usa>

Offshore Wind Executive Summit

Galveston, TX » October 23
<https://www.offshorewindsummit.com/>

OTC Brasil

Rio de Janeiro, Brazil » October 24–26
<https://otcbrasil.org/>

TMA BlueTech Week

San Diego, CA » November 13–17
<https://www.tmablauetech.org/bluetech-week>

Floating Wind USA 2023

San Diego, CA » November 29–30
<https://events.reutersevents.com/renewable-energy/floating-wind-usa>

Underwater Intervention

New Orleans, LA » November 29–December 1
<https://www.workboatshow.com/underwater-intervention/>

Workboat Show

New Orleans, LA » November 29–December 1
<https://www.workboatshow.com/>

EUROPE

Offshore Wind Foundations & Substations

Bremen, Germany » August 28–31
<https://www.ipc.com/events-offshore-foundations-substations>

SPE Offshore Europe

Aberdeen, UK » September 5–8
<https://www.offshore-europe.co.uk/>

DSEI

London, UK » September 12–15
<https://www.dsei.co.uk/welcome>

Underwater Minerals Conference (UMC)

Rotterdam, NL » October 1–6
<https://www.underwaterminerals.org/>

World Engineers Convention

Prague, Czech Republic » October 11–13
<https://www.wec2023.com/>

International Wind Congress

Berlin, Germany » October 23–24
<https://windcongress.com/>

Ocean Energy Europe (OEE)

The Hague, NL » October 25–26
<https://www.oceanenergy-europe.eu/annual-event/oee2023/>

Offshore & Floating Wind Europe

London, UK » October 25–26
<https://events.reutersevents.com/renewable-energy/offshore-floating-wind-europe>

Offshore Energy

Amsterdam, NL » November 28–29
<https://www.offshore-energy.biz/oec2023/>

NCS Exploration Deep Sea Minerals

Bergen, Norway » December 5–7
<https://events.geonova.no/event/deepseaminerals/>

OTHER REGIONS

Australia Wind Energy

Melbourne, Australia » July 25–26
<https://www.windenergyaustralia.com/>

Gastech

Singapore » September 5–8
www.gastechevent.com

Mozambique Gas & Energy Summit

Maputo, Mozambique » September 27–28
www.mozambiqueenergysummit.com

ADIPEC

Abu Dhabi, UAE » October 2–5
www.adippec.com

Mediterranean Offshore Conference (MOC)

Egypt » October
<https://moc-egypt.com/>

Asia-Pacific Deep Sea Mining Summit

Singapore » December
<https://www.asia.deepsea-mining-summit.com/>

SYMPOL 2023

Kerala, India » December 13–15
<http://sympol.cusat.ac.in/>

MONTH & DEADLINES	EDITORIAL FOCUS & CONFERENCES	CONTENT
JULY Spotlights: June 27 Ad: July 7	» UNCREWED VEHICLES BUYERS' GUIDE ☐	Editorial Topics: Special Edition
AUGUST Editorial: July 24 Ad: Aug. 11	» OCEAN OBSERVATION, DATA, & COMMUNICATIONS OCEANS Gulf Coast / September 25–28 MATS / November 7–9	Editorial Topics: Oceanography, Meteorology, Remote Sensing, Telemetry, Data Processing, Seafloor Mapping, Cloud-Based Data Storage Product Focus: Marine Observation Systems, Buoys, Drifters, Marine Research Vessels, Subsea Nodes, CTD, Acoustics, Biosensors
SEPTEMBER Editorial: Aug. 21 Ad: Sept. 8	» REMOTE MARINE OPERATIONS ACP Offshore WINDPOWER / October 3–4 Ocean Energy Europe / October 25–26 Offshore Energy / November 28–29	Editorial Topics: Subsea Inspection, Maintenance, Repair (IMR), Seabed Residency, Subsea Intervention, Oil Spill Response, Remote Operations Centers, Professional Development & Training Product Focus: Inspection AUVs, ROVs, USVs, Work-Class ROVs, Pipeline Pigs, Ultrasonic Imaging
OCT/NOV Editorial: Sept. 18 Ad: Oct. 6	» THE OFFSHORE DEVELOPER'S TOOLKIT TMA BlueTech Week / November 13–17	Editorial Topics: Offshore IoT, Asset Integrity Monitoring, Autonomous Control Systems, Digital Twin Technology, Decommissioning Services Product Focus: Predictive Maintenance Solutions, Electric Workboats, USVs, Untethered ROVs
DECEMBER Editorial: Oct. 30 Ad: Nov. 10	» THE FUTURE OF OCEAN TECHNOLOGY	Editorial Topics: Special Edition

