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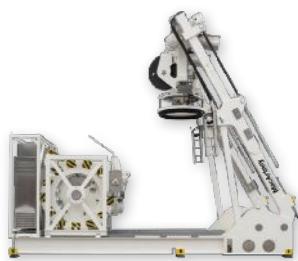
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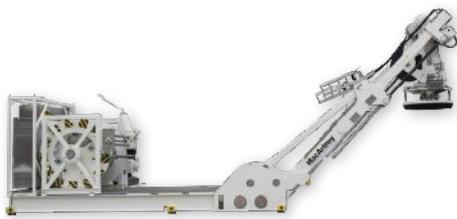
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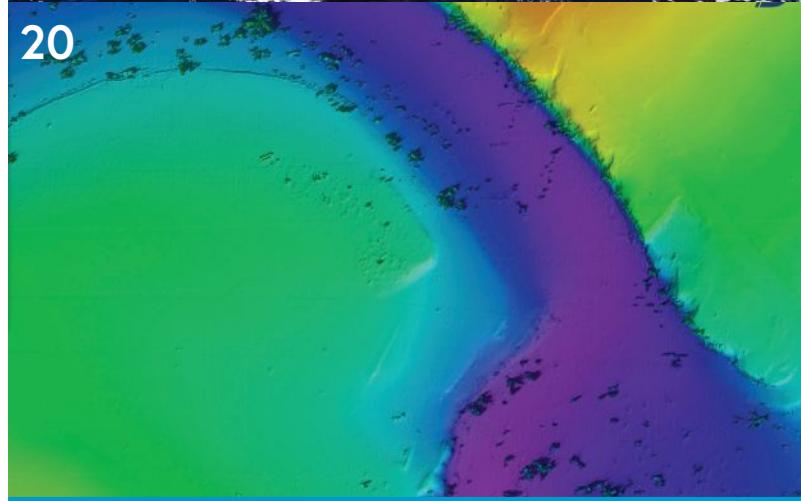
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10



20



DEPARTMENTS

- 14** OCEAN SCIENCE & TECHNOLOGY
- 30** OFFSHORE ENERGY
- 44** SUBSEA INTERVENTION & SURVEY
- 50** DEFENSE & SECURITY
- 58** OCEAN MILESTONES

IN EVERY ISSUE

- 24** CHECK THE TECH
- 34** ENERGY MARKETWATCH
- 56** EVENTS
- 63** OCEAN INDUSTRY DIRECTORY
- 70** ADVERTISERS INDEX



ON THE COVER:

The newest addition to the Saildrone fleet, the 10-meter Voyager USV, is optimized for maritime security and near-shore ocean mapping to 300 meters. (Photo credit: Saildrone)

FEATURES & SPOTLIGHTS

- 10** UNCREWED OCEAN DATA SOLUTIONS
- 20** OPTIMIZING HIGH-RESOLUTION SURVEYS WITH AUVs
- 28** INCREASING THE PACE OF OCEAN EXPLORATION THROUGH MULTI-VEHICLE COLLABORATION
- 36** NEW COST-EFFECTIVE MULTIBEAM SONAR FOR COMPACT USV
- 42** ADVANCED INSPECTION-CLASS UNDERWATER ROBOTS FOR OFFSHORE ENERGY INSPECTIONS

[WITH THANKS - Ed.]

The full extent to which Uncrewed Vehicles, the chosen theme of this edition, are to rewrite the standard operating procedures of ocean professionals remains to be seen, but as new technologies and solutions come online, the incremental integration of intelligent assets designed to promote remote operations signals a new reality for in-field ops.

As the excellent features overleaf clearly demonstrate, we are set on a path towards a significant inflection point, one at which our ability to harness autonomy and stretch technical capabilities.

Our special thanks this month go to Saildrone, Terradepth, Exail, VideoRay, EvoLogics, and CSignum.

editor@oceannews.com

Ed Freeman



SMART SUBSEA SOLUTIONS

Delivering data in most adverse conditions: underwater acoustic modems with advanced communication technology and networking

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UNCREWED VEHICLES: IN A CLASS OF THEIR OWN



By Ed Freeman
Managing Editor, ON&T

Most modern-day technological breakthroughs, regardless of the industry they target, share common ambitions: to increase productivity, reduce overhead, improve communication, stimulate collaboration, optimize security, and so on. Ocean technology is no different, and progress is often best defined by the rate at which new or enhanced in-field solutions help operators establish sustainable competitive advantages within the context of leaner, greener, and safer offshore activities.

The growing prevalence of uncrewed vehicles is something of a twenty-first-century bellwether for ocean tech development. Whether engineered for deployment on or below the waterline, today's manufacturers of autonomous underwater vehicles (AUVs) and uncrewed surface vehicles (USVs) are squarely focused on fielding turnkey systems that promote increasingly remote and efficient ways of working at sea.

The acceptance—and funding—of USV platforms has historically lagged behind the successful in-field integration of AUVs for routine subsea tasks. However, as amply showcased in these pages, USVs are now in ascendency and set to play a central role in the future of offshore energy exploration, naval defense operations, and scientific discovery. As widely reported by ON&T, not even a global pandemic and the subsequent disruption to investment plans, production cycles, and sea trial schedules could meaningfully capsize demand.

BURGEONING USV MARKET

But forecasting this demand—and therefore the mid- to long-term growth of this nascent industry—comes with inherent unknowns. As technologists continue to advance the real-world application of Artificial Intelligence (AI) and Machine Learning (ML), attempting to determine a realistic market value over a set period is subject to dawning variables, but the forecast consensus is for healthy double-digit CAGR throughout the current decade.

Defining the market itself is perhaps the more fundamental challenge. As cited in ON&T's recently published *Uncrewed Surface Vehicle Market*

Summary and Forecast 2022 – 2026, there are only two practical markets for USVs right now (which we categorize as Military and Data Collection) but, before long, the expanding utility and capacity of USVs (and the payloads they support) will almost certainly prompt a reframing of the commercial landscape for USVs.

For now, though, industry headlines point to three dominant trends: first, a significant incline in the mainstream usage of USVs for tasks that traditionally require topside support (moving from prototyping towards full-scale production); second, a consistent cycle of production contracts (measurable demand); and third, a steady flow of investment dollars in new or expanded production facilities, mergers and acquisitions, and strategic alliances.

SPOTLIGHTING UNCREWED VEHICLES

Little surprise, then, that USVs represent a fast-growing category in ON&T's 2023 Uncrewed Vehicle Buyers' Guide (UVBG), which is now accepting submissions for all available uncrewed assets in the marketplace, including USVs, AUVs, ROVs, gliders, crawlers, and other towed vehicles. Now in its eighth edition, the UVBG continues to evolve, but the mission remains unchanged: to be the ocean and offshore industries' intuitive guide to the broadening range of vehicles helping to propel ocean research, subsea exploration, and marine defense toward new frontiers. Please be sure to visit www.oceannews.com/uncrewed-vehicles to find out more.

And it is with this commitment to bringing our readership closer to the news and views shaping this thriving industry that we also announce the launch of our new quarterly newsletter dedicated solely to spotlighting news and insights specific to the exciting world of uncrewed vehicles. Our first edition will be distributed automatically to ON&T subscribers as of early Q2 2023. To manage your ON&T subscription, please visit www.oceannews.com/subscribe.

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» Saildrone has built 100 7-meter Explorers to date, 45 of which have been operational at one time. (Photo credit: Saildrone)

| EDITORIAL |

UNCREWED OCEAN DATA SOLUTIONS



By Brian Connolly
*Vice President Ocean Mapping,
Saildrone*

Whether in the name of scientific discovery, offshore exploration, or maritime domain awareness, ocean professionals are calling for new and practical ways to acquire, process, and analyze increasingly diverse and robust ocean data sets.

This demand is, in no small part, being driven by our expanding technical capacity and the steady integration of sophisticated control and communication systems, all geared to stretch our collective ambitions to inspect and protect the blue planet.

Take ocean mapping, for example. In June 2022, The Nippon Foundation-GEBCO

Seabed 2030 Project—which seeks to produce a definitive global seabed map by 2030—updated the global coverage of seafloor mapping from 20.6% in 2021 to 23.4%. This represents a year-on-year addition of 10.1 million square kilometers of new bathymetric data and another significant milestone, given that coverage back in 2018 was a mere 6.7%.

EFFICIENT TURNKEY USV SOLUTION

Progress of this magnitude and pace relies not only on unprecedented cross-sector collaboration but also on the trial and acceptance of intelligent, economically feasible technologies designed to extend our reach further offshore while reining in any associated carbon footprint or HSSE (Health, Safety, Security, and Environment) exposure.

Saildrone's role in this transition is to provide cost-effective data at scale by operating a growing fleet of uncrewed surface vehicles (USVs) built to withstand the rigors of deployment in the most remote and hazardous seas.

We have branded our bundle of hardware, software, and in-field expertise as our mission-as-a-service (MAAS) offering, of which there are three elements: first, the operation of our uniquely capable and customizable USVs; second, access to an intuitive web portal that offers advanced collaboration features and real-time mission planning tools; and third, a transparent data chain of custody, from raw observations to the real-time validated data.

The result is a genuinely turnkey solution, delivering high-quality data at a fraction of the costs and risks associated with traditional survey methods.

SCALING UP THE SAILDRONE FLEET

While some of our USVs have been designed with specific applications and capabilities in mind, each of our three base models—the 7-meter Explorer, 10-meter Voyager, and 20-meter Surveyor—has been developed to achieve the optimal balance between mission payload flexibility and endurance.

All our USVs are wind- and solar-powered, and so capable of year-round deployment. The Voyager and Surveyor are also supported by onboard generators and additional diesel/electric propulsion options for voyage extension and increased maneuverability.

We are ramping up for a major fleet expansion in 2023. We already built 100 Explorers, 12 Voyagers, and 1 Surveyor (with 4 more planned for 2023). By the end of the 2024, we aim to launch 30 – 40 of the mid-sized Voyagers and 10 – 15 of the larger Surveyors.

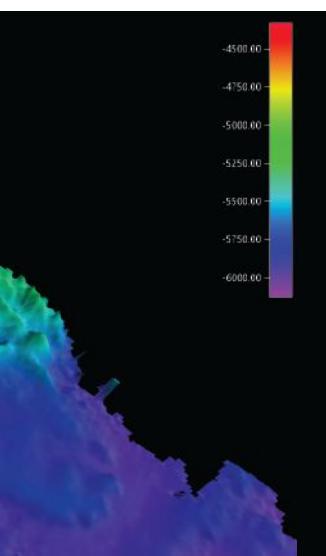
The new Surveyor USVs will feature an upgraded aluminum hull (versus composite), which will not only speed up production but bring added agility to the USV. It would prove completely unfeasible to scale the production of full ocean depth research vessels (and crews) like this but is perfectly attainable—with the right infrastructure and industry partnerships—when it comes to reinforced, long-endurance multipurpose USVs.

OCEAN DATA WHEN AND WHERE YOU NEED IT

Saildrone USVs are outfitted with an Iridium satellite connection and full resolution data is stored on board. The mission portal allows customers to see a time series of all the data. For bathymetry missions, geographic representation of down-sampled data can be used for initial analysis on which users can then communicate directly with the pilot should they wish to redirect the drone to a specific area or data point. While transferring raw multibeam bathymetry off the vehicle in real time is impractical, when the USVs pull into port you can download the high-resolution imagery and video. As new high bandwidth satellite communication services become available, we are prepared to integrate those into our operations to enable near-real time transmission of data from our USVs.

Perhaps our most notorious and arresting video footage to date came about by sending Explorer USVs—equipped with a hurricane wing, rather than the standard tall wing—into the path of major Atlantic hurricanes. Unsurprisingly, scenes of nature at its most brutal—the relentless churn and chaos of towering waves—couldn't help but capture the imagination, but the underlying objective behind these two separate missions, one in 2021 and one in 2022, was to collect environmental data in partnership with the National Oceanic and Atmospheric Administration (NOAA). We are planning to repeat this mission in 2023.

These data, comprising about 20 metrics recorded by multiple sensors, are essential to furthering our understanding of the complex meteorological interactions that trigger massive storms to intensify so rapidly. And it is not just the atmospheric variables—sea surface temperature, salinity, dissolved oxygen, relative humidity, barometric pressure—that will bring great accuracy to forecast models but also information about the system's energy flux.



» Bathymetry data collected by a Saildrone USV depicting a seamount. (Image credit: Saildrone)



COMPLETE MARITIME AWARENESS

However, the utility of Saildrone USVs extends far beyond mapping and probing extreme weather. The cameras on our USVs, which take images every five seconds, use a proprietary dataset of tens of millions of maritime images. These images have been annotated by Saildrone to train our ML applications to enable real-time intelligence and decision support for marine domain security.

This has far-reaching applications for surveillance ops, whether for coastal border control, illegal fishing, the interception of narcotics, etc. Launching crewed vessels or aircraft to run full-time patrol missions of this sort is expensive, whereas a USV can record information via its cameras, radar, or Automatic Identification System (AIS) and then cue a crewed asset to intervene if needed.

We have been working with the US Navy for over a year now to explore different ways in which USVs can support their maritime security efforts. Specifically for US 5th Fleet, Saildrone has provided persistent, low-cost ISR in areas such as the Arabian Gulf and Red Sea. Saildrone USVs have operationally demonstrated autonomous detection and transmission of maritime activity, which directly increases maritime situational awareness for US Navy operators. This intelligence can then be analyzed and used to cue US Navy assets for further investigation. In other words, the USV performed the preliminary risk assessment and then called for further assistance as required.

Clearly, the US Navy has plenty of firsthand experience of using uncrewed vehicles, having accepted Autonomous Underwater Vehicles (AUVs) for tactical ops many years ago, but advances in USV engineering are bringing new possibilities to the front line. Again, scalability is the key; today, we can design, manufacture, and control a broadening range of USVs—from long-endurance models to smaller craft capable of 40 – 50 knots—from the same command post, far quicker and cheaper than it would cost to construct and field crewed assets.

The reality is that no navy in the world has enough available manpower or crewed assets to patrol their own exclusive economic zone (EEZ) entirely, let alone international waters; USVs offer the ideal solution in terms of force multiplication.

» Plans for 2023 include expanding the fleet of Voyager USVs by up to 30 – 40 additional units. (Photo credit: Saildrone)

Other applications include marine mammal and protected species observation, which is an activity that we are looking at very closely. Having a team of round-the-clock dedicated observers on deck is expensive, but essential for most offshore vessels. But if we can use a USV's cameras and sensors to be their "eyes and ears" at sea, trained observers can supervise the USV's data and imagery from a shore-based command. This is just one example of how we are using USV technology to challenge long-established at-sea procedures in a way that keeps people out of harm's way and in-field operations as lean and green as possible.

Offshore wind (OSW) is one specific area that we see an immediate need for USV expansion. We are targeting our Voyager USV for this space. When it comes to the explosion in demand for efficient OSW surveys in the US, Asia, and now South America, there are simply too many survey lines to run and not enough survey vessels to run them. Deploying USVs instead frees up these much-in-demand crewed vessels for other tasks.

