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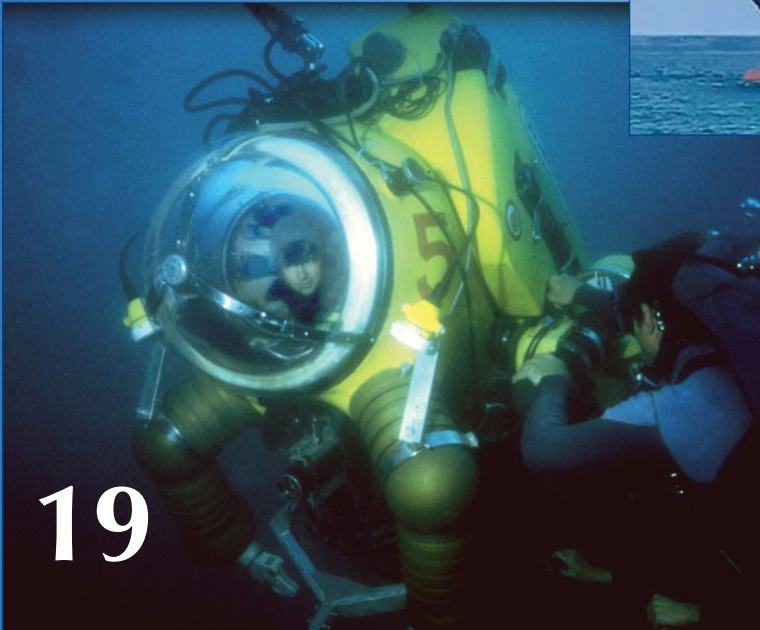




14



10



19



CONTENTS

DECEMBER 2023
Volume 64, No. 12

FEATURES

10

CONTACTLESS SUBSEA POSITIONING

Christina Hill (*Zupt*) explains how HaloCAM has been upgraded with an INS featuring high-resolution imaging to monitor deepwater structures.

14

DEMYSTIFYING THE DEEP SEA

Luke Richardson (*Voyis, Covelya Group*) introduces holistic solutions that illuminate the ocean's depths.

19

Q&A: DR. EDIE WIDDER

An interview with the ocean explorer, conservationist and developer of deep-sea technologies.

23

SEISMIC DATA MANAGEMENT

Kristy DeMarco (*Seagate Technology*) discusses how to streamline the process of acquiring and processing data.

27

RADAR ON LOW BANDWIDTH

Alan Trojanowski (*Cambridge Pixel*) describes how signal processing encodes only essential data.

DEPARTMENTS

6

Soundings

7

Editorial

29

International

31

Ocean Research

32

Product Development

34

Marine Resources

35

Marine Electronics

36

Marine Renewables

37

Contracts/Meetings

38

People

39

Soapbox

40

Professional Services Directory

41

Advertiser Index

COVER IMAGE

During the crew's submersible pilot training in February 2022 aboard the *MY Hodor*, a three-person Aurora submersible by SEAmagine executes its descent to 1,000 m off the coast of Moorea Island in French Polynesia. (Credit: Rodolphe Holler)

NEXT MONTH

Annual Review & Forecast.

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)) Robot Fleet for Offshore Wind Industry. A fleet of marine robots that can tackle complex offshore tasks, part of a recently completed, groundbreaking project funded by Innovate UK, is poised to change approaches in the offshore wind farm industry. Squads of Adaptive Robots (SoAR), a two-year collaborative research and development initiative, was led by the developer of ecoSUB AUVs, Planet Ocean. The project kicked off in September 2021 and culminated this summer with full system testing at Smart Sound Plymouth on England's south coast. Open-water trials successfully showcased coordinated missions designed, monitored and adapted in real time by an intelligent "Autonomy Engine." The trials involved several surface and underwater autonomous systems, with mission management conducted from a remote shore-based command and control facility. The trials simulated an offshore wind farm concession survey mission informed by a comprehensive business case analysis by ORE Catapult. SoAR has led to the introduction of advanced AI-driven mission planning, open-source communications protocols for heterogeneous fleet coordination, and a range of new and enhanced platform capabilities for both surface and subsurface systems.

)) Carbon Capture Pilot Plant Trains Future Workforce. A dedicated carbon capture pilot plant will continue to train the net-zero workforce and engineers and scientists of the future as a result of ABB (*Sea Technology*, August 2023) and Imperial College London signing a 10-year contract to extend their successful partnership. The plant is the only one of its kind as an academic institution. More than 4,500 students have had hands-on experience of ABB's technology solutions at the plant since it opened in 2012 at Imperial College. A report by EngineeringUK says that for the U.K. to meet emissions targets by 2050, there needs to be a workforce with the right STEM backgrounds to be able to respond to the energy transition challenge. The plant uses ABB Ability System 800xA for distributed process control and over 250 instruments, measuring temperature, pressure, carbon dioxide and flow. System 800xA automatically controls and coordinates all aspects of the plant process, which is then visualized on displays in the ABB Control Room, where students can monitor and intervene if necessary. ABB's Ability Verification for measurement devices and new Ability SmartMaster verification and condition monitoring platform are also being used to equip students with the skills needed to optimize instrument performance through predictive maintenance.

)) California Law to Advance Wave, Tidal Energy. Eco Wave Power Global AB, a publicly traded onshore wave energy developer, has reported that California Governor Gavin Newsom has signed California Senate Bill 605 (SB 605) into law; a historic moment for wave energy in the U.S. The legislation directs the California Energy Commission to evaluate the feasibility of wave and tidal energy in California, including the costs and benefits of implementing the technology across the state's coastline. The California Energy Commission will work with various state agencies and stakeholders to identify suitable locations for wave energy and tidal energy projects in both California and federal waters. This comes after California's State Legislature set 2045 as its target for a 100 percent renewable and zero-carbon power grid, with its first benchmark target being 90 percent by 2035. As of 2022, net-zero carbon and renewable energy made up 54.23 percent of California's total energy supply. The primary sponsor of SB 605 is AltaSea at the Port of Los Angeles, a 35-acre ocean technology campus. AltaSea will house Eco Wave Power's first U.S. pilot station, supposedly the first onshore wave energy station in the U.S. SB 605 requires the California Energy Commission to produce a written report by 2025 to the governor and the legislature on its findings, including any "considerations that may inform legislative and executive actions to facilitate, encourage, and promote the development and increased use of technologically and economically feasible wave energy and tidal energy technologies, infrastructure, and facilities in the state." A study by the National Renewable Energy Laboratory (NREL) found that wave and tidal energy have the potential to generate 30 percent of America's energy needs. The NREL also found that California's wave energy potential can power approximately 13 million homes.

)) Ships Propulsion Evolves with Decarbonization Efforts. Decarbonization will be the top item on the maritime sector's agenda for the coming years, but it is unclear which ship propulsion technology will ultimately prevail, according to the SMM Maritime Industry Report 2023 (MIR). While many shipowners are taking a wait-and-see approach, yards and suppliers are already offering innovative efficiency-enhancing and decarbonization solutions. The International Maritime Organization (IMO) wants the global fleet to be carbon neutral around 2050, a goal that will affect approximately 90,000 units globally. Not every decision maker in the industry believes this is attainable, according to the current MIR, which has been commissioned by Hamburg Messe und Congress: 46 percent of respondents doubt that the IMO targets can be achieved within the given time frame, with similar skepticism found among shipyards and suppliers. There are many reasons: While shipowners are mainly concerned about an inadequate supply of alternative fuels and a shortage of suitable technologies, yards see an insufficient willingness to invest on the part of shipowners, whereas suppliers fear that high costs will get in the way. Despite doubts about the timing of the IMO targets, the industry is trying to develop ways to reduce emissions from ships: 77 percent of responding shipowners plan to invest in emissions reduction, six percentage points more than in the previous MIR survey of 2021. Their main focus is on technical improvements, primarily engine technology. **ST**

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We Should Not Abandon Manned Subs Post-Titan

In 1962, JFK delivered the famous words: "We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard." Articulating mankind's resolve to embark on such missions not because of their simplicity but because of their inherent difficulty inspired generations to push the boundaries of exploration in the decades that followed, not just in space but also in the ocean.

The word "hard" does not imply "unsafe" or "reckless." It means "difficult." Ocean exploration is difficult—but that difficulty can be managed with a commitment to safety through meticulous engineering, robust technologies, disciplined practices, rigorous approval processes and the implementation of established operational procedures. This approach fosters a can-do spirit that empowers to expand our knowledge through discovery.

There's been a recent rise in the use of human-occupied vehicles (HOVs), or manned submersibles, for deepwater tourism and scientific research. The past decade has seen the construction of more manned submersibles than in the preceding 25 years. These vehicles have made noteworthy contributions to science, including via citizen science initiatives. Most of these vessels have been meticulously constructed in strict accordance with industry standards and are approved by classification societies and various flag states.

The implosion of the *Titan* submersible in June 2023, resulting in the deaths of five people, was a tragic anomaly. This incident made global headlines and has impacted the manned submersible sector.

HOVs will continue to evolve as technologies for deepwater exploration, but what has become clear to all stakeholders in the wake of the *Titan* incident is the value of established professional standards and industry approval processes—which the experimental *Titan* submersible disregarded.

Over the course of over four decades, during which tens of thousands of dives in HOVs have been conducted at a variety of depths, there had not been a single major incident involving manned subs. Remarkable technological advancements have been achieved in HOVs over those years, all while operating within the framework of formal rules and approval codes. This underscores that the pursuit of cost-effectiveness or enhanced capabilities does not necessitate abandoning well-established approval processes and codes in order to remain competitive and relevant. The business model for subs engaged in deepwater tourism, research and recreation should promote these standards that have proven so successful in ensuring safety. The industry should engage in enhancing regulatory processes, rather than forsaking them. For instance, design approvals through computer analysis could significantly expedite reviews of new concepts, thereby enhancing economic efficiencies.

The *Titan* incident is a stark reminder of the substantial public interest the blue technology sector commands. This interest can be harnessed and directed to bolster the blue economy, and it underscores the industry's imperative to collaborate internationally to advocate for established standards and best practices to foster the ongoing development of the HOV industry.

More than ever, our oceans demand a reinvigorated human commitment to exploration and comprehension. It is imperative that the industry upholds its dedication to professional methodologies and unwavering technical excellence as we move forward.

The confluence of public interest and industry expertise can catalyze a transformational era in the sustainable exploration of our oceans. We will do this not because it is easy—but because it is hard. **ST**

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Annual Review & Forecast

****EUROMARITIME 2024**, January 30-February 1, Marseille, France

FEBRUARY

Instrumentation: Measurement, Processing & Analysis

****Oceanology International 2024**, March 12-14, ExCel, London, U.K.

MARCH

Electronic Charting/Vessel Management/ Ports & Harbors/Dredging/Homeland Security

****UDT 2024**, April 9-11, ExCel, London, U.K.

****OCEANS 2024 Singapore**, April 14-18, Singapore

****XPONENTIAL 2024**, April 22-25, San Diego, CA

APRIL

Offshore Technology/Alternative Energy & Ocean Engineering

****Offshore Technology Conference**, May 6-9, Houston, TX

MAY

Communications, Telemetry, Data Processing

JUNE

Seafloor Mapping/Sonar Systems/Vessels

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Ocean Resources Development & Coastal Zone Management

****OCEANS 2024 Halifax**, September 23-26, Halifax, Canada

SEPTEMBER

Geophysical Exploration/Seafloor Engineering

OCTOBER

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****EURONAVAL 2024**, November 4-7, Paris, France

****CLEAN GULF**, November 18-20, San Antonio, TX

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Contactless Subsea Positioning

HaloCAM Upgrades INS with High-Res Imaging to Monitor Structures

By Christina Hill

The inception of Zupt's HaloCAM stemmed from the knowledge gained through the development of two other Zupt subsea technologies, 3D Recon and our Halo prototype. 3D Recon is a subsea 3D modeling system incorporating two stereo imaging cameras with a navigation grade inertial measurement unit (IMU), and Halo is a compact subsea inertial navigation system (INS).

In 2019, we were presented with a unique project for which we asked if our current 3D Recon system (*Sea Technology*, February 2023) could be used to provide a real-time determination of the verticality and other position of a conductor casing being spud into the seabed without requiring pauses in operation or physically mounting brackets to the structure. Our initial response to the problem was "yes," but 3D Recon was financially prohibitive for this task in the context of the client's budget.

The project, however, could be completed with a more efficient, simpler solution. Instead of using 3D Recon, we turned to repurposing our existing Halo prototype, which is a navigation-grade compact INS for ROVs. Since Halo includes a highly accurate IMU within its core components, it served as the ideal starting point for the hardware development of HaloCAM. We just needed to make it "see."

To bring HaloCAM to life, we replaced the lower end cap of the Halo prototype with a subsea camera selected specifically for this type of work. As a standalone solution, HaloCAM quickly evolved into a highly capable and versatile tool with both machine vision and navigation capabilities. Although HaloCAM was initially con-



HaloCAM.

ceptualized for use in the oil and gas industry, it became apparent that there was significant demand for subsea monitoring of monopile verticality in the renewable energy sector.

HaloCAM Design

The function of HaloCAM is to monitor the verticality, heading and relative position of any structure with a fiducial target; in our case, we chose an AprilTag-style target that adhered to the structure. The integration of a high-resolution machine vision camera with a navigation-grade INS has formed a powerful subsea imaging and positioning solution that offers contactless, real-time data transmission to the surface.

The information delivered through HaloCAM includes positioning parameters such as altitude/stick-up height, inclination, roll, pitch, and the relative heading of the target in relation to the ROV. This ability to position a structure in real time can significantly enhance the



(Top) Target adhered to a subsea structure. (Bottom) HaloCAM mounted to an ROV.



curate placement and alignment in relation to the structure. The ROV is then deployed, and the structure (including the target) descends to the project area on the seabed. The ROV then watches the structure from a safe distance of 2-plus meters away, and HaloCAM uses its high-resolution camera to recognize the pre-installed target to begin collecting data. For example, in an oil and gas application involving conductor casings, the target is securely attached to the casing topside. Once at depth, this target serves as a visual reference point for HaloCAM's monitoring system, allowing it to track and analyze the position of the casing throughout the installation.

