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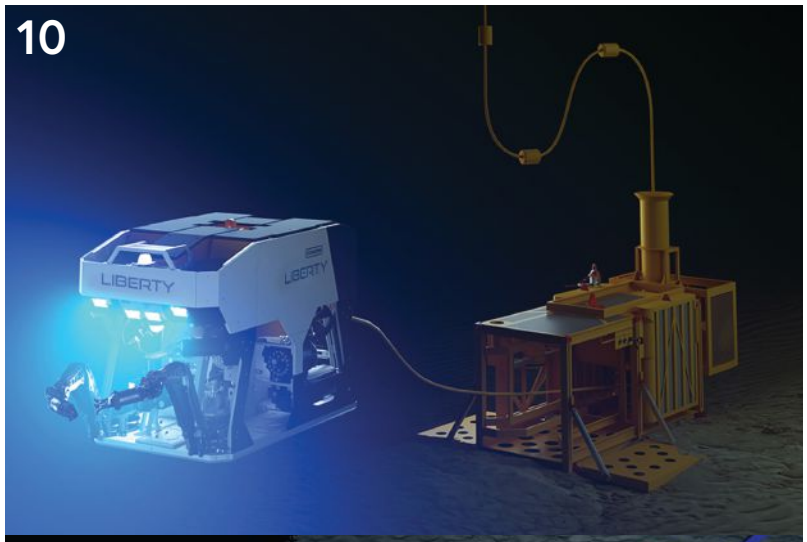

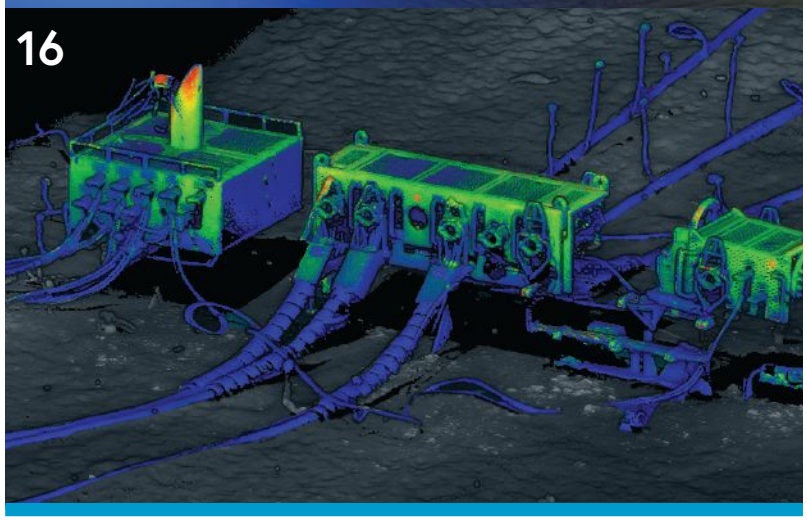

FEATURES & SPOTLIGHTS

DEPARTMENTS

IN EVERY ISSUE

ON THE COVER:
The Liberty E-ROV shown picking up a tool from the tooling storage located on the ROV's own docking cage. (Image credit: Oceaneering)

[WITH THANKS - Ed.]

The integrity management of subsea assets is a complex and multi-tiered process which has traditionally relied on the skilled deployment and piloting of work-class ROVs to carry out underwater Inspection, Maintenance and Repair (IMR) operations from large, multi-purpose offshore support vessels (OSVs).

In recent years, however, advances in marine robotics and remote systems integration have encouraged ocean technologists to challenge this convention and propose increasingly automated products and services that promise to deliver sector-wide efficiencies in the field, establish never-before-seen HSSE standards, and ensure a dramatic reduction in carbon footprint.

May's ON&T unites some of the leading companies seeking to establish a new order for subsea IMR. Our thanks this month go to Oceaneering, Voyis, Fugro, Argeo, C-Kore, Advanced Navigation, and PanGeo.

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ROBOTICS AS A SERVICE: DELIVERING NEXT-GENERATION TECH-INSPIRED SUBSEA INSPECTION

By Moya Cahill,
CEO, PanGeo Subsea Inc.

Whether to help optimize offshore energy exploration or at-sea defense operations, the race is on to deliver inspection solutions that acquire data faster, at higher resolution and accuracy, and with less dependency on manned vessels. This race is being driven by sector-wide demands for increased safety, lower costs, and solutions that are packaged into a smaller carbon footprint. Understanding the unfolding trends in the offshore survey market as it evolves, alongside the ability to translate these trends from idea to product integration, is critical to industry success.

JOINING FORCES

In 2021, united by this challenge, the leadership teams of PanGeo Subsea and Kraken Robotics began discussing how best to commercialize solutions that would ultimately enable both parties to remain frontrunners in the race. The synergies of the two St. John's, Newfoundland-based groups—the combined strength of a multidisciplined diverse engineering, software and ops team, and the power of a combined sonar-geophysical science team—soon became clear. To fully leverage this value, Kraken acquired PanGeo, with the PanGeo ops team spearheading an enhanced service that includes real-time Synthetic Aperture Sonar (SAS) seafloor and sub-seabed 3D imaging data acquisition and real-time processing.

INTEGRATING INNOVATION

PanGeo Subsea's 3D acoustic survey sensor, the Sub-Bottom Imager™ (SBI), has supported the offshore inspection markets for many years by providing cable and pipeline depth of burial capabilities and pre-route boulder and UXO imaging services.

The drive for faster data acquisition to reduce O&M inspection costs has seen several significant developments within PanGeo alone in recent years. The launch of a smaller, more compact ROV skid-based system allows the Sub-Bottom Imager™ (SBI) to mobilize onto Leopard class ROVs, enabling smaller support vessels to be utilized. The most significant development launched in recent years has been the towed SBI platform SeaKite™, a remotely operated towed vehicle within which the Sub-Bottom Imager is housed.

Utilizing a towed SBI for cable inspection surveys has two major impacts on an inspection campaign; firstly, the data is acquired 7x faster than an ROV, significantly reducing the duration of the campaign and secondly, the size of vessel is significantly reduced, typically to a 30-40 m survey vessel compared to a sizeable DP2 ROV support vessel. For pre-route surveys, the SeaKite with its robust payload capability can accommodate magnetometers enabling the acquisition of both acoustic and mag data in one survey pass eliminating any positioning error.

The combination with Kraken Robotics has enhanced the PanGeo service offering by combining the 3D sub-seabed acoustic technology with Kraken's high-resolution SAS seabed data. This together with KATFISH™, Kraken's high speed actively stabilized SAS towfish and SeaVision, Kraken's sub-surface 3D laser imaging systems, will create a compelling offering to the O&M market.

FUTURE HORIZONS

Looking to the future, the combined companies are focusing on the development of Artificial Intelligence and Machine Learning capabilities to push the capacity of the technologies to deliver ever faster data processing to subsea inspection campaigns and site investigation surveys prior to any seabed installation. Ensuring that our sensors and robotics are compatible for both USVs and AUVs will prove critical in the race to deliver world-class IM inspection solutions.

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SUPPORTING SUBSEA IMR WITH RESIDENT ROV SYSTEMS TO REDUCE VESSEL DAYS AND CARBON FOOTPRINT

By Kenneth Solbjør, Alan Anderson, Jamie Cheramie, and Casey Glenn
Oceaneering International

The offshore oil and gas industry has been investigating innovative solutions to help reduce or eliminate carbon footprints subsea and increase worker safety on- and offshore. Remote operations coupled with advanced autonomous solutions can have a significant impact on how business is conducted.

A recent Rystad Energy report from March 2021 states that inspection, repair, and maintenance (IMR) operations are ideal for robotic operations: "The segment [is] where adoption of robotics has gained the most traction among operators in recent years."

"The next generation of robotics solutions is already emerging within subsea IMR in the form of perpetually underwater robotics solutions that offer significantly lower costs and better reach than a conventional remotely operated vehicle (ROV)," the Rystad report said.

LIBERTY E-ROV

Launched in 2017, Oceaneering's Liberty™ E-ROV is a self-contained, battery-powered, work-class vehicle that allows performance of routine tasks that would normally be performed by an ROV and support vessel. It can carry out IMR, commissioning, and underwater intervention scopes. It is an all-in-one deployable and recoverable system that comes with a cage-mounted battery pack, tether management system, and communications buoy that stays on the water's surface to interface with Oceaneering's Onshore Remote Operations Centers (OROCs) via satellite or 4G LTE mobile broadband.

With its 550 kw Lithium-Ion battery pack, Liberty has the endurance to stay submerged for prolonged periods ranging from 180 days in hibernate, 22 days in observation, and 3-8 days for intervention tasks.

Between missions, the Liberty has a quick turnaround on deck for charging and maintenance, and then re-deployed for the next mission. Liberty can also be configured for charging by a downline system from a vessel or rig. This avoids pulling the Liberty on deck for charging.

The Liberty system can also be viewed as a deployment method with packaging that can serve any vehicle shape and size, all depending on the needs.

Once Liberty is deployed subsea by a vessel of opportunity equipped with a subsea crane, the vessel can be relieved.

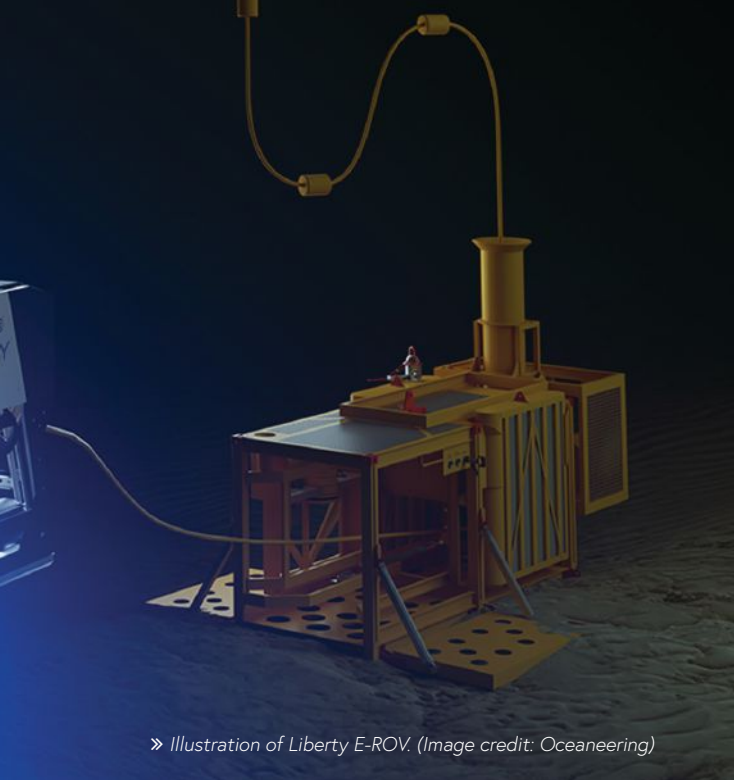
By removing dedicated ROV support vessels, operators can simplify logistics, costs, and reduce their carbon emissions output by an estimated 90%.

Operators can have instant availability to use a work class ROV without any installation of topside equipment.

Since its launch, the Liberty E-ROV has achieved many milestones with its 80 missions and more than 10,000 operational hours and contributed to eliminating 7,200 Support Vessel Hours, 28,800 Offshore Crew Hours and 13,700-ton support vessel CO2 emissions.

» *Liberty is deployed from an emergency preparedness vessel by a dedicated installed deployment system with both LARS and subsea crane capability. (Photo credit: Oceaneering)*

» *Illustration of Liberty E-ROV launch and recovery system. (Image credit: Oceaneering)*



» *Illustration of Liberty E-ROV. (Image credit: Oceaneering)*

KEY ADVANTAGES OF THE SYSTEM INCLUDE:

- » Reduces vessel days required to complete operations
- » Supports efficient installation and recovery operations as the system can be moved using a single lift
- » Very low idle power consumption enables the system to be on site for an extended period supporting the launch of the vehicles well in advance of operations
- » Reduces carbon footprint and mobilization
- » Enables expedited intervention with positioning at strategic locations subsea
- » Operated independent of surface weather conditions
- » Operations supported by remote piloting at Oceaneering OROCs

During 2019-2020, Oceaneering studied how to improve the efficiency of the Liberty operations by eliminating the need for a typical vessel with subsea crane to support deployment. The study centered on using an emergency preparedness vessel that is present on any field in operation. Several challenges, including safeguarding the vessel's primary function (responding to an emergency) were solved alongside the client and vessel owner through design and adapting operational procedures.

Today, the Liberty is only deployed from the emergency preparedness vessel using a special-built launch and recovering system (LARS) with an advanced tandem lift active-heave compensated subsea crane offering a safe working load of 34 tons. The LARS is also used to deploy other subsea assets to the seabed (i.e., tooling) and opening hatches on subsea templates. This adds to Liberty's success and demonstrates how close industry cooperation aiming for a win-win can shape "out of the box" solutions.

» *Liberty E-ROV during a North Sea deployment in 2020. (Photo credit: Oceaneering)*

CASE STUDY

In 2020, a major operator prepared to commence oil production from a North Sea asset and wanted to ensure that no unplanned incidents occurred during start up through the riser. The operator adopted a comprehensive pipeline seabed-to-platform monitoring plan to maintain the highest level of oversight.

The Liberty E-ROV was selected over a conventional system to complete monitoring at depths up to 310 m several times per day over the course of 1-2 months, depending on the findings. A conventional ROV system would have been vulnerable to stoppage during inclement weather windows and would require extensive effort for multiple deployment and recoveries across the monitoring window. If an additional vessel were required, this would add significant cost and generate additional carbon emissions.

Because the location of the work scope was fixed on the platform area, the Liberty system was deployed in a tethered configuration. A dedicated umbilical provided power and data communication connectivity directly from the platform to the ROV system. This solution eliminated the need to recharge Liberty's batteries and negated the risk associated with winter storms in the area that may push the system's buoy out of location.

Liberty completed 822 hours of monitoring spread over 110 top-to-bottom trips conducted across 34 days. The vehicle did not need to dock in the subsea garage and did not require maintenance. No issues were detected during production commencement. This deployment proved Liberty's ability to provide longer, continuous deployments.

FUTURE DEVELOPMENTS

The Liberty system is continuously being improved through lessons learned. Development plans involve creating a deepwater Liberty system with a depth rating of 3,000 m—currently Liberty is rated to 1,000 m. A deepwater solution would use existing subsea infrastructure instead of a buoy for communications and charging.

There are also plans for full electrification with the state-of-the-art resident technology developed with the Freedom Autonomous Vehicle. The current Liberty is a full work class ROV system, but the mentioned resident Freedom technology can be tailored and packaged to serve specific needs enabling an even more cost-effective solution. A "lighter" version of the Liberty could become an integral part of subsea installations to perform specific need-based intervention tasks. Such solutions will aim to achieve residency for more than 12 months, preferably matching planned maintenance intervals where a support vessel would be onsite.

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

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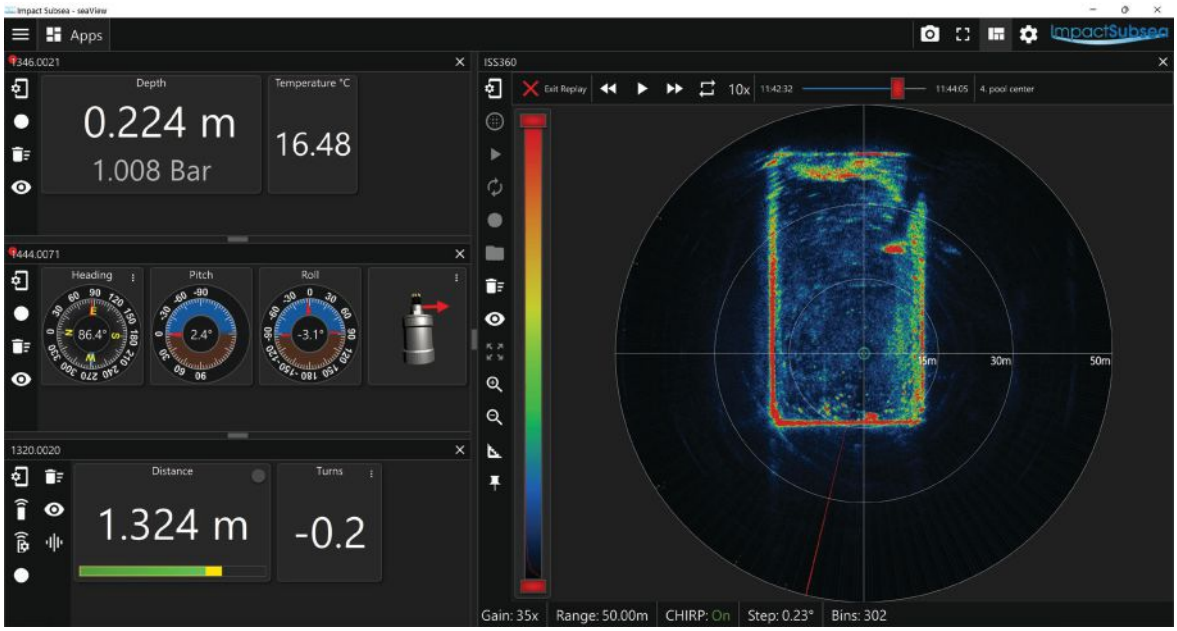

» *Multiple sensors running together in the seaView V3 application. (Image credit: Impact Subsea)*

IMPACT SUBSEA LAUNCHES SEAVIEW V3

Impact Subsea has launched the third generation of seaView software to support their range of Altimeters, Altitude and Heading Reference Systems, Depth Sensors and Sonars.

seaView V3 provides a cutting-edge user interface for the setup and operation of Impact Subsea sensors. The launch of seaView V3 is accompanied by the release of a third generation of sensor firmware.

V3 is an entirely new software development and intends to provide a powerful platform for existing Impact Subsea sensors and future sensor developments.

Commenting on the launch, Alastair Mclennan-Murray, Technical Director of Impact Subsea, stated: "To support our existing and new generation of underwater sensors, we have redeveloped seaView together with our sensor firmware from the ground up. This provides new capabilities to the user and a strong software and firmware base for future product development."

V3 allows a single or multiple Impact Subsea sensors to operate simultaneously from a single application. This is ideal for operations with a single sensor to ROV operations where Sonar, Altitude, Depth, Heading, Pitch & Roll can all be displayed on screen at the same time.

With V3 comes the ability to automatically detect any sensor that has been physically connected to the computer. The user no longer needs to deal with communication port allocation or configuration of required baud rate—this is handled automatically by the software. Sensors are physically connected then automatically displayed on screen. This is a great time-saver for applications where multiple sensors are in operation.

All sensors are fully software configurable, with seaView V3 providing a clear process to set up and configure sensors to suit specific requirements. For example, V3 allows for custom output strings to be created, where users can add new formats of ASCII output strings to a sensor's firmware. This enables quick integration of sensors into existing platforms and software applications by the user, without the need to redevelop systems or request additional support from Impact Subsea.

The 'inversion reset' capability in Impact Subsea sensors has been further enhanced: Three inversions within 10 seconds of power on sets the sensors to RS232; Six inversions, sets it to RS485. This allows sensors to quickly be configured to suit the required communications interface.

A turns counter feature has been added for all Impact Subsea sensors enabled with the integrated Altitude and Heading Reference System. Ideal to keep track of umbilical loops in ROV operations, or other applications where the rotation of an underwater asset requires monitoring.

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For more information, visit: *www.impactsubsea.co.uk/seaview*.

DSV AURELIA TO CHAMPION NEW PHASE OF OCEAN EXPLORATION

The world's deepest diving three-person acrylic submersible has been officially named *Aurelia*. The 'first-of-its-class" sub was built by Triton Submarines for REV Ocean.

The sub offers scientists, researchers and guests an unrivalled experience in ocean observation achieving depths up to 2,300 m (7,500 ft). Aurelia's huge acrylic sphere provides a truly immersive experience for occupants, with near 360-degree unobstructed views. The sub is also fitted with comprehensive scientific sensors, tools, cameras, and sampling equipment.

A public naming competition for the sub was launched in February and the winning name was submitted by Ivar Ruijten, an ROV supervisor/pilot from the Netherlands. The name is fitting because it means gold, or "The golden one" (from the Latin Aurum). Aurelia Aurita is also the commonly seen moon-jellyfish that can easily be recognized by its distinctive four horseshoe-shaped patterns, as seen through the top of the bell.

REV Ocean's other deep-sea vehicle, ROV *Aurora* entered service in October 2021 and successfully dove the Malloy Deep and the Gakkel Ridge in the Arctic Ocean (3800 m), successfully sampling hydrothermal vents for the first time.

REV Ocean's CEO Nina Jensen said: "With both *Aurelia* and *Aurora* now in service we have the best tag-team in the world for conducting cutting edge ocean science, education, and communications."

» *REV Ocean CEO Nina Jensen aboard Aurelia. (Photo credit: REV Ocean)*

Aurelia will next go through extensive sea trials around the Balearic Islands in the Mediterranean over the coming weeks to test its capabilities, performance and science equipment. This will lead to sub's certification for commissioning and acceptance by its owner.

Triton Co-Founder and President Patrick Lahey said: "With the introduction of the Triton 7500/3 (*Aurelia*), it is now possible for REV Ocean to take a pilot and two crew members on dives as deep as 2,300 meters or 7,500 feet while they enjoy the most compelling viewing experience achieved to date from inside the thickest acrylic sphere ever created."

JAN DE NUL AND SEICHE TO TEST AUTOMATED MARINE MAMMAL DETECTION

Jan De Nul Group has partnered with Seiche Ltd to start trials for the development of an automated marine mammal detection system. Seiche's visual and thermal cameras have been installed on board the vessel *Adhémar de Saint-Venant* currently working in the Netherlands. A collaboration agreement to start this innovative pilot project with Seiche's new second-generation HD thermal cameras was signed in May 2021. The first camera trials will be used to optimize the software for future use on projects.

The cameras on board the *Adhémar de Saint-Venant* will be tested on the offshore wind farm project Hollandse Kust (noord) et (west Alpha) in the Netherlands.

The combined visual and thermal cameras, secured to high points on the vessel for an increased visual reach, will be fully tested over the coming 2 months.

Ultimately, this test will be a first step towards the fully automated detection of marine mammals, thereby setting a new standard for all dredging and offshore construction projects worldwide. The aim is to increase the level of protection of marine mammals and to reduce safety risks, costs and impact upon the environment.

Nicola Harris, Associate Director of Environmental Services at Seiche Ltd, said: "We are really excited to be working with Jan De Nul on the testing phase of our new camera systems—allowing us to really showcase the enhanced capabilities of the new devices. It is really great to see construction companies like Jan De Nul showing an active interest in developing such key tools for protecting the environment."