☐ Digital Issue

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UK OPENS STATE-OF-THE-ART ROBOTICS CENTER FOR OFFSHORE RENEWABLE ENERGY

The Digital, Autonomous and Robotics Engineering (DARE) Centre at the Offshore Renewable Energy (ORE) Catapult's testing facility in Blyth was opened in late May by the UK's Minister for Energy Security and Net Zero, the Rt Hon. Graham Stuart MP.

The DARE Centre is the first of its kind in the UK and will provide a unique opportunity for developers, researchers, and wider industry to test, demonstrate and commercialize innovative digital and robotic products and services for the offshore renewable energy market.

As offshore wind in the UK gets ready to triple capacity over the next decade, the adoption of robotics and autonomous systems is vital to achieving this rapid expansion and reaching Net Zero. These technologies play an increasingly important role in the offshore renewable energy sector, and the UK is primed to establish a world-leading supply chain linked to their future development.

Technology tested at the DARE Centre will support the expansion of the offshore wind market and turbocharge the success of services and digital infrastructure surrounding the industry.

Andrew Jamieson, Chief Executive at ORE

Catapult, said: "The DARE Centre is a fantastic facility that will help the UK stay at the forefront of innovation in robotics, AI, and digital solutions to support the growth of offshore renewables."

"The UK has a global reputation for its sub-ocean engineering expertise and ingenuity. The DARE Centre will propel UK businesses and this capability into the fast-expanding offshore wind space."

The DARE Centre includes a robotics assembly bay, an airborne robotics test zone, three dry docks with 20,000-m³ capacity and test control rooms linked to the docks via a live environment monitoring system. The center is the latest part of ORE Catapult's National Renewable Energy Centre in Blyth, which offers a wide range of test and validation facilities, including market-leading wind turbine testing and an offshore demonstration zone.

Companies displaying their technology solutions at the DARE Centre opening included Kinewell, Enshore Subsea, SMD, EnergyVue, BeeX and Sonardyne, Eleven-l, Innovatek, and Aspira Aerial Applications—creating ways to streamline the offshore wind turbine installation and dramatically improve operations and maintenance on

offshore wind farms.

Jonathan Fenning, Managing Director at Aspira Aerial Applications, said: "The DARE Centre will be pivotal in supporting multiple stages of our Innovate UK project to develop spray application using a bespoke drone to improve the operating efficacy of wind turbine technology."

"Looking to the future, our technology can be used to apply other intelligent coatings such as environmentally sensitive de-icers, or coatings to assist with fatigue/crack inspections. We very much intend to maintain our partnership with the DARE team as we move forward."

The DARE Centre has been funded through UK Government's Getting Building Fund, managed in the region by the North East Local Enterprise Partnership (North East LEP), and Innovate UK.

Helen Golightly OBE, Chief Executive of the North East LEP, said: "The offshore wind and green energy sectors in our region are internationally renowned, so it's very fitting that the UK's first center for advancements in digital, autonomous and robotics engineering in renewable energy has opened here in the North East."