HaloCAM processes machine vision, image and IMU data within its single housing subsea to accurately determine the target's position and attitude. The positioning data are processed in real time and presented to the topside user through a user-friendly interface at a rate of 5 Hz. Internal data processing reduces bandwidth requirements and simplifies data output to enhance efficiency in subsea operations.

Key Advantages

Contactless Data Collection. HaloCAM's unique capabilities offer several key advantages compared to traditional methodologies. One of the most prominent advantages of HaloCAM is its ability to streamline the subsea monitoring process. Operational time is significantly reduced through continuous data collection during structure installation, coupled with quick and seamless integration to the vehicle.

Take into consideration the traditional noncontactless positioning method that involves using a bullseye to determine verticality. When using a bullseye for positioning, an ROV must be in close proximity to the structure to properly view it, which has inherent limitations. Under the traditional bullseye method, ROV operations must come to a complete halt during the monitoring process to check alignment. This interruption can be both time-consuming and inefficient. The need for close proximity

directly above the target may pose a risk of damage to the ROV or the hardware mounted on the structure. This damage could go unnoticed and cause problems later down the line.

The contactless data collection through HaloCAM significantly reduces the cost and risk associated with placing expensive sensors onto piles, conductors, or

efficiency of subsea monitoring, especially when assessing the verticality of structures with tight tolerances and real-time requirements.

HaloCAM is mounted to the front of the ROV while the target is securely installed to the structure before deployment. While offshore, dimensional control is completed between the target and structure to ensure ac-

“HaloCAM processes machine vision, image and IMU data within its single housing subsea to accurately determine the target’s position and attitude.”

structures. This simplifies the monitoring process and improves operational efficiency for a wide range of applications when maintaining the verticality of cylindrical structures is essential.

Accuracy of +/- 0.2°. As the system was originally designed, HaloCAM offers an accuracy of +/- 0.2° in verticality, assuming clear visibility (the system is within a clear line of sight) to the structure. The positioning accuracy and update rate of HaloCAM are not affected by shock or acoustic noise from hammering or jetting during installation, and this high level of accuracy ensures that verticality measurements are consistently reliable.

Depending on the desired level of accuracy based on project requirements, HaloCAM has the flexibility to interchange internal components of the sensor. This feature allows clients to customize the sensor’s configuration, tailoring it to their unique project accuracy needs. For instance, if a project demands more accurate measurements, we can easily swap a higher-resolution imaging sensor or IMU to achieve the desired accuracy. Conversely, if a task requires a broader view and permits a slightly lower level of accuracy, a lower-resolution sensor or IMU can be substituted to create a more affordable solution. The “base” accuracy rate of +/- 0.2° and the adaptability to various imaging components make HaloCAM an ideal customizable solution, catering to the unique needs of each project.

Absolute Positioning. In cases where absolute positioning of the structure is required, HaloCAM can incorporate data from the ROV’s navigation solution, further enhancing its positioning utility. By combining navigation data such as ultrashort baseline (USBL), long baseline (LBL) and INS/Doppler velocity log (DVL) from the ROV, HaloCAM will incorporate the coordinates and calculate the absolute position of the target on the structure. This enhanced integration capability becomes particularly valuable for future construction in the field and site planning, ensuring accurate positioning for continued field operations.

Simple Integration with ROV. HaloCAM’s integration with an ROV is straightforward, with a single connection from the ROV. The mobilization to the vehicle is quick and painless, and the ROV crew can interface the sensor without any specialty survey personnel required offshore.

Unlike other camera-based technologies that require external INS inputs, the IMU within HaloCAM is fixed within the subsea housing. This integration into a single

housing also eliminates the need for offset measurements and intricate INS-to-camera dimensional control. As a standalone system, HaloCAM is compatible with a wide range of ROVs, including observation-class ROVs.

Vertical Offset Determination. HaloCAM assists in the planning and execution of future structure installations by delivering accurate distance determinations of the target on the structure to the seabed. The system’s ability to determine distances relative to the seabed is crucial for ensuring stability and structural integrity in oil and gas and renewable energy applications.

The data can be used in several ways. In the oil and gas industry, HaloCAM will precisely monitor the stickup heights of conductor casings above the seabed to prevent the shifting or sinking of these casings. This reduces the risk of operational disruptions and the potential problem of leaving improperly installed assets as hazards in that field.

In renewable energy, HaloCAM will accurately measure the distance between monopile height/penetration from the seabed. This information will then play a crucial role in ensuring the secure installation of other components (transition piece, wind turbine) on the top of the platforms while maintaining stability and structural integrity.

Applications in Renewable Energy and Beyond

Initially designed for determining the verticality and stick-up height of conductor casings during installation, HaloCAM’s capabilities extend beyond this specific oil and gas application. HaloCAM’s versatility has surpassed its initial scope by finding function in not only open-water drilling operations but also meeting specific renewable energy infrastructure operational needs, such as installing suction piles and monopiles.

Accurate monopile installation is critical for offshore wind farm efficiency. These monopiles, measuring approximately 5 to 7 m in diameter, must be driven into the seabed and serve as the sturdy foundation for supporting wind turbines that will later be installed on top. The verticality of the monopiles directly influences the structural integrity and longevity of the mounted wind turbine; because of this sensitivity to verticality, there are highly accurate installation requirements from operators. HaloCAM serves as a tool for overcoming these challenges to achieve accuracy demands.

Leveraging its contactless capabilities, HaloCAM can accurately assess the attitude and differential depth of a

target placed on any subsea structure an ROV can view. This marks a significant advancement in the renewable energy industry, as traditional methods may involve the time-consuming and risky manual installation of bracketry for subsea gyros or acoustic transponder buckets.

While HaloCAM primarily focuses on positioning cylindrical structures, its data output can be offset to accommodate various subsea shapes. Whether it's a hub reference face on a tree or manifold, HaloCAM can adapt to curved or flat surfaces, with the target size tailored to the installation's requirements.

Torpedo piles, which are used to anchor FPSOs, represent one of the applications for which HaloCAM has been considered. A torpedo pile is lowered into the water column and positioned approximately 100 m above the seafloor before deployment. This makes determining the torpedo pile's position extremely critical before it is released to its permanent location. Prior to release, HaloCAM will utilize the ROV positioning solution (USBL) to relate the relative position of the torpedo pile back to the (X,Y) position of the ROV and ensure the pile is properly positioned above its target box.

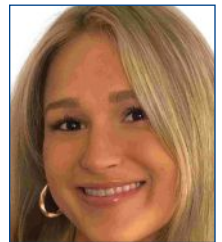
Conclusion

This innovative contactless positioning system, conceptualized from the prior development of Zupt's navigation and imagery technologies, has emerged as a versa-

tile tool with the unique ability to monitor verticality and precise positioning of various subsea structures across oil and gas and renewable energy applications. Whether monitoring the installation of suction piles, monopiles or other subsea structures, HaloCAM provides the data needed for accurate and efficient operations.

HaloCAM's development represents a significant leap forward in subsea imaging and monitoring as a game-changing technology that meets these demands for accurately determining the verticality of subsea structures. Its ability to provide real-time, contactless and highly accurate data has the potential to save critical operational time compared to other traditional positioning methods. As we continue to develop and refine HaloCAM, we envision its use as a remote data collection sensor, operable anywhere with minimal bandwidth connections to the shore, further enhancing its utility and applicability in offshore operations. **ST**

Christina Hill is an accomplished digital marketing specialist, currently lending her expertise to Zupt LLC, a company that offers advanced surveying services and technologies using inertial navigation systems. With over two decades in the energy industry, Zupt specializes in subsea, renewables, integrity management and land applications.



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Demystifying the Deep Sea

Holistic Solutions Illuminate the Ocean's Depths

By Luke Richardson

In a recent UNESCO article, it was estimated that just 5 percent of the ocean has been explored and charted by humans and, with the ocean covering more than 70 percent of the Earth's surface, this leaves the majority of our planet unexplored. With a huge, untapped potential for environmental, geological and commercial resources, finding ways to explore the ocean safely and with minimal environmental impact has been challenging.

The only truly safe and efficient way to explore deepwater is through robotics platforms, including ROVs and AUVs.

Sensors

It is evident that ROVs and AUVs are enabling humans to access the deep with the highest degree of safety and, depending on the operation, with a greater reduction in environmental impact. When using these platforms for operations deep in the ocean, there is a critical reliance on high-quality, high-performing sensors on board to ensure that this type of expensive equipment comes back safely and with usable data. While the mechanics of the vehicle are a continuing challenge for vehicle manufacturers, there is another aspect to consider: the “brains” of the mechanical interface. These are the sensors that all need to complement one another and work together to enable the platform to operate efficiently and effectively.

Taking on the role of a “sensor prime,” Covelya Group is well placed to ensure ocean robotics can perform optimally in the harshest of environments. Through deliver-



Voyis's Discovery camera and Perception skid on the Video-Ray Defender ROV.

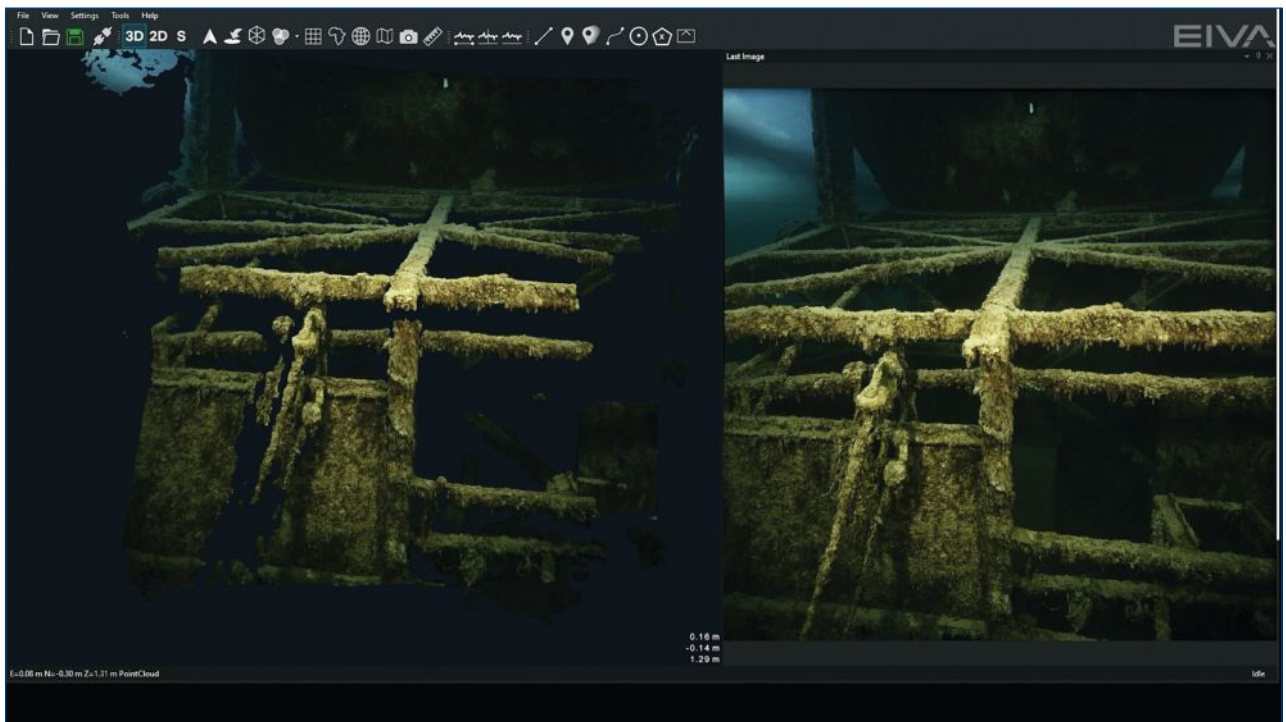
ing core essentials such as navigation, communication, mapping, monitoring and data amalgamation/interpretation with vehicle automation software, the companies within the group provide a synergistic, cohesive solution for improving subsea platform operations in concert.

Navigation

Effective subsea missions start and end with reliable and accurate navigation. Operating deep in the ocean,



(Top) WROV Perception XL dynamic laser scanning skid with technology from EIVA, Sonardyne and Voyis. (Bottom) EIVA's VSLAM software with Voyis's Discovery stereo data acquisition.



vehicles don't have the luxury of utilizing GPS, so pin-point accuracy via another method of navigation is vital. One Covelya Group company that has taken this challenge head on is Sonardyne International, bringing forward its expertise in subsea navigation and communication with over 50 years of experience. Within Sonardyne's product portfolio, there is a network of combined capabilities that offer best-in-class performance for sub-sea position and tracking to ensure successful operations. These systems include the SPRINT-Nav line of co-located inertial navigation system (INS) and Doppler velocity log (DVL) for high-precision navigation; 6G ultrashort baseline (USBL) with AvTrak6 vehicle-mounted transceiver for

simultaneous long-baseline (LBL) ranging; USBL tracking via a surface vessel; and robust telemetry for subsea vehicle-to-vessel and AUV-to-AUV communications.

When deploying autonomous platforms, another critical element of successful navigation is accurate obstacle avoidance. While Sonardyne's suite of navigation sensors provides the foundation for platform navigation, systems such as Wavefront's Vigilant forward-looking sonar (FLS) and Voyis's Discovery Stereo Vision Systems can provide further navigational input for robotic platforms by delivering real-time perception of new or uncharted areas of the ocean. For larger AUVs, Wavefront's Vigilant FLS provides real-time 2D or 3D sonar images of the seabed and



Voyis's Discovery stereo vision system integrated for deepwater WROV operations.

distort signals. Improved signal processing means more reliable acoustic communications are now possible, and the speed of data transfer has improved where the physical channel allows.

Sonardyne's fast and robust 9,000 bps acoustic communications performance means subsea vehicles can communicate to topside vessels via beacons at up to 11 km, enabling unmanned vessels to explore challenging locations while still being able to relay information back to a surface vessel.