Inge Van Tomme, Project Manager of the KPI Department at Jan De Nul Group, added: "By joining forces with a well experienced technology solution partner as Seiche Ltd., we are convinced that we can re-invent the way of detecting and protecting marine mammals for the whole dredging and offshore construction business on projects worldwide."

» *Seiche's thermal cameras on board of the Adhémar de Saint-Venant will be tested on the offshore wind farm projects. (Photo credit: Jan De Nul/Seiche)*

SPECTRUM GEOPHYSICS INVESTS IN EDGETECH 4205 SIDESCAN SONAR

Subsea Technology & Rentals (STR) recently announced that Spectrum Geophysics have purchased an EdgeTech 4205 Side Scan Sonar System to complement their existing pool of geophysical survey equipment.

STR, who are a representative for EdgeTech in the United Kingdom, have seen an active increase in sales over the past twelve months in EdgeTech's sonar imaging systems and underwater technology to support their global offshore energy customers.

Rob Arnold, Geophysics Director at Spectrum Geophysics, said: "Spectrum is pleased to be adding the 4205 Side Scan System to complement our existing pool of EdgeTech geophysical survey equipment. The system will be utilized straight away on a Southern North Sea debris clearance contract for an offshore wind project."

Doug McGowen, EdgeTech's Director, Sales & Marketing, added: "The next generation 4205 is a versatile Side Scan Sonar system that can be configured for almost any survey application from shallow to deep water operations. The system is available in either a tri-frequency side scan sonar configuration or motion tolerant and multi-pulse (MP) configuration. Spectrum selected the 540/850kHz MP version of the 4205 which provides surveyors the ability to operate either at faster survey speeds or in more adverse weather conditions while still obtaining high quality underwater imagery."

NOAA'S OCEAN EXPLORATION COOPERATIVE INSTITUTE TAKES DELIVERY OF DRIX USV

The University of New Hampshire's Center for Coastal and Ocean Mapping (UNH CCOM), as a member of the Ocean Exploration Cooperative Institute (OECI), funded by NOAA Ocean Exploration, has taken delivery of an iXblue DriX Uncrewed Surface Vehicle (USV) and its Universal Deployment System. The autonomous solution will help expand the footprint and efficiency of the OECI's ocean exploration operations.

Delivered in July to UNH CCOM, DriX and its novel Universal Deployment System have successfully completed sea acceptance trials and extensive personnel training during the summer of 2021 as well as integration and a first shakedown cruise onboard Ocean Exploration Trust's E/V Nautilus in March 2022.

"We are delighted to embark on this exciting endeavor, working collaboratively with our partners to develop and enhance autonomous technologies that will expand the limits of our capabilities and bring new efficiencies to our efforts to explore and characterize the vast unknown areas of our oceans," said UNH CCOM Director Larry Mayer.

"NOAA Ocean Exploration is pleased to see the operations of this new DriX technology successfully integrated with Exploration Vehicle Nautilus," said NOAA Ocean Exploration Director Jeremy Weirich. "Being able to operate DriX over the horizon and away from a ship will increase the rate at which we can explore the U.S. Exclusive Economic Zone in support of the National Strategy for Ocean Mapping, Exploration, and Characterization."

Selected by OECI for its mission endurance, ability to operate at high-speed, and excellent offshore seakeeping ability, DriX will support NOAA Ocean Exploration's mission by providing mapping and characterization capabilities and supporting other autonomous vehicles that are independent of the activities of the mother ship, greatly expanding the efficiency and effectiveness of ocean exploration operations. The research being conducted with DriX will serve to inform NOAA on the potential use of autonomous systems in support of the broad NOAA mission.

"We are thrilled to add DriX to the OECI collection of vehicles. It is critical to our vision of expanding the footprint of ocean exploration by collecting valuable ocean exploration data independently and simultaneously with a research vessel and at the same time providing communications and support for submerged assets," said Dr. Adam Soule, Executive Director of OECI.

The DriX vehicle will be a key technology in several ocean exploration expeditions this summer. Learn more and join the expeditions at *https://nautiluslive.org/expeditions/2022*.

» *OECI's DriX during the recent shakedown cruise off the coast of Hawaii. (Photo credit: Ocean Exploration Trust)*

CLASSNK RELEASES GHG EMISSIONS MANAGEMENT TOOL

ClassNK has released ClassNK ZETA (Zero Emission Transition Accelerator), a GHG emissions management tool to track accurate CO2 emissions and confirm and simulate CII ratings.

While the shift toward a zero-emission society has accelerated around the world, the time has come for the maritime industry to systematically plan, manage, and report the GHG emissions from shipping.

ClassNK has provided ClassNK Zero Emission Transition Support Services to support customers involved in the mariatime transportation business make a smooth transition to zero emission while planning and managing GHG emissions in their daily business operations.

ClassNK ZETA is linked with the ClassNK MRV Portal supporting compliance to MRV schemes such as IMO DCS and EU-MRV regulations. Users of MRV Portal can utilize the following four features without preparing additional data.

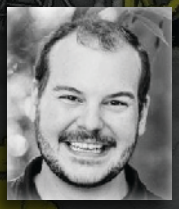
• **Vessel Monitoring:** Displays CO2 emissions, CII rating, etc. of individual ships without delay. Users can also check the estimated annual CO2 emissions and CII ratings based on the current operation status at any time and consider any necessary measures.

• **Fleet Monitoring:** Displays CO2 emissions and CII ratings of the entire fleet for each company or team in charge without delay. Makes it possible to check the CO2 emissions of the fleet and the progress of the company's overall CO2 reduction targets at any time.

• **Simulation:** Simulates the changes in CO2 emissions and CII ratings for an individual ship or fleet that would be seen by slow steaming, installing energy-saving devices, or switching fuels. Various simulations enable users to consider measures for reducing CO2 emissions.

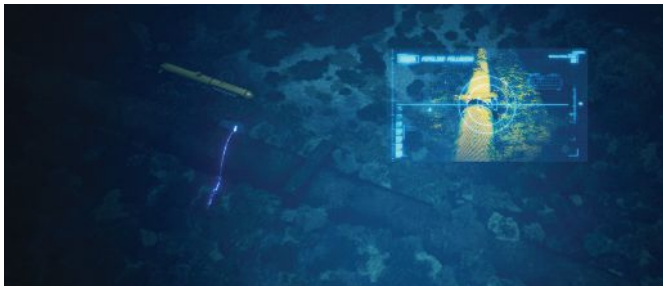
• **Periodical Report:** Outputs CO2 emissions by ship, fleet, voyage, etc. In the future, it will also allow users to meet the reporting needs of various stakeholders, such as financial institutions, cargo owners, and insurance companies.

A NEW ERA OF SUBSEA IMR



By Luke Richardson,
VP Sales & Marketing, Voyis

The methodologies in performing subsea inspection, maintenance, and repair (IMR) services are ever evolving, with new and innovative technologies rapidly advancing the capabilities of what is possible in the underwater domain. Surveyors are continuously looking for new ways to complete traditional survey approaches that both improve the efficiency of the operations by making the most of subsea robotics systems as well as optimize the data output in supporting predictive maintenance on subsea assets. In order to capitalize on this trend, there is a strong impetus towards increased sensor data resolution and providing real-time feedback.



» *AUV Survey with Laser. (Image credit: Voyis)*

STREAMLINING INSPECTIONS WITH ROBOTICS

Robotics systems are becoming more capable of performing critical subsea inspections, primarily due to the increased performance of subsea sensors and the current drive to innovate in the market. The global pandemic has forced leading surveyors to change how they approach offshore operations. With the demand for social distancing, the industry has had to adapt by drastically innovating in remote operations; this is the driving factor for pushing further into an uncrewed survey.

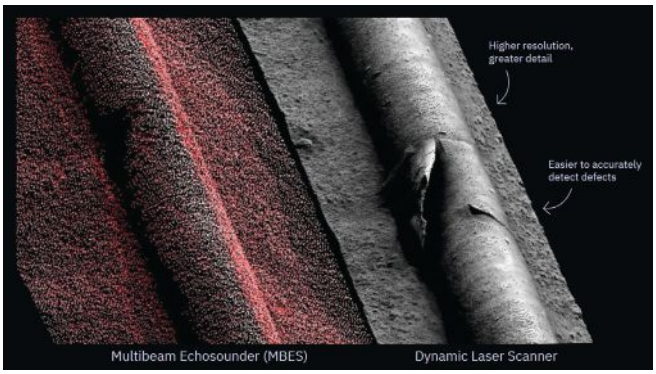
Another key driver of this trend is the emergence of the offshore renewables market and the focus shifting to greener energy production. Survey companies look to match the mission of reducing their carbon footprint and increasing inspection efficiency. Companies like Ocean Infinity with Armada, Oceaneering with Freedom, and Nauticus with the Aquanaut are pushing the boundaries of autonomy, driving some of the most prominent innovations in the market for enabling robotics systems to perform critical inspection missions autonomously. In order to allow these systems to be successful with this mission, the vehicle will demand greater detail and instantaneous results from the sensors onboard to enable automation.

ENABLING AUTONOMY WITH OPTICAL SYSTEMS

Voyis' contribution to this shift in the industry has been to provide substantially improved subsea optical systems with extremely high-resolution datasets processed in real-time to guide the robotic system or enable the vehicle to see the depths like we see the surface. Traditionally, subsea surveys relied on sonar and low-resolution video, which were only processed and analyzed after the survey was complete.

These lower resolution sensor packages required intense scrutiny and interpretation from surveyors, which led to inefficiencies and solely relied on human intervention. Inherently, optical sensors designed for subsea surveys, such as laser scanners with harmonized 4K stills cameras, have extremely high-resolution outputs that provide confidence in qualitative and quantitative subsea environments' data sets.

Furthermore, Voyis has introduced additional advancements in data improvements by removing noise and applying advanced filtering algorithms to laser point cloud data in real-time. Simultaneously, images from the stills camera are instantly enhanced using



» *Comparison of Sonar to Laser Data. (Image credit: Voyis)*

techniques to improve light levelling, undistortion, and applying machine learning-based true color correction. These advancements are all in an effort to provide the best possible data set available immediately, supporting reliable unsupervised decision making from the subsea robotic system.

It is paramount that subsea vehicles receive the highest quality datasets onboard to ensure critical missions, such as vehicle station keeping for localized inspections, object or structure tracking, manipulation for intervention or repair, subsea guidance or docking, are successful.

These optical sensors can further aid in improving the localization of the subsea vehicle by correcting drift seen through the navigation data over large area surveys, such as a subsea oil field. Provided the laser data is supplied to the robotic system in real-time and fully corrected, definitive features of the seabed can be used as a reference to dictate the vehicle's location. Over time and subsequent passes, the same feature may be exposed to the navigational drift prevalent with subsea positioning systems, resulting in data misalignment. Using laser-based loop closure, features can be extracted from the high-resolution model and be used to correct the error. Improving subsea navigation is essential in aiding fully autonomous robotic systems while also ensuring the as-built datasets collected throughout the survey are made with the highest accuracy.

PREDICTIVE MAINTENANCE: GENERATING A DIGITAL TWIN

While optical systems are a core element in enabling subsea automation, there is a supplemental benefit in using these sensors for IMR surveys. The higher-resolution datasets that enable robotic systems are also used to offer certainty for asset failure mitigation while allowing clients to make informed decisions on safely extending the service life of their assets.

One of the most critical elements of understanding the state of a subsea asset is determining the physical site condition of the structure and surrounding environment to ensure there are no potential threats to the integrity of the asset. Using underwater laser scanners, as-built volumetric models of the structure, seabed, and any relevant areas of interest are captured with extreme detail and accuracy.

These digital models can support predictive maintenance by monitoring change in the 3D model over subsequent scans using highly accurate heightmaps of scour geometry, volume of anodes, size of corrosion/marine fouling, or structure positioning shifts.

Provided the datasets are accurately geo-referenced, the analysis of inspection data can be further optimized throughout the survey. Machine learning software, like EIVA's Deep Learning, is beneficial for streamlining survey reporting by flagging areas of interest throughout a survey based on a model developed from a database. Improving the resolution and quality of the input datasets allows the software to detect features with much greater confidence. In addition, with high-quality real-time datasets collected fully geo-referenced, the results are easy to compare with historical scans of the same asset.

Coupling the external model field condition with interdependent sensor datasets installed on the subsea asset can offer a complete digital twin to satisfy a replicated monitoring tool to determine the health of all core components.

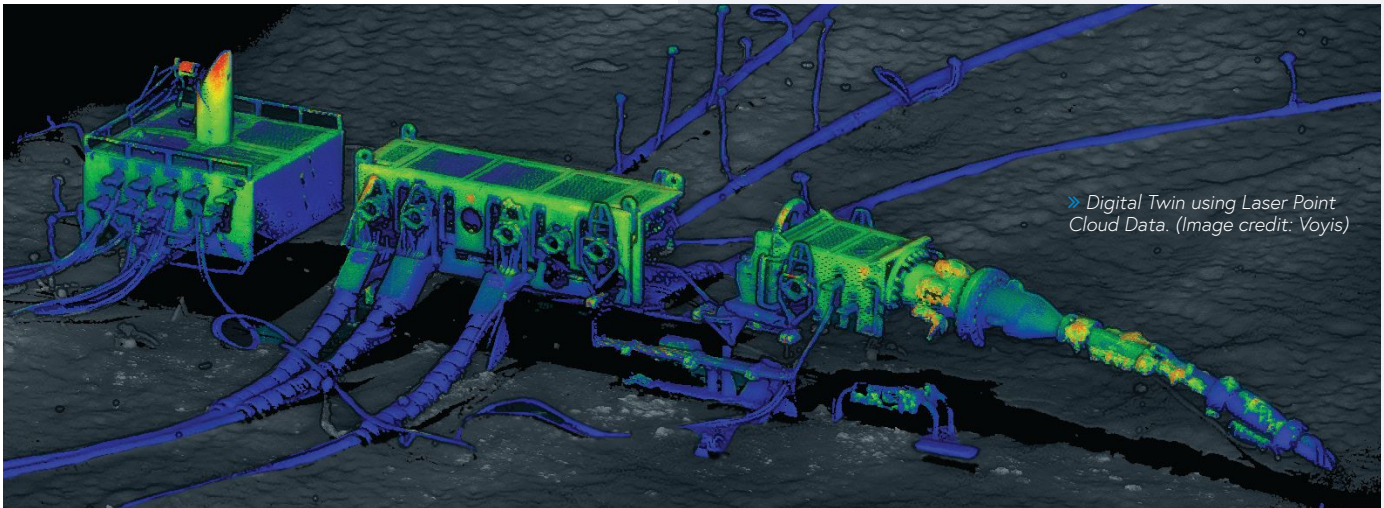
THE FUTURE OF INSPECTION SURVEYS

As autonomy continues to improve, with sensor and robotic systems working effectively in tandem, the next step to further optimize subsea assets' inspection and maintenance regime is to fully adopt autonomous inspections either through uncrewed surface vessels deploying robotic systems or through subsea residency. Today, there is an evident push in the market to make this a reality. However, there is still a long way to go, and optical systems are doing their part to support this cause.

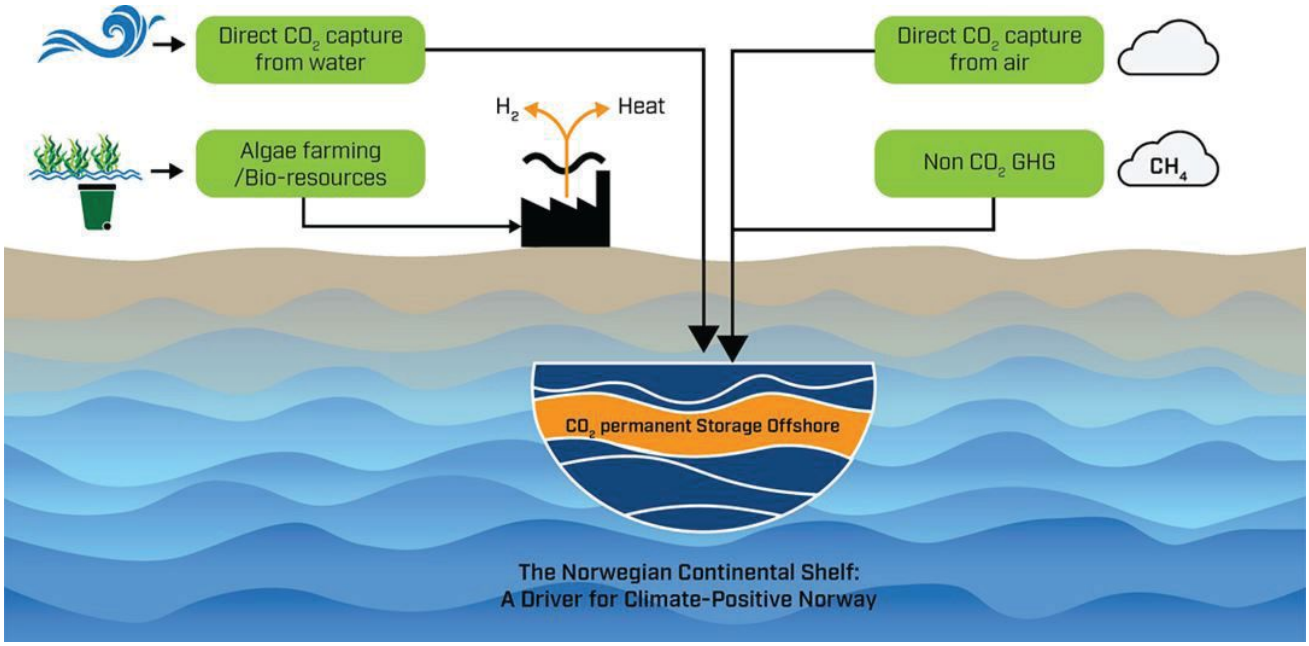
Once the fully uncrewed operation is accepted, the next path is leveraging smaller solutions to drive costs down further and reduce survey carbon output.

These systems will require sensor providers to adapt and ensure that the same capabilities available on the larger vehicles are made possible for smaller platforms. Voyis intends to address this trend by developing turn-key solutions for modular AUVs and inspection class ROVs that adapt to smaller platforms without limiting the performance of the optical package.

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



» *Digital Twin using Laser Point Cloud Data. (Image credit: Voyis)*



» *Climate-positive technologies seek to deliver negative emissions. (Image credit: SINTEF)*

NEW NORWEGIAN PROJECT LAUNCHED TO DEVELOP CLIMATE-POSITIVE TECHNOLOGIES

March 2022 marked the start of "The Norwegian Continental Shelf: A Driver for Climate-Positive Norway" (NCS C+) project, a collaborative and knowledge-building initiative that focuses on developing climate-positive technologies in order to achieve a climate-positive Norway and Europe.

What are climate-positive technologies?

Negative emissions—or activities that remove CO2 from the atmosphere—have been highlighted as key for limiting the increase in the Earth's temperatures to below 1.5°C by many climate efforts, such as the IPCC 2018 Special Report on Global Warming of 1.5°C. To achieve this, several billion metric tonnes of CO2 must be removed from the atmosphere.

Climate-positive, or Carbon Dioxide Removal (CDR), technologies seek to deliver negative emissions, for example, through afforestation or direct air capture (DAC).

To qualify as climate-positive, a technology must meet four criteria:

• Physical greenhouse gases are removed from the atmosphere,

• The removed gases are stored out of the atmosphere in a manner intended to be permanent,

• Upstream and downstream greenhouse gas emissions associated with the removal and storage process are included in the emission balance,

• The total quantity of atmospheric greenhouse gases removed and permanently stored is greater than the total quantity of greenhouse gases emitted to the atmosphere.

Four climate-positive solutions will be further developed

NCS C+ aims to close knowledge gaps towards the deployment of climate-positive technologies by stimulating several CO2 removal pathways. In particular, NCS C+ focuses on potential solutions connected to carbon capture and storage (CCS) in order to ensure permanent storage of CO2 emissions on the Norwegian Continental Shelf.

The four climate-positive technologies considered in the project are:

1. Converting algae and/or waste bio-resources into hydrogen and/or heat with CCS,
2. Removing CO2 from seawater,
3. Removing CO2 from the air (often referred to as DAC), and
4. Removing methane from the air.

NCS C+ paths towards a climate-positive society

In addition to maturing the necessary components of these technologies, NCS C+ will seek to better understand the performances of such concepts, and, as a result, how they can be improved. The project will also seek to understand how re-purposing existing assets on the Norwegian Continental Shelf, as well as leveraging existing Norwegian expertise, can both reduce the cost of these technologies and facilitate their uptake. Finally, legal and social aspects will be addressed in order to further facilitate implementation.

"The NCS C+ project is a key step in supporting a green transition and growth in Norway and Europe, as well as creating Norwegian leadership in the area of negative emissions," said Simon Roussanaly, research scientist at SINTEF Energy Research and leader of NCS C+.

DNV AND PARTNERS LAUNCH SAFEMATE PROJECT

DNV, Kongsberg Maritime, Kongsberg Seatex, Bastø Fosen and NTNU have announced the launch of the new SAFE Maritime Autonomous Technology (SAFEMATE) project. The RCN funded project will work on improving and assessing the safety and efficiency of autonomous navigation systems and deploy a pilot on an operational ferry, the Bastø VI.

The promise of automating more functions in shipping shows great potential, and interest continues to grow throughout the industry as more projects are developed. For autonomous navigation, in particular, the technologies that support object detection and collision avoidance have the potential to enhance safety and efficiency across the whole industry.

For these technologies to be widely adopted, the systems not only need to be developed, but tools and processes that assess and assure their safe function must be in place. The SAFEMATE project is designed to cover both of these aspects and test automated systems to assist navigation, while keeping an operator in the loop.

The SAFEMATE project will focus on routing and collision avoidance, to create a system that is able to detect threats and obstacles in the marine environment, interpret this information, and communicate a solution to an on-board operator. The system will be tested though the use of simulators and with human operators in the loop and then will be deployed in full-scale trials on the Bastø VI, the Bastø Fosen ferry which operates between Moss and Horten.

» *The SAFEMATE project will pilot an automated navigation decision support system on the Bastø VI ferry. (Photo credit: Torghatten AS.)*

VIDEOSOFT SEALS DEAL WITH IRIDIUM

Virginia, US-based Iridium Communications Inc. is the latest international comms business to benefit from Videosoft Global's groundbreaking ultra-low bandwidth video transmission technology.

Running Videosoft's FireLight solution over the Iridium Certus service will enable the live transmission of video from as low as 4kbps to and from anywhere in the world.