» The DARE Centre in Blyth. (Image credit: ORE Catapult)



KYSTDESIGN AWARDED RECORD WROV CONTRACT BY OMEGA SUBSEA ROBOTICS

Kystdesign AS has been awarded a contract by Omega Subsea Robotics AS to supply four state-of-the-art Constructor WROV systems. This accomplishment further solidifies Kystdesign's reputation as a trusted and dependable provider of cutting-edge underwater robotics across diverse industries.

Omega Subsea Robotics is an industrial collaboration between Solstad Offshore and Omega Subsea, formed to facilitate joint investments in ROV systems and associated equipment. With the joint project management and personnel services capabilities of Omega Subsea and Solstad Offshore, the investments further enable Solstad to increase its presence in the oil and gas and renewable energy segments and expand its service offerings.

The record delivery between the companies consists of four Kystdesign Constructor Mk 2 ROV systems—220 hp ROV systems with a depth rating of 3,000 m. The Constructor ROV is a key product in Kystdesign's line-up reflecting the company's steadfast determination to deliver cutting-edge solutions for underwater operations.

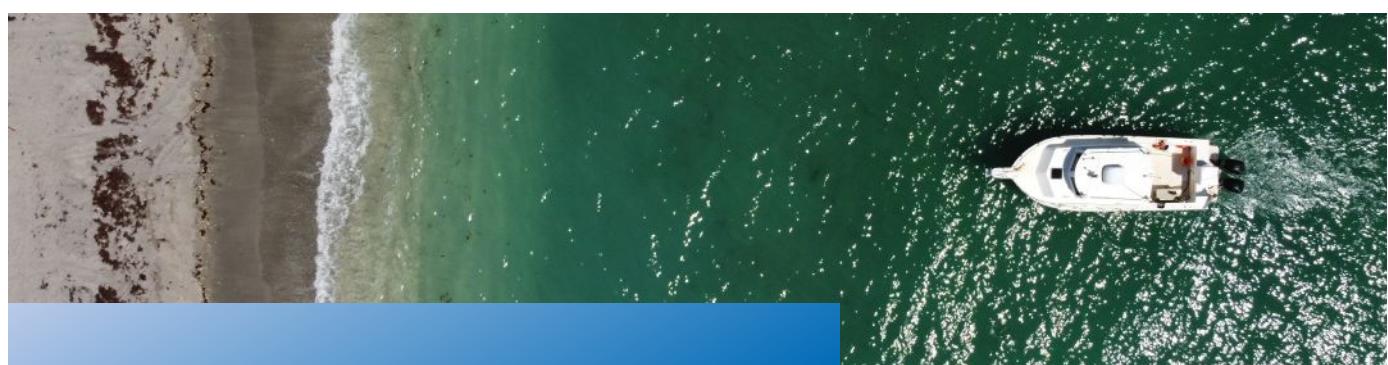
Following delivery by the end of 2023 the ROV systems will be mobilized on board nominated vessels in the Solstad fleet. The nomination of vessels and the timing of the mobilization on board will be determined by Solstad Offshore during the remainder of



» Kystdesign's HQ in Rogaland, Norway. (Image credit: Kystdesign)

2023. Omega Subsea will be responsible for managing, operating, and staffing the ROV systems in the future.

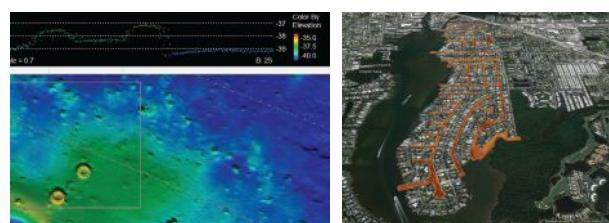
"This is the largest contract in Kystdesign's history," said Tore Neland, CEO of Kystdesign AS. "We are thrilled to begin a long-term collaboration with another local customer. We extend our sincere gratitude to our hardworking employees whose contributions made this achievement possible, and we would like to express our appreciation to Omega Subsea Robotics for their confidence in us."