This communication capability can be implemented both in a surface-to-AUV model as well as an AUV-to-AUV model, enabling vehicle swarms that can undertake extensive exploration while communicating and sharing relevant data across the entire fleet.

Mapping and Monitoring

The UN Ocean Decade acknowledges that we will have a continuing need to use the ocean, seas and marine resources, but we cannot use them sustainably without better scientific understanding. Environmental sensing and mapping subsea ecosystems with extreme accuracy and detail are becoming an integral part of any deep-sea mission, fundamentally allowing humans to generate a complete digital representation of the environment and expanding our

understanding of the unknown. Chelsea Technologies, Wavefront and Voyis have developed capabilities that complement one another in providing a full perception of the darkest areas of the ocean using fluorometry, multi-aperture sonar technology and laser scanning with optical imaging systems.

When considering mapping objectives of the physical terrain subsea, acoustic and optical sensors can work together to give users a more complete understanding of the underwater world. Wavefront's Solstice multi-aperture sonar captures wide-area swaths in a high-enough resolution to identify shipwrecks, airplane wreckage and even threats in the ocean. Once possible points of interest have been identified and further investigation is required, high-resolution laser scanners and cameras can be used for areas that need more detailed inspection.

Multi-aperture sonar can achieve incredible coverage rates, mapping over 200 m on each side of the vehicle, allowing for efficient detection and classification of objects on the centimetric scale. Conversely, optical sensors, such as 3D laser scanners and still cameras, can provide highly detailed quantitative and qualitative data

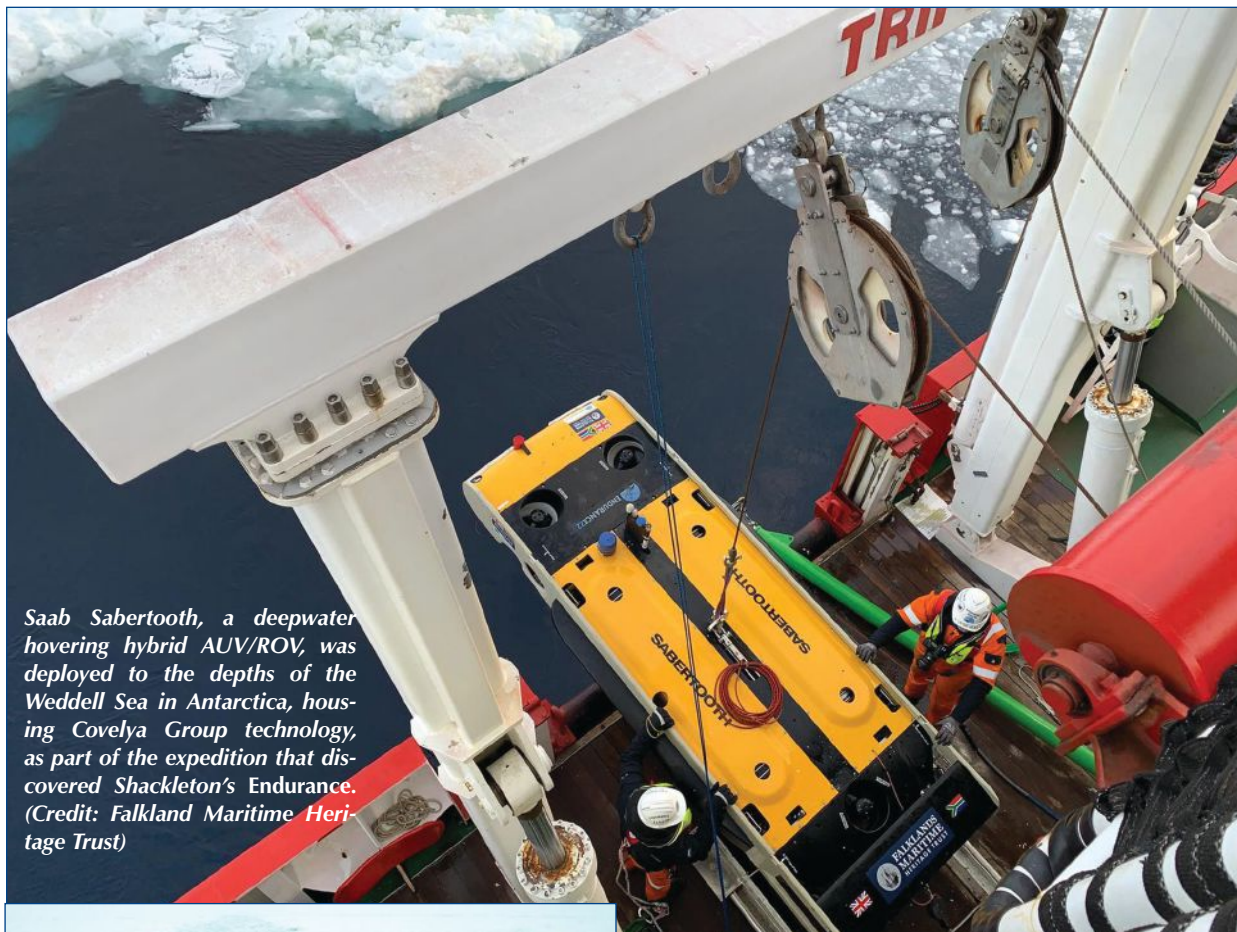
water column ahead of the AUV, with up to 1,500 m of hazard detection, enabling reactive navigational autonomy on wide-area surveys.

Voyis's Discovery Stereo Vision Systems can deliver extremely detailed localized perception through real-time millimetric 3D point cloud depth maps that provide finer visual navigation capabilities via perception of objects within 5 m of the platform for confident manipulation, docking, or inspection tasks. As a compact solution, Discovery is suitable for a wide range of vehicles, including smaller AUVs and ROVs.

Communication

Communicating with a subsea robotic platform, particularly autonomous systems, is crucial to be able to plan, control and navigate these assets on the ocean floor. Communications underwater are especially challenging because radio and satellite communication signals cannot penetrate beyond a few centimeters of water.

Acoustic communications are fundamentally limited by temperature and salinity gradients that bend and



Saab Sabertooth, a deepwater hovering hybrid AUV/ROV, was deployed to the depths of the Weddell Sea in Antarctica, housing Covelya Group technology, as part of the expedition that discovered Shackleton's Endurance. (Credit: Falkland Maritime Heritage Trust)



sets for extremely accurate, millimetric identification of localized areas using a maximum scanning range of 15 m. To achieve both coverage and resolution, the sensors and vehicles must work together as a tightly integrated system, with acoustic sensors first detecting features of interest and then optical sensors reacquiring the target for assessment with higher resolution data.

Delivering a stronger understanding of a subsea ecosystem using robotic systems requires sensors that provide increased fidelity of data quality. High-resolution stills images captured by Voyis's cameras are also optimized for photogrammetry, which enables 3D models to be created from 2D images. By utilizing edge computing to correct image lighting, color and distortions in real time on board the vehicle, photogrammetry software can analyze the position and orientation of the stills images and create a complete colorized model of underwater scenes. These not only provide a virtual representation of

underwater structures but also generate a comprehensive digital twin of a subsea environment to monitor changes over time.

There are a multitude of reasons driving greater exploration of our oceans. Building a broader knowledge of the ocean floor and potentially discovering new species, as well as environmental and climate research, are major motivators. Furthermore, delivering environmental monitoring capabilities beyond the physical geometry and visual aspects within a subsea domain can help humans interpret and learn more about the ecosystem and behaviors within it with substantially greater detail. For example, Chelsea Technologies' STAF (Single Turn-over Active Fluorometry) measures phytoplankton photosynthesis, which is at the very start of life cycles in the ocean. Alongside classical fluorometry, this technology can monitor levels of turbidity and water quality, helping explore and monitor the impact of climate change and human activity on the world's oceans.

Software

The final piece that ties the capabilities of underwater vehicles together is software that can combine all the sensor inputs to create a complete picture of the subsea domain. It can help with mission planning for vehicles, interpret the results on board, and enable tracking and following of features.

EIVA a/s, an innovative software developer that advances survey operations, data automation and vehicle

“Covelya Group’s Sonardyne, EIVA and Voyis have demonstrated the effectiveness of collectively developing a complete offering for subsea platforms by leveraging individual expertise in sensing and software domains for a common objective, bringing to light the greatest details of the ocean depths.”

autonomy, provides software capabilities using inputs from Chelsea Technologies, Sonardyne, Voyis and Wavefront sensors to fast-track data deliverables and improve underwater vehicle effectiveness. EIVA’s NaviSuite is the cornerstone for survey operations, amalgamating data sets across a wide array of sensors mobilized on robotic platforms, offering live data quality control measures and enabling analysis capabilities to interpret results in real time through deep learning. Real-time data interpretation enables vehicles to perform adaptive missions, or corrections, based on direct input from the sensors on board the vehicle and EIVA’s interpretation of the results, streamlining the entire data process.

Complementing sensor technology with EIVA’s software packages can deliver robust vehicle autonomy capabilities. Deploying the suite of navigation and mapping sensors identified earlier, EIVA’s software allows the sensors to provide direct feedback to a vehicle’s mission,

such as pipeline or cable tracking, or execute specific autonomous operations and inspection patterns.

It is through this symbiotic relationship between sensors, software and platform that Covelya Group technology can deliver a truly synergistic approach to deepwater operations. As with any technology, the value is not only with the capture of data but also data extraction and the ability to analyze the findings.

Exploring the Ocean Together

Covelya Group’s Sonardyne, EIVA and Voyis have demonstrated the effectiveness of collectively developing a complete offering for subsea platforms by leveraging individual expertise in sensing and software domains for a common objective, bringing to light the greatest details of the ocean depths. Recently, by joining forces, these three entities were integral to the recent discovery of polar explorer Sir Ernest Shackleton’s legendary ship, *Endurance*, in the depths of Antarctica (*Sea Technology*, August 2022). The companies assisted in creating a digital twin of the wreck.

The foundation of subsea vehicles’ success is the sensors and the software that work together toward a common goal. The physical vessel must be able to withstand the incredible pressures at depth, and it must rely on the “brains” of the vehicle: capabilities that come from the intelligent features and systems on board.

The ability to combine Covelya Group’s vehicle-agnostic offerings into a holistic capability results in cost efficiencies and cohesion of technology. Covelya is leading the charge for autonomy and deep-sea exploration through working on complex operations as a group of companies that can create a full solution for any ocean industry requirements.

For the past four decades, technology has been central to measuring and interpreting the ocean environment. If we are to make the Ocean Decade more meaningful to society as a whole, we need to continue to innovate by making technology more capable. Covelya Group will continue to innovate, supporting the exploration of our world’s waters and working toward a safe and sustainable future. **ST**

Luke Richardson is the vice president of sales and marketing for Voyis, a Covelya Group company, where he explores the innovative platforms and technologies that are enhancing deepwater exploration to better understand the ocean’s deepest and most mysterious regions.



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Q&A: Dr. Edie Widder

Dr. Edie Widder is an ocean explorer, conservationist and developer of deep-sea technologies. Her specialty is marine bioluminescence. The MacArthur Fellow has done hundreds of dives in deepwater submersibles, where she has observed animals that no one had ever seen before. One of her biggest discoveries, literally, is a giant squid, which she captured on video in the dark, deep ocean in 2012. Her recent book is entitled “Below the Edge of Darkness: A Memoir of Exploring Light and Life in the Deep Sea.” Widder discussed her life’s work, which continues as the founder of the Ocean Research & Conservation Association (ORCA), with *Sea Technology*.

You wrote a memoir in 2021. What is the key takeaway that you’d like readers to glean from reading your book?

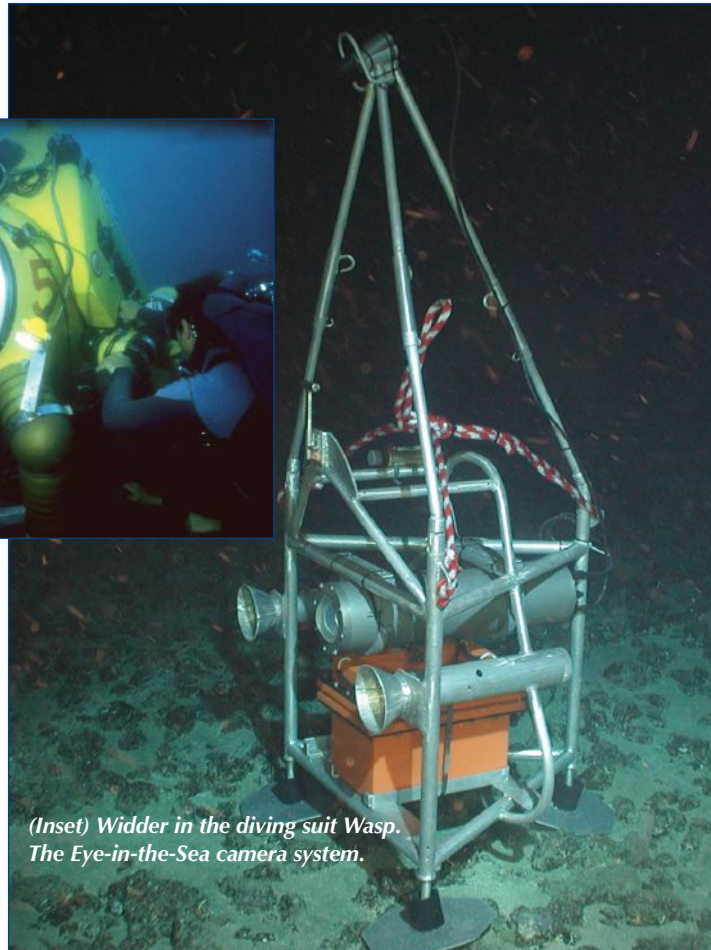
I wanted the most important takeaway to be how much of the ocean there is left to explore.

For a long time, those trying to make this point were saying that we had only explored 5 percent of the ocean, but that was based on how much of the bottom of the ocean had been mapped with sonar. For a biologist like me that wants to know about life in the ocean, that’s not really exploring. I want to see who and what is down there. For that, you need to be in situ with submersibles, ROVs and camera platforms.