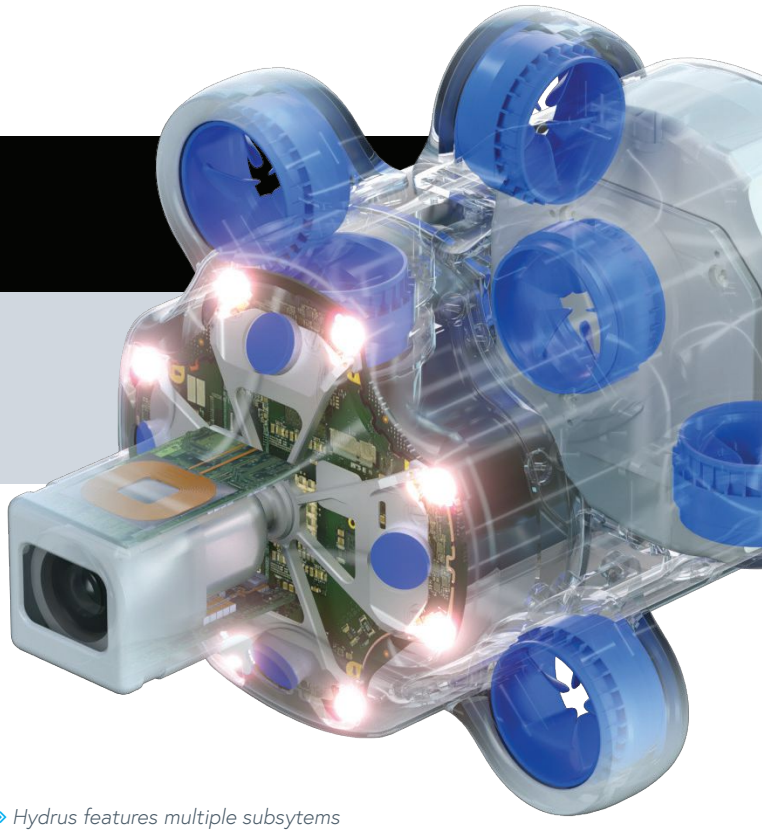
As a Certified Iridium Valued Added Developer, Videosoft's cutting-edge solution enables the company's partner network to offer secure live video, audio and data connectivity for viewing, control, and processing in real-time for a variety of users. Government entities can utilize it for security and surveillance, the maritime industry for beyond-the-horizon connectivity for manned and unmanned vessels, and land users for remote fixed or mobile locations around the globe.

The compression and transmission of live, bandwidth-efficient video data from Videosoft FireLight over the Iridium network is also beneficial for Internet of Things (IoT) applications, disaster control, tactical video surveillance, and more.

Bryan Hartin, Executive Vice President, Iridium, said: "Traditional live video transmission requires a significant amount of bandwidth and can be costly to users. FireLight's capability to support live video transmission over Iridium Certus from as low as 4kbps opens the door for countless critical applications."

CHECK THE TECH

ROBOTICS FOR CHANGE



» *Hydrus features multiple subsytems that are deeply fused by mature artificial intelligence. (Photo credit: Advanced Navigation)*

Oceans are key to survival on planet Earth. Advocates for global change are desperately trying to garner engagement for understanding what happens beneath the waves in order to help fix what happens in our realm, above them.

It has long been an ambition of Advanced Navigation to extend its technical expertise into designing and building standalone robotic systems that can help shape a sustainable future.

Hydrus, a revolutionary autonomous underwater drone, is the first such product. This innovation has undergone a meticulous evolution in its development to deeply embed artificial intelligence in fusing its INS, DVL, USBL, and propulsion systems. This is coupled to an intelligent high-specification image capture and acoustic mapping system for underwater tasks that benefit from professional grade and accurately geo-referenced imagery. All subsystems are encapsulated in an extremely compact hull to form a versatile subsea robot that can navigate and move like no other underwater vehicle.

ELIMINATING COSTS, CO2 & COMPLEX LOGISTICS

The design of Hydrus will be instrumental in opening up access to ocean data gathering and research.

» *Xavier Orr, CEO and co-founder of Advanced Navigation demonstrates the super compact Hydrus at its Sydney launch. (Photo credit: Advanced Navigation)*

Hydrus eliminates much of the cost, carbon emissions and complex logistics of traditional ocean surveys that have made this activity highly prohibitive. It is hoped that with Hydrus in the hands of researchers, scientists and environmental advocates that we can help attain a sustainable future and a stable climate.
"Our first live demonstration of Hydrus was at Oceanology International in London. The response from attendees was exceedingly positive. Hydrus attracted global attention from marine conservationists, research groups as well as significant commercial interest. After years of development, it was an exciting moment for the team to witness such a collective interest in our robotics innovation," said Xavier Orr, CEO and co-founder of Advanced Navigation.

ACCELERATING A SUSTAINABLE BLUE ECONOMY

The potential for Hydrus as a tool in the fight to save our oceans was seen early in the project and gained particular support from Andrew Forrest's philanthropic organization, the Minderoo Foundation, Flourishing Oceans initiative. Also, in collaboration with marine researchers at the University of Western Australia, momentum and practical insight into how Hydrus could be used for the projects became apparent.

"Having technology like Hydrus is one way of supporting our marine researchers and scientists to access cutting-edge technology, which puts them at the forefront of tackling the

» *Extreme compactness and maneuverability are ideal for surveying delicate habitats. (Photo credit: Advanced Navigation)*

greatest threats to our global ocean," said Dr Tony Worby, Director of Flourishing Oceans and the Planet Portfolio at Minderoo Foundation.

Hydrus is being put to the test at Ningaloo Reef in Western Australia, where it will be used by marine researchers to regularly survey specific areas of interest. The purpose of this research is to understand cross-influences between oceanographic effects, coral reefs structures and coastline.

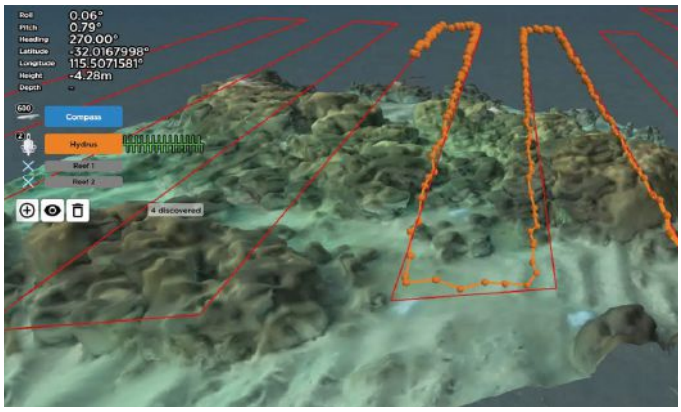
"The ability to deploy Hydrus quickly and from smaller vessels means we do not need to use divers and can be more responsive to weather events for data collection," said Justin Geldard, University of Western Australia Ocean Institute.

To maximize accessibility of the system to the broadest range of users, it is designed to be usable immediately, without requiring initial training or particular experience.

Hydrus, a revolution in underwater drone technology will be influential in helping build stronger, more sustainable oceans for us all.

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

ADVANCED NAVIGATION



» *Hydrus features dynamic AI guidance with obstacle avoidance, altitude control and image quality control. (Image credit: Advanced Navigation)*

» *Hydrus being deployed at Ningaloo Reef in Western Australia. (Photo credit: Advanced Navigation)*

IS ENERGY FALLING INTO ALICE'S RABBIT HOLE TO WONDERLAND?

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

CRUDE OIL:

Volatility is roiling every market—commodity, credit, equity, and even currency. The volatility, spurred by daily news, makes fathoming the direction and duration of any market trend impossible to discern. Each market reacts to news, and the response causes adjacent or dependent markets to respond. A ping in one market suddenly becomes a pong in another before pinging and ponging more times. The ball in constant motion has investors, lenders, traders, and even industry executives reacting with no time to understand what is happening. It is a wild world like Alice's Wonderland.

The Russia-Ukraine confrontation kicked off increased market volatility. Would energy become a weapon in the war, or merely an unfortunate casualty? NATO nations supporting Ukraine suddenly realized that their economies depended on Russian fossil fuels. Without them, economic mayhem would ensue, causing financial ruin for businesses and families, and leading to human suffering. The visceral reaction of wanting to punish the Putin-regime was quickly moderated, as the cost of responses was too great too bear. Instead of strong economic and military responses, the western world entered an era of seeking the maximum pressure on Russia's economy and finances while causing the least disruption at home.

The war has added to the economic challenges economies were facing, as they struggled to contain rising inflation from a faster economic recovery from the pandemic-slowed world, supply chain disruptions, an energy crisis created by natural and human-caused actions, and huge amounts of monetary and fiscal stimulus to help citizens cope with Covid. Forty-year highs in inflation prompted central banks to start hiking short-term interest rates. High inflation and high interest rates are undercutting economic activity, leading to the World Bank and the International Monetary Fund trimming their global growth forecasts for 2022-2023. The U.S. economy surprisingly slumped in the first quarter, despite solid consumer spending. Some of that spending strength is from higher prices! But where do we go from here?

The politics of energy are being driven by messaging for the upcoming mid-term elections. The Biden administration released massive

amounts of crude oil from the Strategic Petroleum Reserve to try to drive gasoline pump prices down. Drivers/voters need relief. At the same time, Biden is rewarding his liberal supporters by hamstringing the petroleum industry, limiting its ability to grow production that would lower pump prices. What is an oil company executive to do?

U.S. oil inventories remain well below the 5-year average, signaling that tight markets and high oil and refined product prices are here to stay. Since the March 31 SPR release announcement, near-term oil futures prices have moved up, while distant prices are lower, reflecting growing concern over the weaker economic outlook.

The turmoil in markets is likely to continue well into the summer. The course of the wars—Ukraine, inflation, Covid, and energy—will drive the news cycle, and in turn the volatility of oil prices.

NATURAL GAS:

Right now, the natural gas market is all about helping Europe avoid a human disaster. The continent is captive to Russian gas supply and haunted by the threat of a supply cutoff, possibly due to the demand for payment in rubbles and not dollars. For several months, an armada of LNG tankers have hauled U.S. gas to Europe, nearly abandoning the Asian market. Choosing where to sell LNG is easy when Europe pays more than Asia and seven-times Henry Hub prices. We will see

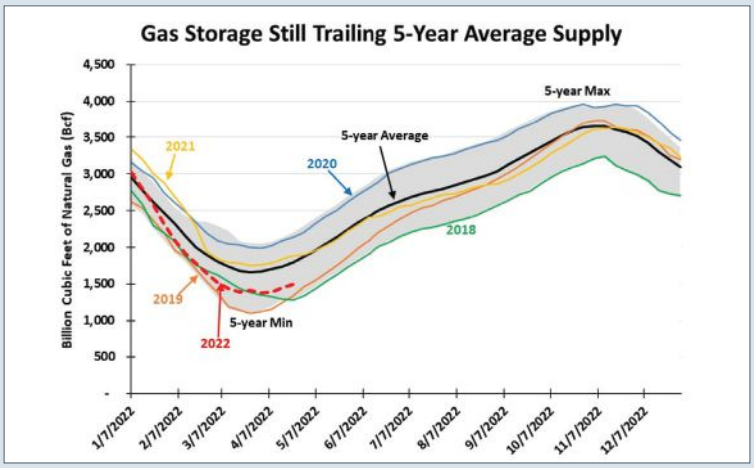
how long Asian buyers are benevolent, especially when the calendar dictates time to refill storage for next winter.

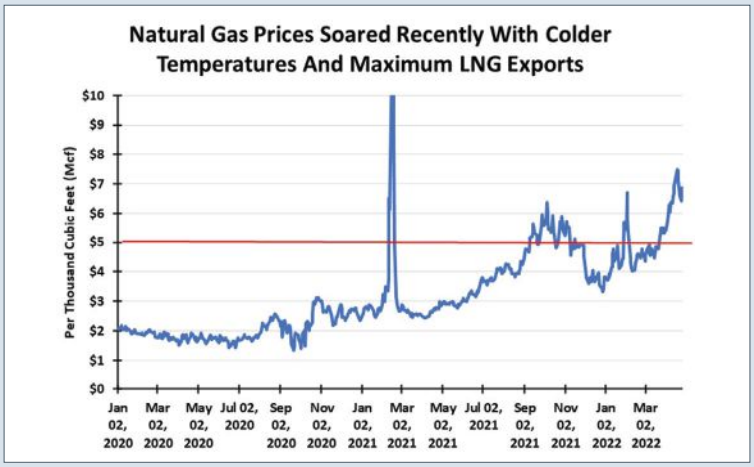
The U.S. and Europe have pledged to get an incremental 15 billion cubic meters of gas to the continent by the end of the year and an incremental 50 bcm by 2030. No one knows how it will get done or where the extra supply will come from. U.S. LNG exporters are running at capacity, although the industry was able to ship 4.3 bcm to Europe in January, a hefty increase over year-ago shipments.

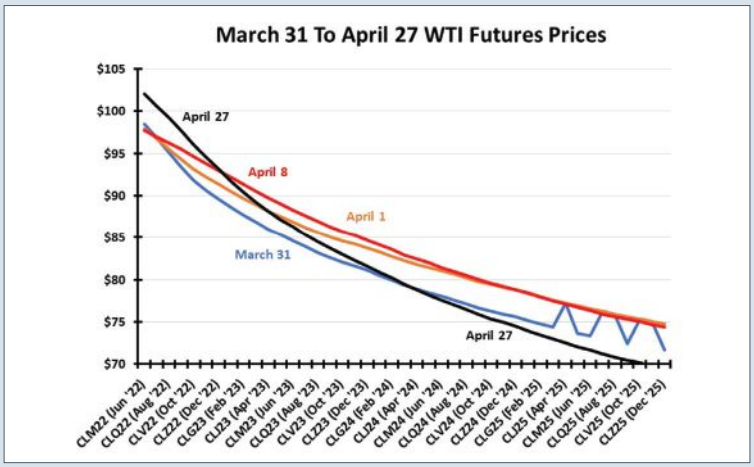
The additional LNG came from the two newest U.S. LNG terminal expansions this year, but there will be no further volumes available before 2024. A tight global gas market exists, as there are few new LNG export terminals being built anywhere. Therefore, for more gas to get to Europe requires redirecting it from other customers. A potential incremental supply source could be China, as it takes more gas from Russia and displaces LNG volumes it currently anticipates importing. Forget the political implications of such an arrangement.

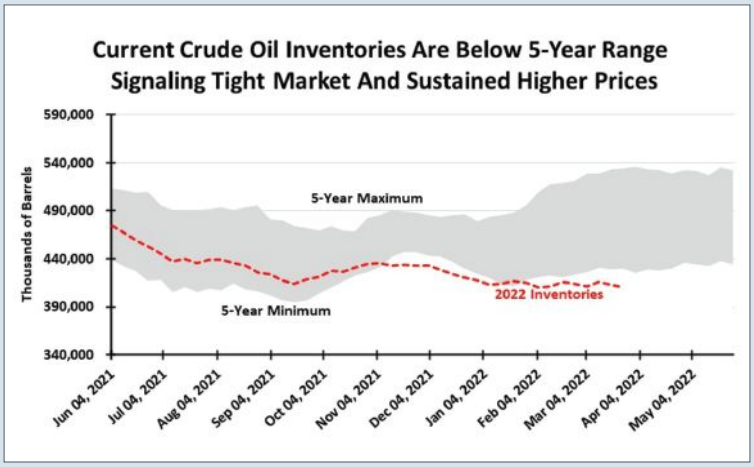
For U.S. gas consumers, the LNG market will operate at capacity keeping demand up and prices elevated. The world finds its gas storage volumes at historical lows, which will need to be rebuilt before next winter. This is also true in the U.S. As the world's largest exporter of gas, high domestic natural gas prices will be sustained. High prices signal the market wants more production if we do not want to enter next winter with low storage volumes, which could mean power supply challenges if weather is colder than normal.

It is still shocking how geopolitical events, the current U.S. administration's anti-fossil fuel governance agenda, and producers responding to the demand of their shareholders to exercise greater financial discipline and return more cash to investors have combined to transition the world's gas industry from chronic oversupply to sustained undersupply. Americans' electricity and gas bills are going up and will stay elevated into next year. Politicians who attack the gas industry and then beg for it to deliver more supply are finding that this hypocritical attitude is extending the industry's typical response time to commodity price signals. That delay is and will continue to create hardships for consumers. This situation could have been avoided if all parties had handled their roles differently.



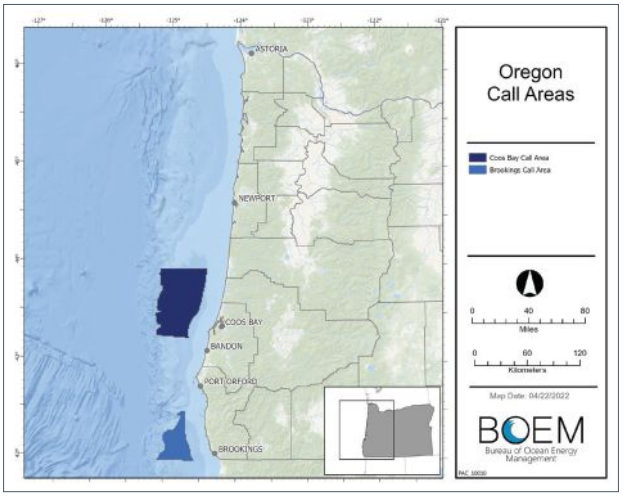




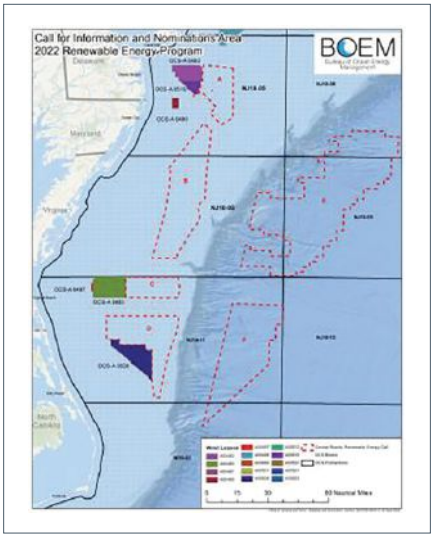


BOEM ADVANCES OFFSHORE WIND ENERGY LEASING ON ATLANTIC AND PACIFIC COASTS

The Department of the Interior has announced that the Bureau of Ocean Energy Management (BOEM) will publish two separate Calls for Information and Nominations for possible leasing in areas that are determined to be suitable off the coast of Oregon and in the Central Atlantic.



BOEM Director Amanda Lefton made the announcement at the International Offshore Wind Partnering Forum, where she outlined the Biden-Harris administration's momentum to spur a clean energy future and create good-paying, union jobs deploying 30 GW of offshore wind energy by 2030. Over the past year, the Biden-Harris administration and the Interior Department have launched the American offshore wind industry by approving and celebrating the groundbreaking of the nation's first two commercial-scale offshore wind projects in federal waters. The Department also held a record-breaking New York Bight auction and announced plans to potentially hold up to seven new offshore lease sales by 2025.



"The Biden-Harris administration is committed to supporting a robust clean energy economy, and the upcoming steps taken toward possible leasing off the coast of Oregon and Central Atlantic provides another opportunity to strengthen the clean energy industry while creating good-paying union jobs," said Secretary Deb Haaland. "We will continue using every tool in our toolbox to tackle the climate crisis, reduce our emissions to reach President Biden's bold goals, and advance environmental justice."

"The Calls for Information and Nominations for Oregon and the Central Atlantic provide an important avenue to solicit information as we identify potential areas that may be suitable for future offshore wind energy leasing," said BOEM Director Amanda Lefton. "Today's announcement reflects years of working with ocean users, Tribal governments, and local, state, and federal agencies as we drive toward achieving the ambitious goals of the Biden-Harris administration to fight climate change and create good paying jobs."

Scheduled to publish in the Federal Register on April 29, each Call will initiate a separate comment period during which the public can submit relevant information on site conditions, marine resources, and ocean uses near or within the Call Areas. Concurrently, wind energy companies can nominate specific areas they would like to see offered for leasing.

These Calls come after robust engagement with stakeholder organizations, ocean users, federal agencies, states, Tribal governments and other parties to identify conflicts and engage early in the process as BOEM seeks to advance offshore wind in areas of least impact. This next step in the process allows BOEM to obtain information from and engage with ocean users and stakeholders as the bureau seeks to identify areas of least conflict for offshore leasing and wind energy development. This information will be used to significantly narrow the area to be considered for offshore wind development leasing as BOEM seeks to identify wind energy areas.

BOEM is seeking information on six distinct areas in the Central Atlantic comprising almost 3.9 million acres. The closest point to the shore of any of the areas is approximately 20 nautical miles off the Central Atlantic coast. Publication of the Call in the Federal Register will initiate a 60-day public comment period ending at 11:59 p.m. ET on June 28. Additional information on the Call, including a map of the areas and directions for commenting, can be found at BOEM's Central Atlantic webpage.

The Oregon Call, the first action of its type off the Oregon coast, requests information on two areas that together comprise approximately 1,158,400 acres. Both areas—the Coos Bay Call Area and the Brookings Call Area—begin about 12 nautical miles from shore at their closest points, off the coast of central and southern Oregon, respectively. Publication of this Call will initiate a 60-day public comment period, which will end at 11:59 p.m. ET on June 28. For more information on the Call, including a map of the areas and instructions for commenting, see BOEM's Oregon webpage.

TRANSOCEAN INVESTS IN EXPLORATION OF SEABED MINERALS TO SUPPORT THE RENEWABLE ENERGY SUPPLY CHAIN

» *Polymetallic nodules, rich in rare earth metals.*

Transocean Ltd. has announced that it has purchased a minority interest in Ocean Minerals Ltd., a company engaged in the exploration of seabed resources containing metals critical to the growing renewable energy market.

Ocean Minerals, through its affiliate, Moana Minerals Limited, was awarded a license by the Cook Islands Seabed Minerals Authority last month for exploration of polymetallic nodules within the application area located in the Cook Islands exclusive economic zone. Critical minerals, such as cobalt, nickel, copper, manganese, and rare earth metals found in the nodules are essential for the production of high-capacity batteries.

Transocean is working with Ocean Minerals on the technology and services that will be required to collect nodules from the seabed upon receipt of a production license. The Cook Islands is one of several offshore locations worldwide with large, accessible deposits of nodules containing a high content of these critical minerals. Responsible recovery of the nodules would provide additional supply required to support growing demand.

"The technical challenges associated with the efficient recovery of deepsea polymetallic nodules represent an opportunity for Transocean to leverage our unique offshore expertise in support of the rapidly emerging energy storage market," said Chief Executive Officer Jeremy Thigpen. "We are excited to work alongside Ocean Minerals to help support efforts to achieve a lower carbon energy economy and meet the growing global demand for critical minerals. A mixture of all energy sources will be required to meet future global energy demands, and our work with Ocean Minerals is another way for Transocean to continue to provide essential offshore energy services."