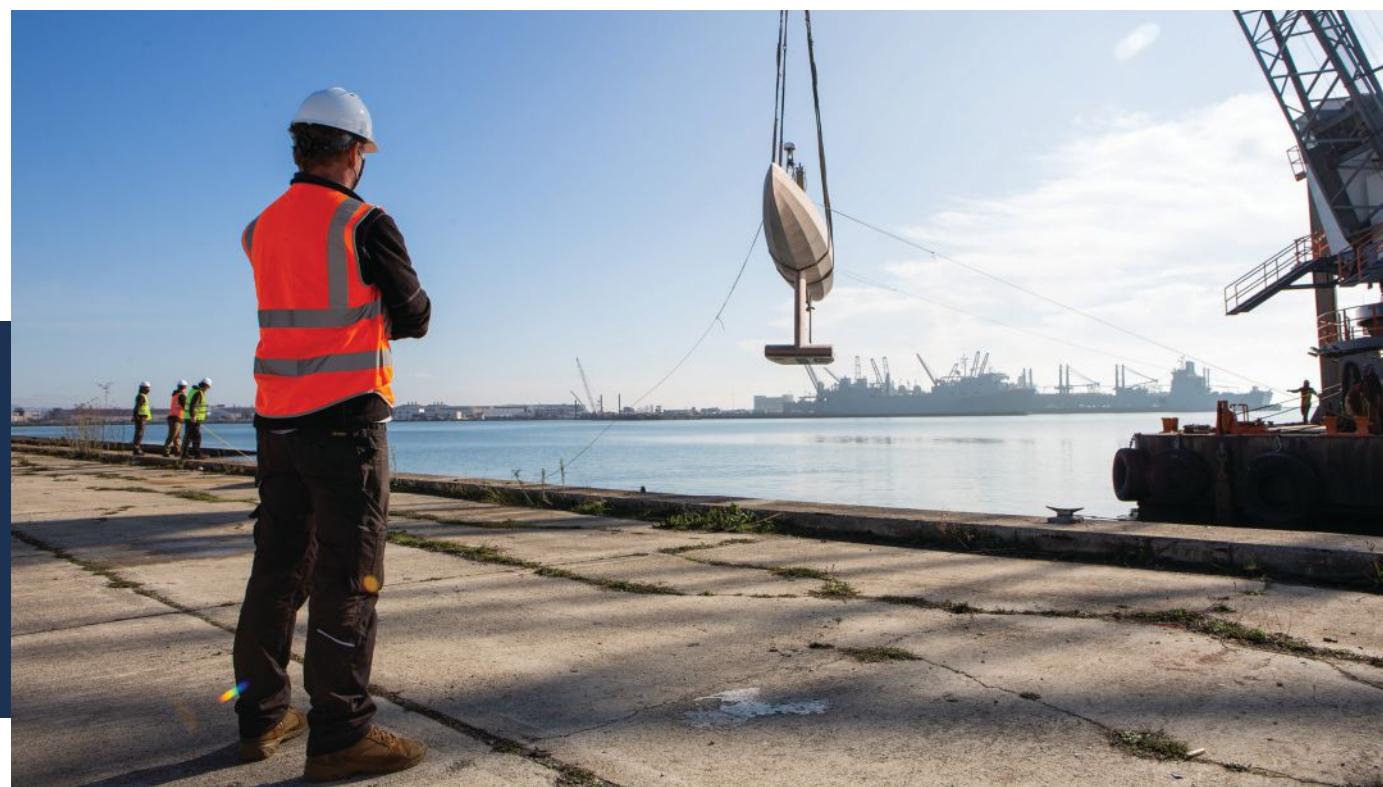
LOOKING TO THE FUTURE

We are also seeing an emerging convergence of technologies in the offshore energy sector, whereby operators are starting to deploy ancillary assets, like an ROV or an AUV, from a USV as part of a two-step inspection or intervention process. While this is still very much work in progress, investment in this tier of system compatibility is one of the likely next steps in establishing increasingly remote marine survey operations, and this is an area that Saildrone is looking at closely.

In 2023, Saildrone will likely pass a monumental milestone of over 1 million nautical miles sailed. Our current dashboard boasts 900,000+ and 24,000+ days at sea. With an expanding fleet and new opportunities to demonstrate our strengthening USV capabilities, so grows our contribution to the collective data bank from which we, the ocean community, can make critical decisions about climate, mapping, and maritime security.

The exciting thing about working in this area is that new discoveries are always within reach. A Saildrone Surveyor recently mapped 16,254 km² of an area off the Aleutian Islands. The waters off Alaska are generally poorly mapped but along the west of the Aleutian arc, where the USV mapped, is essentially unexplored. The Surveyor was also equipped with an eDNA sensor developed by the Monterey Bay Aquarium Research Institute to study the types of species that inhabit the surrounding waters. The National Strategy for Ocean Mapping, Exploration, and Characterization (NOMEC) specifically calls out the Aleutian region as one of the highest-priority regions in the US EEZ and so the data collected will go into the National Archives, contributing not only to the NOMEC goals of mapping the US EEZ 40 meters and deeper by 2030, but also the broader global Seabed 2030 initiative.

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



» The 20-meter Surveyor is engineered for full-ocean-depth, long-endurance mission deployment. (Photo credit: Saildrone)

VOYIS AND IMAGING SYSTEMS CHOSEN AS CAMERA PACKAGE FOR HII REMUS UUVs

With the goal of further improving the autonomous capabilities of its vehicles, HII has selected Voyis Imaging Systems as the standard camera option for all REMUS UUVs (REMUS 100/300/620/6000).

Voyis has developed the Recon UUV module, consisting of a highly advanced 4K stills camera and extremely efficient, high

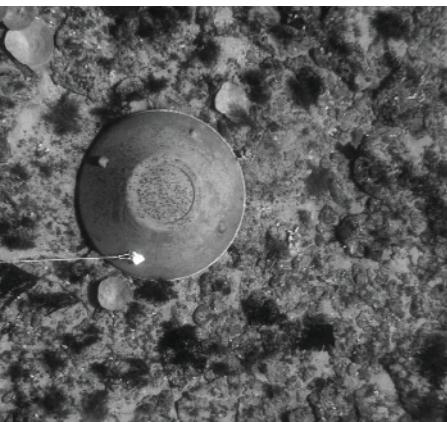
output external light bar, that enhances all REMUS platforms imaging capabilities in any operational situation. The Recon camera module offers extremely crisp stills imagery with on-the-sensor data processing for real-time, highly optimized datasets that improve in-mission autonomy and analysis capabilities.

These enhancements include improving image quality using image undistortion, true color correction, and image light leveling for consistent, actionable datasets available in-mission.

With Voyis cameras, navies are capable of completing the identification stage of MCM (mine countermeasure) operations, and improve target localization for neutralization/recovery completely

» The Recon camera module offers crisp stills imagery with on-the-sensor data processing to improve mission autonomy. (Image credits: Voyis)

submerged using REMUS platforms, improving operational covertness and efficiency. The high resolution imagery captured with Voyis' Recon module provide increased confidence in subsea missions, ensuring REMUS customers receive safe, reliable, and efficient operations.



ASL AND ENVIRONMENTAL SCIENCES PERFORM FIELD TESTING OF PROTOTYPE SPLIT-BEAM SONAR

ASL Environmental Sciences recently announced the successful field trials of a new prototype split-beam sonar. The trials were conducted in the Saanich Inlet near the Institute of Ocean Sciences (IOS), Sidney, BC. This milestone marks the first such deployment of the prototype instrument, as part of a collaboration between



» Left: Dr. Len Zedel preparing to lower the target spheres. Right: Dr. Steve Pearce, Axel Belgarde, and Graeme Thompson examining sonar output. (Photo credit: ASL)

researchers at Memorial University, the Department of Fisheries and Oceans Canada (DFO), and ASL.

The field testing was done from a small IOS launch with Dr. Stéphane Gauthier, Fisheries and Oceans Research Scientist, Dr. Len Zedel, Professor and Department Head of Physics and Physical Oceanography at Memorial University, and graduate student Axel Belgarde, also of Memorial University. ASL staff members Dr. Steve Pearce and Graeme Thompson participated in the study.

Split-beam echosounders use multiple receive channels to determine target location within the acoustical beam. Unlike ordinary single-beam echosounders, split-beam echosounders may determine not only the range but also the direction of arrival of incoming signals. This facilitates accurate measurements of target strength. When detecting fish over multiple pings, a split beam sonar may track the fish and estimate its swimming speed and direction.

This new split-beam echosounder prototype is designed to run autonomously for months at a time, allowing researchers to collect long time series data at the study site. Many researchers find such tools useful when studying fish behavior throughout changing seasons, or when deploying in remote environments.

Uncrewed Vehicle Sensor Solutions

R E D E F I N I N G I M A G E C L A R I T Y

Imagenex Sensors
for Uncrewed Applications

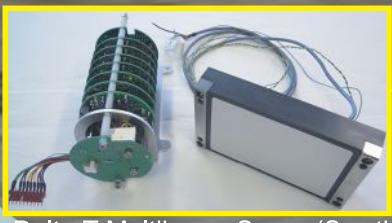
- Upward/Downward Looking Echo Sounder/Altimeter



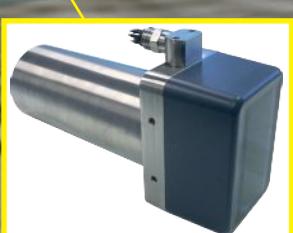
- Sidescan Sonar



- Delta T Multibeam Sonar (Swath)

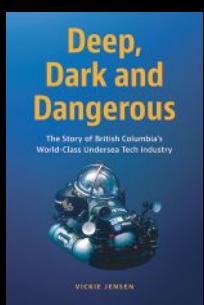


- Multibeam Obstacle Avoidance



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WHOI RELEASES RARE VIDEO FOOTAGE FROM THE FIRST SUBMERSIBLE DIVES TO RMS TITANIC

It has been almost 38 years since the remains of the RMS *Titanic* were first discovered lying on the ocean floor. On September 1, 1985, a team from Woods Hole Oceanographic Institution (WHOI) led by Dr. Robert Ballard in partnership with Institut français de recherche pour l'exploitation de la mer (IFREMER) discovered the final resting place of the ship. In July 1986, nine months after the discovery, a team from WHOI returned to the wreck site, this time using three-person research submersible *Alvin* and the newly developed remotely operated vehicle *Jason Jr.* The trip marked the first time that humans laid eyes on the vessel since its ill-fated voyage in 1912.



On February 10, 2023, a remastered version of the multi-Academy Award®-winning movie *Titanic* was released in celebration of film's 25th anniversary. Timed to coincide with this occasion, WHOI debuted 80 minutes of rare video footage from the 1986 expedition to explore the famous wreck. The newly released video highlights the remarkable achievement by the team to bring iconic images of the ship back to the surface.

Efforts to locate and salvage the *Titanic* began almost immediately after it sank, but technical limitations as well as the vast expanse of the search area in the North Atlantic made it impossible to locate the wreck.

By 1985, WHOI had developed new imaging technology, including Argo, a camera sled that was towed from the research vessel *Knorr* and captured the first photographs of the ship beneath more than 12,400 feet of water. The WHOI-led 1986 expedition returned to explore the wreck with the human-occupied submersible *Alvin*, and a remotely operated vehicle that was able to penetrate the wreck and return with iconic images of the ship's interior. WHOI's Dr. Robert Ballard led both the 1985 discovery and 1986 return to the wreck site and was one of the passengers aboard *Alvin* when it dove on the wreckage.

» A first glimpse at RMS *Titanic*'s portholes. (Photo credit: WHOI)

FUGRO AND IOC/UNESCO LAUNCH WORKING GROUP TO UNLOCK PRIVATE-SECTOR OCEAN DATA

The Ocean Decade Corporate Data Group—co-chaired by Fugro and the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC/UNESCO)—was officially launched in February during an online kick-off meeting. Organized in support of the United Nations Decade of Ocean Science for Sustainable Development, the working group is focused on creating frameworks and mechanisms to make privately owned ocean science data publicly available for the benefit of humanity.

Joining the group as founding members are five private-sector companies representing a diverse range of industries. They include Alcatel Submarine Networks, Ava Ocean, CGG, Equinor and Ørsted. Discussions are ongoing with other industry-leading companies who are expected to join the group at a later stage. Together with co-chairs, members will explore data sharing challenges and opportunities to develop solutions and best practices for making private-sector ocean data publicly available, including during a special session at this week's Oceanology International Americas Conference.

"We are delighted to officially launch this working group to establish ways to unlock the huge potential of industrial ocean data that is currently inaccessible to science," said Dr. Vladimir Ryabinin, IOC/UNESCO Executive Secretary. "Such collaborations

amongst science, industry and governments are transformative in enhancing ocean knowledge and information, and to developing the long-term sustainable solutions that we need to return to the clean, healthy, productive and resilient ocean. I am very grateful to the founding members of this group for engaging proactively with us in this movement and I know they will inspire many others to join."

Fugro CEO Mark Heine concurred, stating, "It is heartening to have such high-caliber businesses answer the call to join this critical working group. As companies who actively collect and own a wide range of ocean data useful for the global science community, we have a unique opportunity to contribute to the Ocean Decade movement through data sharing, collaborative partnerships and technology innovations that will help increase our collective understanding of the ocean and restore its health."



PRECISION MEASUREMENT ENGINEERING TRIPLES MINIDOT LOGGER DEPTHS TO 300 METERS

Precision Measurement Engineering (PME) recently announced that the miniDOT® Logger is now verified to reach measurable depths of 300 meters—three times the device's original logging limits of 100 meters. Verified by third-party and in-house testing, PME has successfully increased the miniDOT range allowing researchers to expand deployments and increase measurable data as needed to generate the most accurate data.

Both third-party and in-house testing was conducted to verify the miniDOT Logger would provide consistent measurements beyond 100 meters. A third-party, privately held design and manufacturing company that focuses on advancing technology to be used in the harshest environments was selected to conduct the initial and subsequent pressure tests.

Three miniDOT Loggers were placed in a pressure chamber at varying starting and ending pressures for a variety of durations. Testing to discern the miniDOT Logger's upper depth limit was completed to establish a baseline limitation to guide further testing. A second round of third-party testing launched additional miniDOT Loggers and verified the success of 300-meter deployments while maintaining structural integrity.

The final assessment indicated the loggers did not undergo any structural changes, therefore confirming current users can deploy their device at 300 meters without having to purchase another.

The miniDOT Logger has proven beneficial in research studies such as dead zone tracking, thermocline occurrences, temperature stratification and ocean

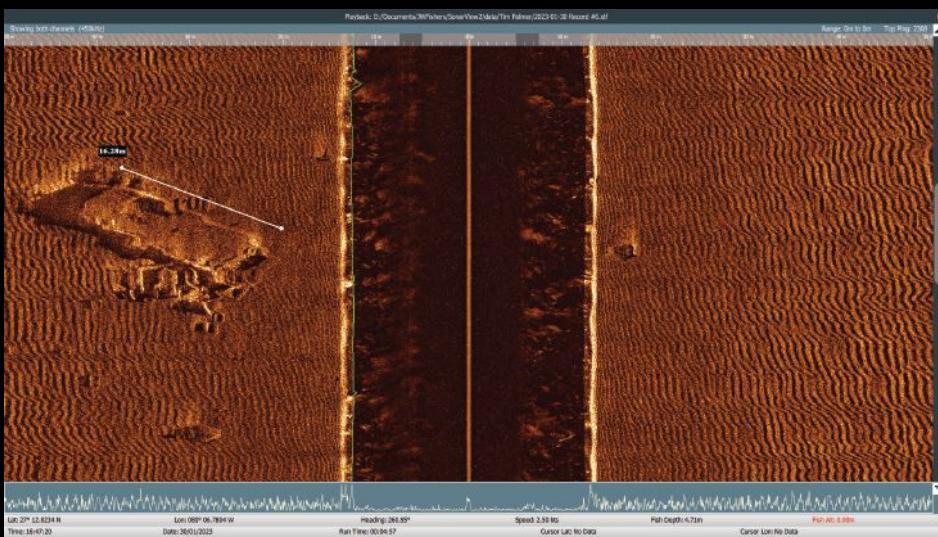
mixing, algae blooms and more. By expanding research applications through increased depths, the miniDOT Logger will continue to assist researchers to complete work that positively impacts our planet.