In that context, we’ve only explored about 0.05 percent of the ocean bottom, and that number still ignores the vast volume of the ocean above the seafloor.

Let’s go back to the beginning. What made you want to be a marine biologist and explorer?

From a very young age I loved observing animals, which made me want to become a biologist. Then, at age 11, while traveling with my parents, I got to explore a coral reef in Fiji. That’s when I decided I wanted to become a marine biologist. It was a good decision. I think I have the best job in the world.



(Inset) Widder in the diving suit Wasp. The Eye-in-the-Sea camera system.



Attack of the Kraken, filmed with the Medusa camera system off Japan in 2012.

You've made many discoveries over the years. Which ones stand out as the most memorable and/or impactful?

My first dive in a submersible was in 1984 in a diving suit called Wasp. Wasp was developed for use by the offshore oil industry for diving on oil rigs down to 2,000 feet. I was lucky enough to be included with a group of scientists that were testing the suit as a new tool for

exploring the largest and least explored habitat on the planet—the midwater. When I turned out the lights on that first dive and saw how much bioluminescence there was, the experience changed the course of my career.

Since then I have spent much of that career trying to better understand who is making all that living light and why. One of the tools I developed to help me do that was an unobtrusive camera system, called the 'Eye-in-the-Sea.' Powered by batteries so it could be left on the bottom, and using far-red light that is invisible to most deep-sea dwellers, it gave me a new window into life in the deep sea that allowed me to see without being seen.

I also developed an optical lure that I deployed with the camera to see how animals would react to certain simulated bioluminescent displays. The first time I used that lure was in the Gulf of Mexico in 1984 when, 86 seconds after it came on, for the first time, it captured video of a large squid so new to science it could not be placed in any known family.

It was a later, midwater version of the Eye-in-the-Sea called the 'Medusa' that captured the first video of a giant squid recorded in its natural habitat [*Sea Technology*, August 2013].

You had to overcome blindness to do your work. Tell us about your struggle and how you learned to deal with this limitation.

My blindness was thankfully short-lived, although it didn't seem so at the time. A spinal fusion when I was 18 went very wrong and, along with multiple life-threatening complications, resulted in my hemorrhaging into both eyes. When I came to after the surgery, I was blind. The blindness in one eye cleared up over a matter of months and, in the other, over a year. I was confined to a bed for four months, so it was less about learning to deal with the blindness and more about dealing with the sense of panic that the blindness and all the other terrible things that were happening to me engendered.

You have performed many deep-sea dives alone, whether in an atmospheric diving suit or a one-person submersible. Can you describe the experience of being in the deep and dark of the ocean?

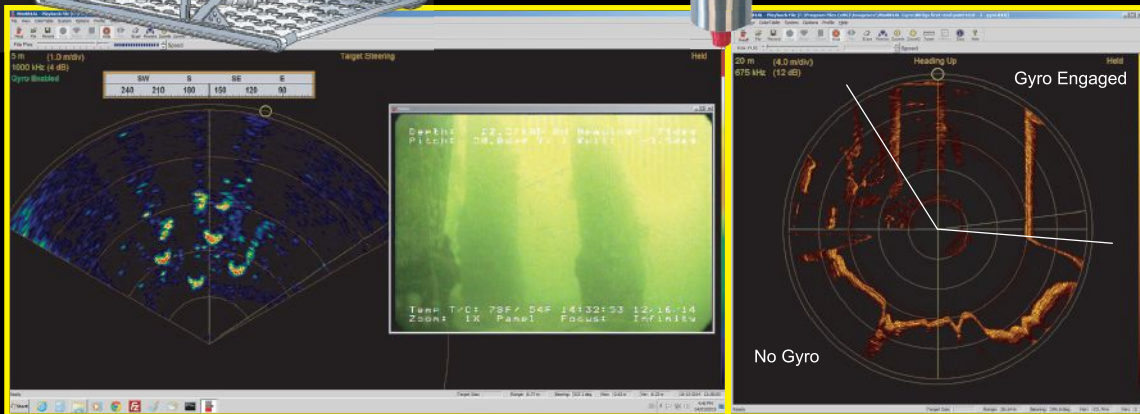
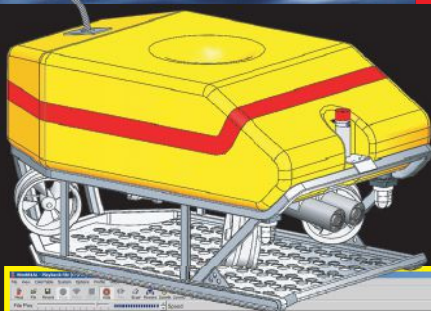
One of the big questions about bioluminescence is how much is there when we're not down there stirring things up. That was a tough question to answer because if you lower a detector from a ship or dive in a tethered suit like Wasp, you are linked to the ship's motion at the surface. It's like a tea bag on a string. Similarly, if you anchor your sensor or observation platform to the bottom, then currents swirl around it, also stimulating bioluminescence.

The perfect solution to the problem turned out to be the little, untethered, single-person submersible *Deep Rover*, which was a prototype at the time we were using it to dive Monterey Canyon in 1985. My first deep dive in *Deep Rover*, I wanted to measure the levels of spontaneous bioluminescence by trimming the sub to

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The bioluminescent minefield mechanically stimulated by a screen mounted in front of a submersible and photographed by Widder. (Right) One of the monitoring stations that make up the ORCA Kilroy network. Measurements include: blue green algae, chlorophyll, conductivity, temperature, fluorescent dissolved organic matter, dissolved oxygen, pH, oxidation-reduction potential, depth, turbidity, salinity, flow speed and direction, nitrite, nitrate, and orthophosphate.



perfect neutral buoyancy and then counting the number of flashes per minute that I observed. But as soon as I trimmed out, I was swathed in utter and complete blackness. There was no hint of bioluminescence unless I stimulated it in some way.

In retrospect, I have been asked about how alone and isolated I must have felt sitting in total darkness with no physical connection to the surface. I had no such thoughts because I was caught up in the thrill of revealing one of nature's secrets. As I sat there straining to see any glimpse of bioluminescence, I was entirely focused on the revelation that I was in a bioluminescent minefield. Contemplating what that must mean for all the animals that live there was all I could think about.

Which of the technologies you've developed thus far are the most significant in the field, in your opinion?

I think the most significant technologies are the unobtrusive camera systems—Eye-in-the-Sea, Medusa and, most recently, the Angler—because not only have we explored an absurdly tiny fraction of the largest habitat on Earth, we've clearly been doing it wrong.

In a world where bioluminescence reigns supreme, platforms that use bright lights and churning thrusters are clearly not the best way to explore.

You founded ORCA for the purpose of ocean conservation. Tell us a bit about the work and accomplishments of the organization.

My motivation for founding the Ocean Research & Conservation Association [ORCA] in 2005 was my dismay at the decline I had been observing in my own backyard, the Indian River Lagoon. A 156-mile-long estuary along the east coast of Florida, the IRL was once described as the most biologically diverse estuary in the U.S., but over the years pollution has led to toxic algae

blooms, fish kills and mass mortality of manatees due to loss of their primary food source, seagrass. Estuaries don't just provide vital habitat for local flora and fauna, they are also the nurseries of the ocean because of how many open-ocean animals use them to spawn. We can't afford to lose them.

At ORCA we are using applied science to track pollution to its source and try to stop it before it enters the lagoon. Our tagline is: Mapping Pollution and Finding Solutions. We accomplish this using our ORCA Kilroy network, a wireless array of sensors that supply real-time water quality data over the internet free, 24 hours a day, available on ORCA's website [www.teamorca.org].

We also do pollution mapping of bottom sediments, which is another powerful tool for determining where and how pollution is entering the lagoon. And we are training and engaging a growing number of citizen scientists in our monitoring efforts to expand our data gathering capacity while simultaneously fostering a greater sense of environmental stewardship in our community.

What advice would you give young people who aspire to a career in ocean tech and exploration?

Ocean tech and exploration are multidisciplinary, so diversify your training. Find a laboratory or a team that is doing the kind of work you want to do, and then ask what kind of expertise they are looking for or imagine they might need in the future. Is it a slot you could learn to fill? **ST**

Seismic Data Management

Streamlining the Process of Acquiring and Processing Data

By Kristy DeMarco



PXGEO 2 14-streamer seismic vessel.

In the energy industry, exploration and production companies continuously strive to find and develop new recoverable hydrocarbon reserves. For service providers, deploying subsurface imaging solutions for seismic data acquisition, especially activating critical data at a faster rate, offers a critical advantage over their competitors. However, data-intensive processing workflows performed at the field level have always presented significant obstacles.

As data become more and more of a significant strategic resource for exploration and production enterprises, it will become vital that service providers discover a new approach to acquiring and processing data in the field. This solution will need to be a cost-effective, efficient and scalable physical data transfer that is built both for mass-capacity storage in the field and frictionless physical transfer to any cloud service.

The Challenges to Data Processing Workflows

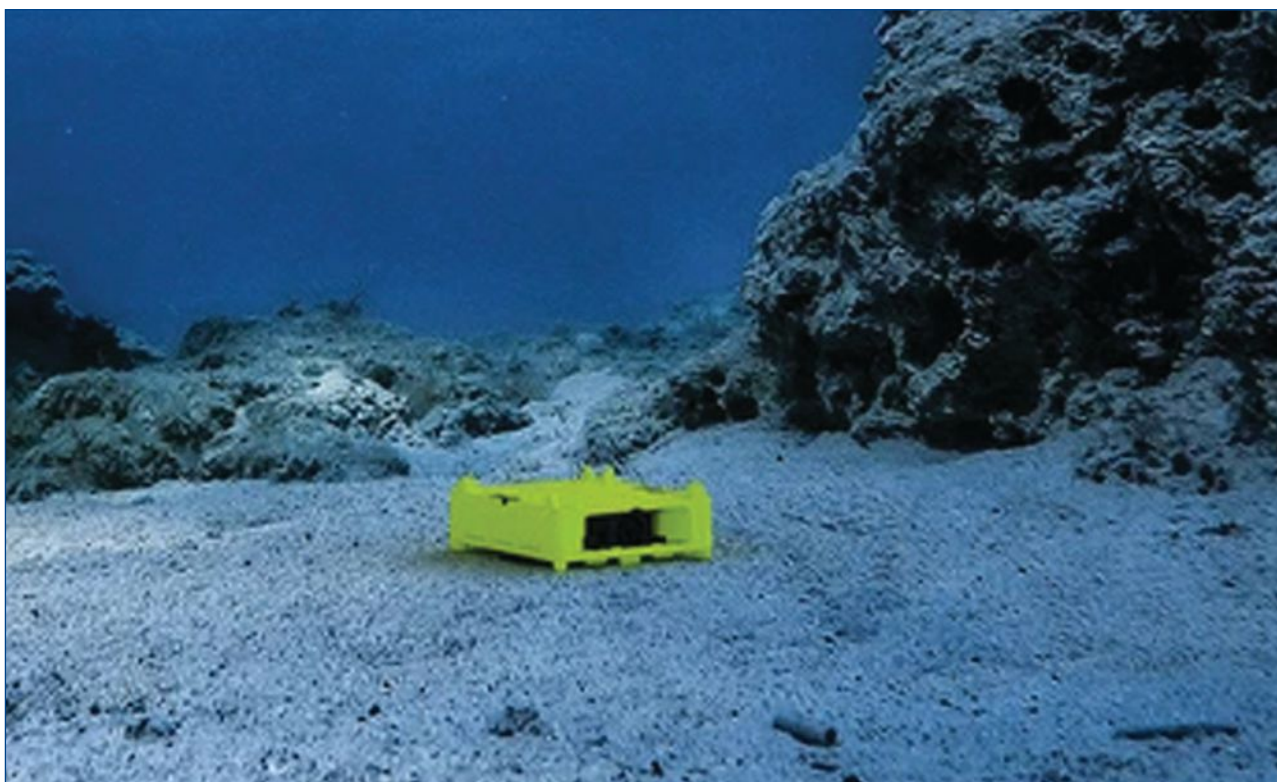
Limited infrastructure on a vessel at sea, barriers to scale, limited transmission bandwidth and network ca-

capacity, and the time from data acquisition to processing all represent the difficulty of aggregating, transporting, and activating large data sets. These are obstacles to exploration and production companies' turnaround time. As the evolution of data acquisition technologies has outpaced approaches to data management in the field, this problem has only compounded.

The consequences are clear: Without the ability to physically transfer ever-increasing data sets back to a central processing center, customers cannot reap actionable insights from those data. In effect, as data ages, it loses value. For service providers whose data management workflows begin on a vessel at sea, things get even more complicated.

Those service providers relying on traditional data management strategies, such as magnetic tapes, to store and transport the data they generate in the field, face weeks for a data acquisition project to be fully completed in remote field locations. Because those data sets have grown from terabytes to petabytes over the years—and quadruple in size during processing and analysis—many

PXGEO's ocean bottom node survey provides seismic imaging.



companies have realized the need to reimagine the way their months-long field projects aggregate, transport and activate data from the field to final delivery.

Field data generally arrive unstructured (as raw data or raw written reports) or semi-structured (e.g., seafloor models and simulations) and are typically collected in raw formats, using industry standards (SEG-D, in the case

of field seismic). These data are of little use until they are promptly extracted, processed via high-performance computing (HPC) to produce various products for geophysical and geological interpretation, delivered, and refined.

Processing in the field has now advanced to a point that various stacking and fast-track products can be pro-

Lyve Mobile Array.



duced before the raw data reach an off-site data center. However, the bulk of pre-stack migration, angle stacks and depth-converted products are still produced in the onshore data centers before shipping to the end client. This necessitates moving data from the field to the core, efficiently and securely, as it isn't until then that product data (typically SEG-Y gathers)—often in the range of 20 to 30 product types—can be delivered to an energy company for reformatting for use within the energy industry's preferred software suite.

Before energy companies can transform data into a deliverable, they must first establish a physical data storage strategy that guarantees effortless and affordable scalability in the field, frictionless physical data transfer from field to data center to cloud, and coordinated and efficient data management along the way.