In addition to its investment in Ocean Minerals, Transocean previously disclosed its commitment to reduce its greenhouse gas emissions intensity by 40% by 2030 and recently announced it will be using one of its rigs to drill one well and a sidetrack for the Northern Lights Carbon Transport and Storage Project.

NEW MCKINSEY REPORT REVEALS OIL DEMAND COULD PEAK IN NEXT 2-5 YEARS

The energy transition continues to gain steam, with oil demand projected to peak in this decade, perhaps as soon as 2025, according to new research by leading global consultancy, McKinsey & Company.

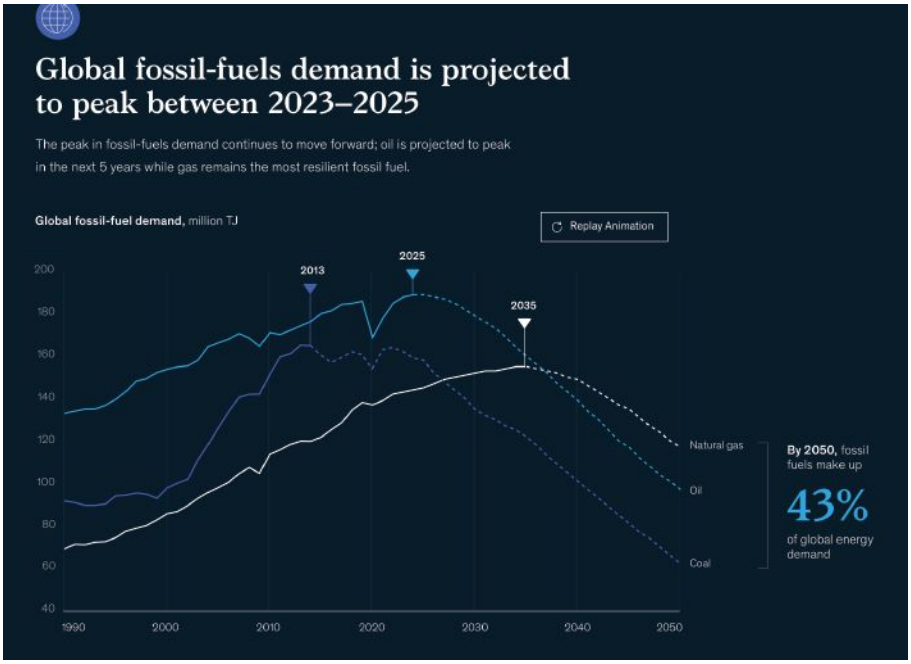
This year's Global Energy Perspective launches when global energy markets are facing an unprecedented array of uncertainties, including the conflict in Ukraine. Nonetheless, the long-term transition to low-carbon energy systems continues to see strong momentum and, in several respects, acceleration.

Leading up to COP26, a total of 64 countries, covering more than 89 percent of global emissions, have pledged or are legislated to achieve net zero in the coming decades. To keep up with these net-zero ambitions, the global energy system may need to significantly accelerate its transformation. The report projects a rapid shift in the global energy mix, with the share of renewables in global power generation expected to double in the next 15 years while total fossil fuel demand is projected to peak before 2030, depending on the scenario. However, even with current government commitments and forecasted technology trends, global warming is projected to exceed 1.7°C by 2100, and reaching a 1.5°C pathway is increasingly challenging.

Christer Tryggestad, a Senior Partner at McKinsey, said: "In the past few years, we have certainly seen the energy transition pick up pace. Every year we've published this report, peak oil demand has moved closer. Under our middle scenario assumptions, oil demand could even peak in the next three to five years, primarily driven by electric-vehicle adoption.

"However, even if all countries with net zero commitments deliver on their aspirations, global warming is still expected to reach 1.7°C. To keep the 1.5°C pathway in sight, even more ambitious acceleration is needed."

The report presents specific outlooks per fuel type such as natural gas, oil, coal, hydrogen and sustainable fuels, as well as a view on the role of CCUS in decarbonizing the energy sector.



Key findings of this year's report include:

» Going forward, the global energy mix is projected to shift towards low-carbon solutions, with a particularly strong role for power, hydrogen and synfuels:

- Renewables are projected to grow 3x by 2050, accounting for 50% of power generation globally already by 2030 and 80-90% by 2050
- Hydrogen demand is expected to grow 4-6x by 2050, driven primarily by road transport, maritime, and aviation
- Hydrogen and hydrogen-derived synfuels are expected to account for 10% of global final energy consumption by 2050
- Rapid technological developments and supply chain optimization have collectively halved the cost of solar, while wind costs have also fallen by almost one-third. As a result, 61% of new renewable capacity installation is already priced lower than fossil fuel alternatives. Battery costs have also fallen by nearly half in the past four years

» Global oil demand is projected to peak in the next three to five years, primarily driven by EV uptake

» By 2050, CCUS could grow more than 100-fold from an almost non-existent footprint today, with investment opportunities exceeding LNG markets today

» Future growth in energy investments will almost entirely be driven by renewables and decarbonization technologies

» Despite net-zero commitments from governments and corporations, an 85% renewable power system by 2050, and the rapid update of EVs and decarbonization technologies, global warming is projected to exceed 1.7 degrees

MINESTO LAUNCHES TIDAL ARRAY BUILD-OUT PLAN IN THE FAROE ISLANDS

Leading marine energy developer Minesto has launched a detailed plan for large-scale build-out of tidal energy arrays in the Faroe Islands. The plan includes four new verified sites that would supply 40% of the nation's growing electricity consumption, enabling the Faroe Islands to reach its policy goal of 100% renewable energy by 2030. Together with utility company SEV, Minesto has presented the plan to a wide range of policy and local community stakeholders—including the Prime Minister and Minister of Environment, Industry and Trade—and it has been received very positively.

The large-scale build-out plan sets out a stepwise installation of tidal kite arrays, each with 20-40 MW installed capacity, at four verified locations. In addition to Minesto's existing grid-connected site in Vestmannasund, the company points out Hestfjord, Leirviksfjord, Skopunarfjord and Svinoyarfjord as ideal arrays. With a total capacity of 120 MW tidal energy, generating an estimated 350 GWh per year, the arrays would supply 40% of the Faroe Islands' growing electricity consumption.

"We're very pleased with the outcome of the joint presentation tour together with SEV, and the interest and positive response of our build-out plan. In our dialogue with the Faroese community, all key aspects of full integration of Minesto's tidal technology into the islands´ energy system have been covered. This includes environmental permitting, legislation for sea-bed access, local partnerships regarding port-access, manufacturing, and funding," said Martin Edlund, CEO of Minesto.

During 2022, the first step is to expand the existing grid-connected site in Vestmannasund, establishing a mini array with three systems at a total installed capacity of 1.4 MW. The second step, planning and permitting ongoing, is a 10 MW array in Hestfjord, with direct electricity distribution to nearby capital Torshavn. After that further build-out of Hestfjord will follow, as well as stepwise build-out of Leirviksfjord, Skopunarfjord and Svinoyarfjord. In total, this makes it possible to deliver a cost-effective path to 100% renewable energy by 2030.

"As we're in the forefront of creating a completely new industry, where we intend to add predictable tidal energy to the global energy mix, we're thrilled to support the Faroe Islands in their explorative and ambitious journey towards a balanced energy system," said added Edlund.

» *Tidal energy is a key component of the Faroe Islands' policy goal of 100% renewable energy by 2030. (Photo credit: Minesto)*

EXXONMOBIL MAKES THREE NEW DISCOVERIES OFFSHORE GUYANA

ExxonMobil has made three new discoveries offshore Guyana and increased its estimate of the recoverable resource for the Stabroek Block to nearly 11 billion oil-equivalent barrels.

The three discoveries are southeast of the Liza and Payara developments. The Barreleye-1 well encountered approximately 230 feet (70 meters) of hydrocarbon-bearing sandstone and was drilled in 3,840 feet (1,170 meters) of water. Drilling at Patwa-1 encountered 108 feet (33 meters) of hydrocarbon-bearing sandstone and was conducted in 6,315 feet (1,925 meters) of water. The Lukanani-1 well encountered 115 feet (35 meters) of hydrocarbon-bearing sandstone and was drilled in a water depth of 4,068 feet (1,240 meters). Operations are ongoing at Barreleye-1 and Lukanani-1.

"These discoveries and the updated resource estimate increase the confidence we have in our ambitious exploration strategy for the Stabroek Block and will help to inform our future development plans for the southeast part of the block," said Liam Mallon, president of ExxonMobil Upstream Company. "ExxonMobil remains committed to delivering value at an accelerated pace to the people of Guyana, our partners and shareholders and reliably supplying affordable energy to meet increasing demand around the world."

ExxonMobil currently has four sanctioned projects offshore Guyana. Liza Phase 1 is producing approximately 130,000 barrels per day using the Liza Destiny floating production storage and offloading (FPSO) vessel. Liza Phase 2, which started production in February, is steadily ramping up to its capacity of 220,000 barrels per day using the Liza Unity FPSO. The third project, Payara, is expected to produce 220,000 barrels per day; construction on its production vessel, the Prosperity FPSO, is running approximately five months ahead of schedule with start-up likely before year-end 2023. The fourth project, Yellowtail, is expected to produce 250,000 barrels per day when the ONE GUYANA FPSO comes online in 2025.

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

NEW OIL AND GAS DISCOVERY BY THE NORTH SEA TROLL AND FRAM AREA

Equinor, which is the operator of production license 293 B, has discovered oil and gas close to the Troll and Fram area. Based on preliminary estimates the size of the discovery is between 4 and 8 million standard cubic meters of recoverable oil equivalent, or 25-50 million barrels of recoverable oil equivalent.

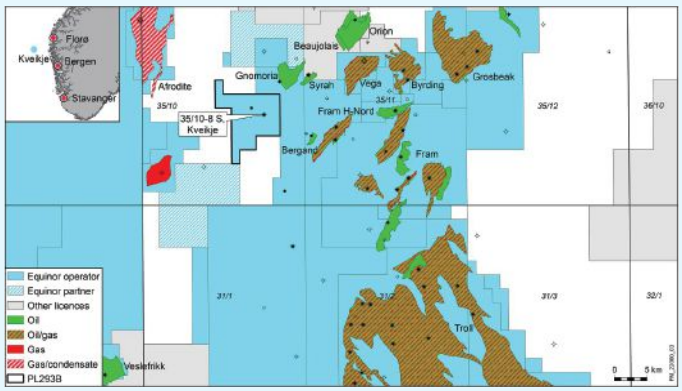
The license owners are Equinor (51%), DNO (29%), Idemitsu (10%) and Longboat Energy (10%).

Temporarily called Kveikje, this is the sixth discovery in this area since the autumn of 2019. Up to more than 300 million barrels of oil equivalent were proven in the five former discoveries.

"We are very pleased to make another discovery in this area that we regard to be commercial. As we did with the other discoveries in this area, we will consider tying this discovery to the Troll B or C platform. By utilizing the existing infrastructure, we will be able to recover these volumes at a low cost and with low emissions," said Lill H. Brusdal, Equinor's vice president for the Troll area.

There were several drilling targets in the exploration well. After Kveikje was discovered, drilling continued to the next target in the upper part of the Cretaceous stratigraphic sequence. Smaller deposits of petroleum were discovered that are considered as non-commercial. The well has been permanently plugged and abandoned.

The well was drilled by *Deepsea Stavanger*.

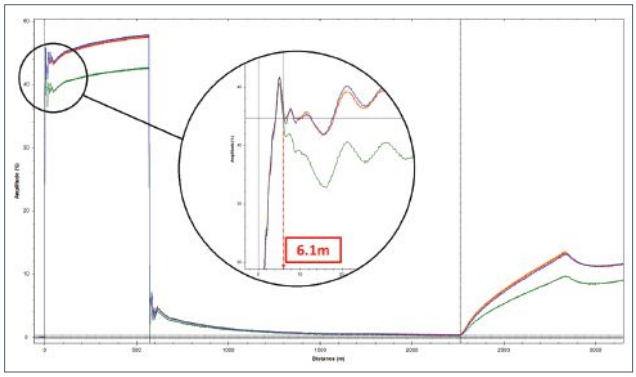


C-Kore
Simplify Subsea Testing

NEW SUBSEA OTDR STREAMLINES MONITORING OF SEABED FIBER OPTICS

» *C-Kore's NEW Subsea OTDR unit. (Photo credit: C-Kore)*

» *C-Kore tools simplify subsea testing. (Photo credit: C-Kore)*



» *Analysis of OTDR traces with C-Kore software. (Image credit: C-Kore)*

C-Kore Systems is proud to introduce the latest edition to their range of subsea testing tools, their Subsea OTDR (Optical Time Domain Reflectometer). Requests from the oil & gas industry to be able to monitor the fiber optics in umbilicals during installation resulted in C-Kore launching a 2-year development program.

Using knowledge gained from supporting customers with a range of automated subsea testing tools, C-Kore has simplified the once difficult task of performing OTDR measurements on subsea equipment. Using the new Subsea OTDR, operators can now easily perform testing on optical fibers on the seabed without the need for mobilizing highly specialized personnel.

OPTIMIZED RANGE & ACCURACY

The C-Kore Subsea OTDR works much like a radar; it sends out a signal of light and detects the reflections that come back. Anomalies (splices, bends, connectors, etc.) along the fiber all send back reflections. By knowing the transmission properties of the fiber and how long it takes for a reflection to return, the distance to each anomaly is accurately calculated. In fact, the C-Kore Subsea OTDR device delivers a powerful combination of both range and accuracy, making it possible for the first time to answer the perennial question, "is the fault in the connector or in the first few meters of the umbilical?".

STREAMLINING SUBSEA TESTING

The design of the Subsea OTDR is based on C-Kore's design philosophy to simplify the process of subsea testing for their customers.

The units are battery powered and programmed ahead of time to run a test sequence for up to 12 fibers. As the unit is automated, specialized personnel are no longer needed to accompany the unit offshore. The wealth of information is data logged in the unit's internal memory and can be sent back to the C-Kore offices for detailed analysis. C-Kore's proprietary software program allows different traces to be laid on top of each other which helps on fault-finding operations to pinpoint the location of faults.

Interest in C-Kore's Subsea OTDR has also been received from the offshore renewable industry. With installation projects planned for the summer of 2022, C-Kore is confident that subsea operators, installers, and manufacturers will all benefit from the adoption of this new technology, saving costs and time on their offshore operations.

For more information, visit: *www.c-kore.com*.

» *Ørsted will own an 80% stake in the Salamander floating offshore wind project. (Photo credit: Ørsted)*

ØRSTED ACQUIRES MAJORITY STAKE IN SCOTTISH FLOATING WIND DEVELOPMENT PROJECT

Ørsted, the world leader in offshore wind, has acquired a majority stake in the 100 MW Salamander floating offshore wind development project on the Scottish coast, entering a joint venture (JV) partnership with Simply Blue Group, a leading Irish blue economy developer in floating offshore wind, wave energy and low-impact aquaculture. Ørsted will own an 80% stake in the project as Simply Blue Group's newest JV partner on the project, alongside minority JV partner, Subsea 7.

Salamander is intended to be progressed through the innovation track of Crown Estate Scotland's forthcoming Innovation and Targeted Oil and Gas (INTOG) leasing round later this year. Established by Simply Blue Group, the project is designed as a stepping-stone for floating wind technology, providing an opportunity for supply chain businesses to gear up for commercial scale floating wind opportunities and help the technology become cost competitive as early as possible. The Salamander project follows on from other such projects Simply Blue Group is developing with major energy operators around Ireland and in Wales.

Martin Neubert, Group Deputy CEO and Chief Commercial Officer at Ørsted, said: "I'm pleased that we have agreed with Simply Blue to become a partner on this promising project which further expands Ørsted's engagement in floating offshore wind and will provide a lot of learnings that we can apply on Scotwind and other floating wind projects as the technology transitions from demo projects to utility scale. Ørsted has been driving the commercialization of bottom-fixed offshore wind for 30 years, and during the next decade we want to help make floating offshore wind similarly successful through projects such as this one."

Sam Roch-Perks, CEO of Simply Blue Group said: "We are delighted that Ørsted is joining with Simply Blue Group and Subsea 7 to develop the Salamander project. Ørsted is a leading player in renewable energy and brings considerable expertise to the prestigious Salamander project. As a leading floating wind developer, Simply Blue Group wants to contribute to the development of the Scottish Offshore wind market and its supply chain. Scotland is one of the best locations on the planet for the development of floating wind projects and we look forward to the collaboration with Ørsted on this exciting and important project."

HEEREMA MARINE CONTRACTORS AWARDED HE DREIHT OFFSHORE WIND PROJECT

The work includes the transport and installation of 64 monopiles and transition pieces. During operations, Heerema will use the IHC IQIP double-walled noise mitigation system NMS-10,000 amongst other systems to reduce noise pollution.

The He Dreiht wind farm is located in the German North Sea, 90 km northwest of Borkum and about 110 km west of Heligoland. With a capacity of 900 MW, He Dreiht is one of the largest planned offshore wind power projects in Europe and is scheduled to go into operation in 2025.

Heerema's Offshore Wind Director, Jeroen van Oosten said: "We are committed to increasing our market share in large monopile installations for offshore wind and are proud to be chosen to enable EnBW to deliver 900 MW of renewable energy."

DNV AWARDS INOCEAN AIP AND BASIC DESIGN APPROVAL FOR NEW 12 MW FLOATING OFFSHORE CONCEPT

DNV has awarded Inocean AS, a Norwegian subsidiary of Technip Energies, Approval in Principle (AiP) and Basic Design Approval for their new INO12™ semisubmersible platform concept. The certificates were presented during the Nor-Shipping trade fair at the DNV stand, by Geir Fuglerud, Director of Offshore Classification at DNV to Øystein D Nilsen, Managing Director of Inocean AS.

The INO12TM floating offshore wind concept has been designed to accommodate a 12 MW wind turbine, with a life span of 25 years without dry docking. The concept emerged initially from internal research at Inocean and was further refined in the WINDMOOR research project, 4-year project funded by the Research Council of Norway and the offshore wind industry. The INO12™ semi-submersible floating wind concept which utilizes a simple and lean design, which has been tailored towards mass production and scalability. The concept also offers the possibility of full assembly at the quayside with direct access to the tower.

"Yet again we would like to express our gratitude to DNV for their proactive approach, for being solution oriented and for having a professional attitude," said Øystein D Nilsen, Managing Director of Inocean. "At the same time, we would also like to thank our parent company Technip Energies for embracing the concept INO12™ and for involving Inocean in their strategic plans for the floating offshore wind business."

"We would like to congratulate Inocean and Technip Energies on being awarded the AiP and Basic Design Approval, which once again is a result of the excellent ongoing cooperation we have enjoyed on the project," said Geir Fuglerud, Director of Offshore Classification at DNV. "The AiP and Basic Design Approval also demonstrates the commitment of Inocean and Technip Energies to showing the industry that the INO12™ concept rests on a foundation of the most advanced technical standards in the industry. Floating offshore wind is a market that we predict will expand massively over the coming years—if we can build on a basis of trusted assurance. And for DNV this means to continue to develop our rules and standards, to empower partners like Inocean to push the boundaries of the technology further and expand the segment's reach, with confidence and safety."

» *The certificates were presented during the Nor-Shipping trade fair at the DNV stand, by Geir Fuglerud, Director of Offshore Classification at DNV (left), to Øystein D Nilsen, Managing Director of Inocean AS.*

EQUINOR AWARDED THE SMEAHEIA AND POLARIS CO2 LICENSES

Equinor has been awarded the operatorships for the development of the CO2 storages Smeaheia in the North Sea and Polaris in the Barents Sea. The two licenses are important building blocks for developing the Norwegian continental shelf into a leading province for CO2 storage in Europe.

The Ministry of Petroleum and Energy announced the award of CO2 licenses in April, and Equinor was awarded the operatorships for the two licenses referred to by the company as Smeaheia and Polaris.

CO2 transport and storage infrastructure (CCS) is crucial for providing CO2 solutions on a commercial basis to industrial customers, such as steel, cement and other heavy industries. This will also help protect existing jobs in these industries while at the same time creating new jobs in the development of new value chains on the Norwegian shelf.

"We are now building on more than 25 years of experience from CO2 capture and storage on the Norwegian continental shelf and we regard the award as an important milestone in the work to make the Norwegian continental shelf a leading province in Europe for CO2 storage. We see that demand for CO2 storage is increasing in several countries, and we want to get started with developing new CO2 storages quickly, so that we can offer industrial solutions that can contribute to decarbonization in Europe," said Irene Rummelhoff, executive vice president for Marketing, Midstream and Processing (MMP).

In its application, Equinor has submitted plans to develop the CO2 storage capacity in Smeaheia at 20 million tonnes annually, which entails a sharp increase in the capacity to store CO2 on a commercial basis on the Norwegian continental shelf. Northern Lights, the CO2 storage facility in the Longship project, has a planned injection capacity of 1.5 million tonnes a year in Phase 1 available from 2024 with plans to develop the capacity to 5-6 million tonnes a year from around 2026.

Through these two projects, Equinor aims to contribute to CO2 reductions equivalent to half of Norway's annual emissions. Equinor has ambitions to develop further storage licenses in the North Sea in the coming years with the aim of building a common, pipeline-based infrastructure that can contribute to substantial cost reductions for the CCS value chains.

"We are pleased that Norwegian authorities have made storage areas available with basis in commercial industries. Rapid scale-up of CO2 storage at Smeaheia is essential to meet the interest and need for this type of service and to ensure storage needs from low-carbon projects in Norway," added Rummelhoff.

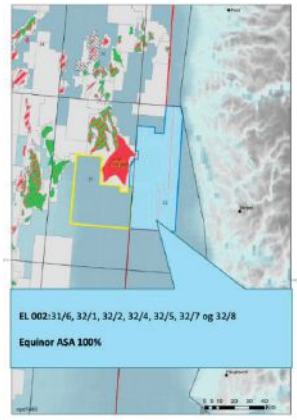
Safe capture and storage of CO2 is also a prerequisite and enabler for developing blue hydrogen and ammonia from natural. With CCS, blue hydrogen and ammonia can more or less eliminate emissions from the use of gas, thus ensuring access to large amounts of low-carbon and reliable energy. With the use of CCS, emissions can also be significantly reduced from gas-fired power plants.