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

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Michelle DeTerra

Birns Aquamate design and manufacture underwater electrical connectors, cable assemblies, and cable terminations. The company produces a wide range of standard industry products such as the 5500 Series, SC, MC, LP, FAWL/FAWM, NANO, TC, Rubber Molded, etc. Birns Aquamate is the only manufacturer to guarantee compatibility with other uw connectors. Birns Aquamate also specializes in fast turn-around for custom design of special connector solutions. All connectors are manufactured under IEC ISO 9001:2015 certification. Dealers in Canada, Brazil, UK, Belgium, Holland, Norway, Germany, South Africa, Holland, Italy, and China.

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📞 +1 772 219 3000 (US Office)
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🌐 www.bluefieldgeo.com

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📞 +47 73 54 55 00
📠 +47 73 51 50 20
✉️ km.seatex.sales@km.kongsberg.com
🌐 www.kongsberg.com/discovery
👤 Finn Otto Sanne at finn.otto.sanne@kongsberg.com

Kongsberg Discovery develops, manufactures and delivers innovative technology to enhance knowledge, surveillance and sustainability in the ocean space. From the deepest sea to outer space, our unique offering allows our customers to understand complex environments, mitigate risk and achieve ambitious objectives. The Kongsberg Discovery portfolio spans hydro acoustics with sonars and echo-sounders, marine robotics, inertial navigation, communication, and underwater and above surface position reference systems using laser, radar and GNSS technologies. Our technology, combined with deep application knowledge and software expertise, provides significant value for our customers.

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45 Spear Road Industrial Park,
Ramsey, NJ 07446 USA
📞 +1 201 825 1400
📠 +1 201 825 1962
✉️ atl@atlinc.com
🌐 www.atlinc.com
👤 David Dack

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

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8502 SW Kansas Avenue
Stuart, FL 34997
📞 +1 770 828 5464
✉️ gstevens@conshelf.com
🌐 www.csaocean.com
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4909 US Highway 1
Vero Beach, FL 32967
📞 +1 772 388 5364
📠 +1 772 388 3165
✉️ info@morganeklund.com
🌐 www.morganeklund.com

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📞 +1 772 419 9627
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🌐 www.marineventures.com

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Pirserteret
N-7462 Trondheim, Norway
📞 +47 73 54 55 00
📠 +47 73 51 50 20
✉️ km.seatex.sales@km.kongsberg.com
🌐 www.kongsberg.com/discovery
👤 Finn Otto Sanne at finn.otto.sanne@kongsberg.com

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255 George St, Sydney NSW 2000
📞 +61 2 9099 3800
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Ackerstrasse 76
13355 Berlin, Germany
📞 +49 (0) 30 4679 862 0
📠 +49 (0) 30 4679 862 01
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🌐 www.evologics.de

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

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1150 McBride Avenue
Woodland Park, NJ 07424
📞 +1 973 785 6000
✉️ marketing@kearfott.com
🌐 www.kearfott.com

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Pircenteret
N-7462 Trondheim, Norway
📞 +47 73 54 55 00
📠 +47 73 51 50 20
✉️ km.seatek.sales@km.kongsberg.com
🌐 www.kongsberg.com/discovery
👤 Finn Otto Sanne at finn.otto.sanne@kongsberg.com

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Ackerstrasse 76
13355 Berlin, Germany
📞 +49 (0) 30 4679 862 0
📠 +49 (0) 30 4679 862 01
✉️ sales@evologics.de
🌐 www.evologics.de

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Pircenteret
N-7462 Trondheim, Norway
📞 +47 73 54 55 00
📠 +47 73 51 50 20
✉️ km.seatek.sales@km.kongsberg.com
🌐 www.kongsberg.com/discovery
👤 Finn Otto Sanne at finn.otto.sanne@kongsberg.com

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📞 +1-250-656-0177
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Gardabaer, Iceland
📞 +354 533 6060
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Stafford TX 77477
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✉️ patrick.yerger@cortlandcompany.com
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West Wareham, MA 02576
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info@edgetech.com
www.edgetech.com
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EdgeTech designs, manufactures and sells industry-leading side scan sonars, sub-bottom profilers, bathymetry systems and combined sonar systems. Additionally, the company produces world class underwater actuated and transponding solutions including deep sea acoustic releases, shallow water and long life acoustic releases, transponders, reliable USBL acoustic tracking and positioning systems, and custom-engineered acoustic products.