In short, the challenges many services providers face in the field include: the inability to scale limited data storage infrastructure in the field; data sets too large to be moved over satellite or 5G; difficulty offloading data from subsurface imaging technologies in remote locations and harsh environments; and delays when ingesting data to the cloud for faster analysis, visualization and business decision making.

New Strategies for Overcoming Data Logistics Obstacles

In order for service providers to deliver immediate analysis for informed decision making and enhanced potential for improved business outcomes, upstream companies should partner with a data storage expert that offers a high-capacity data transfer solution, designed to keep up with the demands of acquisition, processing and visualization workflows. To do this, it is most efficient to utilize one device to both capture and transport raw field data to processing.

The Benefits of Deploying High-Capacity Storage Arrays. When it comes to managing data in the field, instead of recording seismic, survey and surveillance data

on hundreds of tapes, service providers can significantly reduce their hardware footprint by recording data to storage arrays, substantially increasing disk space while reducing IT support requirements on a vessel at sea and maximizing field data storage resiliency.

By leveraging high-capacity, ruggedized and securely encrypted storage arrays to create secure copies of raw data so that, before data are manipulated or moved, one copy of the raw data is securely archived, users can keep up with simultaneous recording, backup, and processing workflows while maintaining a small data storage infrastructure footprint. This makes physically shuttling data from field to ingest logistically straightforward. Using securely encrypted drives that implement a user key management service (KMS) layer protects data both in the field and in transit for robust data security against both cyber and physical threats.

In the end, bypassing limited field infrastructure, bandwidth limitations, and data management silos by organizing all data consolidation, transportation, and processing using one device not only improves time to data but ensures upstream companies have an advantage over their competitors, delivering essential information to stakeholders quickly and maintaining data infrastructure scalability, accessibility, and security throughout the process.

The Benefits of Embracing a DTaaS Strategy for Cloud Import. Additionally, these operations should take advantage of a subscription-based data transport service to simplify data management logistics for physical transfers and ingest to the cloud. By utilizing a cost-effective, data-transfer-as-a-service (DTaaS) model, operators benefit from just-in-time device delivery to and from any location, unburdening data management logistical overhead and maximizing existing budgets by ensuring individual projects only pay for the hardware they need. Leaning on the additional strengths of high-capacity, portable devices to aggregate mass data sets in the field, operators can expect optimized performance in remote environments,

“To optimize large-scale data movement, such as in seismic mapping applications, upstream exploration and production companies should select devices that lift data out of the field and rapidly transport them to a data center or headquarters for redundancy and backup without loss, corruption, or breach.”

robust data security, and scalable and efficient in-field storage for business insights.

Case Study: PXGEO Deploys Seagate Lyve

As an innovative marine geophysical service provider, PXGEO’s solutions bring together the latest in seismic data acquisition techniques to collect superior-quality data in challenging environments. At the heart of these innovative subsurface imaging solutions are two technologies: ocean bottom nodes (OBN) and marine towed steamers (MTS). Across applications, these advanced subsurface imaging solutions provide valuable insights for customers looking to find new recoverable hydrocarbon reserves and develop offshore carbon capture utilization and storage (CCUS) strategies. However, as PXGEO developed its turnkey technology over the years, it found that the amount of data its devices generated exceeded its long-term storage capabilities.

This year, PXGEO launched the next generation of its OBN technology, MantaRay, which is built on a hovering AUV (HAUV) platform capable of deploying and recovering nodes significantly faster and with better precision than traditional methods. To ensure this platform was able to aggregate, transport and activate the data it collected in the field, PXGEO looked to the portable, rackable, and high-capacity edge storage solution from Seagate: Lyve Mobile.

Initially, PXGEO deployed x20 96TB Lyve Mobile Array HDDs to collect more than 1 petabyte of data in the field. Using the Rackmount Receivers from Lyve Mobile—which allows users to install up to two Lyve Mobile Arrays into a standard 19-in. data center rack, complete with redundant power and high-speed interfaces, such as SAS, fiber channel, or iSCSI—PXGEO’s Lyve Mobile deployment was able to provide digitalized copy of all sensor data prior to secure delivery to the processing center with up to 1.3 GB/s throughput.

As a result, Lyve Mobile enabled PXGEO to aggregate, store, process and mobilize more data. For the geoscience team in the field whose job it is to quality control and package the data prior to delivery, this meant they were able to quickly pass data to their specialized partners, tripling or quadrupling the speed of transmission. After the data were fully processed and interpreted, PXGEO used Seagate’s Cloud Import service to quickly transfer the data as a designated Amazon S3 bucket for client delivery, which meant the client was able to receive the final project data five weeks before deadline.

Because PXGEO embarked on a massive workflow shift away from tapes and toward a digital-first workflow, it was able to modernize its entire process, unlocking the data logistics challenges to speed and significantly accelerating the data delivery schedule.

In summary, the results of the joint case study were a major success. After Lyve Mobile’s first deployment in the field, Dan Kulykov, IT infrastructure and support manager at PXGEO, described their combined solution as “a miracle.” Today, PXGEO’s entire fleet deploys Lyve Mobile devices.

Key Takeaways

To address the constantly evolving landscape of upstream, midstream and downstream energy industry segments, the Lyve Mobile and PXGEO case study proves that it is a best practice to partner with a data storage expert that offers a high-capacity physical data transfer solution, designed to accommodate mass data physical transfers from field to core and scale alongside growing data needs. To optimize large-scale data movement, such as in seismic mapping applications, upstream exploration and production companies should select devices that lift data out of the field and rapidly transport them to a data center or headquarters for redundancy and backup without loss, corruption, or breach.

From a hardware perspective, investing in cost-optimized data storage hardware, software, and services enables users to move petabytes of data from one location to the next for immediate processing and analysis, as well as long-term data archival, accessibility and security. Working with a data transfer partner whose services help teams quickly and easily transfer their data from any endpoint, field, or core location to the cloud of their choice also helps operators digitalize and thereby optimize their legacy data—saving costs on the front end and better organizing data archives on the back end. **ST**

Kristy DeMarco is the director of product life cycle management and vertical markets for Lyve services at Seagate Technology. In her current role, she leads the Lyve services go-to-market team, focusing on accelerating time to data for edge-to-cloud workflows across multiple data-intensive applications. She has held numerous roles in the networking, storage and IoT industries, managing a diverse set of product lines, from consumer products to enterprise hardware and software services.



Radar on Low Bandwidth

Signal Processing Encodes Only Essential Data

By Alan Trojanowski

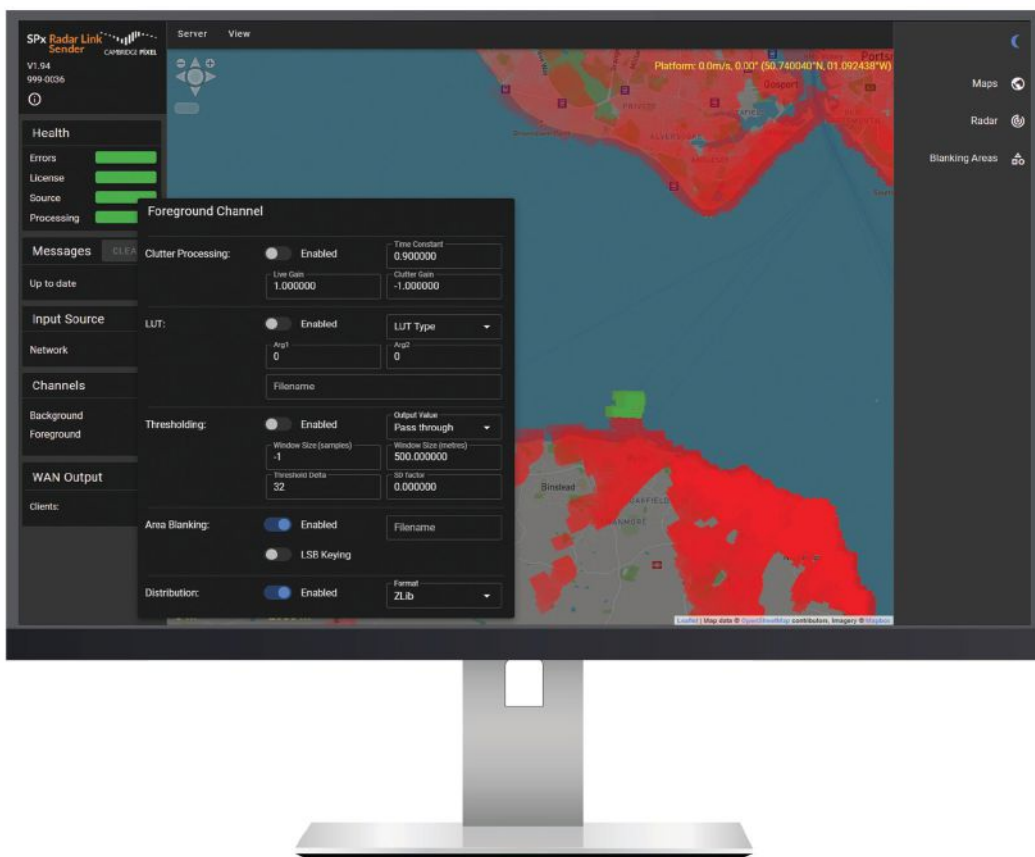
If an uncrewed submarine surfaces in an environment where bandwidth is limited or unreliable, it can present a critical challenge to the remote operators who need to see a clear and consistent image of the radar video.

Even when there is a good data link, maritime bandwidth can be very expensive, and the cost of transferring radar data from multiple vessels to their remote operators can soon add up.

The solution can be found in radar signal processing. By encoding the radar video to include only the most essential data, less bandwidth is needed. This can be implemented continuously to reduce bandwidth costs, or on an as-needed basis by monitoring the data link availability and reliability.

The specific radar data that are the most critical to each operator can vary. Therefore, the signal processing





needs to be tailored to the user, or a highly configurable solution is needed, such as Cambridge Pixel's RadarLink. This handles both the data link monitoring and the signal processing, with a range of settings to preserve the data most critical to each operator.

Cambridge Pixel's radar imaging technology has supported many USV developers to deliver complex projects faster, such as BAE Systems' uncrewed P24 RIB, developed for the U.K. Royal Navy. Their modular products provide control of the USV's radar, plot extraction, target tracking and fusion of radar tracks with AIS tracks. The new RadarLink solution can be used alongside this modular software, wherever low or unreliable bandwidth is a problem.

Preservation of the critical data is achieved by separating the radar video into background and foreground images, which can then be distributed using different levels of compression and, hence, quality. The goal is to prioritize what is important, either by location, amplitude or some other characteristic. Less critical components of the images, such as coastline or clutter, may be processed as background video and can be sent with lower resolution (spatial decimation) or less frequently (temporal decimation). This allows important target information to be coded in the foreground, clearly visible at the best resolution and updated on each radar sweep.

Sending the encoded radar video over unreliable network connections still presents the challenge that data packets may be dropped and there may be missing video in the recovered data stream. There are different network protocols that can be used for sending the data, but TCP/

IP is not appropriate for real-time data transfers, and while the UDP/IP protocol is simpler, it has no mechanism for recovering lost packets. The RadarLink solution is to use SRT (secure reliable transport) over UDP, which can handle a low level of packet loss without introducing significant latency.

RadarLink is a brand-new solution, but the imaging technology comes from an existing product, SPx Radar Web Server. In a similar fashion, that solution processes radar video as a series of images with user-configurable settings. This is then made available to operators in a standard web browser, making it easy to display the radar video on portable devices. Due to this ease of use, and the ability to spot objects in the radar video that have not been picked up by other sensors, such as AIS, the solution has been adopted for coastal and maritime security projects around the world.

Processing the radar image in this way ensures that the vital details are always available and enables users to make informed decisions with confidence. **ST**

As the head of marketing at Cambridge Pixel, Alan Trojanowski leads the global marketing and communications for this employee-owned small/medium enterprise, which exports radar processing solutions to more than 50 countries. He is a fellow of the Chartered Institute of Marketing and operates in the B2B, defense, maritime and security sectors.



international

BV Invests in Orbit MI

Bureau Veritas (BV) and OrbitMI, a New York-based maritime software company, have announced a strategic collaboration cemented by Bureau Veritas investing in OrbitMI. Aimed at accelerating the development of both existing and new data-driven solutions, the collaboration will leverage combined strengths to address the opportunities of the digital transformation and the decarbonization of shipping.

BV's Marine & Offshore division and OrbitMI will address clients' immediate regulatory and decarbonization requirements posed by CII, EU ETS and the recently enacted FuelEU standards, as well as their longer-term digital transformation journey.

New Member of SEA-LNG

Seaside LNG of Houston, Texas, has joined SEA-LNG, the multi-sector industry coalition established to demonstrate the benefits of the LNG pathway for shipping's decarbonization.

Seaside LNG is the only company with integrated shore-side liquefaction, LNG storage and bunkering capabilities in North America. The company maintains the largest fleet of Jones Act-compliant LNG barges in North America and has successfully performed more than 400 safe LNG transfers. Scaling up alternative fuel supply and developing the required infrastructure is key to the success of the shipping industry's decarbonization transition. SEA-LNG offers a practical platform for collaboration across the entire LNG value chain.

Structural Integrity, Digital Twin Collaboration

DNV and Light Structures AS, a supplier of fiber-optic condition monitoring systems based on Fiber Bragg Grating (FBG) technology, have signed a memorandum of understanding to cooperate on the development of new methodologies and solutions at the intersection of structural health monitoring and digital twin functionalities.

A key goal of the cooperation is to leverage the structural integrity monitoring data acquired using Light Structures' SENSFIB systems for complex marine and offshore projects. DNV and Light Structures plan to collaborate on customer-requested project and solution design, modeling, hydrodynamic analysis, hybrid twin databases, interfacing, instrumentation, installation and commissioning, and co-marketing activities.