» The miniDOT® Logger is now depth-rated to 300 m. (Photo credit: PME)

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* A broken shipwreck and scattered pieces ~17m long on water floor

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JAIA ROBOTICS AGREES PARTNERSHIP WITH MARINE ACOUSTICS

Jaia Robotics, Inc., a leader in low-cost, micro-sized autonomous marine vehicles, has agreed a partnership with Marine Acoustics, Inc. (MAI) to add a passive acoustic capability onto their JaiaBot™ hybrid autonomous surface/underwater vehicles called JaiaBots.

MAI's extensive expertise in the collection, analysis, and modeling of underwater acoustics data has earned them an excellent reputation in the Environmental Services, Energy, and Defense sectors. Their experienced and highly qualified engineering team will lead the selection and development of the passive acoustic

system, the sales and marketing of the JaiaBot-ECHO, and develop new deployment opportunities.

Jaia Robotics continues their product development at pace and will co-lead the integration of the MAI developed acoustic system into their JaiaBot-HYDRO vehicle. JaiaBots can be operated individually or in multi-vehicle fleets at depths from 1 m to 100 m and in a wide variety of aquatic environments including open ocean, surf zones, estuaries, rivers, and lakes.

JaiaBots represent a significant advancement in affordable aquatic drones supporting the environmental data collection needs of academia, industry, and government agencies, including the US Department of Defense.

"The addition of an acoustic sensing capability opens a wide variety of new markets including the offshore renewable energy sector, defense, and the fast-growing aquaculture and fisheries industries," said Ian Estaphan Owen, CEO and Co-Founder of Jaia Robotics.

"We are proud to have entered into a partnership with a prestigious organization like MAI, which further endorses the unique multi vehicle synoptic data applications that the JaiaBot system can provide, at a cost that is more affordable than anything else available."



» Michael Rock of Jaia Robotics with a JaiaBot. (Photo credit: Jaia Robotics)

SEABED 2030 AND ANNOUNCES NEW PARTNERSHIP WITH ORANGE FORCE MARINE

A new partnership has been announced between The Nippon Foundation-GEBCO Seabed 2030 Project and Orange Force Marine Ltd., a specialized commercial marine services company providing crowdsourced bathymetry solutions in support of the complete mapping of the ocean floor.

Orange Force Marine (OFM) offers a range of marine consulting services and survey solutions to its clients in industry, academia, and government, as well as providing education and training services to reduce risk and enhance safety at sea. OFM recently brought to market an innovative approach which facilitates automatic data collection and transmission via the Mussel Crowdsourced Bathymetry (CSB) kit while data processing and distribution is performed via a cloud-based infrastructure.

This commercial initiative supports various industry, government and not for profit mapping efforts, and notably volunteer crowdsourced bathymetry activities. Championed by the International Hydrographic Organization (IHO) and supported by the IHO Data Centre for Digital Bathymetry (DCDB), Seabed

2030 endorses OFM's unique solution of robust and non-intrusive CSB units which enable seamless data transfer, without the need for operator intervention. The vessel-to-shore communications—handled via Wi-Fi or cellular or satellite—automatically transfer data to the IHO's crowdsourced bathymetry database for storage, visualization, and analysis.



Multi Mission Capable AUV

The Osprey autonomous underwater vehicle (AUV) is built upon the proven field configurable Gavia modular design with a 2000m depth rating and a larger 12 $\frac{3}{4}$ " diameter that can accommodate additional energy and sensor options to meet demanding applications.

The Osprey can carry a variety of sensors allowing it to meet operational requirements from defense, commercial and scientific uses including:

- Pre/Post Construction Support
- Pipeline Inspection
- Mine Countermeasures (MCM)
- Rapid Environmental Assessment (REA)
- Search and Recovery (SAR)
- Oceanography
- Marine Archeology



Osprey AUV

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OPTIMIZING HIGH-RESOLUTION SURVEYS WITH AUVs



By **Jeff Snyder**
VP of AUV Surveys, *Terradepth, Inc.*



The opening of offshore wind development lease blocks on both the east and west coasts of the United States has created significant demand for marine geophysical surveys. The schedule pressures and escalating costs felt by offshore wind developers and their partner electric utilities is quite real, and increased demand for high-resolution geophysical (HRG) surveys in the oil and gas industry only place further constraints on survey asset and crew availability.

A growing emphasis on deeper projects (particularly for floating offshore wind farms) may introduce added complications such that high-accuracy, surface-based surveys lack critical resolution in depths greater than 100 msw. Expanding the adoption of AUV-based data collection can directly address resource, staffing, and data turnaround challenges to make offshore development faster, easier, and safer.

Improving the temporal and areal resolution of these surveys is also possible when leveraging the operational benefits of unmanned systems, particularly autonomous underwater vehicles (AUVs), which can provide high-quality data with lower overhead and greater operational flexibility. Surveys with AUVs can characterize the seafloor with superior resolution independent of water depth, plus provide programmatic agility to perform repeat surveys necessary to enhance the definition of seafloor dynamics that can adversely impact these offshore energy developments.

The potential to reduce costs, manage risks, and accelerate offshore renewable energy development using readily available AUV technology justifies immediate consideration by regulatory agencies and developers, especially considering the unique benefits that AUVs can provide throughout a project's timeline.

There are also two metrics by which AUVs can demonstrate superior performance: *Improved Temporal Resolution* and *Consistent Areal Resolution*.

TEMPORAL RESOLUTION

In some regions, such as the continental shelf of the eastern United States, seafloor dynamics pose significant risks to foundations and cable routes. Failure to properly characterize sediment transport dynamics during the design phase of an offshore development can lead to long-term operations and maintenance challenges and existential risks to subsea assets. For example, pipelines partially buried in an area subject to significant sediment transport—a detail easily ill-defined during the siting and design of the installation—will subsequently be at risk to exposure, scour, and potential undermining.

» Teledyne Gavia AUV staged on deck of an 8-meter-long vessel of opportunity prior to deployment. (Photo credit: Terradepth)



The current approach to HRG surveys that rely upon large surface vessels to execute expansive survey campaigns cannot adequately characterize these seafloor dynamics because different scales of bedforms may change over different periods of time or due to discrete metocean events with highly variable return periods. Thus, the variation of seafloor conditions must be characterized (and appreciated) on the time scale of weeks or months, as well as years and decades.

AREAL RESOLUTION

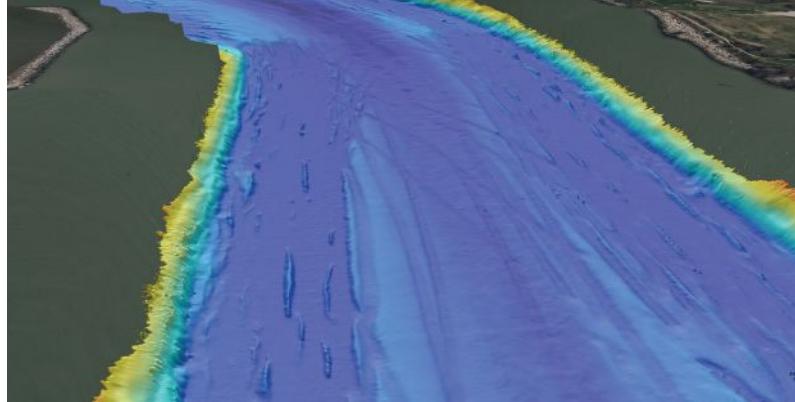
As the developments move into deeper water (such as the recently auctioned lease areas offshore California), the water depths will directly impact the actual resolution of any HRG surveys conducted from surface vessels, potentially driving the need for subsea survey assets (large towed platforms, ROVs or AUVs) to collect seafloor data with adequate resolution to assess risk of the anchoring systems, inter-array cables, and export cables. The use of such ancillary assets calls for larger surface vessels from which to deploy them, further driving up operational costs. These realities will likely jeopardize data quality, increase costs, and extend survey durations.

UTILITY OF AUV & HRG SURVEYS

Portable AUVs carrying industry-leading geophysical sensors can support HRG surveys by providing a cost-effective alternative to traditional vessel-based operations. A full range of geophysical sensors including multibeam echosounders, sidescan sonars, sub-bottom profilers, and magnetometers are now available on commercial-off-the-shelf (COTS) AUVs.

At Terradepth, we invested in Teledyne Gavia AUVs due to its form factor, portability, modularity and overall high performance. These AUVs can be utilized at various phases in offshore renewable energy development to provide immediate, tangible benefits to HRG survey campaigns because they support lower cost, more efficient operations by virtue of several key features, which include:

1. Lower costs of operation
2. Reduced staffing requirements
3. One Operator-to-Many AUV operations generate 2x or greater production rates
4. Self-contained systems and smaller form factors that grant greater support vessel flexibility
5. Reduced carbon emissions during survey operations
6. Tangible reductions in schedule to save developers significant time and money



» 3D render of Freeport Ship Channel collected with a Reson T20 MBES onboard a Teledyne Gavia AUV. (Image credit: Terradepth)

7. Faster, easier mobilizations to support frequent, repeatable surveys = higher temporal resolution
8. Consistent, constant altitudes relative to the seafloor produce superior areal resolution

In addition, AUV-based HRG surveys can supply important data, *independent of total water depth*, regarding:

1. Seafloor depth and character
2. Seafloor sediments, bedrock, boulders, and bedforms
3. Presence, location, and condition of pipelines and cables
4. Periodic surveys of submarine cable routes and wind turbine generator (WTG) foundations to evaluate cable location, depth of burial, evidence of anchor drags or fishing gear trawls, scour, foundation or anchor condition
5. Condition of cable protection systems

PARADIGM SHIFT

AUV-based surveys represent a cost-effective strategy to execute broad area or targeted survey campaigns. Recent advances in the performance of AUVs—and their sensors—dramatically improved their compatibility with high-specification marine geophysical surveys, while portability and modularity promote tremendous operational flexibility.

We are already seeing broader acceptance of AUVs and ASVs as useful (even preferred) tools for seabed characterization and asset monitoring in the more mature wind farm developments in Europe. The flexibility and reliability of these platforms, when deployed as part of a deliberate campaign of repeat surveys in a specific survey footprint, can immediately help developers and project stakeholders to better understand sediment transport dynamics and human activities as a function of time with the objective of better managing risk during design, construction, and operations.

Using AUVs for HRG surveys can also supply critical, high-resolution seafloor data to detect and characterize detailed seafloor conditions that might otherwise be missed during surface surveys. In North America, we may be approaching a point where greater adoption of these unmanned assets will be necessary to manage risk and maintain project timelines.

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



» Sidescan sonar imagery of an exposed pipeline, collected with a Teledyne Gavia AUV. (Image credit: Terradepth)

AUTONOMOUS ROBOTS HELP RESEARCHERS EXPLORE THE OCEAN



» Engineers Brett Hobson and Brian Kieft recover a Tethys-class LRAUV offshore California. (Photo credit: Tom O'Reilly/MBARI)

Autonomous robots are essential to the future of ocean science and exploration. MBARI engineers have been developing ocean science robots that work independently of support vessels. MBARI's long-range autonomous vehicle (LRAUV) is a nimble robot that can be deployed from beaches, piers, and small boats to run complex missions on its own for weeks to months.

The LRAUV is about two meters (6.6 feet) long and weighs 110 kilograms (242.5 pounds). Designed from scratch by MBARI engineers, it travels through the water without direct control from shore. It collects information about the physical, chemical, and biological characteristics of its surroundings. MBARI has a fleet of eight LRAUVs, each unit carrying a unique payload for water sampling, microbial analysis, acoustics, or imaging.

MBARI engineers designed the LRAUV to function without a host ship. However, the early deployments still required small

boats to launch the vehicle. It was not until 2017 that the first fully ship-free operations began during a collaboration with the National Oceanic and Atmospheric Administration (NOAA) using the LRAUV to monitor blooms of toxic algae. Since then, MBARI has been routinely launching LRAUVs from beaches and piers along the coast of California and the Great Lakes.

In December 2022, MBARI engineers ran the first deployment of the LRAUV from the beach outside MBARI's research facilities in Moss Landing, California.

Mechanical Engineer Brett Hobson and Software Engineer Brian Kieft donned wetsuits and rolled the LRAUV into the water while Software Engineer Tom O'Reilly kept watch from shore. Once afloat in the surf, Hobson and Kieft unstrapped the robot from its cart and released the vehicle to complete a short mission out to sea. After it completed its mission, the LRAUV returned to Hobson and Kieft who then secured the vehicle on its cart again

and rolled it back on to the beach in the crashing waves.

Launching and recovering the LRAUV from shore instead of from a ship frees up research vessels to host the complicated expeditions that they are best suited for. When launched from land, the battery-powered LRAUV is an emissions-free tool and its new docking station recharges the vehicles with energy harvested from the sun.

Critically, shipless deployments help expand access to the ocean. Understanding the complex physical and biological processes that sustain marine ecosystems, and ultimately human well-being too, requires robust observing systems. Autonomous systems are capable of continuously monitoring ocean health in real time and can operate independent of ships and technicians, 24 hours a day, 365 days a year. Ongoing investment in developing LRAUVs help support this bold vision for autonomous exploration.

EDGETECH RECEIVES MAJOR ORDER FROM ECHO81 FOR 6205S2 BATHYMETRY SYSTEMS

EdgeTech, a leader in high resolution sonar imaging systems and underwater technology has received a significant order from ECHO81 for its 6205s2 bathymetry systems, 4205 and 4125 side scan sonar systems, 3400-OTS sub-bottom profilers, and 2050-DSS combined side scan and sub-bottom deep tow systems.

ECHO81 is EdgeTech's exclusive partner and distributor in the US and Latin America for the 6205s2 and 3400 product lines. In late 2022, ECHO81 also purchased EdgeTech's 3000 m rated deep tow system, Model 2300, which is equipped with advanced bathymetry, side scan, and sub-bottom sensors, as well as INS and USBL systems. To further enhance its sub-bottom profilers arsenal, EdgeTech supplied ECHO81 with its new and improved low-frequency sub-bottom profiler model SB-0512e in December of last year.

"We are honored to have received this large order from ECHO81 and are confident that our advanced sonar technology will meet their clients' needs for high-quality underwater mapping and exploration," said Doug McGowen, Director of Sales and Marketing at EdgeTech. "We look forward to a continued partnership with ECHO81 and providing them with the best equipment and support."



» 3400-OTS sub-bottom profiler (left) and 6205s2. (Photo credit: EdgeTech)

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Photo Credit: Liquid Robotics

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CHECK THE TECH

FIRST WIRELESS COMMUNICATIONS ACROSS THE WATER-AIR BOUNDARY

Enabling underwater wireless communication is the key to unlocking multiple important use cases such as positioning applications, wireless sensor data uplink, and asset condition monitoring with simpler, more cost-effective deployments than wired alternatives.

Now, there is a proven, reliable radio-based communication technology that is delivering impressive results in real-world trials beyond what has ever been achieved before. The CSignum HydroFi™ Modem transmits data over tens of meters from below the water to receivers at or above the waterline. The HydroFi Modem enables monitoring from locations that were never previously possible. Whereas acoustic technology is limited to water-to-water communications in deep water, HydroFi allows the delivery of data directly to users and client systems which are located invariably topside in the air.