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209 - 1875 Broadway Street
Port Coquitlam, BC
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+1 604 944 8248
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www.imagenex.com
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www.massa.com
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Ackerstrasse 76
13355 Berlin, Germany
+49 (0) 30 4679 862 0
+49 (0) 30 4679 862 01
sales@evologics.de
www.evologics.de

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Wellseedamm 1-3, 24145 Kiel,
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+49 431 22039 880
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info@subctech.com
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Ackerstrasse 76
13355 Berlin, Germany
+49 (0) 30 4679 862 0
+49 (0) 30 4679 862 01
sales@evologics.de
www.evologics.de

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21 Thorhill Drive Dartmouth,
Nova Scotia B3B 1R9 Canada
+1 902 468 2505
+1 902 468 4442
emily@metocean.com
www.metOcean.com
Emily MacPherson

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35 Meadowbrook Drive
Milford, NH 03055, USA
+1 603 673 9570
sales@airmar.com
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AIRMAR Technology is a leading developer and manufacturer of acoustic and ultrasonic sensing solutions. We push the boundaries of ultrasonic technology to develop advanced products that withstand the harshest ocean environments while reliably facilitating data gathering from surface to full ocean depth. Our comprehensive suites of marine, oceanographic and survey transducers, plus our WeatherStation® instruments, deliver performance that meets the most challenging mission requirements. Ideal applications include shallow and deep-water survey, sub-bottom profiling, navigation, fisheries research, aquatic habitat assessment, underwater scientific applications and more. Customization of transducers for specific marine applications is available.

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Ackerstrasse 76
13355 Berlin, Germany
+49 (0) 30 4679 862 0
+49 (0) 30 4679 862 01
sales@eologics.de
www.eologics.de

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553 South Street
Quincy, MA 02169
+1 617 715 7000
justin.reid@gd-ms.com
www.gdmissonsystes.com/bluefin
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1734 Broadway Street,
Port Coquitlam, BC, V3C 2M8
+1 604 942 5223
info@ise.bc.ca
<https://ise.bc.ca/>
International Submarine Engineering Ltd. (ISE) is a world leader in the design and integration of autonomous and remotely operated robotic vehicles and terrestrial robotics. Over our 40+ years in business, we have accumulated a great deal of expertise in the design, manufacture, and maintenance of: Autonomous Underwater Vehicles (AUVs), Remotely Operated Vehicles (ROVs) for subsea operation, Human Occupied (HO) submersibles, Customized systems for the offshore oil industry, Customized systems for the Military-Naval sector, Hydraulic, pneumatic, and electric robotic manipulators, Teleoperated and autonomous robotic systems, Robotic systems for nuclear Industry applications, Communications and real-time control system.



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L3HARRIS TECHNOLOGIES, INC.

275 Martine Street
Fall River, MA 02723 USA
+1 508 678 0550
+1 508 678 0552
IVER.Sales@L3Harris.com
www.L3Harris.com
Jim Kirk

L3Harris Technologies is an agile global aerospace and defense technology innovator, delivering end-to-end solutions that meet customers' mission-critical needs. The company provides advanced defense and commercial technologies across air, land, sea, space and cyber domains. L3Harris develops autonomous, lightweight Unmanned Undersea Vehicles (UUV). L3Harris has established itself as the leader in man portable UUVs, providing highly capable vehicles to a wide array of military, commercial and research customers. With over 15 years experience in the underwater field, our engineers have developed a reliable and easy to use platform that is trusted to complete marine missions all around the world.