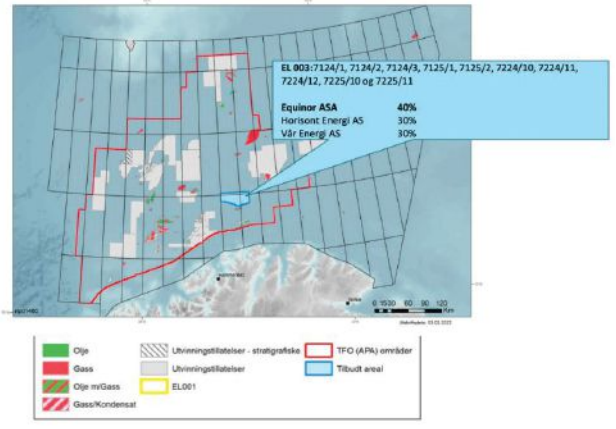
» *Irene Rummelhoff, executive VP for Marketing, Midstream and Processing (MMP).*

In the Barents Sea, about 100 kilometers off the coast of Finnmark, lies the CO2 storage Polaris. The storage is a key part of the Barents Blue project which Equinor is developing in collaboration with Vår Energi and Horisont Energi. The project is developing an ammonia production facility at Markoppneset in Hammerfest that will reform natural gas from the Barents Sea to clean, blue ammonia using carbon capture and storage. The first stage of the development includes capture, transport and storage of two million tonnes of CO2 each year.

In October 2021 Equinor launched Norway energy hub, with a goal to help maintain and further develop Norway as an energy nation, by creating new value chains, solutions and jobs in Norway. Norway energy hub consists of four building blocks: decarbonization of oil and gas, industrialization of offshore wind, commercialization of CCS and large-scale hydrogen production.

Equinor has an ambition to develop value chains for CO2 transport and storage with an annual capacity of 15-30 million tonnes of CO2 within 2035.





TECHNIP ENERGIES TO PROVIDE FEED FOR EQUINOR FLOATING OFFSHORE WIND FIREFLY PROJECT IN SOUTH KOREA

Technip Energies has been selected by Equinor South Korea Co Ltd to perform a Front-End Engineering Design (FEED) for the offshore floating wind Firefly project, located 70 km offshore the East Coast of South Korea.

The FEED contract covers engineering of the floating wind turbine substructures for the proposed 800 MW offshore wind farm. The design of the substructures will include Technip Energies' in-house floater technology INO15™. With a capacity of 15 MW, INO15™ technology is a three columns semi-submersible floater which is well suited for fabrication in large series. The substructure design is in alignment with Equinor's wind semi design principles.

Firefly wind farm is planned for an area of 2 x 75 km^2 off the coast of the city of Ulsan in South Korea and will serve to feed the Korean grid. It is planned to be in operation in 2027.

Willy Gauttier, VP Offshore Floating Wind at Technip Energies, commented: "We are glad to have been awarded this FEED by our long-lasting client Equinor and that the INO15™ floater technology has been selected for the development of the offshore wind farm. It perfectly illustrates that engineering and technology will be key to accelerate the energy transition. Through the Firefly project, we are committed to support Equinor in its objective to reach an installed net renewables capacity of 12-16 GW by 2030."

» *The Firefly project is located 70 km offshore the East Coast of South Korea. (Image credit: Equinor)*

» *The SeaRaptor 6000 AUV can dive to 6,000 m and supports a unique sensor suite for geophysical and hydrographic survey. (Image credit: Argeo)*

A sophisticated package of electromagnetic sensors developed by Norwegian company Argeo is radically improving the monitoring of power cables, pipelines, and wind turbine foundations, the scanning for buried UXO, and the mapping of deep-sea minerals. Furthermore, by fitting the sensors into an autonomous underwater vehicle capable of doing, for example, cable inspection at 6 km/h, Argeo is setting new efficiency standards in the ocean inspection arena.

The SeaRaptor 6000 is an impressive piece of machinery. The yellow, survey grade deep water autonomous underwater vehicle (AUV) is built to operate at abyssal depths. Able to reach 6,000 m, the AUV carries a package of sensors that will radically change geophysical and hydrographic surveying, according to Argeo CEO Trond Crantz:

"We've developed a unique array of electromagnetic tools, patent pending, that will transform the way ocean survey and inspection is performed.

"Our sensors will provide data for assessing the condition of subsea infrastructure and for surveying the seabed. The data produced will be more detailed and precise than conventional methods, and we can do it much faster. On top of that, we can operate largely without surface vessels. We've presented this strong technology combo to several offshore wind and oil & gas companies, and they're considering this a gamechanger in the industry."

REDUCING VESSEL TIME

The Argeo mission is to go smaller, smarter, and more sustainable. By replacing large, expensive, and labour-intensive surface vessels with small, autonomous underwater vehicles, Argeo offers the oil & gas and offshore wind industries a way to substantially reduce the effort needed to inspect subsea assets and infrastructure.

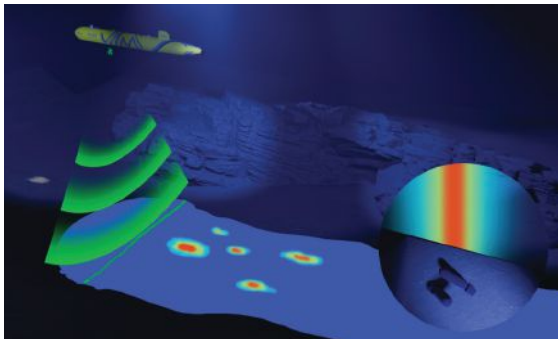
According to Trond Crantz, currently 90% of these costs are vessel related; he estimates that by deploying the SeaRaptor 6000 and similar advanced inspection tools, operators can replace up to 70% of all vessel activities.

And that is good news to the sector, because it's searching high and low for solutions that drive operational efficiency while helping to reduce the cost of survey and inspection. Not least to deliver on the increasingly important parameters of sustainability and ESG.

INSPECTION OF CATHODIC PROTECTION

The newly developed electromagnetic sensor package will be integrated into the SeaRaptor 6000, built by Teledyne Gavia, and into the rest of the AUV fleet in time. An additional SeaRaptor 6000 will be joining the Argeo AUV fleet soon.

Argeo's SeaRaptor 6000 and its sensor package will soon be heading out to its



» *The electromagnetic field the AUV is transmitting while moving across the ocean floor, revealing objects weighing 1-3 kg and upwards, buried in the sediment. (Image credit: Argeo)*

THE SWISS ARMY KNIFE OF UNDERWATER INSPECTION: AN AUTOMOMOUS ROBOT TRANSFORMING OCEAN SURVEY

By Argeo

first commercial assignment, using its hypersensitive tools for inspection of the Cathodic Protection of pipelines.

While the AUV moves along the pipeline, its electromagnetic sensors measure the electric currents from the pipeline's sacrificial anodes. In this way, it assesses the condition of the anodes and can pinpoint which ones are ready for replacement. The system can also be used for monitoring power cables, and for detecting oil or gas leaks. The AUV performs its task at a speed of 6 km per hour, 5 times faster than conventional methods.

UXO DETECTION

In addition to inspecting Cathodic Protection, Argeo sensors can detect unexploded ordnance.

"Up to now you use passive magnetometer systems on large surface vessels, to locate this kind of metallic objects. The method is time consuming, expensive, and inaccurate," Trond Crantz explains.

"To detect UXO, we've extended the scope of our sensor system. For inspection of Cathodic Protection, we're using a passive system. To detect UXO, we're making it active: we're not only listening to a signal, but we're also sending a signal out and measuring the reflections coming back. The electromagnetic field our AUV is transmitting while moving across the ocean floor, will reveal objects weighing 1-3 kg and upwards, buried in the sediment. We can detect UXO with high accuracy, and even make a 3D map of its location. Pinpointing a small metallic object, at that speed and with that radius—our system is the only in the world able to do that."

Furthermore, the Argeo AUV can track a pipeline, or a power cable buried up to 2 m below the sea floor. Apart from reporting about its condition, for instance a leak or a rupture, the sensors estimate how deep it is buried and reveal if it has been exposed by sediment shift.

While monitoring the pipeline, the AUV is not dependent on a preprogrammed path but can track the cable autonomously without any input from the surface. Its steering algorithm navigates using input from the electromagnetic sensors and the AUV will follow the cable or pipeline closely, even if its actual position differs from where it's supposed to be.

MAPPING DEEP-SEA MINERALS

Argeo's technology can be adapted to work on a very large scale and can even be implemented to support the seabed mapping of deep-sea minerals by connecting two SeaRaptors, one functioning as a Source AUV, the other as a Receiver AUV. Together they can map the conductive layers in which minerals can be found, down to a depth of 100 m below the ocean floor and produce a 3D map of the area. Argeo is the only company in the world that can perform such surveys, with technology implemented in an AUV. And we can do it at depths up to 6.000 m.

"All in all, we can help tackle a wide variety of the challenges the offshore industry is facing, when it comes to survey and inspection," says Trond Crantz.

"Merging unique sensor technology with autonomous surface and underwater vehicles, powered by sophisticated algorithms, allows us to introduce a fully automated, highly sensitive survey and inspection solution. Now we can dramatically improve efficiency and imaging quality, and what's more, we can significantly reduce emissions related to survey and inspection."

For more information, visit: *www.argeo.no*.

REACH SUBSEA HIRES KONGSBERG MARITIME TO BUILD GAME CHANGING UNMANNED VESSELS

Reach Subsea ASA, a provider of subsea services globally, has signed a landmark contract with Kongsberg Maritime AS, part of the Kongsberg Group, for the construction of the first two in a series of Reach Remote unmanned offshore surface vessels (USVs), which will serve as mobile power banks, data centers and communication modules for underwater ROVs. Both the USVs and ROVs will be operated from an onshore control center.

"We are happy and proud to achieve this important milestone for the Reach Remote project, which will be a gamechanger for the industry and for us. Reach Remote will enable 20-30 percent reduced cost for clients and 90-100 percent reduction in emissions compared to today's large, manned control vessels," said CEO of Reach Subsea, Jostein Alendal.

The Reach Remote project is developed by Reach Subsea jointly with Kongsberg Maritime and Massterly. In February 2022, a collaboration agreement with Wilhelmsen, covering an equity investment in Reach Subsea and a strategic co-operation for the commercialization of Reach Remote was announced. Wilhelmsen has been a pioneer in driving autonomous and remote marine operations and represents the ideal global partner needed for Reach to commercialize Reach Remote.

Additionally, Reach Subsea has recently announced the acquisitions of OCTIO, including Monviro, and iSURVEY. The acquisitions represent a strong strategic fit with the Reach Remote service concept.

Reach Subsea expects delivery of the two first Reach Remote systems mid-2023. The total investment for the first two Reach Remote units, which includes the Kongsberg contract as well as upfront development and infrastructure investments to the benefit of future units is NOK 380-400 million. The investment will be financed through loans from SR-Bank and Eksfin and proceeds from the private equity placement in which Wilhelmsen invested NOK 150 million in February 2022.

"With our strong partners, world-leading technology, and solid financial foundation, Reach Remote is an attractive project, which we will bring to the market with perfect timing. We see firm demand from the traditional oil and gas segments combined with rapidly growing emerging market segments like renewable energy," added Alendal.

HELIX ENERGY SOLUTIONS AWARDED MULTI-YEAR WELL INTERVENTION SERVICES CONTRACT BY SHELL

Helix Energy Solutions Group, Inc., a leading provider of offshore energy services, has entered into a new multi-year contract with Shell Offshore Inc. to provide Well Intervention services in the U.S. Gulf of Mexico. Commencing in March 2022, the three-year contract includes an anticipated 75 days utilization per year with the option to add additional utilization days.

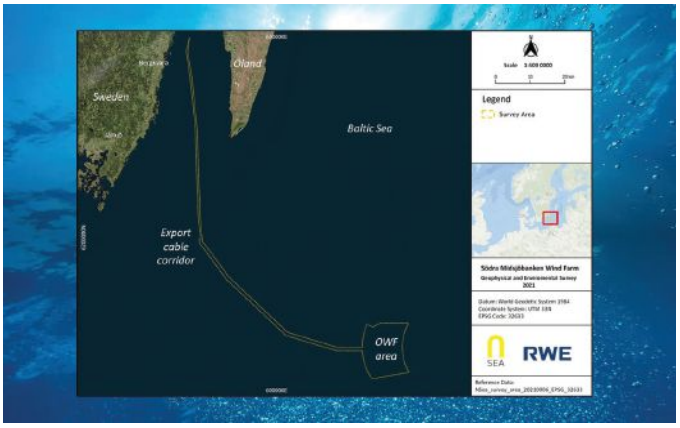
Under the contract Helix will provide either the *Q4000* or *Q5000* riser-based semi-submersible well intervention vessel, a 10k or 15k Intervention Riser System (IRS), remotely operated vehicles, project management, and engineering services to cover operations from fully integrated well intervention to fully integrated plug and abandonment well services.

The *Q4000* and *Q5000* well intervention vessels provide an optimal platform for a wide variety of tasks, including subsea well intervention, field and well decommissioning, installation and recovery of subsea equipment, well testing and emergency well containment.

Scotty Sparks, Helix's COO, stated: "Shell continues to be a valued customer of Helix. We appreciate their continued confidence in our fully integrated well intervention services, our commitment to safety and cost-effective and efficient solutions. We are confident in the efficiencies and value we bring to our customers, and this contract further signals the increasing demand for our services."

» *The Q4000 is a DP3 semisubmersible vessel purpose-build for well intervention and construction in water depths to 10,000 ft. (Photo credit: Helix)*

N-SEA COMPLETES ENVIRONMENTAL BASELINE SURVEY IN THE BALTIC SEA



RWE Renewables is currently developing the 1600 MW Offshore Wind Farm (OWF) Södra Midsjöbanken located in the southern Baltic Sea. N-Sea, along with their partner Ocean Ecology, were contracted for late season provision of vessel, equipment, and personnel to perform a geophysical site survey and environmental baseline survey, as well as full data processing, sample analysis, interpretation, and reporting.

The main purpose of the scope of work was to determine the benthic composition of the area. The geophysical survey consisted of: vessel mounted MBES (Bathymetric) Survey and towed Side Scan Sonar with piggy-backed Magnetometer to discover archaeological artefacts, boulders, debris, and other natural / non-natural objects. The environmental survey included investigation of occurring habitat types and benthos. Benthic environments were investigated through grab sampling and drop-down imaging/video capture at each sampling location.

A rapid turnaround of vessel mobilization and execution was required during the pandemic; leveraging the full spectrum of supply chain relationships and personnel resources to ensure correct manning and equipment. HSE and environmental sensitivity were of the highest priority to comply with licensing conditions and mitigate marine mammal disturbance. Operational efficiencies were identified and initiated to minimize schedule duration.

Shoreside processing was combined with regular data transfer to enable advanced analysis of data to plan the environmental work scope and real-time QA/QC of acquired data to ensure full coverage and quality. Constant review and communication with the client ensured targets were met with minimal overlap.

"A solid performance by the vessel, onboard team and collaboration with our partners ensured completion of the offshore scope within the required timelines and delivery to our client's satisfaction. An efficient and transparent data processing and reporting flow contributed to a controlled and efficient approach to acquisition and project success," said Paul van Waalwijk van Doorn, Managing Director Survey.

EFFICIENT AND ACCURATE POSITIONING DURING DEPTH OF BURIAL INSPECTIONS

By Mark Bruce,
Product Owner for Next Generation ROV Systems, Fugro

Why use a 90 m vessel for multiple surveys on a subsea pipeline when you can get the job done in a single pass, using a small electric powered remotely operated vehicle (eROV) launched from an uncrewed surface vessel (USV)? Depth of burial (DOB) inspections and surveys on pipelines are about to become faster, safer and more cost effective.

Clients require accurate positioning and DOB data for their subsea pipelines, as well as accurate multibeam data for the seafloor topology.

The rental market for subsea pipe trackers is quite bare. The TSS660 pipe tracker is currently one of the two main purchasing options available on the market and is designed ideally for use on a larger ROV.

We decided to trial the TSS660 on our observation class size Blue Volta eROV—the world's first ROV to be developed specifically for deployment from a USV.

In winter 2021, in the Dutch sector of the North Sea, we deployed the *Blue Volta* from our 12 m USV, *Blue Essence*. This proved to be a fast, safe and cost-effective solution.

PROMISING RESULTS

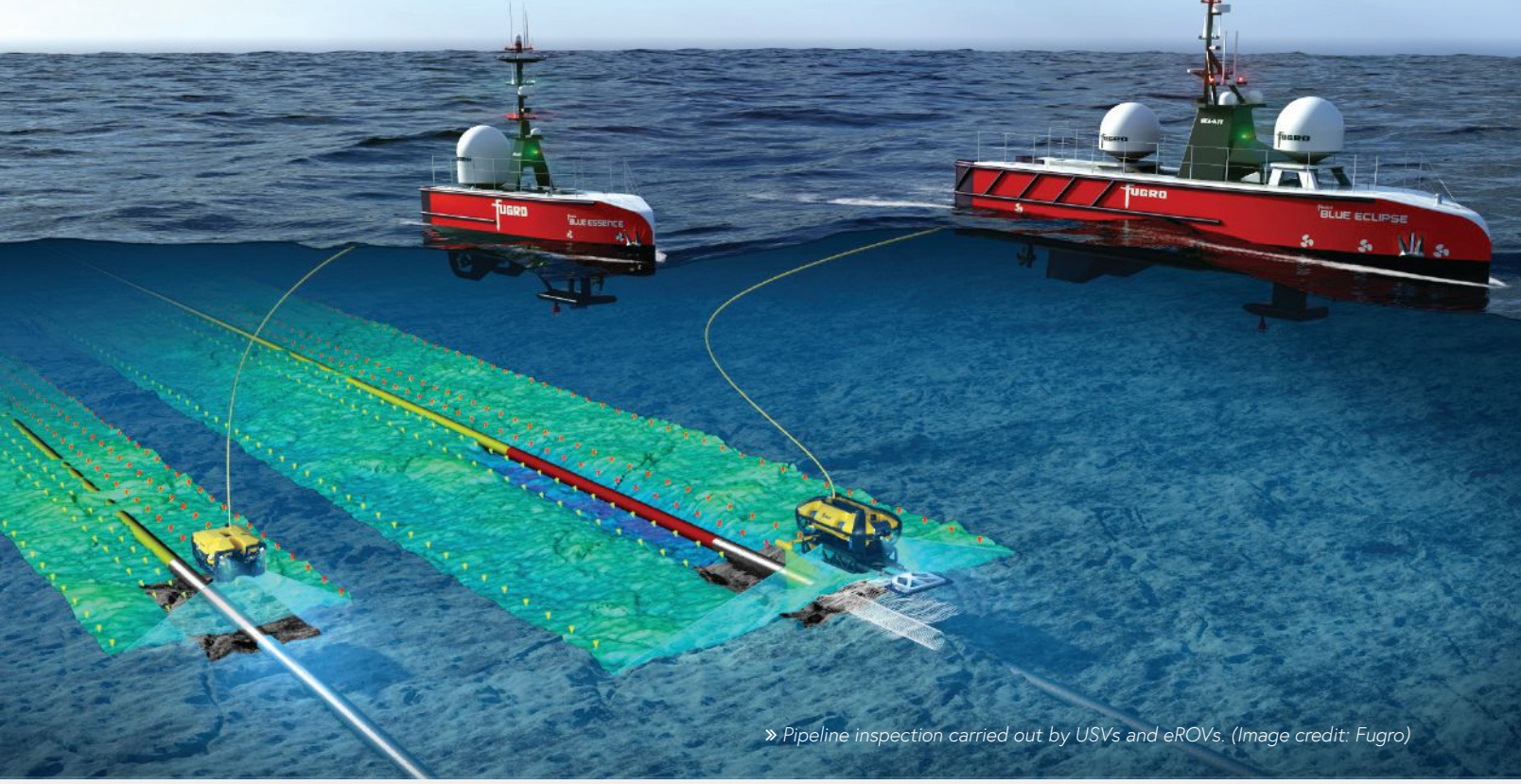
The eROV and USV pilots found that when the USV went faster, maintaining the heading became easier. But when the vessel went too fast, this impacted on data quality. The pilots of both systems quickly learned how to work together to achieve the optimum speed and position, to gather accurate and high-quality pipeline data.

The data was collected around the clock; our onshore remote operations center (ROC) in Holland covered the day shift and our ROC in Aberdeen covered the night shift. Despite the harsh winter weather conditions, we completed multiple pipelines DOB data. This ability to gather high-quality data on a 24/7 basis is a huge benefit for any offshore project working to tight project timescales.

The USV gathered data at up to 1,500 m per hour, which is comparable to the speed achieved by standard crewed inspection vessels, which typically have around 90 people

» *Fugro Blue Essence 12 m USV is a unique solution for efficient remote inspections.*

» *eROVs launched from an USVs are set to unlock new efficiencies for depth of burial inspections and pipeline surveys. (Image credit: Fugro)*



» *Pipeline inspection carried out by USVs and eROVs. (Image credit: Fugro)*

onboard. The potential cost savings and reduced carbon footprint for clients are huge. For example, even efficient conventional survey vessels use approximately 7,000 liters of fuel a day, compared to our USV and eROV solutions significantly lowering its carbon footprint, by consuming 200 liters per day. All completed with no offshore personnel involved, the safety risks are dramatically reduced.

CHALLENGES

• We had to remove 10 kg from the eROV to offset the weight of the electronics pod of the TSS660 to stay neutrally weighted.

• Attached to the front of the eROV, the pipe tracker nearly doubled the length of its footprint and made it hydrodynamically challenging. This limits the control over the front half, which can result in a 'nodding' action.

» *Fugro Blue Volta fitted with the TSS660 pipe tracker. (Photo credit: Fugro)*

• The goal is to be able to complete all scope of work within a single pass however this has its own challenges:

1. Pipe trackers struggle to obtain feedback from their coils when a pipe is buried more than three meters under the seabed. To gather quality positioning data, the eROV must remain very close to the seabed at all times; Survey multibeam echosounders ideally would have the eROV two or three meters above the seabed, to create a wide swathe for data gathering, conflicting with the above requirement.

2. The latency of remote feeds required the eROV operator to think slightly ahead and remain ready to react quickly, to prevent the eROV from running into the seabed or bumping into an object. Future advanced autonomy on our eROV will help to resolve this.

WHAT'S NEXT?

We are working to develop a small and slimline DOB solution on a 'skid' that has the same footprint as the eROV, to give us a more compact, hydrodynamic and stable solution during survey operations. This stability will aid improvement in data quality and efficiency.

We are also exploring new ways to follow the subsea pipeline autonomously. Fusing the feedback from the pipe tracker directly into our flight control system. This will eradicate latency and pilot errors.

The Holy Grail of DOB inspections with a small observation class vehicle is to obtain DOB data and a good swathe of quality positioning multibeam echosounder (MBES) data simultaneously.