While acoustic and optical solutions can be potentially hazardous to marine life and limited to through water applications, HydroFi technology is safe and operates well in shallow conditions or splash zones, high turbidity and biofouling—wherever incumbent technologies struggle to operate due to significant environmental noise sources or biofouling from long term deployments with limited maintenance.

HYDROFI MODEM

The modem is capable of communication up to a 28-35 m range depending on the specific deployment environment. It transmits at 200 bits/second, is depth-rated to 250 m, and supports the standard RS-232 interface for external system and sensor connectivity. Designed to work seamlessly with the standard interfaces of sondes, sensors, AUVs, ADCPs and dataloggers, HydroFi technology will complement existing deployments of acoustic and optical networks in adverse conditions.

TECHNICAL OVERVIEW

Depth Rating	250 m (820 ft)*
Ambient Operating Temperature	-20°C (-4°F) to 45°C (113°F)
Dimensions	OD 110 mm Length 500 mm with 9-cell battery pack
Weight	4.4 kg (9.7 lbs)
Housing Material	Acetal
Data Interfaces	RS-232*
Configuration Method	CSignum Custom Configuration Application
Communications Baud Rate	200 bps*
External Sensor Pack Interface	8-way female subconn
Internal Battery Capacity	9-cell alkaline as standard

*CSignum has plans to enhance range and data rate, increase depth rating up to 3,000 m (9,842 ft) and expand data interfaces to support RS-485, SDI12, and others.



» HydroFi Modem is capable of communication up to a 28-35 m and depth-rated to 250 m.
(Photo credit: CSignum)

UNCREWED DATA RECOVERY WITH HESS AND OCEAN AERO

The HydroFi Modem is poised to potentially revolutionize the way we collect data subsea and really supercharge our ability to monitor the underwater environment as well as any infrastructure deployed in it. Automating data acquisition and retrieval to enable large scale ocean observing as well as monitoring of large assets such as petroleum or gas pipelines, is now possible.

The HydroFi Modem has undergone successful trials for AUV and ASV data recovery. The modem was used in an industrial asset integrity initiative underway at HESS for monitoring, inspecting, and repairing assets at sea using autonomous vehicles in the oil and gas sector, a project that also has promising potential for environmental monitoring.

HESS and Ocean Aero have successfully completed initial trials in which a HydroFi Modem deployed on a Triton AUV sent and received information from underwater sensors positioned either on the sea floor or on submerged buoys. HydroFi's unique advantage of being able to transmit through the water-air boundary allows the data to be collected by either underwater, surface or even airborne vehicles.

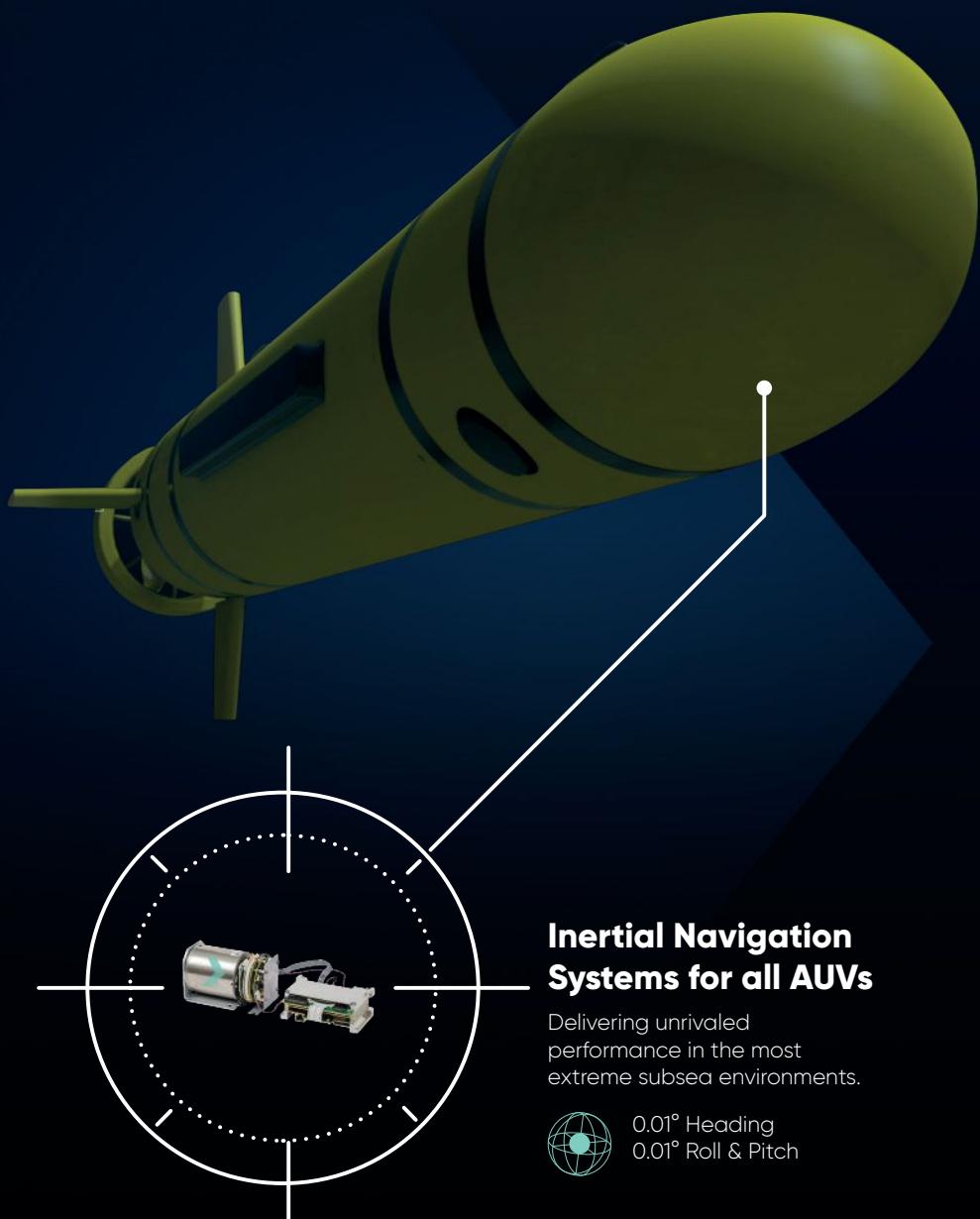
A water-air maximum communication distance of 22 m was demonstrated alongside a 30 m underwater-only range. The HydroFi was able to operate reliably in both directions—Triton to surface and surface to Triton.

According to Keith Blystone, Chief of Staff at Ocean Aero: "By autonomously collecting and communicating subsurface data wirelessly with the Triton, we can speed up information gathering for Hess—and that means faster decision making."



» HydroFi Modem deployed on a Triton AUV above and below the surface. (Photo credit: CSignum)

EMPOWERING AUTONOMOUS NAVIGATION



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NEW EXPEDITION SEEKS TO REDUCE RISK OF EXTRACTING SEABED METALS



» The SMARTEX project will deploy the latest subsea tech to develop further understanding of the impacts of deep-sea mining. (Photo credit: NOC)

Scientists from the National Oceanography Centre (NOC) have embarked on a month-long research expedition from Costa Rica to the Central Pacific to understand the impacts of deep-sea extraction of polymetallic nodules on the seabed.

The Seabed Mining And Resilience To Experimental impact (SMARTEX) project will provide the critical scientific understanding to reduce the risk of extracting these nodules in a 6 million km² region of the central Pacific Ocean.

The polymetallic nodules are highly enriched with metals including copper, nickel, cobalt, and manganese. These are important in the construction and development of sustainable technologies such as batteries, electric cars, and renewable energy devices.

The SMARTEX project will be vital in developing understanding of the impacts of deep-sea mining and developing a safer, more sustainable way to extract these metals to protect the abyssal ecosystem. The nature of these areas is largely unknown, including its capacity to cope with and recover from wider extraction projects.

Dr. Daniel Jones, Associate Head of the Ocean BioGeosciences group at the NOC, said: "Removing metal from the sea floor leads to a change in the structure of the seabed, its shape, and the nature of the sediments within. Understanding the impacts of extraction on these areas as well as the recovery of the environment is a critical part of SMARTEX. The way that seabed life responds to mining will be determined by understanding how mining affects the numbers, types, and distribution of animals."

NOC's SMARTEX project supports the UK Government's Critical Minerals Strategy which listed the minerals considered of critical importance as well as the long-term strategy for diversifying and improving the supply chain of these minerals. The strategy also asks important questions about whether to engage in the extraction of metals and minerals on the seabed and how to do it.

Dr. Jones added: "We will provide objective information to answer the government's critical minerals strategy. SMARTEX will investigate one of the areas sponsored by

the UK and it's our job to continue providing expert, independent advice when needed."

The project follows a test of excavating equipment that was carried out in the late 1970's, which lead to a large trove of data that enabled scientists to monitor disturbed areas and assess the longer-term impacts of seafloor extraction. The timescale of over 44 years makes this information even more critical to help make informed decisions on how to mine responsibly and sustainably.

Dr. Jones concluded: "No one has been able look at the realistic impacts of mining over such a long period of time before. The data we will gather from monitoring in this vast area for a year will capture the variabilities that occur near the seabed and make predictions about where sediment ends up settling."

The expeditions, which kicked off in early February, are due to conclude on March 26, 2023, in an area of the central Pacific known as the Clarion Clipperton Zone (CCZ) at abyssal depths of 5,000 m.

OCEANTOOLS LAUNCHES C7-30 MULTIPURPOSE IP CAMERA

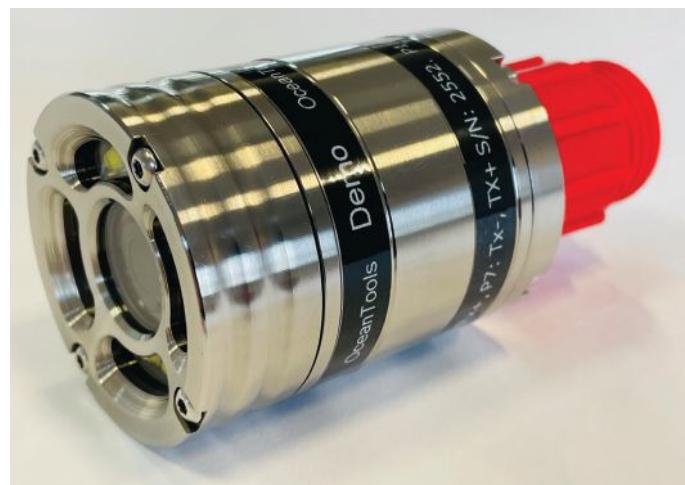
OceanTools Ltd, world-leading underwater technologists based in Aberdeen Scotland, has officially launched its C7-30 High-Definition IP subsea camera. Another market first for OceanTools, the C7-30 is a multipurpose IP camera with an integral high-intensity controllable light ring to illuminate the underwater environment and provide clear video footage at depths down to 6000 m.

The compact C7-30 subsea observation camera offers an impressive 2 MP HD over IP video output with a Wide Dynamic Range providing superb video quality under all lighting conditions. The integral light ring has 12 LEDs that can provide a light output of up to 2,250 lumens the intensity of which can be varied by analogue voltage control, power cycling or serial RS 485 control.

Brian Hector, Technical Sales Manager of OceanTools, said: "This camera is a market first, offering 2MP HD streaming video with internal lights in a package of only 53 mm diameter."

Kevin Parker, Managing Director of OceanTools, added: "We are obviously delighted to have sold more than 20 units in the first week this great camera has been on the market. Our customers tell us they are moving away from standard-definition cameras.

With this new addition, OceanTools are ideally placed to provide cameras for the changing market."



» The C7-30 has 12 LEDs that can provide a light output of up to 2,250 lumens. (Photo credit: OceanTools)

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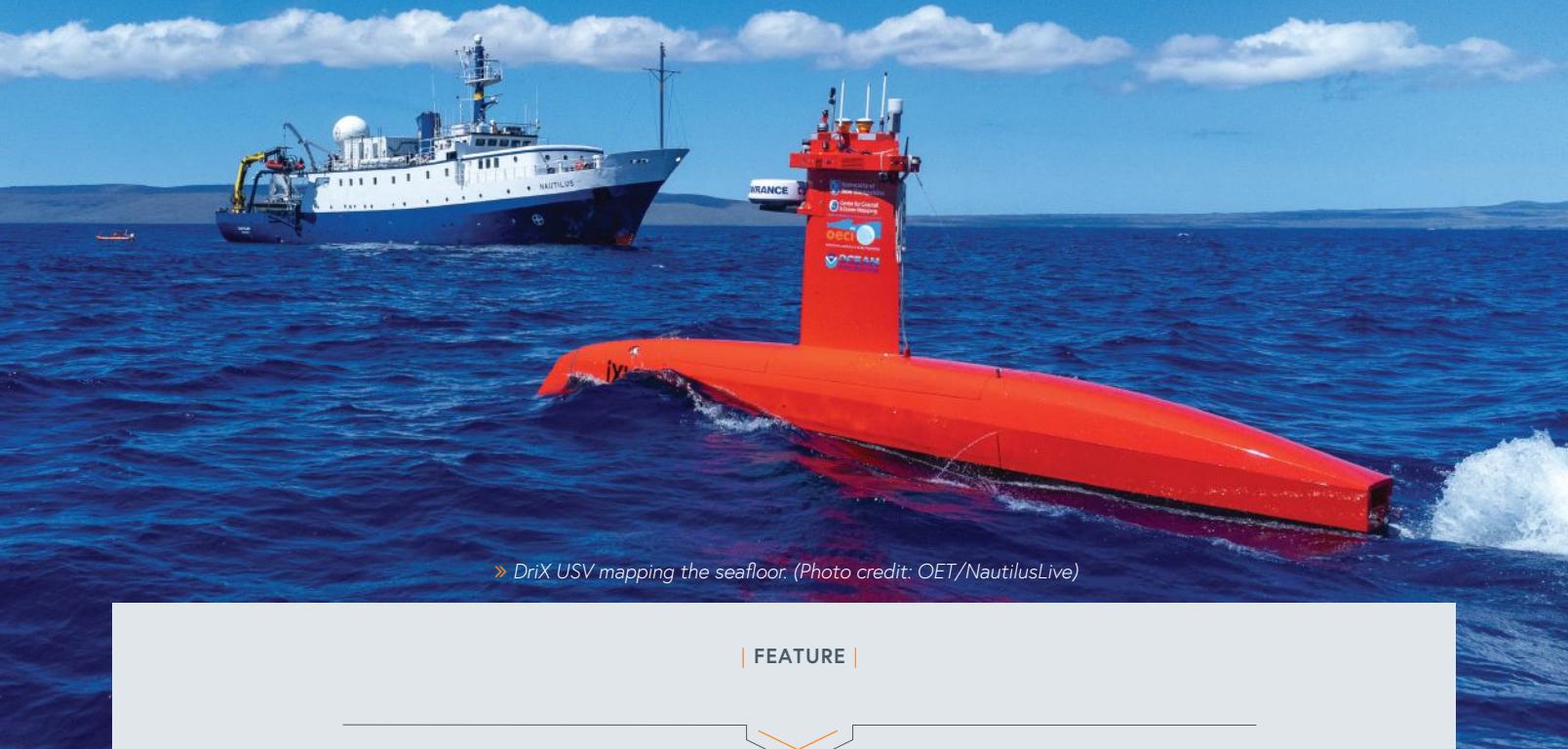
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» DriX USV mapping the seafloor. (Photo credit: OET/NautilusLive)

| FEATURE |

INCREASING THE PACE OF OCEAN EXPLORATION THROUGH MULTI-VEHICLE COLLABORATION

By
exail

The Ocean Exploration Cooperative Institute (OECI) Technology Challenge, which took place from May 6 – 22, 2022 in the Pacific Ocean, set out to test collaborative capabilities of multiple uncrewed vessels for ocean exploration expeditions, with the aim of increasing the pace of ocean exploration and finding ways of improving exploration efficiency.