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38190 Commercial Ct.

Slidell, LA 70458 USA

+1 985 847 1104
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jeff@outlandtech.com
www.outlandtech.com
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7765 SW Ellipse Way,

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+1 772 742 3700
info@searobotics.com
www.searobotics.com

SeaRobotics Corporation, headquartered in Stuart, Florida, specializes in the design and manufacture of intelligent marine robotics, including a line of Autonomous Surface Vehicles (ASVs) for commercial and defense markets around the world. Applications for SeaRobotics vehicles range from bathymetric and hydrographic coastal surveys to, harbor, and riverine inspection and surveillance. From ground-breaking ASV design through to custom manufacturing for theme parks, SeaRobotics designs, engineers and manufactures smart solutions for complex marine challenges. In addition to our ASV line, SeaRobotics also designs and builds hull and tank bio-inspired underwater grooming and cleaning systems.



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212 East High Street,
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11989-A FM 529
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+1 713 460 1400
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www.oceanus.com
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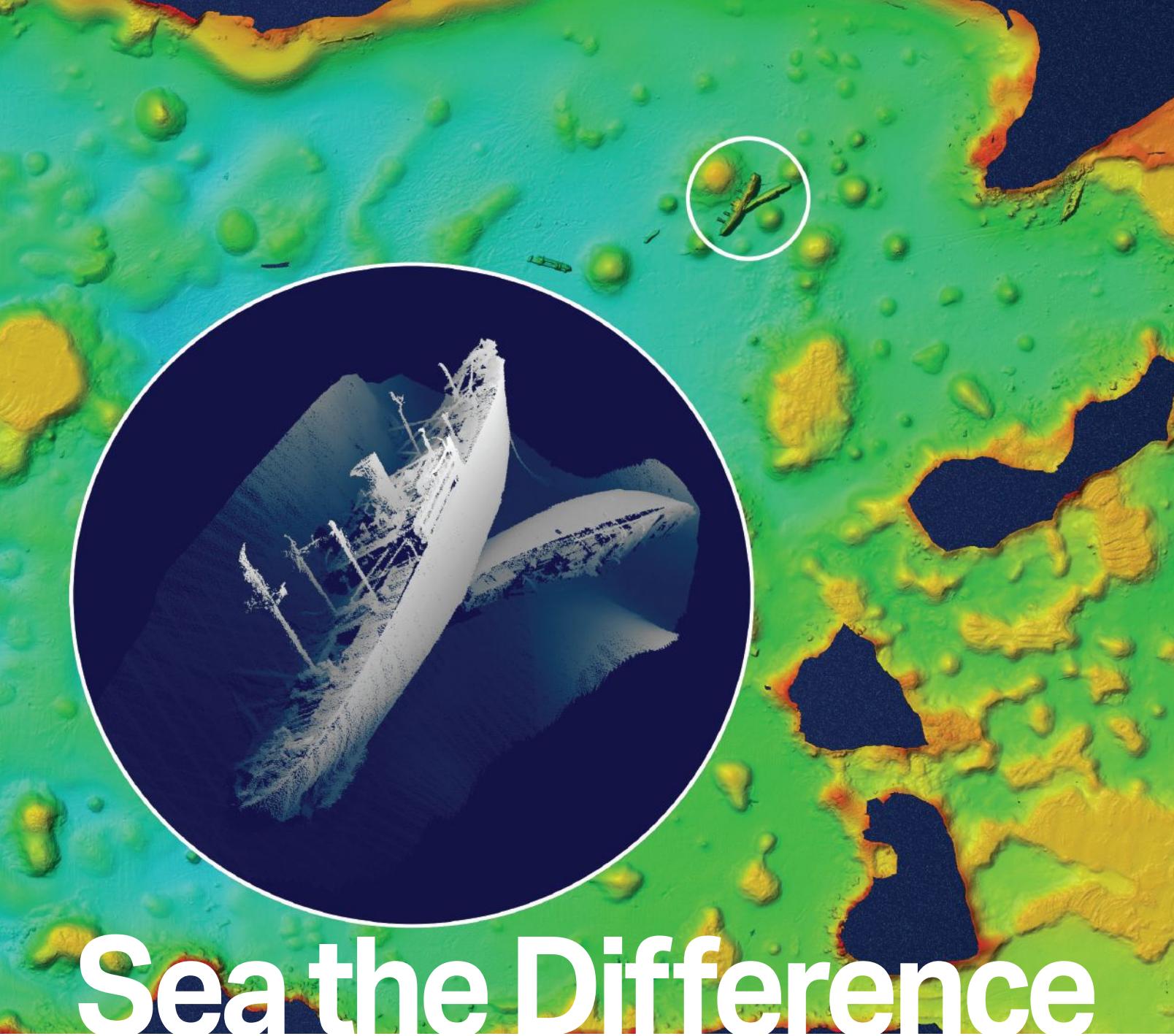