To this end, we will continue our search for the ultimate single-pass pipeline inspection operation that combines our USV and eROV equipped with multiple state-of-the-art sensors. Our innovation teams are busy driving their focus towards a faster, safer, cost-effective pipeline inspection solution.

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

SHEARWATER RECEIVES 3D SEISMIC SURVEY CONTRACT FROM KNOC OFFSHORE SOUTH KOREA

Shearwater GeoServices Holding AS has been awarded a contract for two 3D seismic surveys offshore South Korea, together with seismic data processing and imaging by Korea National Oil Corporation (KNOC). This is Shearwater's first contract with KNOC.

The contract includes reservoir properties prediction analysis following processing. It will be the company's first reservoir characterization project in partnership with Qeye, reflecting a complete workflow from geophysical data collection through to geoscience deliverables.

"By delivering the full sequence of geophysical services, from acquisition through to final subsurface property prediction, we support our client's ambitions to shorten project timelines, increase technical assurance and generate additional value," said Shearwater CEO Irene Waage Basili. "We look forward to working with KNOC in a new geographical market, and to deliver high-quality seismic data and reservoir characterization."

The Myungtae 3D survey, in Block 6-1 Central & East, covers approximately 2,575 km^2. The data will be processed through a full time and depth imaging sequence, with delivery of predicted reservoir properties. The second survey covers approximately 500 km^2 and with data processed through a full-time processing sequence.

Shearwater will use the Geo Coral to acquire the two 3D surveys. The surveys are expected to take approximately four months to complete during the summer of 2022. The Geo Coral is a high-capacity seismic vessel, capable of multicomponent acquisition, and has been operating throughout the Asia Pacific region for the past two years.

» *Geo Coral, a high-capacity seismic vessel. (Photo credit: Shearwater GeoServices)*

NEXTGEO SELECTS PANGEO SBI FOR FURTHER SURVEY ON HOLLANDSE KUST WEST BETA

Marine geoscience and offshore construction support service provider NextGeo has been carrying out various works as part of its contract with TenneT TSO B.V. for UXO survey services in support of the vast offshore wind energy program promoted by the Dutch Government in the Dutch sector of the North Sea.

Following the completion of a successful route survey campaign performed on Hollandse Kust West Beta (HKWb) last year, NextGeo has selected PanGeo Subsea (a Kraken Robotics Company) to provide its SBI to conduct a detailed survey around the Baloeran wreck close to cable routes to provide a clearer picture of subsea conditions underneath the seabed level.

NextGeo CEO Giovanni Ranieri said: "The relationship between NextGeo and PanGeo is just at the beginning, but this represents a key milestone for both companies with multiple potential developments in the current energy transition market."

Applying state-of-the-art beamforming synthetic aperture sonar arrays that provide a real-time 3D view of the sub-seabed, PanGeo's SBI gathers highly accurate and usable data and has a proven track record in cables and UXO detection. The SBI has been installed on Ievoli Ivory's WROV to ensure a maximized coverage of the targeted area characterized by strong currents, shallow water depth and very low visibility.

"We are truly excited to have the opportunity to team up with NextGeo and work together on the HKWb campaign. TenneT is no stranger to the SBI data, we value this and strive to continuously explore ways to enhance our service delivery. We look forward to building a strong working relationship with NextGeo to leverage onto future projects in the region," said Moya Cahill, PanGeo Subsea CEO.

» *NextGeo and PanGeo partner in UXO survey project. (Photo credit: NextGeo)*

» *Feritech's Sealance will be available from September 2022. (Image credit: Ferritech Global)*

NEW PRODUCT SET TO REVOLUTIONIZE SUBSEA GEOTECHNICAL SURVEYS

Feritech Global has announced the launch of a new product which is expected to create a step change in subsea geotechnical surveying. The Sealance brings the various functions required for geotechnical surveying together in one streamlined product, enabling significantly reduced timescales for projects.

The Sealance is an adaptable survey device offering simultaneous deployment of up to three geotechnical tools. It offers the most comprehensive range of equipment currently available on the market. Sampling can be achieved using the two powered feed systems, coupled with any two of the following tools: Vibrocorer, Cone Penetration Testing equipment, push corer or rotary coring drill. The Feritech heat flow system can also be deployed simultaneously.

Rob Ferris, MD of Feritech Global, said: "The new Sealance benefits from a bespoke twin tool deployment system with additional integrated heat flow, the first of its kind. Because two tools and heat flow can be deployed simultaneously, this greatly reduces the length of time needed to complete a site survey, especially in deep water."

"Of course, reduced project time also leads to very significant cost savings. With the cost of hiring a vessel running anywhere up from £20,000 a day, saving several days on a project immediately delivers real cost reductions. We also expect that the Sealance will be smaller, lighter, and less expensive than its competitors. The impact of this product on the geotechnical surveys market will be huge, delivering a step change in efficiency."

The Sealance will be available from Feritech Global from September 2022 and can be pre-booked for projects.

ROTECH SUBSEA COMPLETES DEEPWATER BERTH EXCAVATION AT KEY PORT ON THE RIVER CLYDE

Deploying its specialized TRS2 jet trenching and sand wave clearance tool, Rotech Subsea has successfully completed the excavation of two deepwater births at a key port on the River Clyde, Glasgow. The leader in Controlled Flow Excavation (CFE) and suspended jet trenching completed the excavation of the 600 m^2 area to client specification with ease, 1 day ahead of schedule.

A leading marine civil engineering contractor commissioned Aberdeen-based Rotech Subsea in late Q4 2021 to clear 1.5 m of silt that had accumulated in the berths at Scotstoun. Rotech's powerful TRS2 tool was selected to excavate the pits due to its very high flow rate capabilities, which allowed it to disperse the large volume of silt required. The TRS2's maximum outlet pressure is 60kPa with a maximum jet flow of 8,000L/s.

Launched by quayside crane into waters ranging from 10-15 m depth, the TRS2 traveled along a pre-planned route suspended by the crane, clearing each pit to a depth of 1.5 m in multiple passes within 4 hours. The cohesion-less silt was excavated out of and clear of the pits with trench depth monitored in real time by a tool-mounted sonar imager.

"This key port berth excavation on the River Clyde was a great example of the versatility of our TRS2 suspended jet trencher," said Rotech Subsea Director of Subsea, Stephen Cochrane. "Often mobilized on offshore cable de-burial and post-lay trenching works, due to its unrivalled power, the TRS2 is equally adept in the maritime setting completing sandwave clearances and harbor and dock excavations. It's very high flow capabilities of 8,000L/s means the tool can disperse a huge amount of material in a targeted manner."

2AFRICA DEPLOYMENT UNDERWAY WITH FIRST LANDING IN GENOA

The 2Africa consortium, comprised of China Mobile International, Meta, MTN GlobalConnect, Orange, stc, Telecom Egypt, Vodafone and WIOCC, has announced the first landing of the 2Africa cable—in Genoa, Italy.

The landing sets the tone for more landings in the coming months as the cable is extended to a total of 46 locations by the completion of the project in 2024.

Announced in May 2020, the 2Africa subsea cable system together with its Pearls extension are designed to deliver seamless international connectivity to approximately 3 billion people, representing 36% of the global population and connecting three continents, Africa, Europe and Asia.

At 45,000 km, it will be the longest subsea cable ever deployed, serving communities that rely on the internet for services from education to healthcare and business, with all experiencing the economic and social benefits that come from this increased connectivity.

Vodafone, the 2Africa landing party in Genoa, has partnered with Equinix to land the cable directly into the Equinix Carrier Neutral Data Center (CNDC), with Retelit delivering the fronthaul. As with all 2Africa cable landings, capacity will be available to service providers in Genoa on a fair and equitable basis, encouraging and supporting the development of a healthy internet ecosystem.

Working with a local Italian operator, 2Africa has also developed a new terrestrial route connecting the Genoa cable landing station (CLS) directly to major CNDCs in Milan.

Good progress on the survey work and manufacturing continues with the 2Africa project remaining on track for completion in 2024.

DEEPOCEAN ACQUIRES INSTALLIT TO ACCELERATE OFFSHORE RENEWABLES GROWTH

DeepOcean Group ("DeepOcean") has entered into an agreement to acquire Norwegian engineering and technology company Installit AS and its subsidiaries to strengthen the group's offering within offshore renewables.

"The acquisition of Installit demonstrates DeepOcean's focus on supporting and enabling the energy transition. It accentuates DeepOcean's engineering competence in key growth areas and increases our competence base within offshore renewables," said Øyvind Mikaelsen, CEO of DeepOcean.

DeepOcean acquires Installit from Oslo-listed Endúr ASA, which is a leading supplier of construction and maintenance projects and services for marine infrastructure. The parties have agreed to not disclose the financial details of the transaction, which has already been completed.

Subsea cable specialist

Installit is an engineering and technology company headquartered in Oslo, Norway. It was founded in 2000 by an experienced team of personnel from the renewables industry.

Installit provides project management and engineering services within subsea cable installation and repair, including HV cables, plus subsea installation and decommissioning, and marine operations for the marine and renewables industries.

"Installit's expertise in high voltage cable installation and nearshore operations complements DeepOcean's cable repair and renewables offerings. Together we will bring competitive solutions to the market," added Mikaelsen.

DeepOcean provides survey, engineering, project management, installation, maintenance, and recycling services to offshore-based industries.

Ramping up renewables

Installit will be integrated into DeepOcean and establish DeepOcean's engineering hub in Oslo, Norway.

DeepOcean's acquisition of Installit follows last year's move to establish the Windstaller Alliance together with Solstad Offshore and Aker Solutions. The Windstaller Alliance aims to provide the world's most cost-efficient and complete product supply, fabrication and marine services offering within offshore wind and other offshore renewables segments.

"DeepOcean is taking the necessary steps to provide an even more complete offering to clients in the offshore renewables industry. Alongside our continued core service segments of oil and gas, ocean solutions and increasing exposure to offshore renewables, we see great potential for the joint Installit and DeepOcean offering in the offshore renewables market," concluded Mikaelsen.

» *Øyvind Mikaelsen, CEO of DeepOcean*

» *Jan De Nul's Cable Laying Vessel Connector. (Photo credit: Jan De Nul)*

JAN DE NUL TO INSTALL IRELAND-UK INTERCONNECTOR

Jan De Nul Group has signed a contract with Sumitomo Electric Industries, Ltd. for the installation of two subsea HVDC cables and one fiber optic cable that will link the existing electricity grids in Ireland and the United Kingdom.

The subsea cable route for the 500 MW Greenlink Interconnector is about 160 km long between County Wexford in Ireland and Pembrokeshire in Wales.

Jan De Nul Group's Cable Laying Vessel *Connector* will be mobilized for the Greenlink Project. The vessel is equipped with two cable carrousels with carrying capacity of respectively 6,000 t and 4,000 t.

Jan De Nul is responsible for the end-to-end subsea cable laying and cable protection works. At the shore sides, Jan De Nul will perform the Horizontal Directional Drillings starting later this year in 2022. The offshore installation campaigns will be performed in 2023 and 2024. Jan De Nul's cable-laying vessel Connector will install the subsea cables which will predominantly be buried in the seabed. Where the seabed does not allow cable burial, the cables will be protected by the installation of rock or concrete mattresses on top of the cables.

Harada Kazuhira, Executive Officer and General Manager of Power Project Division at Sumitomo Electric: "We are delighted to be working with our partner Jan De Nul to build the Greenlink between Ireland and UK. This interconnector will form a critical part of the infrastructure to achieve net-zero emissions."

Wouter Vermeersch, Manager Offshore Cables at Jan De Nul Group, said: "We are honored to work alongside Sumitomo Electric to establish this important link for the electricity grids between Ireland and UK. Jan De Nul and Sumitomo Electric have been developing the installation solution in close collaboration over the last 2 years and we are now ready to fully engage in the actual realization of it."

Greenlink is a subsea and underground electricity interconnector linking the power markets in Ireland and Great Britain and due for commissioning in 2024. Being awarded the status of Project of Common Interest by the European Union, it is one of Europe's most important energy infrastructure projects, bringing green electricity to approximately 380,000 homes.

Greenlink brings significant benefits on both sides of the Irish Sea for employment, energy security and the integration of low carbon energy sources. For Ireland, it provides a natural link to continental Europe and the Nordic electricity markets via Great Britain.

» *Rendering of the proposed cable manufacturing facility.*

SHOVEL-READY OFFSHORE WIND CABLE FACTORY SITE FOR NJ

Rise Light & Power (Rise) and Delaware River Partners LLC (DRP) recently announced an historic partnership to position New Jersey as a leading manufacturing hub in the growing offshore wind industry.

As part of its Outerbridge Renewable Connector project, Rise announced it is prepared to invest millions to develop a shovel-ready site for a submarine cable manufacturing facility at DRP-owned Repauno Port & Rail Terminal in Greenwich Township (Repauno).

The proposed submarine cable manufacturing facility will have a footprint of approximately 30 acres, along with dock access. Upon approval of the Outerbridge Renewable Connector project, pending before the BPU, Rise and DRP will commence development and permitting work to make the site shovel-ready and to attract an offshore wind cable manufacturer, who would ultimately construct and operate the facility. Submarine cable manufacturing facilities of similar size typically generate approximately 500 jobs during construction and over 100 good-paying, full-time jobs during operations.

"This opportunity will bolster New Jersey's leadership in offshore wind with a major investment to create good-paying jobs and become a national supply chain leader," said Clint Plummer, CEO of Rise Light & Power.

"The Outerbridge Renewable Connector will revitalize and repurpose infrastructure to meet New Jersey's bold clean energy goals. We are excited about this partnership with Delaware River Partners."

"We are proud to enter into a partnership with Rise Light & Power to develop New Jersey's first submarine cable manufacturing facility," said Hank Alexander, DRP's CEO. "The Repauno Port & Rail Terminal is an ideal location for this project. Conveniently situated along the Delaware River, we are accessible and fully capable of meeting the offshore wind industry's needs."

"Wind power is coming to Jersey. Atlantic Shores, Ocean Wind, New York Bight are underway and I'm sure others will follow. Submarine cables taking the power generated by offshore wind to the Rise Light & Power site for distribution is a sensible plan," said Senator Edward Durr, representing the District of New Jersey in which Repauno is located. "Manufacturing those submarine cables at Repauno is a great opportunity to bring good paying jobs to the Third Legislative District and help generate additional economic development in our community."

With a demand for 800 to 1,000 miles of cable per year in the U.S. and growing, the addition of a new submarine cable manufacturing factory positions New Jersey as a critical link in the offshore wind supply chain to meet this growing demand. Currently, there is only one operational U.S. offshore wind cable manufacturing facility out of South Carolina. A typical offshore wind cable manufacturing plant may produce approximately 120 miles of cable per year, depending on size.

Rise and DRP will develop the site to be shovel-ready and collaborate to attract manufactures of two types of subsea cables required for offshore wind farms. First are inter-array cables that connect turbines within the offshore wind farm to an offshore substation, and the second are export cables that connect the offshore substation to the onshore grid.

NKT FINALIZES THE POWER CABLE SYSTEM FOR HORNSEA 2

NKT continues to support the transition to renewable energy in the UK by completing the power cable system connecting the Hornsea 2 offshore wind farm to shore. With a capacity of 1.3 GW Hornsea 2 will be the world's biggest offshore wind farm when fully operational.

NKT has commissioned the 220 kV HVAC power cable system for the Hornsea 2 offshore wind farm located 89 km off the English east coast. The wind farm holds a central position in the transition to renewable energy in the UK and will power more than 1.3 million households when fully operational.

Patrick Harnett, Ørsted's Programme Director for Hornsea 2, said: "Once fully operational later this year, Hornsea 2, located 89 km off the UK's east coast, will be the world's largest operating offshore wind farm, taking the title from its sibling project Hornsea 1, with the power to generate 1.32 GW of clean energy. Constructing a project of this size and scale is only possible through strong collaboration, hard work, and dedication. We work very closely with our partner companies and have the finishing line in sight as we install the remaining turbines and continue testing, commissioning, and energizing Hornsea 2."

Claes Westerlind, Executive Vice President and Head of HV Solutions Karlskrona, said: "Offshore wind is a cornerstone in mitigating climate change and we are pleased to continue to be a key player in making offshore wind a main element in the green transformation of the UK power supply. With Hornsea 2, we are happy to continue the long-term collaboration with Ørsted in connecting a greener world."

The power cables for Hornsea 2 were manufactured at the NKT factory in Karlskrona, Sweden, which runs on 100% green electricity minimizing the carbon footprint of the cable system. As part of the environmental focus of the operation, the installation of the submarine power cable systems was completed by NKT Victoria, one of the most energy efficient cable-laying vessel in the industry.

NKT has extensive experience in connecting offshore wind parks to the UK mainland including commissioned projects such as Hornsea 1, Moray East and the Walney Extension. Currently, NKT is involved in ongoing offshore wind projects such as the Dogger Bank offshore wind farm, which will be the first offshore wind farm in the UK to be connected to shore with a HVDC power cable link.

» *Once completed, Hornsea 2 will be the world's largest offshore wind farm. (Photo credit: NKT)*

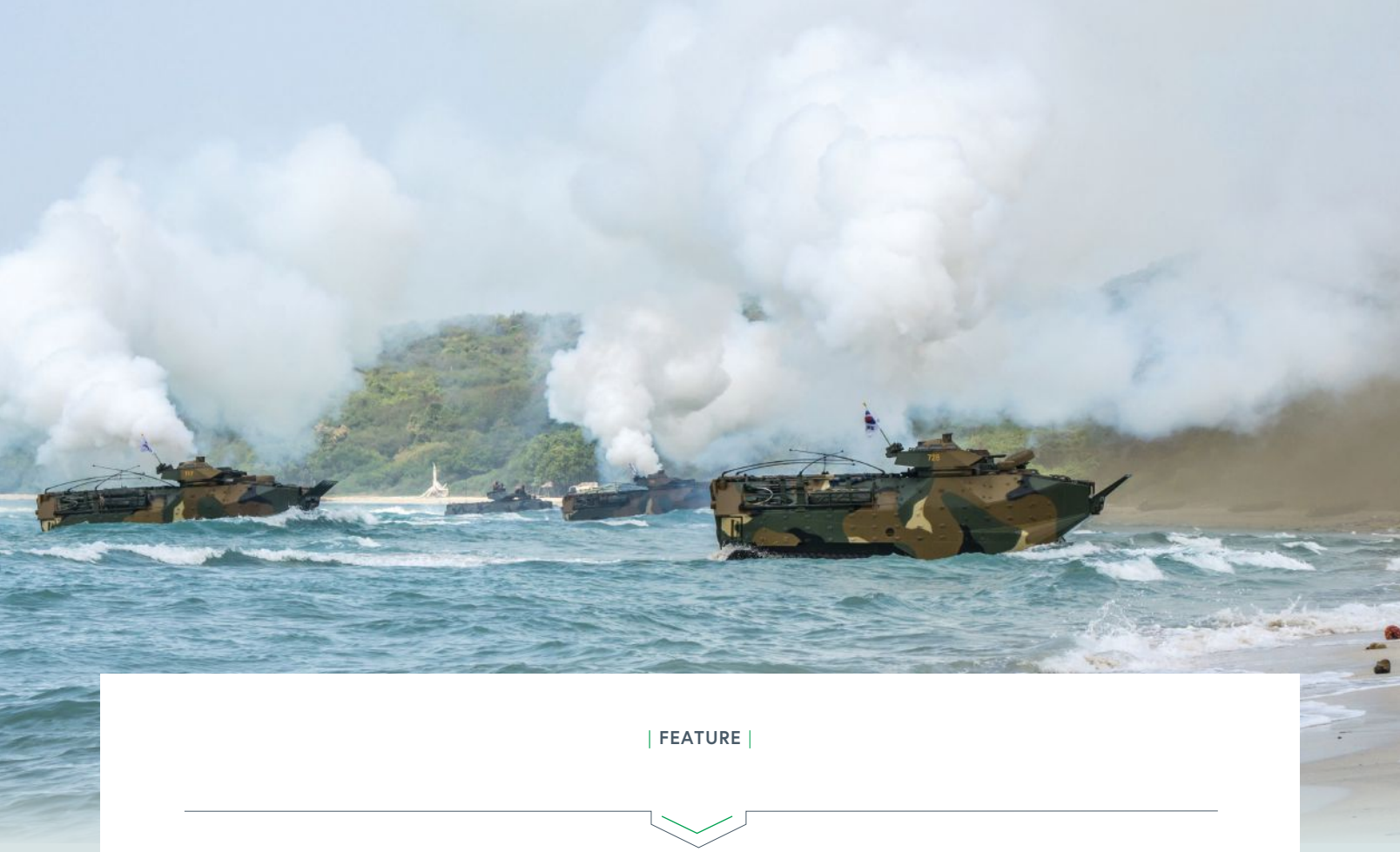
ELLALINK ANNOUNCES COOPERATION AGREEMENT WITH GLOBENET

EllaLink has announced a new Point of Presence (PoP) in GlobeNet, allowing simplified customer access in both infrastructures.

With this, Brazilian customers of GlobeNet will be able to use the EllaLink cable—which stretches 6,000 km under the waters of the Atlantic, between Fortaleza (Ceará) and Sines (Portugal)—to access the ecosystem of service content providers and Internet Exchange Points (IXs) in Europe. Similarly, European companies will be able to use the EllaLink cable to access GlobeNet's network.

The two companies offer robust differentiators for international bulk data traffic. The EllaLink cable, for example, guarantees an ultra-high-speed connection, benefiting the performance of digital business, cloud services, e-banking, online gaming, and entertainment media on both sides of the Atlantic.

GlobeNet, meanwhile, offers connectivity with direct low-latency routes and advanced IT infrastructure in its CLSs and Data Centers, through a submarine cable network that covers more than 26,000 km, passing through Argentina, Brazil, Colombia, Bermuda, Venezuela and the USA.



| FEATURE |

LEVERAGING EMERGING TECHNOLOGY TO ENHANCE MARITIME LOGISTICS

By George Galdorisi,
Director of Strategic Assessments and Technical Futures at the Naval Information Warfare Center Pacific

It will take years to capture all the lessons learned from the current conflict in Ukraine. One that will likely be examined in war colleges in the future is the vital importance of logistics. Seth Cropsey, former deputy undersecretary of the Navy, put it this way in a recent Wall Street Journal opinion piece:

Western observers of Russia's failure in Ukraine likely will soon begin arguing that Moscow's inefficiencies diminish Washington's need to rebuild the U.S. military. But Russian failure has stemmed from logistical issues, and the U.S. military's capabilities, like Russia's, aren't prepared for major combat with a global power.