OECI is a partnership between The University of Rhode Island, The Ocean Exploration Trust (OET), The University of Southern Mississippi, the University of New Hampshire (UNH), Woods Hole Oceanographic Institution (WHOI) and primary funding partner National Oceanic and Atmospheric Administration (NOAA) Ocean Exploration.

The underlying aim of the Challenge was to develop approaches to having multiple uncrewed vehicles communicate with each other and collaborate with each other, improving the efficiency of operations and expanding the overall exploration footprint. A key objective was also to find out if it was possible to make deliberate adjustments to the mission plan of a robotic vehicle from a significant distance away from the mother ship.

Historically, the offshore use of uncrewed assets would typically

be limited to one scientific operation at a time. Even when it was possible to launch several vehicles from the one command ship, it was only ever truly possible to control them individually, and the mother ship would always need to suspend mapping operations in order to deploy a vehicle. However, the OECI Technology Challenge sought to validate a new way of sending complex marine robotic systems on independent missions at the same time, without disrupting the support vessel's ongoing ocean mapping operations.

Four vehicles were showcased in the Challenge: UNH's DriX USV (developed by Exail, previously iXblue); WHOI's mid-water slow-moving Mesobot ROV designed to explore the mesosphere; WHOI's remotely operated hybrid vehicle Nereid Under-Ice, or NUI for short, which is supported by a fiber optic cable, allowing it to act as a standard ROV as well as an AUV if the cable breaks; and last but not least, the Ocean Exploration Trust's E/V *Nautilus*, the principal research platform.

With each of the robots being deployed from the E/V *Nautilus*, the real challenge was to have these vehicles in the water at the same time and communicating with each other even though they didn't all have the same protocols.



» Launching of the NUI vehicle. (Photo credit: OET/Marley Parker)

This was the perfect opportunity to test the viability of the interoperability of the four uncrewed assets and, therefore, the genuine possibility of multi-vehicle tracking and positioning.

EXPLORING VAST AREAS IN A SINGLE MISSION

The DriX USV was launched on its own to map the water column and, in doing so, track diurnal migration of the deep scattering layer. To do this DriX used its Kongsberg EK80 multibeam echosounder within its gondola, 2 m below the hull and so clear of any wave activity and surface bubbles, the necessary conditions for optimum data acquisition.

DriX's Marine Broadband Radio (MBR) enabled the USV to send real-time data to the E/V *Nautilus* from up to 20 km away. The MBR enabled the vessel and DriX to sail independently at considerable distance from each, executing mapping procedures in different areas simultaneously, and so effectively multiplying the size of the area covered in each timeframe.

When DriX identified a target during its mapping operations, the Mesobot AUV is automatically sent to the target in order to sample the diurnal vertical migration. DriX was able to track, monitor, and even re-task Mesobot by circling above it, maintaining its acoustic communication with real-time data links established between them. DriX essentially acts as an "aircraft control tower" by maintaining clear acoustic communication with the Mesobot AUV.

Thanks to this acoustic communication link via a USBL system installed within DriX's gondola, teams were able to monitor Mesobot's position in real time and send the information to the display systems onboard the E/V *Nautilus*, giving full situational awareness of all participating vehicles. DriX can then redirect Mesobot in real-time, from miles away, to new features revealed by DriX and obtain real-time information on water column properties and areas of interest.

Thanks to this acoustic communication capability, DriX can also retrieve the data collected by the AUV without having to wait for it to resurface, enabling fast data transmission to the operations center through high-bandwidth communication.

UNCREWED COLLABORATION

WHOI's NUI was able to dive down below Mesobot to explore the seabed, supported by the fiber optic tether linking it to the E/V *Nautilus*. DriX then acoustically tracked the NUI and reported its positions to the *Nautilus'* display systems, offering complete situational awareness to the onboard crew. As with Mesobot, DriX sent acoustic commands to NUI and received acoustic data from NUI in return, which was then forwarded to the mother ship.

When NUI was in full AUV mode, and therefore no longer attached to E/V *Nautilus* via the tether and free to perform other missions, DriX was able to provide long-range tracking for NUI, and long-range relay between NUI and *Nautilus*. In other words, *Nautilus* can receive real-time data mapping from NUI via DriX without NUI needing to resurface, greatly improving efficiency.

EXPANDING MISSION CAPABILITIES

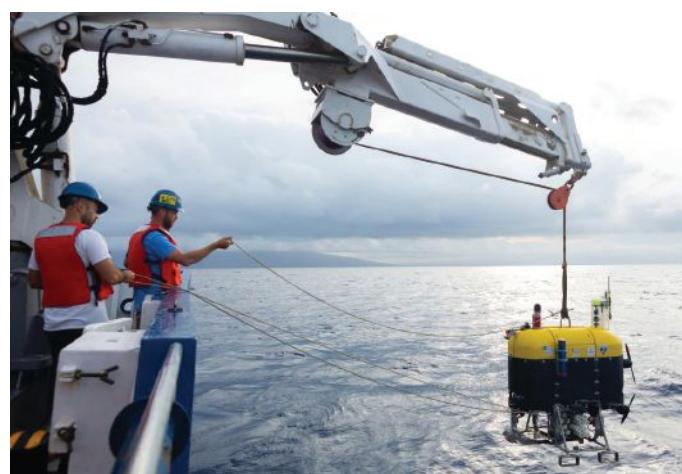
The mission was a great success, exceeding expectations. It illustrates how it is possible to explore the ocean's seafloor, mid-water and surface simultaneously, leaving the topside support vessel free to perform other mapping tasks and in-field operations, drastically reducing any mission downtime.

Research teams and oceanographers can now use autonomous systems such as the DriX USV in conjunction with manned vessels, significantly increasing their potential mapping coverage while also optimizing mission efficiency and the volume of data gathered in a set period.

The OECI Technology Challenge gave observers an insight into the countless possibilities that multi-vehicle collaboration presents, all of which help to extend the reach of ocean exploration. Jason Fahy, Expedition Lead, NA1389 Technology Challenge, OECI perhaps said it best: "These technologies are already great on their own but so much more powerful when working together."

For more information about the OECI Technology Challenge, visit: www.web.uri.edu/oeci.

For more information about Exail, visit: www.exail.com.



» Mesobot team members deploy the vehicle over the edge of the E/V *Nautilus*. (Photo credit: OET/Marley Parker)

JAN DE NUL AND DEME TO BUILD WORLD'S FIRST ARTIFICIAL ENERGY ISLAND

The Belgian consortium TM EDISON (Jan De Nul and DEME) has won the tender for the construction of the world's first artificial energy island. The construction of the foundations of the Princess Elisabeth Island will begin in early 2024 and will last 2.5 years. After that, the installation of the high-voltage infrastructure can be started. The latter will be necessary for bringing the electricity from Belgium's future offshore wind zone to shore.

The island will also be the first building block of an integrated European offshore electricity grid that will connect various hubs and countries together. For instance, Belgium wants to build additional joint interconnections with Great Britain and Denmark. These will give access to the massive amounts of renewable energy that are needed to make the industry less dependent on fossil fuels in the short term.

The tender process for the island started in January 2022. Elia received multiple bids from companies based in Belgium and abroad. On the basis of the defined criteria, the Belgian consortium TM EDISON emerged as the winner. Elements such as technical quality and commercial and contractual conditions played a significant role. Attention to safety also played a decisive role. In addition to a specialized fleet, DEME and Jan De Nul hold experience and expertise in the field of dredging, land extension, coastal protection, and civil engineering.

An innovative tour de force

The Princess Elisabeth Island will be the world's first artificial energy island that combines both direct current (HVDC) and alternating current (HVAC). The island's high-voltage infrastructure will bundle the wind farm export cables of the Princess Elisabeth zone together, whilst also serving as a hub for future interconnectors with Great Britain (Nautilus) and Denmark (TritonLink). These are so-called 'hybrid interconnectors' that have a dual function and are therefore more efficient. They facilitate the exchange of electricity between countries and are also connected with gigantic offshore wind farms in the North Sea that will in due course provide Belgium with large volumes of renewable energy.

12 football fields in size

The energy island will be located about 45 kilometers off the coast. The area set aside for the installation of the electrical infrastructure will be approximately 6 hectares in size, which is equivalent to about 12 football pitches. The artificial island will be located within the Princess Elisabeth wind zone and will be constructed from concrete caissons filled with sand. A small harbor and helicopter platform will also be provided in order to allow maintenance crews to visit the island. The energy island has received funding from the European Covid Recovery Fund. The Belgian government decided to award the island with a grant of approximately €100 million.

Timing

Now that the construction contract has been awarded, the design of the island can be finalized. The construction of the island



» The island will also be the first building block of an integrated European offshore electricity grid. (Image credit: TM EDISON)

will start in early 2024 and will continue until August 2026. The caissons will be built and installed in 2024 and 2025. These will form the contours of the island. After that, the base of the island will be raised and prepared for the construction of the electrical infrastructure. It will be connected with the new offshore wind farms and with the Elia onshore grid. In order to deliver the additional electricity to consumers, it is crucial that the Ventilus and Boucle du Hainaut grid reinforcement projects are realized at the same time. Elia aims to ensure all wind farms are fully connected to the mainland by 2030.

CHEVRON TO DIGITIZE ITS GLOBAL ASSETS USING KONGSBERG DIGITAL'S DIGITAL TWIN TECHNOLOGY

Kongsberg Digital has entered into a strategic agreement with the integrated energy company Chevron Technical Center, a division of Chevron U.S.A., Inc. to digitize its global assets using Kongsberg Digital's digital twin technology. The agreement includes a multi-year commitment.

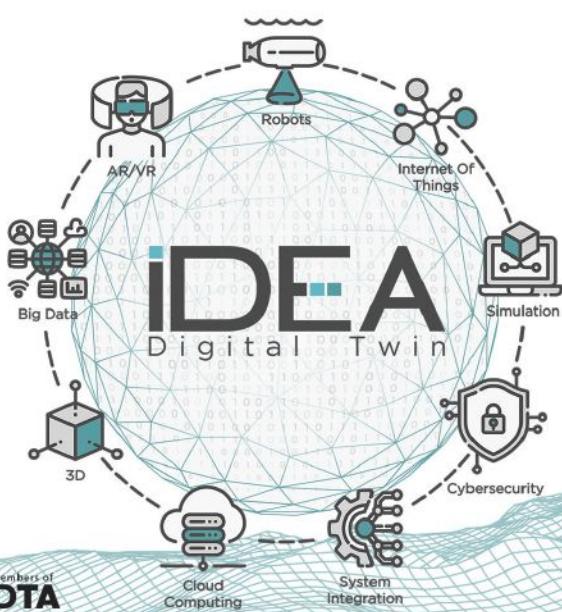
The contract, which was signed in January 2023, represents expansions of work performed on contracts signed in 2021, with a committed multiple-asset deployment plan and further applications to enrich Chevron's user experiences. The digital twin solution will aid Chevron in work planning and project execution. The digital twin solution will also enable faster troubleshooting, reduced cost, decision making, and lower personal and process safety risk.

» Shane McArdle, CEO at Kongsberg Digital (left) with Eric Sirgo, Vice President, Facilities Designs & Solutions, Chevron Technical Center





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INDUSTRY VIEW ON MARKET FOR FLOATING OFFSHORE WIND MASS COMMERCIALIZATION



» Ditlev Engel, CEO, Energy Systems at DNV

wind expecting to increase investment in floating offshore wind in 2023.

"The view from the industry is clear. There is overwhelming confidence that floating wind can achieve commercial success in a little over 10 years. DNV predicts that by 2050, 15% of all offshore wind installed capacity will come from floating turbines. However, barriers must be overcome. Governments can play a leading role in making the market attractive for investment, with long-term, stable policy and regulatory frameworks, and by adapting critical infrastructure such as grids and ports. The industry itself will need to look at cost reduction through greater standardization and scale-up. At DNV we are committed to supporting the industry. This is an exciting time for the industry, as we move towards commercialization, floating offshore wind is opening new possibilities for wind power locations and will play a critical role in the transition to a cleaner energy supply," said Ditlev Engel, CEO, Energy Systems at DNV.

Reaching full commercialization will depend, in part, on the investment potential of key markets. Market size was cited by 21% of respondents as the first criteria for choosing a market to invest in, followed by regulatory and political stability (16%), and power grid suitability (12%).

For floating offshore wind to scale-up, it is paramount that its levelized cost of energy (LCOE) drops as much and as quickly as possible. DNV's Energy Transition Outlook forecasts that levelized costs for floating offshore wind will fall by almost 80% by 2050. 21% of survey respondents believe that standardization—either through a reduction in the number of concepts or the emergence of a preferable concept will be the biggest factor for LCOE reduction. Bigger turbines and industrialization come next, closely followed by larger wind farms (allowing for economies of scale and greater installed capacity). Standardization was also cited by the industry as a crucial factor to mitigate risk.

Supply-chain challenges also come into play, as the offshore wind sector is battling high commodity prices and capacity limitations.

DNV, an independent energy expert and assurance provider, has published new research about the industry's perception of the growing market for floating offshore wind and its possibilities for mass commercialization. The research, which surveyed 244 developers, investors, manufacturers, advisors and operators across the globe, found that 60% of respondents think floating offshore wind will reach full commercialization by 2035, with 25% believing it will be as early as 2030. Reaching these targets is ambitious, but early signs are promising, with 60% of organizations with revenue-producing business in

The top risk cited by floating wind professionals was a lack of port infrastructure.

The second biggest risk cited was installation vessel availability, tied with capacity. While floating wind is generally not reliant on the advanced and bespoke vessels used in bottom-fixed offshore wind, the sheer number of mooring and anchoring installation vessels and the capabilities required could be a challenge for the industry, as more moorings and anchors are set to be installed over the next 10 years than have ever been seen in the oil and gas industry.

"Commercial attractiveness will rely on cost reduction and capture prices in various markets. Cost reduction does not happen by waiting, which makes it crucial that the first generation of larger floating windfarms are installed by 2030, to deliver on the promising outlook for floating wind," explains Magnus Ebbesen, Segment Lead Floating Offshore Wind at DNV.

About 300 GW of floating offshore wind will be installed globally in the next 30 years, requiring around 20,000 turbines, each mounted on top of floating structures weighing more than 5,000 tonnes and secured with so many mooring lines that if they were tied end-to-end, they would wrap around the world twice.