AYRO Raises €30 Million+

AYRO, the designer and manufacturer of the OceanWings wingsail solution for cargo ships and yachts, has closed a €19.2 million (\$21 million) Series B round, led by Blue Ocean, managed by SWEN Capital Partners, which brings the total funding for AYRO to over €30 million. Existing investors Ocean Zero and Bpifrance, through the Ecotechnology 2 fund, as part of France 2030 initiatives, participated in the round, alongside new investors AmlInvest, Colam Impact, Normandie Partici-

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pations, Normandie Littoral and FCPI Capital Innovant n°2 managed by SWEN Capital Partners. Christian Lim, managing director of Blue Ocean, will join the board of AYRO.

Guidelines for Safe Install of Onboard CCS

DNV has published new guidelines for the safe installation of onboard carbon capture and storage (OCCS) systems on board ships, amid growing pressure on the shipping industry to develop effective technologies to reduce emissions as part of the ongoing maritime energy transition. Different methods for reducing greenhouse gas (GHG) emissions will be necessary to achieve international, regional and national emissions targets. Post-combustion OCCS onboard trading ships is expected to be among these future solutions, especially on vessels where the use of alternative fuels is not feasible.

DNV's new guidelines are designed for stakeholders across the value chain, including ship designers, builders, OCCS system manufacturers and shipowners, and apply to both newbuilds and retrofits. They cover all aspects for safe installation, including exhaust pre-treatment, absorption with the use of chemicals/amines, after-treatment systems, liquefaction processes, CO₂ storage and transfer systems.

Partner Addition to Seabed 2030

The Nippon Foundation-GEBCO Seabed 2030 Project, has joined forces with PlanBlue, for the global effort underway to map the entire seafloor by 2030.

PlanBlue is a private company that has operationalized underwater hyperspectral imaging and AI-driven data processing. With PlanBlue's technology, the seafloor can be monitored quicker, more efficiently and in more detail. PlanBlue specializes in ground-truthing aerial and satellite imagery to facilitate the expansion of blue carbon financing and biodiversity protection worldwide.

Pole Star Acquisition

Pole Star Global has acquired StratumFive. StratumFive's Podium5 brings together fleet monitoring, regulatory compliance, performance analytics and voyage optimization into one powerful platform. The combination expands Pole Star's fleet coverage and complements its vessel compliance and tracking solutions, PurpleTRAC and MDA, used by government agencies, global banks and vessel operators globally. The Podium5 platform leverages the previously acquired FleetWeather capability, with a proven track record of enhancing vessel performance and safety through advanced model-based route optimization.

Whitepaper on 2023 IMO GHG Strategy

ClassNK has released the whitepaper "Pathway to Zero-Emission in International Shipping – Understanding the 2023 IMO GHG Strategy."

In July 2023, the International Maritime Organization (IMO) adopted the 2023 IMO Strategy on Reduction of GHG Emissions from Ships, which includes goals such as achieving net-zero GHG emissions by or around

2050. While the strategy sets numerical targets for reducing GHG emissions and indicative checkpoints, the maritime industry has not yet reached a common understanding of what these numerical targets mean for international shipping. ClassNK has published the whitepaper to encourage broad discussions among stakeholders and accelerate efforts toward decarbonization.

Ship Concept with Micro-Nuclear Reactor

Crowley has teamed with nuclear power company BWX Technologies Inc. through a memorandum of understanding for a ship concept that has the potential to generate alternative, zero-carbon-emission energy for defense and disaster needs by including a microreactor on board. The memorandum of understanding with BWXT's Advanced Technologies subsidiary will allow both companies to jointly pursue and develop opportunities relative to the design, engineering and development of new shallow-draft hull ships that will supply small-scale nuclear energy to shore-side locations.

The new ships would feature the latest technology available for factory-fabricated microreactors, readily deployed into a shipyard configuration for ease of installation on the vessel. The onboard power plant would supply energy to shore facilities, such as military bases in remote island locations; backup utility grids after disasters; and provide power in other scenarios where traditional electricity sources are damaged or not possible.

The new vessel concept envisions a 378-ft. ship that pulls from the logistics and marine capabilities of Crowley and the nuclear capabilities of BWXT.

4K Camera on REVOLUTION ROV

Voyis's Discovery camera has been integrated with Deep Trekker's REVOLUTION ROV. With a unique rotating head facilitating optimal positioning of attachments such as imaging sonar and grabbers, the ROV can descend to 305 m, employing six powerful thrusters for precise control in both vertical and lateral movements, even in challenging currents. This adaptable thruster configuration ensures stability and fine-tuned adjustments during inspections and surveys.

Voyis's Discovery Cameras, enhanced by the Nova Mini Lights, bring a new dimension to underwater exploration by capturing 4K video with minimal latency while simultaneously generating high-resolution still images and IMU data. The resulting assets can be processed through edge computing to produce intricate 3D models.

VideoRay Acquires Blue Ring Imaging

VideoRay, the producer of the Mission Specialist Defender robot recently selected by the U.S. Navy for underwater mine detection and disposal, has successfully acquired Blue Ring Imaging, a St. Petersburg, Florida-based innovator in 3D visualization, multi-view perception and simulation for unmanned systems.

Blue Ring Imaging, known for its OctoView cutting-edge mixed reality software and OctoCAM multi-view 360° camera, will improve situational awareness and object detection capabilities of the Defender. **ST**

Blindspots in US Caribbean Grouper Protection

New research from FAU Harbor Branch Oceanographic Institute has found that the current marine management zones in the U.S. Caribbean designated to protect grouper species are missing some important areas.

Groupers are known to gather by the hundreds, even thousands, to spawn during certain times of year. Recent evidence suggests that some reproductive times are expanding beyond the months and locations where the managed areas were established.

Using an autonomous mobile wave glider equipped with hydrophone recorders and a machine learning fish sound detector and classifier tool called Fish Acoustic Detection Algorithm Research, scientists located spawning activity well beyond the zones of protection. Continued monitoring of groupers' new spawning activities is vital to promoting population recovery.

Bubbles in Ice Increase Rate Of Glacier Melt

Oregon State University research has uncovered a possible clue as to why glaciers that terminate at the sea are retreating at unprecedented rates: the bursting of tiny, pressurized bubbles in underwater ice.

Published in *Nature Geoscience*, the study shows that glacier ice, characterized by pockets of pressurized air, melts much more quickly than the bubble-free sea ice or manufactured ice typically used to research melt rates at the ocean-ice interface of tidewater glaciers.

Tidewater glaciers are rapidly retreating, the authors said, resulting in ice mass loss in Greenland, the Antarctic Peninsula and other glacierized regions around the globe.

Glacier ice results from the compaction of snow. Air pockets between snowflakes are trapped in pores between ice crystals as the ice makes its way from the upper layer of a glacier to deep inside it. There are about 200 bubbles per cubic

centimeter, meaning glacier ice is about 10 percent air. These are the same bubbles that preserve ancient air studied in ice cores. The tiny bubbles can have very high pressures, up to 20 times the normal atmospheric pressure at sea level.

Lab-scale experiments performed in this study suggest bubbles may explain part of the difference between observed and predicted melt rates of tidewater glaciers. The explosive bursts of those bubbles, and their buoyancy, energize the ocean boundary layer during melting. This has implications for the way ice melt is folded into climate models, especially those that deal with the upper 40 to 60 m of the ocean. The researchers learned glacier ice melts more than twice as fast as ice with no bubbles. The models currently used to predict ice melt at the ice-ocean interface of tidewater glaciers do not account for bubbles in glacier ice.

Right now, data from NASA attributes about 60 percent of sea level rise to meltwater from glaciers and ice sheets, the authors noted. More accurate characterization of how ice melts will lead to better predictions of how quickly glaciers retreat, which is important for communities planning for climate change adaptation.

Scania Powers Hawaii RV

Scania was chosen to power a new research vessel for the University of Hawaii at Manoa on behalf of the Hawaii Institute of Marine Biology. The twin V8 vessel was built by All American Marine of Bellingham, Washington.

The vessel is equipped with two fixed-pitch propellers, powered by twin Scania DI16, 082M, Tier 3 engines, rated at 800 mhp at 2,100 rpm. This propulsion package was selected to ensure excellent fuel economy while maintaining an estimated fully laden cruise speed of 22 to 24 kt. and a fuel-efficient minimum survey speed of 3 kt. The twin-engine speed, fuel-efficiency and reliability coupled with 1,800

gallons of fuel capacity will enable the University of Hawaii to access and study marine environments throughout the Hawaiian Islands.

The research vessel is a 68.5-ft. by 25-ft. semi-displacement aluminum catamaran hull that was developed by Nic de Waal of Teknikraft Design in Auckland, New Zealand. The vessel was constructed to U.S. Coast Guard standards and will operate as a multipurpose research vessel in the Hawaiian waters and offshore on ocean routes. The vessel can support a science team of eight during offshore multi-day missions and 22 students/crew on shorter day excursions.

Sensors for Germany's New RV

KONGSBERG will provide scientific sensors and scientific handling equipment for Germany's new ocean research vessel, the 135-m *Meteor IV*. The new 10,000-GT vessel will be able to house 35 scientists plus 36 crew.

Meteor IV will be built by Meyer-Fassmer Spezialschiffbau for the German Federal Ministry of Education and Research. The vessel, due for delivery in 2026, will replace existing research vessels *Meteor* and *Poseidon*.

Kongsberg Discovery will supply the EM 124 and EM 712 multibeam echosounders for seabed mapping at various depths. Kongsberg Discovery will also provide the Seapath 380 with motion gyro compass (MGC) R3 to combine with the EM series of echosounders to create an exact picture of the seabed.

To monitor ecosystems and marine life, *Meteor IV* will use Kongsberg Discovery's EK80, a high-precision scientific echosounder with ADCP capability, which can be used to measure the velocity of fish in a water column.

The EK80 measures speed and direction of currents in a water column, which helps researchers understand how organisms, nutrients, and other biological and chemical constituents are transported through the ocean.

Meteor IV will focus particularly on climate and environmental research in the Atlantic Ocean. **ST**

productdevelopment

For more information on any of these products, visit our website at www.sea-technology.com/products

Navigation Sensor Suite



Nucleus1000 is now available with full INS capabilities, enabling absolute position outputs obtained using the Nucleus's onboard inertial and acoustic sensor package. Equipping the compact suite with a full INS enables true navigation (latitude/longitude or X/Y output) for small AUVs, ROVs and USVs. Nortek AS.

Biocide-Free Antifouling Coating

Silic One, available in the U.S. and Canada, uses nonreactive polymers to create an invisible barrier between the hull's surface and the water, tricking marine life into believing that the hull is liquid and significantly reducing their attachment. Silic One creates a smooth, low-friction surface across a boat's entire hull, making it difficult for organisms to attach and easy for them to be removed by the boat's motion. Hempel.

EU Emissions Trading Software

The EU Emissions Trading Scheme (EU ETS) starts January 1, 2024. Shipowners, ship managers and charterers will then have to buy emission allowances (EUAs) for every tonne of CO₂ emitted. The EU ETS solution covers all processes and obligations of emissions trading. It enables intra-year accounting of the required emission allowances; efficient coordination between all involved stakeholders; and adaptation of the Union Registry through the transferral of data from the Union Registry and assignment

to the relevant accounting periods, vessels, and stakeholders. zero44.

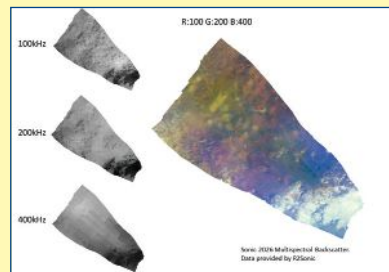
Offshore Wind Craft

Midi-SOV is a 55-m offshore wind craft that fills a crucial operational gap between crew transfer vessels and service operation vessels. It incorporates a low waterplane shape that broadens above the waterline, effectively minimizing and dampening roll motion. This vessel can be equipped with methanol-diesel dual-fuel engines, electric propulsion and a supporting energy storage system. Chartwell Marine Ltd. and VARD AS.

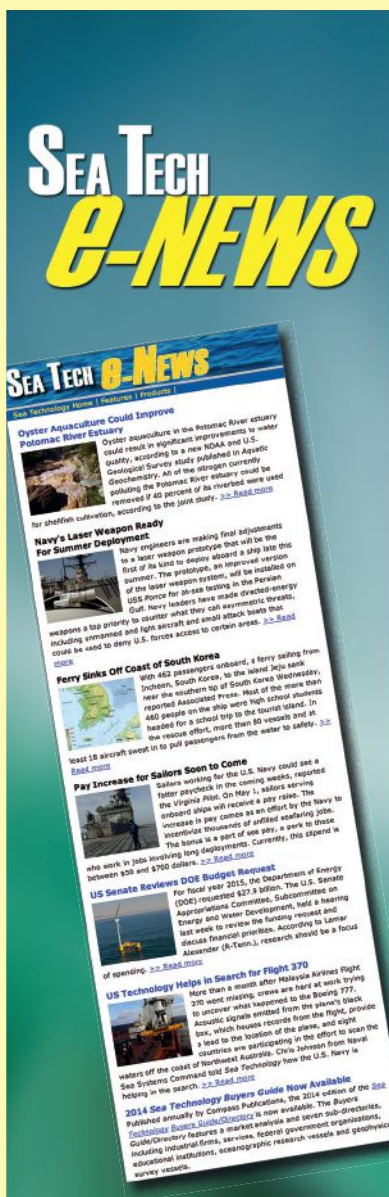
Berthing Aid System

Verified by ClassNK, the system uses LiDAR to calculate the relative distance and angle between the quay and hull, and displays superimposed images for situational awareness. The system aims to improve safety during berthing by measuring and visualizing the positional relation between the quay and ship, which was previously measured visually and communicated verbally by the crew. Furuno Electric Co. Ltd.

Hydrographic Data Processing



CARIS HIPS and SIPS 12 introduces new workflows for multiple-frequency data sets and creating/managing vessel files. The software simplifies splitting out individual frequencies to their own products (bathymetry and backscatter). There are also speed improvements and enhancements to automation by adding python support in CARIS



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process models. To better support the increasing variety of sonar installations, HIPS and SIPS 12 introduces a new vessel editor and vessel file format. Teledyne Geospatial.