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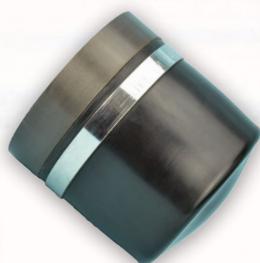
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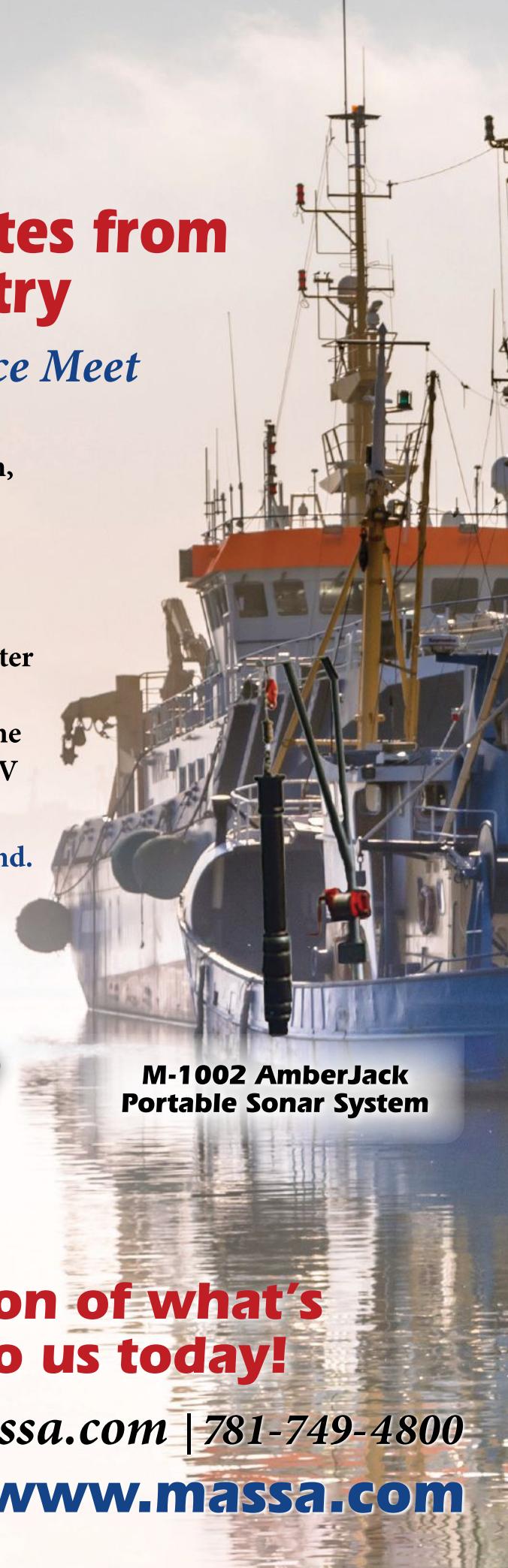
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