WHEN TRUST MATTERS

FLOATING WIND: TURNING AMBITION INTO ACTION



BP AND PARTNERS CONFIRM DEVELOPMENT CONCEPT FOR GREATER TORTUE AHMEYIM PHASE 2

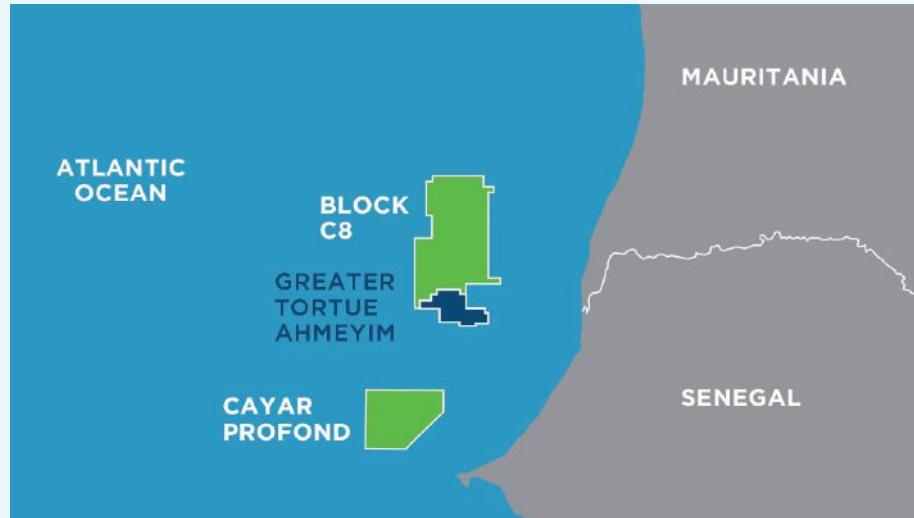
bp and partners have confirmed the development concept for the second phase of the bp-operated Greater Tortue Ahmeyim (GTA) liquefied natural gas (LNG) project that they will take forward to the next stage of evaluation.

The partnership—composed of bp, PETROSEN, Société Mauritanienne des Hydrocarbures (SMH) and Kosmos Energy—will evaluate a gravity-based structure (GBS) as the basis for the GTA Phase 2 expansion project (GTA2) with total capacity of between 2.5–3.0 million tonnes per annum.

GBS LNG developments have a static connection to the seabed with the structure providing LNG storage and a foundation for liquefaction facilities.

The concept design will also include new wells and subsea equipment, integrating with and expanding on existing GTA infrastructure. The partnership will consider powering LNG liquefaction using electricity to help drive operational emissions lower. bp and its partners are now working with contractors to progress the concept towards the pre-FEED stage.

Gordon Birrell, bp's Executive Vice President for operations and production, said: "We aim to build on our strong collaboration with our partners, and the Governments of Mauritania and Senegal, to further develop a long-term, successful energy hub in West Africa. GTA continues to underpin our strategy to develop the



most resilient hydrocarbons to help provide energy security today."

GTA is located 120 km offshore in water depth of 2850 m, one of the deepest subsea developments in Africa. Phase 1—currently under development—will export gas to an FPSO approximately 40 km offshore where the gas will be processed and liquids separated, before exporting gas onward to floating LNG facilities 10 km offshore. It is expected to produce around 2.3 million tonnes of LNG per year when operations commence.

In July 2021, the GTA project was granted the status of 'National Project of Strategic Importance' by the Presidents of Mauritania and Senegal. This recognition demonstrates the commitment of the host governments

and the significance of the project to both countries.

bp and the two Governments already have a long-standing and wide-ranging cooperation encompassing the GTA project and other potential energy developments. In October 2022, bp announced the signature of an exploration and production sharing contract for the BirAllah gas resource in Mauritania. In addition, bp continues to work with partners on the development of a major gas-to-power project in Senegal, Yakaar Teranga.

Most recently, bp signed a memorandum of understanding (MoU) with the Government of Mauritania to deliver a program exploring the potential for large-scale production of green hydrogen in the country.

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COMMODITY PRICE VOLATILITY CONTINUES



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

CRUDE OIL:

Daily crude oil price movements are a weathervane of investor sentiment about the potential for an economic recession this year. The Federal Reserve Board continues to fight US inflationary pressures by boosting short-term interest rates to slow the economy. They hope higher rates, which cascade throughout the economy, will lift the cost of capital, operational expenses, financing costs, and reduce consumer demand. Less consumption means businesses can slow operations and hire fewer workers, which will reduce labor costs that push up the cost of consumer goods.

A slowing economy will sap oil demand. So far, there are few signs a significant recession is imminent. On days investors believe a recession is near, they push oil prices down. Whenever they believe a recession is unlikely this year, they bid up oil prices. February provided a lesson on the yin-yang of oil prices and recession sentiment. From the start to the end of the month, oil prices declined about two percent from \$78.87 to \$77.05 a barrel. In the first three days of February, the oil price fell seven percent or nearly \$4.50 but over the next 10 days it climbed by nearly \$7 a barrel. After climbing above \$80, nine days later the price had dropped by \$6 but then rallied by \$3 to end the month. The oil price volatility closely tracked the release of economic data initially showing a weak labor market, which was then offset by strong consumer spending data. Higher inflation data was offset by stronger manufacturing data. The month ended with worse inflation news, but a new dynamic entered the oil price equation—China.

On the world stage, oil prices are driven by the issue of how strongly and quickly China's economy will recover from its multi-year lockdown. China's economic data is always distorted in the early months of the year because of the nation's New Year's Celebration. This year's data may be more distorted by the economic reopening at the same time as the holiday, but if investors see an upward trajectory for China's oil demand, prices will continue to move higher.

The wildcard for the global oil market is the sanctions on Russia's crude oil and refined products, the latter having only been implemented in early February. Russia has cut its oil output by 500,000 barrels per day but continues finding consumers for its supply. The unknown is how the world adjusts to the loss of Russia's substantial supply of diesel fuel, especially for Europe. It is a major problem for Europe, whose refineries do not produce sufficient diesel to meet demand. Russia's diesel output is going to other countries, some of which will likely be transshipped to European customers. While global oil markets are disrupted, new shipping and trading patterns are evolving, but they will be less efficient and more costly than previous patterns.

Investors and traders should watch China's economic data, prospects for US and Europe recessions, and geopolitical events, as these issues are likely to move oil prices, at least in the short term. Long-term, the question is how fast the energy transition may erode oil consumption. But as bp's CEO Bernard Looney confirmed, oil's use will be greater and be needed for longer than he had predicted two years ago. Oil is what powers the world's economy and delivers life's improvements. That reality is now being acknowledged.



» How will the world adjust to the loss of Russia's substantial supply of diesel fuel?



» Even with all LNG export terminals in operation, natural gas prices are unlikely to rally due to the change of seasons.

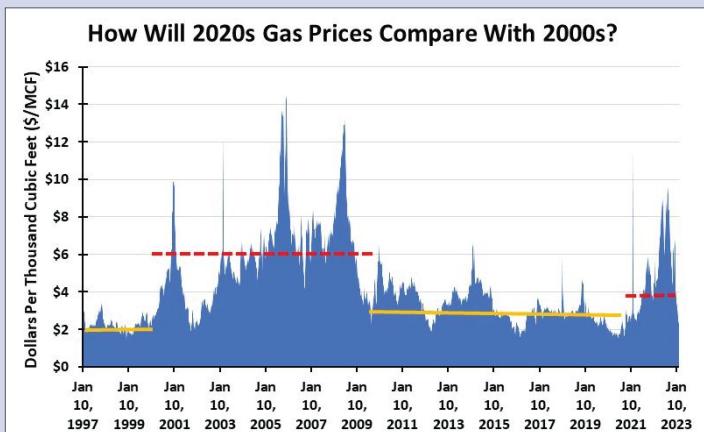
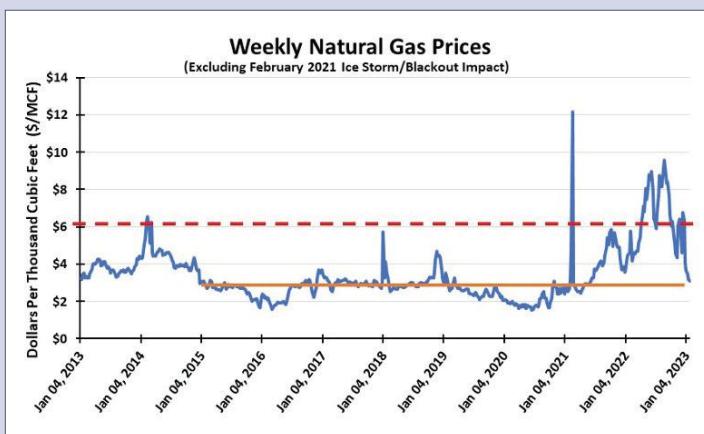
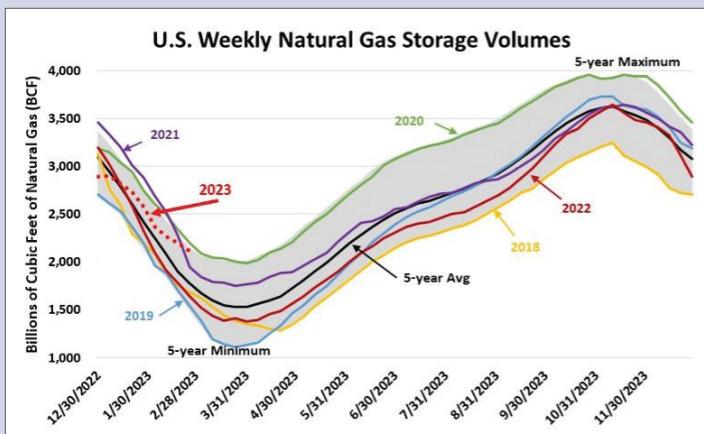
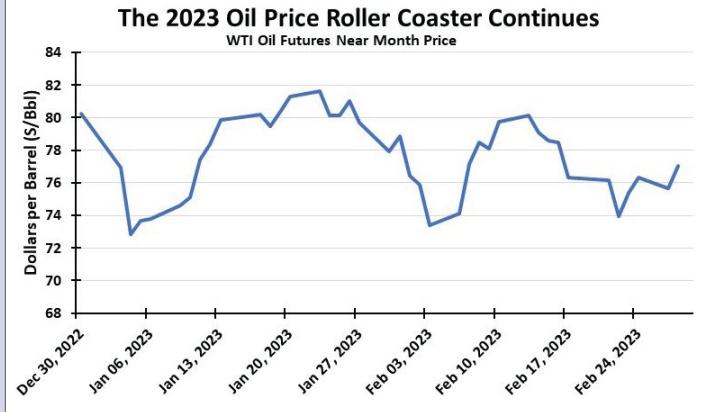
NATURAL GAS:

Natural gas prices have fallen like a rock so far in 2023 as warm weather both here and in Europe has sharply curtailed consumption. The European demand drop reflects both warmer winter temperatures and consumption cutbacks managed by civilians and businesses in response to higher prices and warnings of an extended energy crisis. Fear of a cold winter and sky-high gas prices had prompted people to reduce thermostat settings to ease their financial pain.

In Europe, last summer and fall, the need to fill gas storage to the brim to ensure adequate supply for a cold winter had driven up prices. High prices cut current gas use and entice producers to send gas into storage caverns. The United States experienced a similar response. The difference between Europe and the US is the latter's natural gas production. According to the Energy Information Administration, recent weekly US natural gas production averaged about 113 billion cubic feet a day, up five percent from a year ago. Growing output has come as demand remained relatively flat year-over-year, leading to sharply lower gas prices.

When we examine the weekly gas storage chart, we see how 2023's volumes have increased sharply compared to the 5-year average volume. Since the beginning of 2023, storage has gone from one percent below the 5-year average to 19 percent above. Compared to last year, the increase has been greater, going from a five percent deficit to a 27 percent surplus. Putting the numbers into perspective relative to total storage volumes, the deficit from the 5-year and 2022 levels have added 342 and 451 billion cubic feet to storage. Those volumes compare with total gas storage for the week ending February 24, 2023, of 2,114 billion cubic feet. These numbers explain why natural gas prices have been falling like a rock this year (see accompanying chart).

For one day recently, Henry Hub natural gas futures traded below \$2 per thousand cubic feet. As a winter storm rolled across the United States, gas prices rallied from the \$2 level to around \$2.80. That put gas prices at about the level experienced during the 2020-21 winter but well below last winter's prices. Natural gas prices are likely not to rally further, even with all LNG export terminals operating, because we are approaching the end of the winter heating season. Europe's warm winter has dulled its need to purchase US LNG, which had pushed gas prices up last year. Once again, Mother Nature has thrown a curveball at energy markets.



NEW COST-EFFECTIVE MULTIBEAM SONAR FOR COMPACT USV

EvoLogics, a German provider of underwater communication and positioning systems, continues to make waves in the marine robotics industry with their Sonobot 5 uncrewed surface vehicle (USV). The vehicle is already a field-proven product with steady, dependable, and scalable serial manufacturing, with a series of hardware upgrades planned for 2023.

Enhancements include the EvoLogics' exciting announcement of a new multibeam echosounder option for the Sonobot 5 USV, the EvoLogics Multibeam, which will be unveiled at Ocean Business 2023 in Southampton, UK in April.

The new multibeam sonar, designed specifically for the Sonobot 5, is based on a Norbit OEM solution, an entry-class multibeam sonar with a professional approach. The EvoLogics Multibeam comes with a high-grade dual GNSS and INS positioning and motion control which is standard for all Norbit echosounders. With 256 beams at $1.45^\circ \times 1^\circ$, a range of over 200 m, and a ping rate of 50 Hz, this system enables professional surveillance that complies with the IHO's S-44 standard.

SIZE MATTERS

The new sonar offers the advantages of multibeam riverbed mapping in a compact and lightweight unit that seamlessly integrates with the vehicle.

The smart and highly integrated design of the Sonobot 5 enables outstanding one-man transportation and deployment. With powerful thrusters and a full working day battery capacity, the Sonobot 5 represents the smallest and easiest-to-handle autonomous vehicle equipped with a professional multibeam sonar.

BETTER DATA, QUICKER

All incoming data is stored onboard the vehicle and displayed to the operator at the land station live during the mission.



» *EvoLogics Sonobot 5 USV in action. (Photo credit: EvoLogics)*

The system is compatible with Norbit data collection tools and all third-party software packages currently supported by the Norbit WBMS sonar family for easy post-processing of the collected data.

The EvoLogics Multibeam offers high-resolution imaging and mapping of the seafloor with faster and more detailed bathymetric surveys compared to a single beam echosounder. The choice of echosounder technology depends on the specific requirements and budget of each survey project, and EvoLogics' team of experts is readily available to advise on the most effective solution for a particular task.

LIVE DEMONSTRATION

Attendees at Ocean Business 2023 will have the opportunity to see the Sonobot 5 equipped with the new EvoLogics Multibeam in action during the conference's Training & Demonstration Programme, scheduled to take place on April 18th at 11:30.

EvoLogics' expert operators will perform bathymetric scans with the upgraded

USV, using the new multibeam, single beam echosounder, and a side-scan sonar imaging of a designated site to give observers a hands-on example of the most common and suitable survey missions performed with the Sonobot 5.

The demonstration will then focus on underwater search and reconnaissance, showcasing the object recognition technology that automatically detects and visually highlights objects of interest via the control software onshore. This AI-based system offers faster and more accurate surveys, reducing the workload and pressure on the operator.

With both their European and American teams prepared to take on difficult new projects together, EvoLogics is excited to join the industry community at Ocean Business 2023. The team looks forward to discussing the new EvoLogics Multibeam for Sonobot 5 at stand M4.

For more information, visit: www.evologics.de.