While each of the U.S. military Services have their unique logistics needs, it is the U.S. Marine Corps that arguably has the biggest challenge. Even for those with only a passing knowledge of modern warfare, the challenge of amphibious operations—during which the attacking forces must bring everything they need in great quantities to dislodge an adversary from a position ashore—is clear. In any amphibious operation, the defenders tend to have the upper hand.

USVs RESUPPLY TROOPS

This is precisely why the Marine Corps has been so proactive in devising exercises, experiments and demonstrations to explore ways to leverage emerging technologies to enhance their logistics efforts. The INDOPACOM Joint Exercise Valiant Shield exercise, overseen by Commander Marine Forces Pacific (MARFORPAC), recently experimented with a new tech-led approach to providing sustainment to Marines on the beachhead.

MARFORPAC used USVs during exercise Valiant Shield to resupply the landing force. The exercise coordinator used a catamaran hull, 12-foot MANTAS USV to provide rapid ship-to-shore logistics sustainment. While this small, autonomously operated USV carried only 120 pounds of cargo, the proof-of-concept worked and demonstrated that unmanned surface vehicles could potentially resupply troops ashore.

However, resupply in 120-pound increments is far less than is required to provide what is needed by Marines on the beach. The Valiant Shield exercise provided the impetus to continue to explore the use of USVs for amphibious force sustainment. The Navy and Marine Corps are looking to scale-up small USVs to provide larger sustainment quantities.

SCALING UP PAYLOADS

While there are a range of larger USVs that can be evaluated by the Navy and Marine Corps, the basic specifications of the 38-foot Devil Ray (T38) Expeditionary Class USV demonstrate the ability of USVs to provide a continuous stream of logistics support to Marines on the beach. The T38 can carry a payload of 4,500 pounds. The vessel travels at cruise speed of 25 knots. More robust logistics resupply can be provided by larger USV of the same family of Expeditionary Class unmanned surface vehicles. The T50 Devil Ray can carry a payload of 10,000 pounds. Like its sister T38, the T50 has a cruise speed of 25 knots. Given the speed and carrying capacity of the T38 and T50, it is readily apparent how they can support the rapid buildup of combat power on a contested beach.

To put this in concrete terms, having observed many amphibious exercises, most of these ship formations stand approximately twenty miles off the beach and launch smaller craft toward the shore. Using this notional stand-off distance, an amphibious formation equipped with four T38s traveling at their cruise speed of 25 knots could deliver 18,000 pounds of material from the amphibious ships to the beach per hour. Multiply that by twenty-four hours and you get a buildup of well-over 400,000 pounds of vital material per day, enough to support a substantial force of troops ashore. Using four T50s in a similar manner, the amount of vital material delivered approaches one million pounds a day.

This logistics concept would also complicate an adversary's attempts to interdict resupply operations. Rather than hunting down and killing a single large, slow, vulnerable surface ship, a mother ship could deploy multiple unmanned surface vehicles outside the adversary's weapon systems range. This would force the adversary to hunt and destroy each individual USV rather than simply tracking and destroying a surface ship moving between advanced bases or warships and resupplying them one at a time.

Over 2,500 years ago, Sun Tzu noted: "The line between disorder and order lies in logistics." General Robert Barrow, then-Commandant of the U.S. Marine Corps, coined a phrase that is still a staple of U.S. War College curricula: "Amateurs talk about tactics, but professionals study logistics."

The prospect of assaulting a hostile shore today is more daunting than ever, and that is why the Marine Corps is seeking to leverage new technologies to enhance their logistics capabilities. The capacity of Marines to push inland must depend on the security of their logistical support. Using USVs to take on a portion of this logistics task takes Sailors and Marines out of harm's way while providing a constant stream of reliable logistics sorely needed by Marines on the beach.

» *A 12-foot MANTAS USV was recently used by MARFORPAC during exercise Valiant Shield to resupply the landing force. (Photo credit: Jack Rowley/MARTAC)*

» *Larger USVs like MARTAC's 38-foot Devil Ray (T38) have the extended payload and endurance capacity to provide a continuous stream of logistics support to landing Marines. (Photo credit: Jack Rowley/MARTAC)*

BAE SYSTEMS' SAN DIEGO SHIPYARD TO MODERNIZE THE DESTROYER USS MUSTIN

BAE Systems has received a $89.4 million contract from the U.S. Navy to perform major modernization work aboard the Arleigh Burke class guided-missile destroyer USS *Mustin* (DDG 89).

The value of the competitively awarded contract could reach $95.2 million if all options are exercised.

Under the depot maintenance period (DMP) availability contract awarded, BAE Systems San Diego Ship Repair will dry-dock the ship, perform underwater hull preservation work, recondition the engineering spaces, upgrade its command and control equipment, and refurbish the crew's living spaces. The DMP work is expected to begin in May 2022 and be completed in November 2023. The company expects to dry-dock the ship at the San Diego Naval Base and then complete the remaining work at its Barrio Logan facility.

"A depot maintenance availability is a significant project for upgrading the capability of Aegis destroyers," said David M. Thomas, Jr., BAE Systems San Diego Ship Repair's vice president and general manager. "Our ship repair team has the critical know-how for repairing DDGs from our prior work. The DMP availability we'll perform on the USS *Mustin* will usher the ship into a higher phase of fleet readiness."

BAE Systems' San Diego shipyard is completing similar work aboard the guided missile destroyer USS *Preble* (DDG 88) and has previously completed a DMP availability aboard USS *Shoup* (DDG 86).

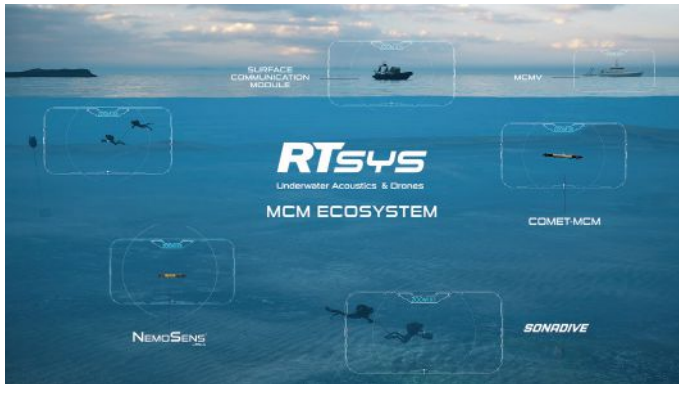
USS *Mustin* is the 39th ship in the Arleigh Burke class and was commissioned in July 2003. The ship is named in honor of the Mustin family who has more than a century of service in the U.S. Navy. One other U.S. Navy combatant has carried the family name, USS *Mustin* (DD 413).

» *Work on the USS Mustin will begin in May 2022. (Photo credit: BAE Systems)*

RTSYS ANNOUNCES AUVS CONTRACT AWARD WITH SLOVENIAN NAVY

RTsys, a French manufacturer of autonomous underwater vehicles (AUV) and handheld imaging sonar for EOD divers announces the contract signature with the Slovenian Navy for the supply of one COMET-MCM AUV and two NEMOSENS micro-AUVs.

These 3 autonomous vehicles will be added to the existing range in use of SONADIVE handheld sonar units and therefore will give to the Slovenian Armed Forces through its EOD Diving Department full capabilities for Mine Counter Measures from very shallow water up to 300 m depth.



The COMET-MCM is designed to quickly and efficiently cover large underwater areas with both high-definition sonar imaging and TV camera capabilities, by offering the most accurate real-time tracking and positioning of the market. Alternatively, micro-AUVs NEMOSENS, man-portable and modular vehicle offering the same capabilities of live tracking and high accuracy positioning would operate in very shallow water (less than 5 m) for various scope of operations like beaching, rapid environmental assessment or identification and localization of underwater mines.

"Delivering a new complete MCM ecosystem to a NATO Country is always a privilege for RTsys and confirms the attractiveness of our company in the supply of sea-proven manned and unmanned solutions," said Pierre-Alexandre Caux, RTsys business director.

"Autonomous vehicles combined with EOD divers' skills remain the most reliable and efficient combination to operate safe MCM operations while reducing the time of divers' action into the water. It also makes sense for Navies worldwide to cooperate closely with one unique manufacturer, from their original clarification of needs up to final delivery, operational training, spare part management and long-term support for maintenance."

» *Exercise Cold Response took place in Northern Norway*

NATO SHIPS COMPLETE EXERCISE COLD RESPONSE

Over 30,000 troops, 50 surface and sub-surface assets and 200 Aircraft from 27 countries participated in the exercise. The training demonstrated the flexibility, capabilities and readiness in the challenging arctic environment of Northern Norway.

SNMG1 led by Commodore A. van de Sande of the Royal Netherlands Navy, consists of the flagship HNLMS *De Zeven Provincien*, the German Combat Support Ship FGS *Berlin*, HDMS Peter *Willemoes*, FGS *Erfurt*, and HMS *Northumberland*.

"This large NATO exercise showed what NATO is about: operating together to defend our Allies," said Sande. "Cold Response 2022 delivered high-end training across the spectrum of (naval) warfare. It was good to see all these NATO units operate together in the High North of Norway, at sea, in the air and ashore."

SNMG1 ships supported the amphibious operations with air defense, conducted naval surface fire support and anti-submarine coverage.

SNMCMG1 supported other task groups with lead through operations, in mine danger areas within the exercise scenario. The staff embarked extra officers from the Finnish, Norwegian and U.S. navies and they all worked together to deliver outstanding results in MCM operations.

This maritime group is currently led by Commander Ott Laanemets and is comprised of LVSN *Virsaitis*, BNS *Lobelia*, FGS *Bad Bevensen*, ENS *Sakala*, HMS *Grimsby*, HNLMS *Schiedam*, HNOMS *Hinnoy*.

"For us Cold Response is the first major exercise for this season," said Laanemets. "We have operated under the overall command of COM UKSTKFOR, side by side with surface and amphibious task groups, enabling the amphibious maneuver in the littorals and keeping the sea lines of communications open. Cold Response has proven our capability in operating in such difficult environment as the fjords of Northern Norway.

"Overall the exercise was a success with MCM vessels managing to find and train on exercise mines whilst HDMS *Vaedderen* got a different experience from what they are used to doing whilst working with LVNS *Virsaitis*," said Laanements.

Ships from both Task Groups are now headed for a pre-planned deployment to the Baltic Sea, to participate in common training and visit ports of allied and partner Nations.

BLUEPRINT LAB TO DEVELOP REMOTE OPERATION SYSTEMS FOR UNDERWATER EXPEDITIONS

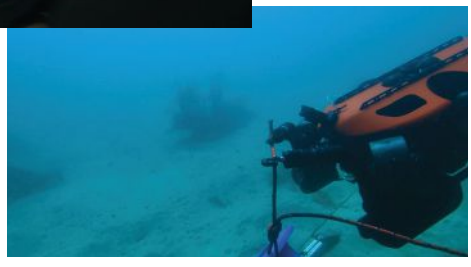
The Australian government has announced a $19 million investment in protecting Australian Defense Force members. Blueprint Lab has been awarded $1.04 million to develop remote operation systems for underwater expeditions as part of this investment. These cutting-edge remote operations will protect ADF members in the field.

"We are very excited to receive this investment from the Australian Government," said Anders Ridley-Smith, Director - Business Development, Blueprint Lab. "Blueprint Lab has been working with various military stakeholders in Australia, the US, and the UK for many years and it is an honor to have this official backing from Defense. This contract will enable us to fast-track our technology developments and more quickly contribute to our vision to enable remote intervention in harsh environments in the realm of the Clearance Diver remit."

Minister for Defense Industry Melissa Price announced the Defense Innovation Hub grants that demonstrate the Australian government's drive to invest in advanced Australian research and development to protect and sustain ADF personnel: "I am delighted to see this investment in businesses and a research organization to help Defense harness cutting-edge capabilities that could help protect and sustain ADF personnel in the field," Minister Price said.

New South Wales based Blueprint Lab develops advanced robotic arm solutions for harsh environments. They are creating the next generation of remote operation systems. Their products enable complex inspection and intervention in maritime infrastructure management (UWILD, NDT, CVI, Sampling), military/police operations (Special Recovery), marine science, autonomous robotics research applications, and more.

» *SRS Fusion vehicle with Reach Alpha 5 manipulators conducting diver-less complex remote operations. (Photo credit: Blueprint Lab)*



SAAB ANNOUNCES NEW AUTONOMOUS AND UNDERSEA SYSTEMS PRODUCTION FACILITY IN THE US

Saab has announced a new 10,000 sq. ft. production facility for Anti-Submarine Warfare (ASW) in Cranston, Rhode Island. The Cranston facility will also house the Autonomous and Undersea Systems Division of Saab, Inc. led by industry veteran Jeff Smith. The new Saab location is adjacent to partner SyQwest's headquarters and close to the U.S. Naval Undersea Warfare Center in Newport, RI.

Saab is partnering with SyQwest, a leading manufacturer of subsea acoustic systems, to leverage the advanced production and test capabilities of their ISO 9001 rated facility.

The new division will significantly increase Saab's presence in the United States, leveraging market-leading capabilities in ASW Training Targets, Remotely Operated Vehicles, Unmanned

Underwater Vehicles, and emerging capabilities in Unmanned Surface Vehicles. Saab plans to hire 15-17 people by the end of the year to support its initial work in Rhode Island.

Saab currently produces these systems throughout Sweden and the United Kingdom. This US expansion is part of Saab's strategy for international growth focusing on key operational countries.

» *Anthony Lorusso, Director of Autonomous and Undersea Systems at Saab (left) and Robert Tarini, SyQwest's Chairman, at Saab's new Cranston, RI facility.*

USS MOMSEN CONDUCTS UNDERWAY OPERATIONS WITH INDIA NAVY

The U.S. and Indian navies concluded at sea bi-lateral operations off India's West Coast in the Arabian Sea, April 27.

The operations included the U.S. Navy's guided-missile destroyer USS *Momsen* (DDG 92) and the Indian Navy's guided-missile frigate INS *Trishul* (F 43), which focused on building interoperability and strengthening relationships.

"Our crew strives to work efficiently and effectively to ensure we are able to operate together with our partners while underway. Conducting an exercise with the Indian Navy off of their western coast is a chance that we did not want to miss," said Cmdr. Erik Roberts, commanding officer of *Momsen*. "Our commitment to a Free and Open Indo-Pacific is bolstered every time we perform at-sea operations with those who share our maritime goals."

The U.S.-India bilateral operations focused on division tactics, a passing exercise, communications checks, and formation sailing, providing both navies the opportunity to work together to further common maritime goals.

Momsen is assigned to Commander, Task Force 71/Destroyer Squadron (DESRON) 15. CTF 71/DESRON 15 is the Navy's largest forward-deployed DESRON and the U.S. 7th Fleet's principal surface force. U.S. Navy's 7th Fleet is the largest forward-deployed fleet and routinely operates and interacts with 35 maritime nations while conducting missions to preserve and protect critical regional partnerships.

» *USS Momsen. (Photo credit: U.S. Navy)*

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

Suriname Energy
Paramaribo, Suriname » June 28-30
https://suriname-energy.com/en

US Offshore Wind
Boston, MA » July 18-19
https://reutersevents.com/events/offshore-wind

Dredging Summit & Expo
Houston, TX » July 25-28
https://dredging-expo.com/

SPE Subsea Well Intervention
Galveston, TX » August 9-11
https://www.spe.org/events/en/2022/symposium/22ssi/subsea-well-intervention

Underwater Minerals Conference
St. Petersburg, FL » October 2-7
https://www.underwaterminerals.org/

IWCS Cable & Connectivity Forum
Providence, RI » October 10-13
https://iwcs.org/

OCEANS
Hampton Roads, VA » October 17-21
https://hamptonroads22.oceansconference.org/

ACP Offshore WINDPOWER
Providence, RI » October 18-19
https://cleanpower.org/events/offshore-windpower-2022/

Offshore Wind Executive Summi
Galveston, TX » November 8
https://www.offshorewindsummit.com/

EUROPE

Undersea Defence Technology (UDT)
Rotterdam, The Netherlands » June 7-9
www.udt-global.com

Underwater Technology Conference
Bergen, Norway » June 14-16
https://www.utc.no/

Seanergy
Normandy, France » June 15-17
https://www.seanergy-forum.com/en/dbec

Seawork
Southampton, UK » June 21-23
https://seawork.com/

Offshore Northern Seas (ONS)
Stavanger, Norway » August 29 - September 1
https://www.ons.no/

Offshore Wind Power Substations
Bremen, Germany » August 30 - September 1
https://www.iqpc.com/events-offshore-windpower-substations

Deep Sea Minerals
Bergen, Norway » October 26-27
https://events.geonova.no/event/deepseaminerals/

Offshore Energy
Amsterdam, The Netherlands » November 29-30
https://www.offshore-energy.biz/offshore-energy-2022/

OTHER REGIONS

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

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

Mediterranean Offshore Conference
Alexandria, Egypt » October 18-20
www.moc-egypt.com

ADIPEC
Abu Dhabi » October 31 - November 3
https://www.adipec.com/

Telecoms World Asia
Bangkok » November 2-3
https://www.terrapinn.com/conference/telecoms-world-asia/index.stm

MONTH & DEADLINES	EDITORIAL FOCUS & SHOW DISTRIBUTION	CONTENT FOCUS & PRODUCT/SERVICE
JANUARY **Editorial:** Dec. 17 **Ad:** Jan. 13	» **Uncrewed Surface Vehicles** Floating Wind Solutions / March 1-3 Oceanology International / March 15-17	**Content Focus:** Remote Marine Operations, Force Multiplication, Ocean Research, Search & Rescue, Tooling **Product/Service:** A/USV manufacturers, multibeam echosounders, side scan sonars, control systems, thrusters, positioning systems, thermal cameras, communication systems
FEBRUARY **Editorial:** Jan. 24 **Ad:** Feb. 10	» **Naval Defense & Security** UDT / June 7-9	**Content Focus:** Intelligence, Surveillance & Reconnaissance (ISR), Mine Countermeasures (MCM), Harbor Security, Anti-Submarine Warfare (ASW) **Product/Service:** AUVs, USVs, marine robotics, search and rescue technologies, underwater tracking & communications
MARCH **Editorial:** Feb. 21 **Ad:** Mar. 10	» **21st Century Marine Survey** AUVSI XPONENTIAL / April 25-28 IPF / April 26-28 OMAE / June 5-10 💻 H2O Conference / June 14-16	**Content Focus:** Hydrographic Survey, Sensor Innovation, Research Vessels **Product/Service:** Sensor manufacturers, UAVs, multibeam echosounders, sonars, software & analytics, deck handling equipment, survey companies, research vessels
APRIL **Editorial:** Mar. 21 **Ad:** Apr. 07	» **Green Energy** US Offshore Wind / July 18-19 OTC / May 2-5	**Content Focus:** Renewable Offshore Energy (Wind, Solar, Tidal & Wave), Green Hydrogen, Power Storage Supply Chain **Product/Service:** Offshore wind supply chain, alternative offshore energy technologies, subsea batteries, hydrogen powered vessels
MAY **Editorial:** Apr. 18 **Ad:** May 05	» **Subsea IMR Technology** Canadian Hydrographic Conference / June 6-9 Seanergy / June 15-17	**Content Focus:** Shore-based Command Systems, Subsea Residency, Digital Twins **Product/Service:** AUVs, ROVs, robotic tooling, buoyancy materials, cameras & lighting, pressure sensors, propellers, tethers, simulation software
JUNE **Editorial:** June 06 **Ad:** June 23	» **Oceanography** Dredging Summit & Expo / July 25-28	**Content Focus:** Data Collection, Transmission & Communication, Data Analytics & Software Platforms **Product/Service:** Buoys, drifters, acoustic modems, releases & transponders, magnetometers, subsea cables, connectors, weather stations
JULY **Spotlights:** June 14 **Ad:** July 11	» **Uncrewed Vehicles Buyers' Guide** 💻	**Content Focus:** Special Edition
AUGUST **Editorial:** July 25 **Ad:** Aug. 11	» **Submersibles & The Deep Sea** OCEANS / October 17-21 Offshore Northern Seas / Aug. 29- Sept. 1	**Content Focus:** Deep-sea Exploration, Seafloor Archaeology, Deep-sea Science, Ocean Mining **Product/Service:** Crewed submersibles, support vessels, mining machines, geotechnical technologies
SEPTEMBER **Editorial:** Aug. 22 **Ad:** Sep. 08	» **Artificial Intelligence & Remote Marine Operations** Offshore Energy / November 29-30 ACP WINDPOWER / October 18-19	**Content Focus:** Swarm Technology, Control Systems, Automation, Ocean Health, Maritime Efficiency **Product/Service:** Uncrewed vehicles, simulation & modelling platforms, cloud-based data analytics
OCTOBER **Editorial:** Sep. 19 **Ad:** Oct. 06	» **Offshore Energy**	**Content Focus:** Sector Diversification, Seabed IMR, Sensor Innovation, HSSE, Decommissioning, Oil Spill Response, Renewables **Product/Service:** Marine survey, oil spill response, renewable energy technologies, geotechnical services
NOVEMBER **Editorial:** Oct. 17 **Ad:** Nov. 03	» **Underwater Imaging**	**Content Focus:** Bathymetric Mapping, IMR, Habitat Characterization, Acoustic Sensing **Product/Service:** Observation ROVs, AUVs, cameras, lights, diving innovation, tracking & positioning systems, optical and acoustic sensors
DECEMBER **Editorial:** Nov. 14 **Ad:** Nov. 18	» **The Future of Ocean Technology**	**Content Focus:** Special Edition

💻 Digital Issue

ASHTEAD TECHNOLOGY APPOINTS NEW REGIONAL GENERAL MANAGER FOR THE MIDDLE EAST

International subsea rental equipment and solutions specialist Ashtead Technology has appointed Scott Stephen as the new Regional General Manager for its Middle East business to support its continued growth in the region.

Based in Abu Dhabi, Mr Stephen will help to solidify the company's existing market position in the region and spearhead further business expansion as part of its international growth strategy.

» *Ashtead Technology's Scott Stephen*

Ashtead Technology has an established presence in the Middle East and strengthened its position with the acquisition of Abu Dhabi based TES Survey Equipment Services in 2016. In 2019, the company invested in a new facility in Musaffah, Abu Dhabi, to expand their footprint and increase the range of equipment and services offered to customers in the region.

Mr. Stephen, who has been with the company for five years and has held various senior business development roles across different disciplines during his tenure with Ashtead Technology, brings a wealth of knowledge and experience to his new position.

Allan Pirie, Ashtead Technology CEO, said: "The Middle East represents a significant growth opportunity for our business and we are delighted to have Scott leading our operations in the region and driving the next phase of growth. This recent strategic appointment reflects our ambitious growth plans for the region, and internationally, as we look to expand our service offering across all key offshore energy markets to solve our customers' underwater survey, mechanical solutions and asset integrity challenges."