Microplastics, eDNA Collection



Designed to overcome the challenges of sampling at depth, Ascension is a 22-lb. tethered sampling device that collects filtered microplastics or eDNA samples down to 400 m from the side of a small vessel or fixed installation without heavy and expensive deployment equipment. Suitable for marine and freshwater environments, Ascension is equipped with seven discrete filter housings, each containing a 47-mm-diameter filter for direct in-situ filtration. Ocean Diagnostics.

Mission-Critical Smartphone

RG880 supports companies and public safety organizations in their digitalization process and can be operated worldwide on all networks. The smartphone is equipped with the PTT/MCPTT-optimized Snapdragon 680 4G mobile platform from Qualcomm Technologies and supports 3GPP Release 12. The Android 13 rugged device with 5.5-in. screen is slim and handy in design. RugGear GmbH.

Hull Management Service

"Always Clean" is a service that delivers maximum hull performance for commercial vessel owners, and it is being enhanced with the launch of EverClean IQ. Using multiple sensors and cameras, a robot accumulates valuable data on ships while they are being serviced. EverClean IQ manages and processes the data into clear and concise reports for the customers, enabling

users to see how their hull is changing over time in a single, easy-to-use interface. Greensea IQ.

Carbon Capture and Storage

Lloyd's Register has awarded approval in principle for an amine absorption-based Carbon Capture & Storage (CCS) system, which uses absorption technology to mix CO₂ flue gases with a proprietary amine solvent, which is then heated to produce a chemical reaction that reverses the absorption and separates the CO₂ from the solvent. The CO₂ from this process is then liquefied and stored under cryogenic conditions on board, with the solvent ready to use in the same process again, creating a regenerative loop for CCS. ERMA FIRST.

Mini-BWTS

To meet increased demand for ballast water treatment systems (BWTS) from operators of workboats, yachts, research ships, OSVs and similar-size vessels, BIO-SEA

L01-0030 Mini is a fully automated filtration and UV-based system designed to treat ballast water flow rates between 13 and 30 m³/h. The unit has a skid footprint of just 1 m². BIO-UV Group SA.

Vessel Connectivity

Low Earth orbit (LEO) satellite connectivity delivers high-speed, low-latency broadband services to maritime customers worldwide. Seamless, reliable and high-performance connectivity supports mission-critical applications and enhances crew welfare on board. Eutelsat OneWeb and Applied Satellite Technology (AST).

4K Camera

ecoCAM is a compact video and still-image camera in the ecoSUBm5-Power+ AUV system that suits machine learning applications. Rated to 2,500 m, it allows for forward- and downward-looking orientation for seabed imaging. ecoSUB Robotics Ltd. **ST**

Move Toward Ropeless Gear For US South Atlantic

The South Atlantic Fishery Management Council (SAFMC) has voted to start the process to permanently allow ropeless, or on-demand fishing gear, in the black sea bass fishery from North Carolina to Florida.

Entanglement in fishing gear, specifically the lines and ropes used in fixed gear, is one of the biggest threats to critically endangered North Atlantic right whales.

Fishermen in the black sea bass fishery utilize a range of fishing gear, including hook-and-line and “pots” or fish traps. Because of the risk that ropes and lines used in pots and traps pose to North Atlantic right whales, the fishery observes two seasonal closures each year off the coasts of Florida, Georgia, South Carolina and North Carolina. These closures remove the gear and the lines from the water during the whales’ calving season. Today’s action is the first step in the process to permanently allow fishermen who use ropeless or on-demand fishing gear to continue to fish during seasonal closures without an exemption. Fishermen who wish to use traditional gear will still be able to do so outside of the closures.

The preliminary estimated cost to equip the South Atlantic black sea bass pot fishery with on-demand gear is around \$500,000, which may be offset by grants and federal funds for gear modification.

Caribbean King Crab Hatchery

Mote Marine Laboratory & Aquarium has opened its Florida Coral Reef Restoration Crab Hatchery Research Center, which is the first fully operational Caribbean king crab hatchery of its kind that will aid in its effort to save Florida’s coral reefs.

The new facility was funded in part by an award from the National Marine Sanctuary Foundation as part of the Mission: Iconic Reefs (M:IR) Capacity Building Grant program.

3D Model Ship Classification

Bureau Veritas (BV) and Hanwha Ocean have completed a joint development project (JDP) to enable 3D model-based approval for the classification of ships.

The JDP tested and validated the workflow of 3D model-based classification approvals, with classification reviews directly based on the 3D model provided by the designer instead of traditional 2D drawings. Potential benefits include improved accuracy, a better visualization of design, reduced cost, increased efficiency and enhanced collaboration.

Hanwha Ocean provided the cargo hold region of one LNG carrier using OCX (Open Class eXchange) format. Based on this 3D model, Bureau Veritas automatically generated the calculation models used in BV’s rule-checking software: MARS (prescriptive rule check) and VeriSTAR Hull (finite element analysis). In addition, BV provided Hanwha Ocean with access to its web-based collaborative platform (VeriSTAR Project Management) to share comments and the progress of the design review in real time.

As a leader in digital initiatives, BV has developed a 3D model-based approval for classification of ships. In parallel, Hanwha Ocean has a plan to develop and establish 3D structural design procedures by deploying a future digital design paradigm to improve processes based on the latest technology.

Hydropower Companies Use AI to Monitor, Safeguard Fish

Canada’s Ocean Supercluster (OSC) has announced the HydroAware Project to expand hydropower and safeguard habitats using AI-powered fish monitoring. This project will help advance fish monitoring technology by enhancing reliable fish tracking in harsh marine environments and increasing the availability of fish tracking insights from remote locations.

Hydropower companies, aiming to maximize energy production while complying with legislation

such as the Fisheries Act and Species at Risk Act, face the challenge of safeguarding fish populations from harm by their infrastructure. They use fish tracking solutions to monitor fish behavior in and around their infrastructure to minimize impacts and ensure safe fish passage.

The HydroAware Project will enhance fish tracking technology with AI, providing hydropower companies with the ability to collect evidence of safe fish passage, expediting regulatory approvals, and promoting renewable hydropower generation in Canada. The project is led by Innovasea.

Maritime Training Vessel

Philly Shipyard has delivered a new vessel purpose-built for training new cadets and officers who will ultimately crew both government and commercial-owned sealift ships. The 159.85-m *Empire State VII* was built by TOTE Services LLC under the National Security Multi-Mission Vessel (NSMV) program for the U.S. Maritime Administration (MARAD), and it integrates a suite of Furuno marine electronics.

The first of five new training vessels built in the United States for each of the state maritime academies in America, the *Empire State* includes a full training bridge and numerous training spaces, can accommodate over 600 cadets, and will be put into service at SUNY Maritime College in Fort Schuyler, New York. This training ship and instructional hub boasts a dual mission: to facilitate the education of merchant mariners and to provide vital aid in humanitarian and disaster relief operations during national crises.

Ocean Census Collaboration

Ocean Census has partnered with the World Register of Marine Species (WoRMS), hosted and managed by the Flanders Marine Institute (VLIZ). This collaboration will harness WoRMS’s expertise in marine taxonomy and taxonomic data management.

Ocean Census aims to uncover 100,000 new species in the coming decade. **ST**

Funding to Develop Supply Chain Forecast

Online cargo platform Shipnext has secured a substantial, multi-year grant from Flanders Innovation & Entrepreneurship (VLAIO) to strengthen the adoption of predictive analytics and AI in the supply chain. A dedicated team based at Shipnext's headquarters in Antwerp, Europe's second largest port, will develop a supply chain volatility forecast, helping the platform's users to understand likely transportation costs several weeks in advance, as well as anticipated demand for shipping assets.

A new algorithm will be created, making use of various freight matrices and a range of data sources for specialized commodity trade-related analytics. The project, initially designed for users shipping commodities such as steel, coal, chemicals and agricultural products, will utilize natural language processing, machine learning, big data analysis and predictive analytics.

Shipnext, which has around 3,500 daily users, including brokers, traders, shippers, forwarding companies and carriers, will receive an initial grant of €400,000. Over the next five years, further funding will be provided by VLAIO, which aims to stimulate entrepreneurship in the Flanders region by supporting innovative businesses with financial subsidies.

AI Robotics Facility

Advanced Navigation, an innovator in artificial intelligence (AI) for robotic and navigation technologies, has unveiled a new high-tech robotics facility for autonomous systems based at UTS Tech Lab in Botany, New South Wales, Australia. The facility will scale up the manufacturing of Advanced Navigation's world-first AI navigation systems for GPS-denied environments, including its digital fiber-optic gyroscope (DFOG) technology, Boreas.

Advanced Navigation is one of only four companies in the world with the capability to manufacture

strategic-grade fiber-optic gyroscopes. This technology empowers reliable navigation for marine vessels, space missions, aerospace, defense, autonomous vehicles and flying taxis with AI-based physics algorithms.

Partnership to Advance Augmented, Virtual Reality

Crowley and ABS have entered an agreement to jointly explore how to advance the use of augmented and virtual reality technologies for vessels and other marine environments.

The ABS partnership agreement builds on Crowley's new service network using augmented reality on select vessels. Crew wear goggle technology to provide real-time visuals of ship equipment to remote technicians to collaborate on solutions. The technology, developed by Kognitiv Spark, allows mariners and shore-side crew to more quickly complete maintenance, updates and upgrades on board with digital collaboration.

ABS and Crowley will collaborate in a joint pilot project for classification-related survey support activities, such as aspects of annual and special surveys, including task crediting. In addition, the project will include a variety of activities involving surveyors, engineers and back-office survey support, virtual walkthroughs, and livestreaming using fully remote and hybrid survey techniques.

Report Recommends Digital Collaboration

A new report commissioned by Bureau Veritas (BV) calls for greater data sharing in the maritime sector and outlines the benefits of a fresh approach to digital collaboration that will support shipping's energy transition.

Written by maritime innovation consultancy Thetius, the "Common Interest" report benchmarks shipping's progress on using digital solutions to collaborate on decarbonization goals and shows how

industry frontrunners are breaking down the technical, legal, financial and cultural barriers. The research is based on interviews with a series of maritime leaders and case studies from across the maritime sector's digital landscape today.

The report identifies key areas where digital collaboration has the potential to open new opportunities for growth and optimization, such as in ship performance analytics and "just in time" arrivals, supporting decarbonization and voyage efficiency.

The report also identifies four primary challenges to more effective data sharing: competition laws, data siloes, costs, and cultural and behavioral resistance.

Largest Electric LARS

MacArtney has delivered the world's first and largest all-electric launch and recovery system (eLARS) for Jan De Nul's offshore support vessel *Symphony* and the new cable trencher *Swordfish*.

A notable feature of the compact eLARS is the intelligent self-assessment capability for preventive maintenance. The integrated control system can be operated remotely from shore.

Compared to traditional hydraulic systems, the eLARS significantly lowers maintenance costs via reduced spare parts requirements and no need for regular hose changes and filter replacements. The absence of pressurized oil over water enhances safety and environmental sustainability.

Saildrone USV Fleet Reaches Deployment Milestone

Saildrone's fleet of USVs has surpassed a cumulative distance of 1,000,000 nautical mi. during more than 32,000 days at sea, deployed on missions around the globe.

"This million-nautical-mile milestone is a huge achievement in a relatively short time frame," said Saildrone founder and CEO Richard Jenkins. "It underscores the reliability we have achieved and confirms our unique position as the only proven long-range, long-dwell USV." **ST**

WindWings On the Water

Cargill and BAR Technologies' WindWings innovation has set sail on open waters, testing new technology that will bring cutting-edge wind propulsion to commercial shipping for the first time.

Mitsubishi Corp.'s *Pyxis Ocean*, chartered by Cargill, is the first vessel to be retrofitted with two WindWings, which are large wing sails measuring up to 45 m high that can be fitted to the deck of bulk cargo ships to harness the power of wind. Manufactured by industrialization partner Yara Marine Technologies, they are expected to generate average fuel savings of up to 30 percent on newbuild vessels, which could be even higher if used in combination with alternative fuels. The installation of the wings took place at the COSCO shipyard in China.

The installation demonstrates a step-change in attitudes toward technologies that can enable an energy transition for existing vessels. The maritime industry faces a huge challenge to reduce average CO₂ emissions by 30 percent by 2030 and is working toward 50 percent by 2050. The WindWings project, which is co-funded by the European Union as part of the CHEK Horizon 2020 initiative, can help the industry meet those targets by offering a retrofit solution that is capable of decarbonizing existing vessels, which is particularly relevant given that 55 percent of the world's bulker fleet is up to nine years in age.

The performance of the sails will be closely monitored over the coming months to improve their design, operation and performance. *Pyxis Ocean* will be used to inform the scale-up and adoption across not only Cargill's fleet but the industry. BAR Technologies is already planning to build hundreds of wings over the next four years and is researching newbuilds with differing hydrodynamic forms.

AirWing Approaches Approval

Bureau Veritas (BV) is working with GT Green Technologies on ap-

proval in principle (AiP) for the AirWing technology. By working closely with BV and other commercial partners, such as PEI TECH LLC, GT Green Technologies is lining up to deliver the first AirWing20 unit for installation on a vessel in 2024.

AirWing was awarded funding by the U.K.'s Department for Transport through its Transport Research Innovation Grant program.

USVs, AUVs Survey Wind Farm

Teams from wind farm owner Northland Power and marine technology company Subsea Europe Services have successfully concluded a pilot project to apply USVs and AUVs to marine survey and underwater inspection operations at the Deutsche Bucht Offshore Wind Farm in the German North Sea. The project was commissioned to verify performance and further develop the operational workflows of Subsea Europe Services' Autonomous Surveyor USV for multibeam surveying and A.IKANBILIS hovering AUV (HAUV) for subsea inspections, such as scour and marine growth surveys, when deployed from a service operations vessel (SOV) mothership already resident for operations and maintenance at the wind farm.

The so-called "mothership concept" was proven successful throughout the pilot, with seamless integration of the various teams and equipment working aboard the *Albert Betz* SOV, resulting in a wider weather window for marine survey and underwater inspection operations, with launch and recovery up to Sea State 3 and data acquisition according to the specified requirements.