» *Rendering of Sonobot 5 USV equipped with EvoLogics Multibeam. (Image credit: EvoLogics)*



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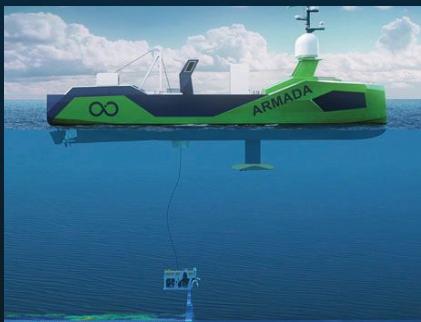
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SHELL KICKS OFF PRODUCTION AT VITO IN GULF OF MEXICO



» The Vito platform in Gulf of Mexico. (Photo credit: Shell)

Shell Offshore Inc. recently announced that production has started at the Shell-operated Vito floating production facility in the US Gulf of Mexico (GoM). With an estimated peak production of 100,000 barrels of oil equivalent per day, Vito is the company's first deep-water platform in the GoM to employ a simplified, cost-efficient host design.

"Vito is an excellent example of how we are approaching our projects to meet the energy demands of today and tomorrow, while remaining resilient as we work toward achieving net zero emissions by 2050," said Zoe Yujnovich, Shell's Upstream Director. "Building on more than 40 years of deep-water expertise, projects like Vito enable us to generate greater value from the GoM, where our production has amongst the lowest greenhouse gas intensity in the world for producing oil."

The Vito development is owned by Shell Offshore Inc. (63.11% operator) and Equinor (36.89%). In 2015, the original host design was rescoped and simplified, resulting in a reduction of approximately 80% in CO₂ emissions over the lifetime of the facility as well as a cost reduction of more than 70% from the original host concept.

Vito also serves as the design standard for our Whale project that will feature a 99% replication of the Vito hull and 80% of Vito's topsides.

Shell's Powering Progress strategy to thrive through the energy transition includes increasing investment in lower-carbon energy

solutions, while continuing to pursue the most energy-efficient and highest-return Upstream investments.

Originally discovered in 2009, the Vito field spans four Outer Continental Shelf (OCS) blocks in the Mississippi Canyon and is located at a depth of more than 4,000 feet (1,220 meters) of water. The host is located approximately 150 miles (241 kilometers) southeast of New Orleans and 10 miles (16 kilometers) south of the Shell-operated Mars TLP.

Shell announced a final investment decision (FID) on the Vito project in April 2018.

Vito is a four-column semi-submersible host facility with eight subsea wells (31,000 feet or 9,400 meters) with deep (18,000 feet or 5,500 meters) in-well, gas lift, and associated subsea flowlines and equipment.

Vito will produce into Shell Midstream's Mars Pipeline system.

The Vito field includes leases subject to the Gulf of Mexico Energy Security Act of 2006, which share lease revenues with Gulf producing states and the Land & Water Conservation Fund for coastal restoration projects.

Current estimated recoverable resource volume of the Vito development is 290 million boe. The estimate of resources volumes is currently classified as 2p and 2c under the Society of Petroleum Engineers' Resource Classification System.

SVAL, STOREGGA AND NEPTUNE APPLY FOR CO2 STORAGE LICENSE

Sval, Storegga and Neptune have applied for a CO2 storage license in the Norwegian North Sea. The project, called Trudvang, has the potential to store up to 225 million tonnes of CO2.

The application comes after the Norwegian Ministry of Petroleum and Energy on January 11, 2023, announced a new area in the North Sea for applications related to injection and storage of CO2.

Truls Olsen-Skåre, Senior Vice President Sustainability & HSEQ in Sval Energi, said: "Carbon capture and storage (CCS) is a solution that can significantly reduce CO2 emissions. The Trudvang partners have worked jointly since December 2021 to identify, nominate, and apply for this license. We have undertaken a substantial amount of work already, including subsurface evaluation of the storage complex, and technical and economic assessment of the CCS value chain. This work has shown that Trudvang can be matured into a commercially viable project with safe and efficient carbon storage."

Significant capacity

The Trudvang license has a significant storage potential. It will be possible to inject about nine million tonnes of CO2 per annum for 25 to 30 years—a total storage capacity of at least 225 million tonnes of CO2. Dynamic modelling indicates that the total storage capacity could, over time, be substantially higher than this.

Olsen-Skåre said: "In Europe, approximately 300 million tonnes of hard to abate CO2 is emitted each year. The Trudvang project has the potential to reduce these emissions on a large scale."

The Trudvang storage license is located in the Norwegian North Sea, to the east of the Sleipner field and about 165 kilometers from the coast. The storage reservoir is in the Utsira formation.

Fully operational in 2029

Olsen-Skåre said: "We will focus on accelerating all phases of the work program to be able to start injecting CO2 in 2029, and we will continue our work with existing and new parties to mature the full value chain."

The Trudvang project envisages the capture of CO2 by multiple industrial emitters in Northern Europe and the UK, the shipping of liquid CO2 from export terminals to an onshore receiving terminal in the south-west of Norway and then transport via a purpose-built pipeline to the Trudvang location for injection and permanent storage.

Sval is the proposed operator of Trudvang with a 40% ownership. Storegga and Neptune each has a 30% ownership.

Nick Cooper, CEO of Storegga said: "CCS is essential, as one of the few technological solutions that can prevent CO2 from industrial operations from entering the atmosphere and worsening climate change. Our Trudvang announcement today, and this round of CO2 storage license applications, builds on Norway's pioneering progress with the world's first industrial-scale, multi-user CCS project."

Neptune Energy's Global Head of Subsurface, New Energy, Pål Haremo, added: "The North Sea has great potential as a hub for carbon storage given the availability and proximity of existing infrastructure, depleted reservoirs, and saline aquifers. In addition to our CCS projects in Norway, Neptune is working on potential projects in the Netherlands and UK, as we aim to build a portfolio for carbon storage linked to our core areas in the North Sea."

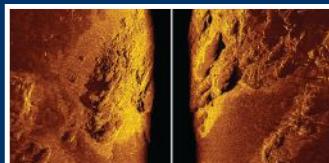


» Truls Olsen-Skåre, Senior Vice President Sustainability & HSEQ, Sval Energi



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INEOS AND WINTERSHALL DEA LEAD WORLD-FIRST CCS BREAKTHROUGH

Project Greensand demonstrates, for the first time, the feasibility of CO₂ storage from being captured at an INEOS Oxide site in Belgium, to being transported cross-border and finally safely and permanently stored in the INEOS-operated Nini field in the Danish North Sea.

The First Carbon Storage event to celebrate the achievement was held in Esbjerg, Denmark on March 8, and hosted by INEOS and Wintershall Dea, lead partners in the Project Greensand consortium.

By 2030, Project Greensand aims to store up to 8 million tonnes of CO₂ per year in this area while continuing to make significant contributions to our understanding and growth of carbon storage technology.

The European Commission estimates that the EU will need to store up to 300 million tonnes of CO₂ per year by 2050 to meet its climate goals.

Project Greensand is a consortium of 23

organizations with expertise in Carbon Capture and Storage (CSS), including business, academia, government, and start-ups. It is supported by the Danish state through the Energy Technology Development and Demonstration Program (EUDP). CCS is considered a key technology in reaching the Danish 2045 net zero target.

Lars Aagaard, Denmark's Minister for Climate, Energy and Utilities said: "The Danish subsoil can store a lot more carbon than we ever will capture in Denmark. Therefore, I am extremely pleased that the whole perspective on the Danish subsoil from day one is based on an industrial thinking where these resources should be brought to the market and help other countries meet their climate target on a commercial basis."

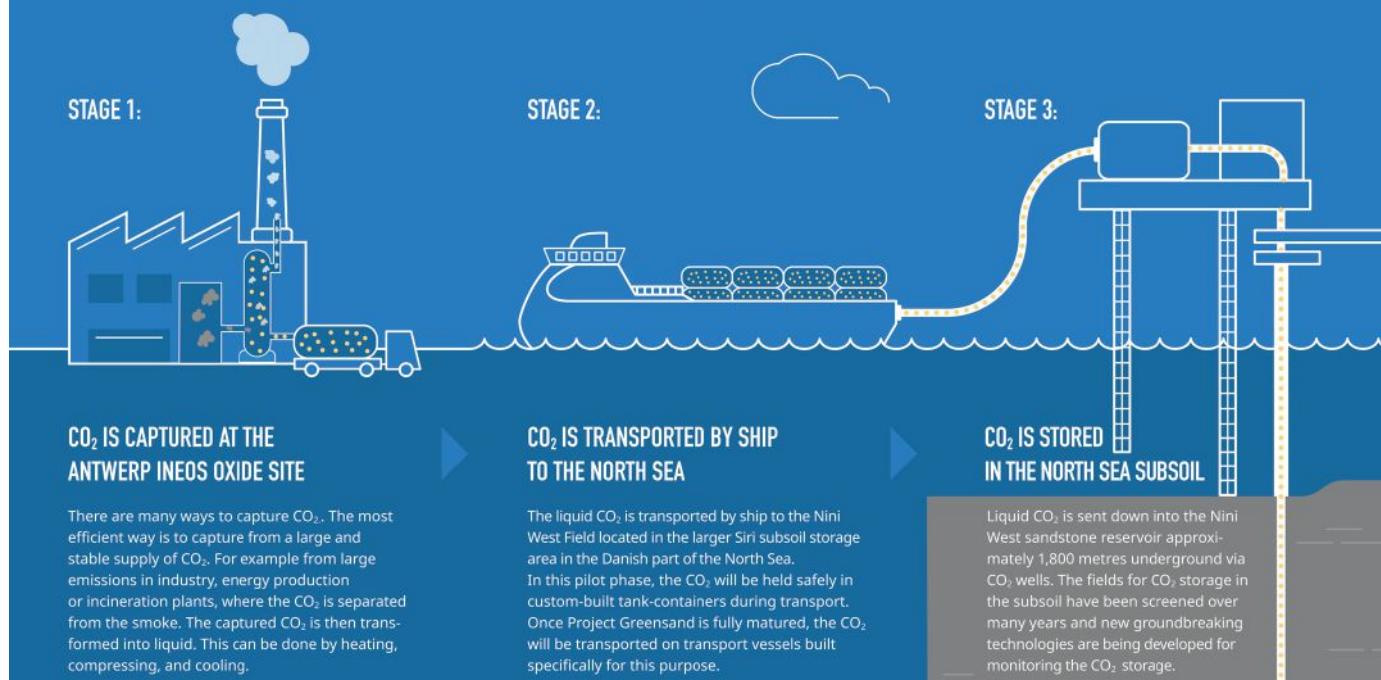
The CO₂ injected into the Nini field is stored at a depth of about 1,800 meters below the seabed and will be closely monitored.

Hugo Dijkgraaf, CTO at Wintershall Dea, added: "Project Greensand proves that Carbon Capture and Storage is a viable way to permanently store CO₂ emissions under the North Sea. It has a crucial role to play in reaching net zero in Denmark, Europe and beyond. INEOS and Wintershall Dea are leveraging two decades of experience from oil production in the Nini West field and have extensive knowledge of the reservoirs being used."

Sir Jim Ratcliffe, Chairman and CEO of INEOS, commented: "This is a breakthrough for Carbon Capture and Storage. It is the first time that carbon dioxide has been successfully captured, transported cross-border, and safely stored offshore anywhere in the world. This important milestone firmly demonstrates that CCS is a technology that can deliver on a global scale. The task at hand for the industry and policymakers is now to support the continued development and deployment of CCS as an essential tool to mitigate climate change."

THE ROAD TO FIRST CARBON STORAGE – A FULL CCS VALUE CHAIN

First Carbon Storage of Project Greensand marks a key development in terms of scalability and potential, demonstrating how CCS can move across borders through an international infrastructure that connects emissions sources with storage capacities. In the following overview, the journey from CO₂ capture in Antwerp to storage in the North Sea shows how this international, full value chain works in practice.



WEAKENING COMPETITIVENESS IN OCEAN ENERGY

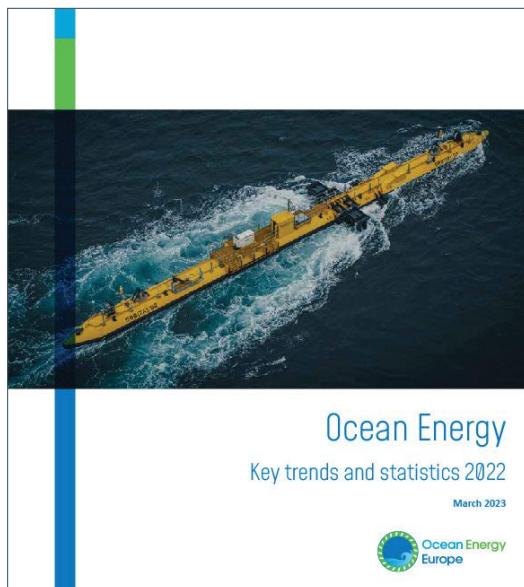
A WARNING SIGN FOR EU'S CLEANTECH AMBITIONS

Despite ambitious EU deployment targets, fewer projects hit European waters in 2022 than in any year since 2010. Meanwhile, global competitors like the US and China are catching up fast.

If the EU is determined to come out on top in this new era of global cleantech competition, it cannot let its frontrunner position slip away. How the bloc responds to this test of its leadership in wave and tidal energy will be an object lesson for its wider Green Deal industrial vision.

Back in 2020, the EU's Offshore Renewable Energy Strategy targeted global leadership in wave and tidal energy and set ambitious deployment targets. But fast-forward two years, and both tidal and wave energy capacity additions in Europe have hit a ten-year low, outstripped by increased activity in the rest of the world.

2022 tidal stream installations in Europe were limited to small-scale projects, and were dwarfed by a single state-funded, large-scale Chinese device. In wave energy, last year was the fifth in a row where the rest of the world installed more capacity than



Europe. Europe still holds the lead in terms of cumulative wave capacity, but only just.

The drivers of this new dynamic are clear—public funding and policy support. The US now commits circa \$110 million for ocean energy annually and is building the world's largest wave energy test site. China continues to pour state funds into large projects. And both the UK and Canada are providing dedicated revenue support, among a host of other measures.

But it's not too late—the Green Deal Industrial Plan can empower the European Commission to rapidly restore Europe's leadership in ocean energy.

Initial efforts to implement the Offshore Strategy's ocean energy actions show that, given the right tools, progress can be made rapidly. Dedicated Horizon Europe funding calls have already given the European ocean energy sector a boost, and new regional agreements between Member States on offshore renewables offer a framework to speed up deployments in the medium-term.

The advertisement features the headline 'Ocean Data-as-a-Service™' in large white letters, with the subtitle 'VERTICALLY INTEGRATED OCEAN DATA' below it. It highlights four main service areas: 'LONG-ENDURANCE AUV' (with a hybrid-electric recharge, multi-vehicle autonomy, and long duration), 'AGILE DATA COLLECTION' (with low-logistics operations, high-resolution data, and nimble and agile capabilities), 'OPERATIONAL EFFICIENCY' (with near real-time delivery, reduced time and cost, and low carbon impact), and 'DATA MANAGEMENT' (using Absolute Ocean software to visualize, share, analyze data, collaborate across stakeholders, and compare changes over time). The background shows a 3D map of an ocean floor with various data layers. At the bottom, it says 'EXPLORE END-TO-END SOLUTIONS AT TERRADEPTH.COM OR EMAIL CONTACT@TERRADEPTH.COM' and features the TerraDepth logo.

ADVANCED INSPECTION-CLASS UNDERWATER ROBOTS FOR OFFSHORE ENERGY INSPECTIONS



By Chris Gibson

CEO, VideoRay

The underwater inspection of marine equipment and subsea assets can be challenging and expensive. Traditional work-class vehicles, while larger, are not always the best solution for conducting offshore missions. Instead, inspection-class underwater robotic systems can offer a safer, easier and more cost-effective option. However, not all systems of this size are robust enough to withstand harsh oceanic conditions, so choosing a system with an established record of success and durability is important.