Scott Stephen, Regional General Manager, Middle East, said: "I am delighted to take on this new position at this exciting stage in the company's growth journey. Ashtead Technology has established itself as a reputable partner in the Middle East and I look forward to building on this and growing our capabilities and track record in the region to support our customers' offshore energy projects."

MACARTNEY OPENS OFFICE IN SWEDEN

MacArtney, a leading supplier of underwater technology, is set to expand in Scandinavia with the opening of a dedicated office in Mölnlycke near Gothenburg, Sweden.

To date, the Swedish market has been served from MacArtney's head office in Denmark with a distributor in Sweden—Marine Survey, led by Cecilia Drougge. A long-term, rewarding business relationship, creating a solid base, branding the MacArtney portfolio within underwater solutions such as underwater connectivity and data acquisition.

However, the extensive marine and offshore activities along Sweden's coastline, matching MacArtney fields of operation, motivated the establishment of a local office in Gothenburg. An ideal location for interacting with renewable and defence enterprises and supporting ocean science initiatives involving industrial, academic and scientific institutions.

Emil Andersson, who has worked for MacArtney over the last three years, mainly involved in global sales, will now be charged with leading the sales efforts in his home country and welcomes the expansion: "The Swedish market has grown rapidly in the last couple of years. Especially in terms of large-scale projects, resulting in a growing volume of orders for products such as our connectors, winches and underwater systems. The potential for spin-off business is enormous, and we are therefore scaling up our presence, opening an office staffed initially by myself and a Sales Administrator."

Local engagement is essential for growth. It opens more and new doors, which MacArtney's CCO Rasmus Bonde is highly enthusiastic about:

"We want to continue servicing the connectivity business and support our customers in Sweden. Our aim is to create a fully-fledged MacArtney setup, building our relationships with Swedish customers and get in even closer collaboration on new projects," said Bonde.

» *Sales Manager Emil Andersson will now be charged with leading the sales efforts in Sweden.*

BOXFISH RESEARCH ANNOUNCES NEW SOUTH KOREAN ROV RESELLER

Boxfish Research, a New Zealand manufacturer of ROVs, has announced an authorized reseller agreement with DK M-Tech, a market-leading provider of specialized marine equipment in South Korea.

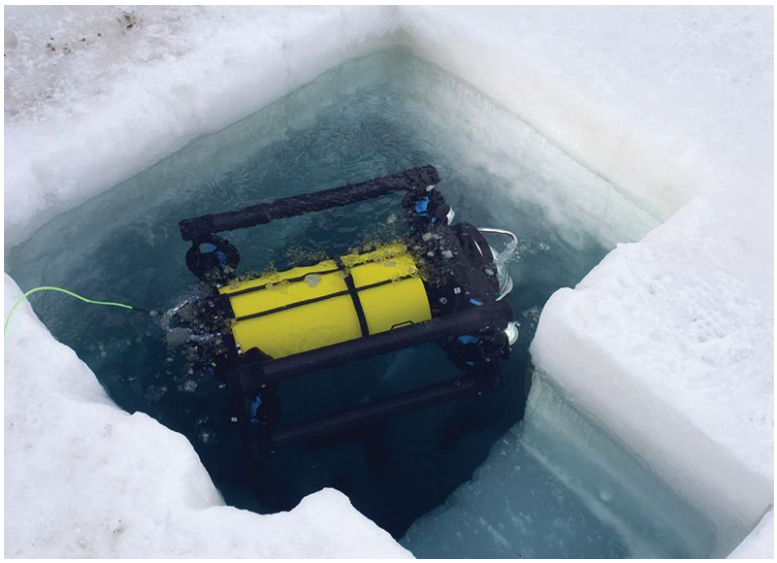
This new business partnership introduces Boxfish Research's innovative ROV systems to the Korean market and enhances DK M-Tech's capacity to improve Korea's maritime safety and marine environment.

Based in Auckland, New Zealand, Boxfish Research designs and manufactures cutting-edge underwater robotic vehicles recognized internationally for their unparalleled vision technology, maneuverability and reliability.

Boxfish ROVs are lightweight, versatile and easy to use with six degrees of freedom of movement, an auto-stabilization system and pilot assist features. Their underwater drones can operate in harsh polar conditions and challenging remote locations capturing tack-sharp uncompressed 4K video at depths of up to 1,000 meters.

DK M-Tech distributes state-of-the-art equipment and systems to the Korean marine industry, building strong and successful customer relationships. Together Boxfish Research and DK M-Tech will deliver an indispensable underwater tool to the market that enhances safety, efficiency and capability in diverse industries, including commercial diving, offshore energy, biosecurity and search & research, marine science and cinematography.

Craig Anderson, Co-founder, Boxfish Research said: "We are excited to partner with DK M-Tech and have them join our community of resellers. This agreement brings our world-leading underwater vision technology to a new market and enhances our capacity to serve customers in the Asia Pacific region."



» *Launching the Boxfish ROV from a hole in the ice in Antarctica 2019. (Photo credit: Boxfish)*

» *OFG's new CTO, Dr. Lucy MacGregor*

OCEAN FLOOR GEO-PHYSICS APPOINTS NEW CTO TO DRIVE INNOVATION

Ocean Floor Geophysics, Inc (OFG), a leading provider of subsea survey services and technology, has appointed Dr. Lucy MacGregor as its new Chief Technology Officer (CTO). OFG's retiring founder and CTO, Peter Kowalczyk will continue to be actively involved in OFG's operations, providing expertise, mentorship and guidance as Chief Scientist Emeritus.

With the recent addition of the ultra-high resolution seismic P-Cable technology, OFG now provides the broadest range of marine geophysical technology and services available in the offshore market today, offering an extensive range of sensor solutions from surface, AUV and ROV platforms, combined with unique multiphysics processing, integration and interpretation know-how.

As CTO, Dr. MacGregor will help propel OFG's growth in emerging technologies and markets such as autonomous subsea infrastructure inspection, carbon capture and storage (CCS), renewable energy (wind farms), and seabed minerals.

Retiring CTO Peter Kowalczyk said: "It is with great pleasure that I see Dr. MacGregor taking on the role of CTO. She brings a rock-solid science background and great skills to her new position. I know she will support both OFG's team and customers exceptionally well."

"I am delighted to be joining a world-class team of scientists and engineers at OFG," Lucy MacGregor added. "I look forward to working with them to further develop and deploy their innovative technology in new and emerging markets."

ONE SEA WELCOMES SEA MACHINES ROBOTICS TO AUTONOMOUS SHIP ECOSYSTEM

One Sea, the high-profile ecosystem leading the way towards an operating autonomous maritime ecosystem by 2025, has welcomed Sea Machines Robotics as its latest recruit and Management Board member.

With AI and maritime autonomy as its primary focus, Sea Machines Robotics is a leading developer of autonomous command, control and advanced perception systems for vessels. Based in Boston, but with an international office network, Sea Machines operates one of the most active fleets testing autonomous ship technologies worldwide.

Drew Orvieto, Naval Architect and Senior Director of Product Management at Sea Machines will serve as the first board member within the United States for the One Sea ecosystem. Orvieto agreed to a two-year commitment where he will continue to advance acceptance and regulations around autonomous systems and applications in maritime operations globally.

One Sea Senior Ecosystem Lead, Päivi Haikkola, said: "We are delighted to have Sea Machines Robotics on board, as both a member and part of the One Sea Management Board, as we continue to work towards our 2025 goal and address the regulatory challenges facing autonomous ship operations. Sea Machines Robotics has been developing a range of intelligent technologies since 2015 which are helping unlock new opportunities and enhance vessel safety, performance and efficiency. This strongly aligns with One Sea's mission to create an autonomous maritime ecosystem and a safer, more efficient operating environment."

» *One Sea has developed an advisory and advocacy role for stakeholders with an interest in the safety, efficiency and environmental gains available to the autonomous ship. (Image credit: One Sea Ecosystem)*

"We are now at a juncture where technological advances are outpacing the regulatory process to transform the maritime industry," said Arthur Seaman, Product Manager, Government and Compliance, Sea Machines Robotics. "One Sea is at the forefront of driving the development of a regulatory framework for MASS. We are convinced that the MASS business sector needs strong and reliable leadership at the IMO. We are excited to join One Sea at this crucial time in the development of our industry's future and look forward to working with One Sea and its members to achieve our common objectives."

From its formation in 2016, the One Sea ecosystem has developed an advisory and advocacy role for stakeholders with an interest in the safety, efficiency and environmental gains available to the autonomous ship. Members include international maritime technology experts, such as, ABB, Cargotec, Finnpilot, Fintraffic, Haltian, Kongsberg, Monohakobi Technology Institute (MTI), TietoEVRY and Wärtsilä, as well as a range of stakeholders involved in aspects of vessel management.

OMNI INTEGRITY SECURES DIGITAL INTEGRITY MANAGEMENT CONTRACT FOR THREE60 ENERGY

OMNI Integrity, (an ICR company), has announced a 12-month contract award, with extension options, to provide full asset integrity lifecycle management software to support THREE60 Energy's UKCS and International Duty Holder assets.

OMNI provides a complete 360 data-capture solution and can integrate with Internet of Things (IoT) sensors and mobile tablet technology to cover all inspection and condition monitoring methods.

William McLean, Director of OMNI, said: "We are delighted to support THREE60 Energy as a technology partner and enhance their robust digitalisation strategy. OMNI covers the entire integrity process, bringing a 40% time saving on manual integrity management methods. This will provide THREE60 Energy greater control over integrity data whilst providing a platform for integrating advanced inspection methods. We are really looking forward to working together on this collaborative journey."

» *William McLean, Director of OMNI, with Stephen Diplock, Operations Director at THREE60 Energy*

Stephen Diplock, Operations Director at THREE60 Energy said: "OMNI is a great digital fit for our business. We have a broad technology offering across our services and solutions and this enables and supports our shared vision of adding real value for our customers through the full asset lifecycle."

DANOS MARKS 75 YEARS IN BUSINESS

From its founding in 1947 in Larose, Louisiana, Danos has continuously evolved and expanded to serve its customers. This year, the family-owned and managed company celebrates 75 years as a leading service provider to the energy industry. With nearly 2,500 employees, Danos services approximately 150 customers across 17 states.

CEO Paul Danos credits the company's longevity to three generations of leadership upholding an unwavering commitment to shared values.

"When I reflect on the key to Danos' sustained success, I think about our values of integrity, safety, service, respect and improvement. These founding principles have guided the company for 75 years. Although we've said them in different ways over the years, they are the core of who our organization is today," says Danos.

Throughout 2022, Danos will be celebrating with a 75th Anniversary Road Show. The company will host a series of events in Louisiana and Texas to honor and thank employees, customers and the many partners who have been integral to the organization's success since 1947. In addition, company employees have pledged to volunteer 1,947 hours to nonprofit organizations in honor of the Danos' founding year.

As for the company's future in the ever-evolving energy industry, Danos commented: "While many of our established service offerings remain vital to the transitioning industry, we are also actively expanding our capabilities to ensure we remain in step with our customers."

In recent years, the expansion has included significant advancements in technology-based solutions delivering improved workforce capacity and employee skill development and an automated warehouse management system that improves operational efficiency and increases customers' returns.

Danos added: "We are excited about the future and the growing number of opportunities to deliver the 'Danos difference' to new and established customers."

» *Danos remains a family-owned and managed company. (Photo credit: Danos)*

» *Fugro's Middle East personnel complete the world's first Maritime Autonomous Surface Systems (MASS) training delivered by SeaBot XR. (Photo credit: Fugro)*

FUGRO RECEIVES WORLD'S FIRST PROFESSIONAL CERTIFICATE TO OPERATE USVS

Fugro personnel from its Middle East office have completed the world's first Maritime Autonomous Surface Systems (MASS) professional certified training delivered by SeaBot XR at their training academy CEbotiX, the National Centre for Operational Excellence in Marine Robotics based in Southampton, UK. This certification marks a landmark step in the development of a recognized training program that ensures qualified marine personnel acquire the skills needed to safely and effectively operate MASS.

Fugro and SeaBot XR have been working together since 2019 to develop the skills required by the connected mariner. This initial training course, designed uniquely for Fugro personnel, adds to the existing skills of their qualified mariners to ensure a safe transition from sea to shore. Focus is placed on critical topics such as mission analysis, situational awareness, cyber security, and resource management.

The training is based on experiential learning, where trainees are provided with an in-depth theoretical knowledge, before taking a staged approach to the command-and-control process. Candidates are able to apply their newly acquired skills directly to the working environment allowing them to deal with the challenges associated with emerging technologies.

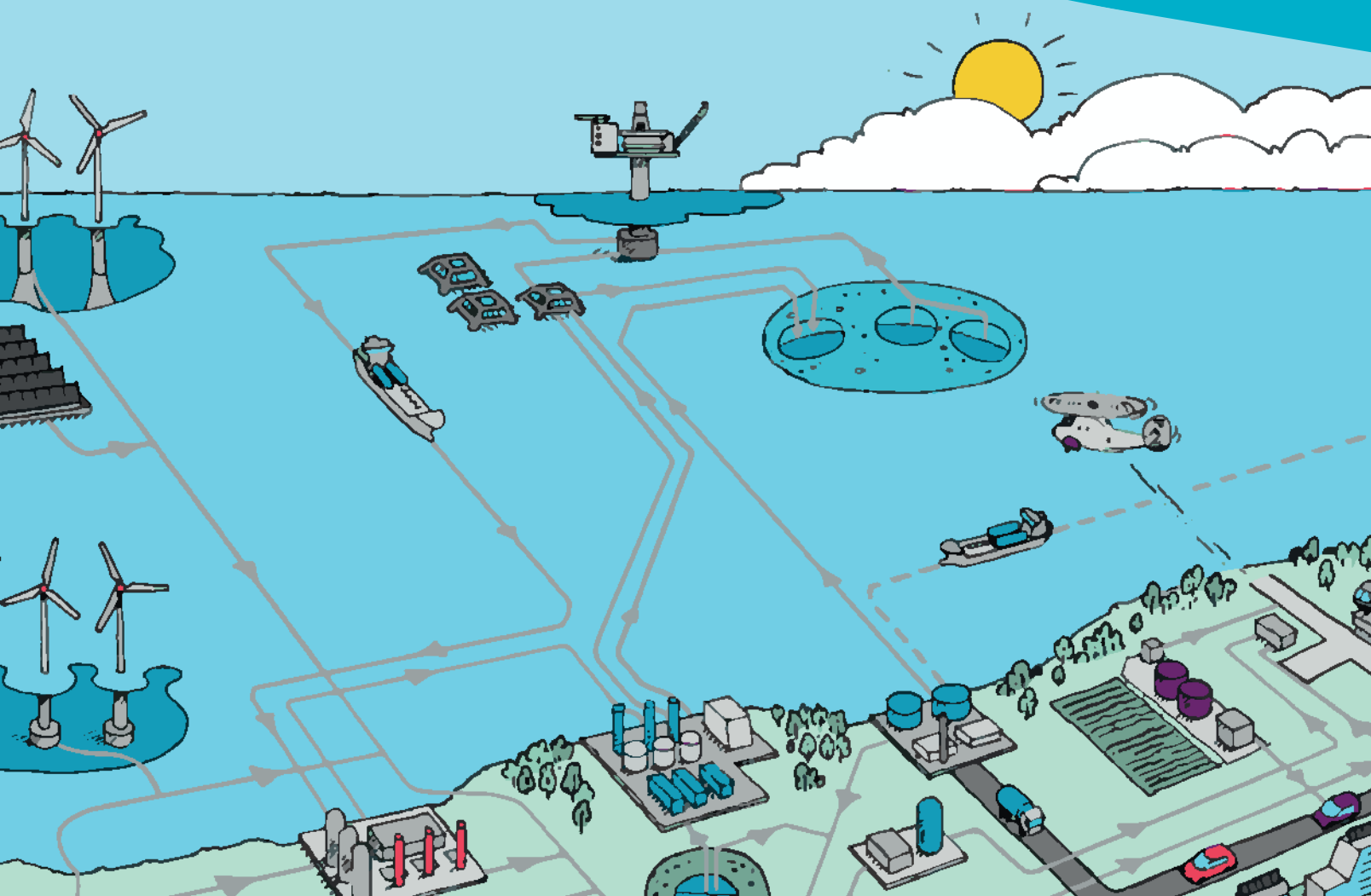
Gordon Meadow, CEO at SeaBot XR, said: "It's exciting to see this first cohort of MASS professionals complete this phase of training which lays the foundation for MASS operations. This is the start of their journey where trainees will complete additional modules as they advance in the profession. We will continue to roll out the broader MASS certified professional training scheme throughout 2022 and 2023 as the complexities of the vessels and the tasks they complete increases. The training and skills required will continue to evolve to ensure people and technology can coexist in maritime."

Hannes Swiegers, Fugro Director IRM Services and Remote Operations, said: "Whilst remote and autonomous technology will revolutionize the way we conduct business, the continued success of Fugro rests on the skills of our personnel. By investing in our people and ensuring that long-established industry standards are upheld, Fugro can confidently assure clients and regulators that our high safety and operational standards will remain as we develop our global network of remote operations centers and autonomous vehicles to support the maritime industry for a safe and sustainable world."

ONS 2022 TRUST

29 AUG – 1 SEPT STAVANGER – NORWAY

THE BROAD ENERGY INDUSTRY WILL BE THERE WILL YOU?



OCEAN INDUSTRY DIRECTORY

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Nortek excels in the development and manufacture of acoustic Doppler instrumentation. Doppler Velocity Logs (DVLs) are used for subsea navigation. Acoustic Doppler Current Profilers (ADCPs) are used to understand physical processes in the ocean, rivers, lakes and laboratories. We pride ourselves on being innovative in product development and production processes. Nortek provides solutions to engineers and scientists by offering real-time data collection and support from our responsive technical team.

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Dan Cote, Sales Manager

DeepWater Buoyancy Inc. is the world's largest producer of subsea buoyancy products for the oceanographic community and has a vast product line of buoyancy solutions for offshore oil & gas, energy and technology companies. This product portfolio has been built over the course of 40 years serving these industries. Though products are offered for shallow water applications, the company specializes in deepwater, providing solutions to depths of 6000 meters and beyond.

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Dirk Fieberg

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Alberto Lopez Pastor

Cathx Ocean design and manufacture advanced subsea imaging and precision measurement systems for subsea operations. Designed to meet stringent technical, operational and integration requirements associated with various subsea applications and vehicle types, Cathx Ocean's systems offer precision, reliability and peace of mind. Products include advanced still imaging, colour laser point cloud and video systems, designed to deliver precision subsea data in a way that allows automation for subsea vehicle operations. The range includes the Hunter system (AUV Imaging and Laser), the Scout system (Observation Class ROV Imaging and Laser Profiling), the Pathfinder system (Work Class ROV Imaging and Laser Profiling) and the Prowler I & II systems (Towed Vehicle Imaging Range and Scale Measurement).

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For over 30 years, DeepSea Power & Light has provided high-quality and innovative products to the oceanographic community. The company's expertise and product line has grown to include underwater video systems, lighting solutions, pressure relief valves, and lasers.

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Remote Ocean Systems has been an industry leader in the design and manufacture of reliable, high-tech equipment and systems for the most severe subsea, oceanographic, shallow water, industrial, commercial and military environments since 1975. Our product line includes high accuracy and robust positioners and rotators and a wide variety of lighting including: halogen and LED technology offering 10,000+ lumens, flood, spot, dimming and non-dimming types. Our cameras offer exceptional sensitivity in low light conditions, high definition color, compact size rated to 6000-meter depth. We also have a fully staffed engineering department to help with your special requirements.

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SIDUS Solutions LLC, 'SIDUS' is a worldwide company that designs, manufactures and installs systems in the most extreme of environments. SIDUS products include Cameras, Pan & Tilts, Lights and Lasers for use in hazardous areas for and SUBSEA, serving the, energy, scientific, military, nuclear, and shipping industries. Engineering experience makes us the perfect choice for application specific surveillance systems to provide end to end safety and security. SIDUS provides complete integration, design, documentation, and commissioning for all systems. From sea-floor observation platforms, to surveillance systems on drilling rigs, or sonar deployment systems - SIDUS is a field proven solution.

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

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SONAR SYSTEMS

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EdgeTech designs, manufactures and sells industry-leading side scan sonars, sub-bottom profilers, bathymetry systems and combined sonar systems. Additionally, the company produces world class underwater actuated and transponding solutions including deep sea acoustic releases, shallow water and long life acoustic releases, transponders, reliable USBL acoustic tracking and positioning systems, and custom-engineered acoustic products.

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Imagenex Technology Corp. is an innovative company that was founded in 1988 by pioneers in the development of high resolution sonar. With thousands of systems in use on imaging and profiling projects all over the world, Imagenex has developed a reputation for products that break new ground for depth capability, size, cost, imaging quality and functionality. Each system in this growing product line integrates the latest in sub-miniature electronics into industry proven, robust underwater housings for a total package that is small, rugged, and will provide years of maintenance-free use. Products include multibeam, mechanical scanning, and sidescan sonars.

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General Dynamics Mission Systems' family of Bluefin Robotics products consists of autonomous unmanned underwater vehicles (UUVs) and related technologies for defense, commercial, and scientific customers worldwide. Their core autonomous product line includes Bluefin®-9, Bluefin®-12, Bluefin®-21, and subsea power technologies. General Dynamics offers a full range of modular, free-flooded UUV platforms and products, integrated with over 70 different sensors on more than 100 vehicles. We design, develop, deliver, and provide operations and sustainment support for UUVs worldwide to research institutes and industry, providing UUVs and auxiliary equipment to the United States' and International Navies for various defense applications.

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

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

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Okeanus Science & Technology is an established provider of winches, handling systems, and custom solutions for the oceanographic and subsea industry. Proven, reliable, and cost-effective, standard and custom designed winches range from small all-electric instrumentation winches to high horsepower all-electric or hydraulic umbilical and multi-purpose oceanographic systems. Okeanus also provides a range of standard and custom designed A-Frames, over-boarding sheaves, docking assemblies, HPUs, and other auxiliary equipment. We deliver turnkey solutions to commercial, scientific, and defense clients around the world. Okeanus has offices in Houston TX, Houma LA, and East Greenwich RI.

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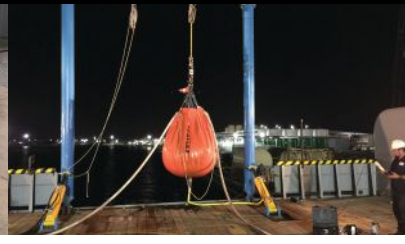

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