While Subsea Europe Services continues to fine-tune and further automate workflows based on the experiences of the pilot project, both Autonomous Surveyor and A.IKANBILIS are available for offshore wind farm deployment right now. Full commercial readiness of a combined turnkey USV/HAUV solution for major projects and permanent mothership deployment

is expected by the first quarter of 2024.

Northland Power is the full owner of Deutsche Bucht offshore wind farm, which has an operating capacity of 252 MW, meeting the annual energy needs of 300,000 people and reducing Germany's annual CO₂ emissions by 700,000 tons.

US Offshore Wind JV

Morgan Stanley Investment Management (MSIM), through Morgan Stanley Infrastructure Partners (MSIP), and Crowley have created a new joint venture (JV) to advance offshore wind energy solutions for the U.S.

The joint venture will strategically combine Crowley's end-to-end maritime and logistics capabilities through the newly created Crowley Wind Services Holdings LLC and the financial strength and expertise of MSIP.

Investment funds managed by MSIP, a private infrastructure fund platform within MSIM, will hold a majority stake in Crowley Wind Services Holdings, while Crowley will operate the business.

MSIP and Crowley's partnership will focus on repurposing and operating existing U.S. port facilities and leasing them under long-term contracts to offshore wind developers. The terminals will support manufacturing, assembly and storage of wind farm components, as well as provide developers with maritime services, such as Jones Act-compliant feeder vessels to transport components from ports to offshore wind installations.

Fugro Geotech Lab in Taiwan

Fugro has opened a geotechnical testing laboratory in Kaohsiung, Taiwan, for the offshore wind market and the energy and infrastructure sectors.

The new lab is expected to increase Fugro's lab capacity in Asia-Pacific by 20 percent and reduce the turnaround time on testing by at least 30 percent.

Soil testing services are critical to understand the site conditions for the foundation design of offshore wind farms. **ST**

contracts

TechnipFMC, Newcastle, U.K., has been awarded a large integrated engineering, procurement, construction and installation contract for its Rosebank project, west of the Shetland Isles in the U.K. This covers the manufacture and installation of sub-sea production systems, flexible and rigid pipe, and umbilicals, as well as connection to the host facility. Equinor.

Praxis Automation, Leiderdorp, Netherlands, has been awarded a long-term contract for newbuild and existing offshore support vessels, to be equipped with a total of 59 shipsets of Praxis DP-2 systems, as well as customized equipment and software for digitization of the fleet in phases. Rawabi Vallianz Offshore Services.

MIND Technology Inc.'s Seamap unit, the Woodlands, Texas, has received orders totaling approximately \$3.4 million for BuoyLink GNSS positioning systems. Most of these orders are expected to be delivered in the next fiscal year. Undisclosed.

Institutional investors advised by J.P. Morgan Global Alternative's Global Transportation Group, London, U.K., have concluded an order for two 49,800 deadweight dual-fuel methanol chemical IMOII medium-range newbuilds, to be constructed at Guangzhou Shipyard International in China. Both vessels are scheduled to be delivered in 2026. TotalEnergies.

Trelleborg Marine and Infrastructure, Dubai, United Arab Emirates, has agreed on a pioneering trial operation of two of its DynaMoor Type-L ship mooring systems to start in 2024, with the goal of enhancing the safety, efficiency and movement of moored vessels at the Hitachinaka thermal power station/port. JERA Co. Inc. and Nippon Yusen Kabushiki Kaisha.

Lomar, London, U.K., will deploy robotic technology on up to 15 of its

vessels. The autonomous hull-cleaning technology reduces hull fouling, lowering fuel consumption, costs and carbon emissions. Alicia Bots Inc.

The Port of Antwerp-Bruges, Belgium, has ordered five diesel-powered RSD Tugs 2513 fitted with the Damen Marine NOx reduction system, and one electric RSD-E Tug 2513. This is part of the ongoing renewal of its fleet. The port bought the first diesel RSD Tugs 2513 three years ago, and their performance has paved the way for this new order. Damen Shipyards.

Echandia, Stockholm, Sweden, will supply two passenger vessels with battery systems to enable full electrical propulsion. The battery systems will each have a capacity of 496 kWh. Ö-varvet.

Intellian Technologies Inc., Pyeongyangtaek, South Korea, has signed a memorandum of understanding to develop a next-generation GMDSS safety terminal designed for operation over Inmarsat's ELERA L-band network. Inmarsat Maritime, a ViaSat business.

SSI, Victoria, Canada, will supply its ShipConstructor design and modeling solution to support structural modeling for two hull modules of Hull 096, a 130-m battery-electric Ro-Pax catamaran under construction for Buquebus of Uruguay. Tasmania's Incat shipyard. **ST**

meetings

JANUARY

January 24-25—Coastal Futures, London, U.K. cms@coastms.co.uk and www.coastal-futures.net.

January 30-February 1—EUROMARITIME, Marseille, France. www.euromaritime.fr.

FEBRUARY

February 5-7—Floating Wind Solutions, Houston, Texas. https://floatingwindsolutions.com.

February 11-13—Geo Week, Denver, Colorado. www.geo-week.com.

February 18-23—Ocean Sciences Meeting, New Orleans, Louisiana. www.agu.org/ocean-sciences-meeting.

February 26-29—Blue Innovation Symposium, Middletown, Rhode Island. https://blueinnovationsymposium.com.

MARCH

March 12-14—Oceanology International, London, U.K. https://www.oceanologyinternational.com.

APRIL

April 9-11—Undersea Defence Technology, London, U.K. www.udt-global.com.

April 14-18—OCEANS 2024 Singapore, Singapore. https://singapore24.oceansconference.org.

MAY

May 6-9—Offshore Technology Conference, Houston, Texas. 2024. otcnet.org.

May 20-23—MTS Buoy Workshop, Sequim, Washington. www.mtsociety.org/buoy-workshop.

JUNE

June 10—Speed@Seawork, Cowes, U.K. https://seawork.com/about/speed.

June 11-13—Seawork, Southampton, U.K. www.seawork.com.

NOVEMBER

November 4-7—EURONAVAL, Paris-Nord Villepinte, France. www.euronaval.fr.

November 7-10—Europort, Rotterdam, Netherlands. www.europort.nl.

November 19-21—MAST Australia, Adelaide, Australia. Mastconfex.org.

For more industry meetings, visit sea-technology.com/meetings. **ST**

people

VideoRay has welcomed **Margo Newcombe** as vice president of marketing and partner programs. She has more than 25 years of marine industry experience, having directed marketing, communications and customer development programs for many of the industry's leading underwater and subsea technology companies. Newcombe is now developing and implementing marketing strategy and global initiatives across multiple channels and platforms to drive demand for VideoRay's growing line of Mission Specialist ROVs.



Global Maritime, a provider of marine and offshore engineering consultancy services, has appointed **James Vavasour** as the global business stream director for marine warranty survey (MWS) services. Bringing a wealth of expertise to the team as an influencer and prominent figure in the international insurance market, he is a naval architect and author with extensive

industry experience. Vavasour is a fellow of the Royal Institute of Naval Architects.

Scantrol has appointed **Terje Ånderbakk** as project manager. He specializes in control systems for fisheries and research vessels and has more than 20 years of experience from Rapp Marine/MacGregor, where he was responsible for engineering, installation and support of winch control systems. He was also sales manager for Fishery & Research at MacGregor.

Dionne Ruurda is the new director of Amsterdam IJmuiden Offshore Ports. She previously worked as a communication adviser and project manager with companies such as Tata Steel, Citymarketing Velsen and Techport.

Silverstream Technologies, specializing in air lubrication technology for the global shipping industry, has appointed **Catriona Savage** into the newly created position of chief technology officer. She will lead the continued development of the Silverstream System and will further develop the technical center of excellence built by Silverstream Technologies.

Ronan Stephan has become chairman of France Energies Marines. His career has been focused on research and innovation. For 15 years, he has held senior positions in major public institutions, and he will position the institute in ambitious collaborative projects.

Crowley has appointed **James Fowler** as senior vice president and general manager of its Crowley Shipping business unit that serves diverse U.S. and international maritime and logistics sectors. Fowler most recently served as managing director of marine and stevedoring operations for Cooper Marine and executive vice president for Blakeley BoatWorks.

SBG Systems has welcomed **Pallav Mathur** as sales manager for India and the South Asian Association for Regional Cooperation (SAARC) region. He brings expertise in the navigation and geospatial industry, specializing in sales, pre-sales and support.

Christian Thomsen is the new CEO of maritime survey software and equipment manufacturer EIVA, part of Covelya Group. He has joined EIVA after seven years with logistics solution provider, Lyngsoe Systems, where he was senior vice president.

Catherine Mulvihill is the new CEO of the International Foundation for Aids to Navigation (IFAN). She has four decades of experience in the marine industry, including in container shipping and operations, ports and terminals, and marine insurance.

Valeport has welcomed **Amy Thompson** as product manager. She is an oceanographic engineer and brings more than a decade of expertise in customer relations. **ST**

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We Can Live on the Seafloor, Not Just Visit, for Ocean Science—Rick Goddard

Rick Goddard is director of the Sentinel product team at DEEP, where he is responsible for delivering the company's subsea habitat program.



Starting his career as a naval architect in the U.K. Ministry of Defence, he then moved into consultancy, spending 15 years working in the marine sector on everything from aircraft carriers to uncrewed subsea vessels before joining DEEP in 2021.

Our goal at DEEP (www.deep.com) is to provide equipment that enables humans to live, explore, research, protect and preserve our oceans. Our subsea habitat program, the Sentinel System, is central to this mission.

The need for a permanent presence beneath the waves has never been clearer; barely 5 percent of our oceans has been explored, and only 20 percent has been mapped. And yet the oceans account for 70 percent of Earth's surface and provide over half of the oxygen we breathe. Understanding, mapping and monitoring this crucial biosphere will allow us to preserve and protect life on this planet.

Subsea habitats afford their occupants direct, unbridled access to our oceans in a manner unmatched by remote sensing technologies. ROVs, sonar-equipped ships and satellite monitoring, while valuable tools, pale in comparison to direct observation.

Imagine, if you will, Jane Goodall attempting to study chimpanzee behavior from a helicopter, hovering 50 m above the Gombe rainforest. Occasionally, she is lowered through the dense canopy to observe, for a scant few moments, that which hasn't fled the disturbance overhead. Now, imagine her living on the forest floor, *fully immersed* among the flora and fauna. The difference is profound.

Subsea habitats, both in concept and in operation, have been with us since the 1960s and '70s. Those initiatives provide the prologue to DEEP's story.

In 2023, the closest methodology we have for humans to directly access, say, a 200-m-deep seabed is saturation diving. Highly trained teams live in pressurized chambers on the deck of a dive support ship and are deployed daily in diving bells. Post-shift, they return to their chambers, where they remain "at pressure" for the duration of their deployment so they can decompress safely from depth.

Saturation systems are cramped and uncomfortable. There is little capability to visually connect with the outside world at depth, and saturation divers work, eat and sleep in close proximity to one another. It is difficult for a scientist, researcher, environmentalist or archaeologist to be fully effective, let alone thrive, in such an environment.

In contrast, Aquans, as we refer to them, inhabit the Sentinel System for the duration of their deployment, are fully immersed in the subsea environment, and have a constant connection to the outside world through colossal, 2-m-diameter viewing ports. The system is designed for 28-day missions, after which it would be resupplied and a new crew deployed.

Each Sentinel module offers large, reconfigurable wet and dry labs and an adjacent dive center. A dive excursion from within can be as straightforward as you and I walking out of our back door. Comfortable, individual living quarters provide Aquans with privacy and quality rest.

Modules can be tailored for specific purposes, and multiple modules can be combined to match the scale and technical requirements of each mission.

The design of a system like this is not without challenge. For example,

maintaining life at pressure requires a large proportion of helium, which, for various reasons, causes issues with off-the-shelf electronics. Almost all electrical equipment needs to be redesigned and retested.

Helium is also a superb conductor of heat. To remain comfortable, Sentinel must be warmed to more than 30° C, driving humidity. The scale of the atmosphere conditioning system necessitated by the habitat's vast volume (400 m³) exceeds that of anything previously developed, let alone anything that is already helium- and pressure-tolerant.

Another challenge is food preparation, which is a surprisingly complex process in this environment. Our in-house chef is working with our engineers to develop fire-safe, low-energy cooking techniques and simplified, tasty meal plans to tackle these issues.

None of this is routine. We're pushing the limits of manufacturing by employing state-of-the-art additive technologies at record scale to "print" segments of our hull, for example. Our team is necessarily diverse, comprising engineers, industrial designers, human factors experts, saturation divers, material scientists and hyperbaric medical professionals. Each is encouraged to seek and embrace challenge, and to innovate in response.

The Sentinel System is more than a simple pressurized cylinder mounted to the seafloor. It is the result of two years and 70,000 hr. of intense engineering development.

With this revolutionary technology, DEEP will unlock the mysteries on our ocean doorstep, conduct vital research and protect our most valuable resource: our planet's life support structure.

The Sentinel System isn't just a technological advancement; it represents a commitment to the future of our planet, for generations to come. **ST**

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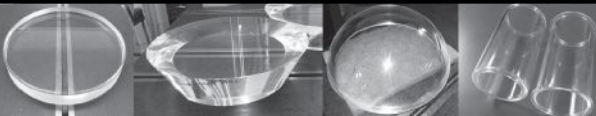
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www.generaloceanics.com	
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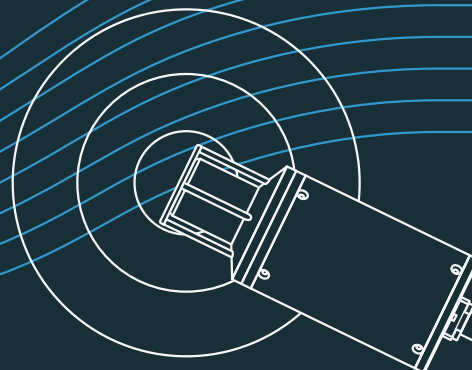
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