VideoRay Mission Specialist underwater robots are an excellent choice for offshore inspections. They are designed to carry heavy payloads and tools while navigating tight spaces that larger work-class vehicles cannot access.

For example, the Mission Specialist Defender system boasts seven powerful thrusters that can handle currents up to

four knots and has a 1,000-meter depth rating. This makes it ideal for precise control, heavier payloads, lifting, and specialized operations. It can move in any direction and maintain active pitch to move the vehicle upward or downward.

The Mission Specialist Pro 5 system, with three thrusters and a 305-meter depth rating, is designed for speed, efficiency and portability and is perfect for missions with size, space, weight, and deployment speed constraints.

VideoRay Mission Specialist systems can be equipped with Greensea navigation, control, autonomy and user interface technologies.

The advanced, user-friendly vehicle control system provides exceptional stability and maneuverability for complex tasks. With multimode control, the vehicle can operate at a high level of autonomy,

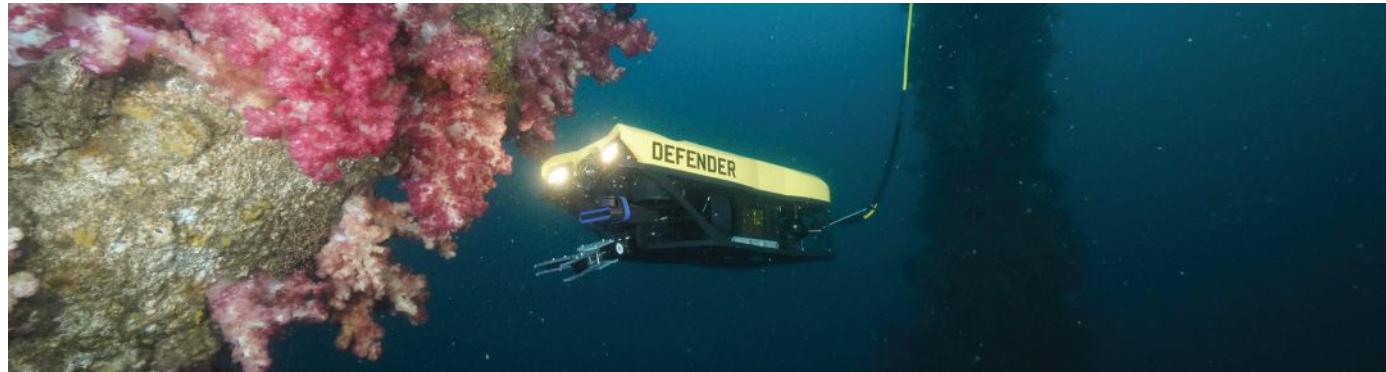
enabling the pilot to focus on the intricacies of the mission.

Large and small energy production operations worldwide trust VideoRay underwater robotic systems for at-sea missions. Here are three case studies that exemplify the broad utility of our multipurpose platforms:

PROCEANIC

The first success story comes from the Proceanic Group of Companies, a full-service engineering, project management and underwater robotic inspection company based in Houston, Texas, with offices in Singapore, Malaysia, and Brazil. Over the past ten years, the company has purchased multiple VideoRay Mission Specialist inspection-class underwater robotic systems to support its base business operations and expand its reach.

Proceanic works extensively in the South Atlantic Ocean West Africa region, the Gulf of Mexico, Brazil, and Southeast



» The Mission Specialist Defender system is powered by seven thrusters to enable it to navigate in strong currents. (Photo credit: Shibuya Diving Industry, Co.)



Asia, where they need underwater robotic systems that perform well in extreme conditions. For over a decade, Proceanic operators have relied on VideoRay's Mission Specialist Defender and Pro 5 systems, both of which have provided the reliability and robustness required in a marine environment. These systems are adaptable and flexible, allowing personnel to integrate and upgrade the tooling in the field easily.

In addition to being a key customer, Proceanic is a valued partner and serves as an authorized VideoRay service center on the US Gulf Coast. Over the last decade, Proceanic has completed more than 200 complex offshore subsea campaigns, including inspecting the world's largest floating production storage and offloading (FPSO) vessel.

OCEANEERING

The second case study comes from Oceaneering International, a global subsea engineering company headquartered in Houston, Texas. Michael Johnson, Program Manager of International Diving Programs at Oceaneering, needed a rugged underwater robotic system that his team could easily carry onto a vessel, deploy and use to inspect and clean ships. The team's offshore support vessel (OSV) was located in the southern Atlantic Ocean off the coast of Angola, and the Oceaneering team needed an underwater robotic system that could handle difficult subsea environments, transport easily to locations around the world, require only one operator, maneuver in confined spaces, and accommodate specific probes and cleaning tools.

After evaluating the Mission Specialist Defender system, the Oceaneering team recognized how easy it is to integrate accessories onto the rugged Defender system for reliable operation in harsh environments offshore. During the project, they recorded vessel inspection images and easily transferred them to Oceaneering management locations.

» CSpect used a combination of the VideoRay Defender and Pro 5 systems to carry out cost-effective underwater inspections of wind monopiles in the North Sea. (Photo credit: CSpect)

Oceaneering was impressed with the portability and low overall weight of the Mission Specialist Defender system. The company now has a dependable underwater robotic system on its vessel off the coast of Angola that personnel can easily transport anywhere in the world. The Oceaneering team uses the Defender system to inspect vessels, including required testing using a cathodic protection probe and cavitation cleaning using a cavitation cleaning tool.

CSPECT

The final installment in this three-part demonstration of the real-world application of advanced subsea robotics comes from CSpect, a company that specializes in the inspection of offshore wind monopile and wind turbine foundations in the North Sea, and so services the largest global renewable energy contractors in the world. Headquartered in Belgium, CSpect sought a mobile solution to conduct wind turbine jacket inspections without the need for a larger work-class vehicle and an entire crew onboard an OSV. CSpect partnered with VideoRay to develop a cost-effective way to provide underwater inspection of wind monopiles to the North Sea wind farms marketplace.

The robot's weight and maneuverability are key to performing monopile inspections while reducing cost. Operators can drop the durable Mission Specialist submersibles into the water from the monopile, making it less expensive than using work-class vehicles. There is no need for an OSV, A-frame, crane, or additional personnel.

CSpect used a combination of the VideoRay Defender and Pro 5 systems,

coupled with its own engineered tooling, to conduct comprehensive inspections of wind turbine jackets. By eliminating the need for larger work-class systems and teams onboard an OSV, CSpect has reduced costs by more than 50%, decreased inspection time by more than 50% and improved safety by eliminating the need for a shipboard team. Also, because no OSV was deployed, CSpect reduced the overall carbon footprint of the mission to near zero.

REDEFINING SUBSEA INSPECTIONS

At VideoRay, our mission is to redefine subsea inspections by developing underwater robotic systems that are ready to perform critical jobs in the harshest marine environments. Much more than underwater cameras, VideoRay's inspection-class systems deliver industry-leading power and maneuverability, enabling operations in currents up to four knots. The durable modular platform is built to handle heavy payloads and a wide array of sensors and tooling. And they can operate at significant depths for hours, days or even months at a time.

VideoRay Mission Specialist robots are rugged enough to work anywhere, handling tough jobs and applications. They are used around the world in demanding underwater missions to support national security, first responders, object search and recovery, infrastructure examination, and science and research.

Mission Specialist systems are designed to support new ways of working at sea by offering unmanned solutions that greatly reduce—if not eliminate—human dive time in hazardous conditions. By packing the power and functionality expected from larger, more expensive systems into a form factor that is sized just right, VideoRay's inspection-class robots bring a new dimension and utility to portable, one-man deployable marine robotics designed to significantly reduce costs while streamlining logistics.

To find out more, visit videoray.com or call +1 610-458-3000.

» The adaptability of the Defender and Pro 5 systems allows offshore personnel to integrate tooling in the field. (Photo credit: Proceanic)



FUGRO BLUE ESSENCE USV RECEIVES APPROVAL TO UNDERTAKE FULLY REMOTE SURVEYS



Fugro's Blue Essence®, a 12 m uncrewed surface vessel (USV), has received approval from the Maritime and Coastguard Agency (MCA) to operate the first USV with an electrical remotely operated vehicle (eROV) in UK waters. The MCA is the government body that regulates vessels in the UK ensuring they meet technical, safety and environmental requirements of the region. Fugro sees this as a breakthrough development as USVs play a vital role in the future of the maritime sector by improving safety, reducing carbon emissions, and delivering data more efficiently.

With previous maritime regulations based on crewed vessels, the MCA has been working in consultation with companies like Fugro to help drive innovation without compromising safety. Fugro was able to demonstrate the operational safety of its USVs to the satisfaction of the MCA as maritime regulator.

The MCA granted Blue Essence® category 2 approval, meaning the vessel can be operated within 60 nautical miles of a 'safe haven'; the next stage in the UK regulatory process will be to obtain Category 0 MCA approval which will allow the vessel unrestricted service subject to agreement of relevant port authorities.

The uncrewed vessel, developed in partnership with SEA-KIT International, is equipped with Fugro's Blue Volta® eROV and an array of geophysical equipment to undertake subsea inspection and site characterisation surveys. Blue Essence® allows experts to deliver projects from Fugro's onshore remote operations centers (ROCs) safely out of harm's way while experiencing a healthier work-life balance. The USV consumes significantly less fuel than large ROV support vessels resulting in a 95% reduction in carbon emissions and enables real-time data delivery, leading to faster and more informed decision making.

Katy Ware, Director of UK Maritime Services for the MCA said: "Technology has allowed incredible innovation in the maritime sector. Our role in all of this is to make sure that we have the regulation and training regimes which allow it to develop without jeopardising safety or welfare."

Nick Simmons, Director USV and Remote Working Europe and Africa at Fugro added: "The opportunities this development opens for UK operations are really exciting. Fugro's Blue Essence® fleet has already been successfully operating in Europe and Australia and recently completed a fully remote inspection off the coast of the Netherlands, in Europe's busiest part of the North Sea, demonstrating the benefits of this innovative way of working. We are delighted that the USV can fly the UK flag and are looking forward to undertaking our first operations in the UK soon."



» Blue Essence and Blue Volta receive approval to operate in UK waters.
(Photo credit: Fugro)

DEEPOCEAN AWARDED TWO CONTRACTS BY EQUINOR IN THE NORWEGIAN SEA

Ocean services provider DeepOcean been awarded two contracts by Equinor for the Irpa and Verdande field developments, located in the Norwegian Sea. The two projects will be executed in a consortium between DeepOcean and Subsea7.

Project management and engineering will commence immediately at DeepOcean's office in Haugesund, Norway. Offshore operations are planned to take place in 2024, 2025 and 2026 utilizing both Subsea7's and DeepOcean's fleet of vessels.

DeepOcean's share of the contract has a value above \$60 million.

"We have learnt to know Equinor through many years of close collaboration with their organization and multiple operations on the Norwegian continental shelf. They are a demanding but fair operator that constantly challenges us suppliers to further improve safety and reduce emissions and operating costs. We consider winning this contract as a confirmation that we are doing the right things," said Olaf Hansen, Managing Director – Europe, at DeepOcean.

The Irpa field development project, located in the Aasta Hansteen area at 1,350 meters water depth, involves a subsea tieback of approximately 80 kilometers to the Aasta Hansteen FPSO. The contract scope includes engineering, transportation and

installation of a MEG pipeline, a production riser, umbilical, subsea structures and tie-ins.

The Verdande field development project, located in the Nordland Ridge area, involves a subsea tieback to the existing Skuld field and Norne FPSO facilities. The contract scope includes engineering, transportation and installation of a 7.5-kilometer pipe-in-pipe production pipeline, umbilical, flexibles, subsea structures and tie-ins.



» Offshore operations in 2024 – 2026 will use Subsea7 and DeepOcean's fleet of vessels. (Image credit: DeepOcean)



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OPTIME SUBSEA SIGNS AGREEMENT FOR REMOTE-CONTROLLED SUBSEA WELL SYSTEMS

Optime Subsea signs a long-term framework agreement with Wintershall Dea regarding rental of the technology company's remote-controlled subsea well completion and intervention systems.

Under the scope of the agreement, Wintershall Dea will rent three Remotely Operated Controls System (ROCS) including its universal landing string system (panpipe), and two wireless electric subsea control and intervention systems (eSCILS) from Optime Subsea. The latter will also provide technical service personnel to support Wintershall Dea's operations.

The framework agreement is valid for a firm period of three years plus two additional two-year options (3+2+2). If both option periods are exercised, Optime Subsea estimates that the contract could generate total revenues of around NOK 500 million.

"This contract manifests our position as the leading global supplier of remote-controlled well completion and intervention systems. Our solutions are tailored to simplify subsea, entailing less equipment offshore, lower weight, less

logistics, lower HSE risk, lower emissions and lower costs. We look forward to supporting Wintershall Dea in achieving this," said Jan-Fredrik Carlsen, CEO at Optime Subsea.

Wintershall Dea will utilize the ROCS and eSCILS equipment at its operated fields on the Norwegian continental shelf.

ROCS and eSCILS

The ROCS is a fully battery-powered and umbilical-less system for well-completion operations. ROCS eliminates the need for the costly and heavy umbilical that normally runs from the topside to seabed to control the tubing hanger during completions, which also means that a large topside hydraulic unit is not required. In total, this avoids mobilization of approximately 50 tonnes of topside equipment. Further, ROCS is mobilized in a single basket, prepared and made up onshore, allowing it to be ready to run immediately when offshore, from a rig. In addition, the ROCS will be supplied with Optime Subsea's universal landing string system (Panpipe), capable of being sheared and sealed on all its length.



» With the ROCS (left to right) Jan-Fredrik Carlsen, CEO; Trond Løkka, chief innovation officer; and Torfinn Kristensen, vice president of services

The eSCILS is a battery-powered and umbilical-less subsea access device for well interventions and workover operations. eSCILS is lowered down to the seabed next to the well and can be connected to any type of subsea tree. A computer is all that is needed for a topside control system, no additional rig equipment is needed. With a footprint as little as 3.5 x 2.5 meters, eSCILS can be transported to and from the rig on a ship and be mobilized and demobilized in one day. As a result, operations can be done significantly safer, faster, and more cost-efficient than conventional solutions. Optime Subsea will manufacture all equipment at the company's headquarter in Notodden, Norway.

10-system series

In 2022, Optime Subsea made an upfront three-figure NOK million investment to build ten similar ROCS systems. A North Sea operator ordered the first two systems, a West African operator the third, and now Wintershall Dea has secured the next three.

"The decision to make such a large upfront investment was based on our market position and interest received from operators globally, plus an attempt to manage supply chain constraints. Looking back, it was obviously an ambitious but smart decision. We expect to close contracts for the remaining four systems during the next six months," added Jan-Fredrik Carlsen.



» With the eSCILS (left to right) Trond Løkka, chief innovation officer; Jan-Fredrik Carlsen, CEO; Torfinn Kristensen, vice president of services

ROV TECHNICAL TRAINING PARTNERSHIP

ADVANCES INDUSTRY SKILLS AGENDA

Subsea resourcing specialist DRIFT Offshore, which provides people and expert support services for projects internationally, has struck a partnership agreement to deliver technical training on Seatronics' industry-leading VALOR ROV system.

The collaboration with subsea technology provider Seatronics, a brand in Acteon's Data and Robotics division, will serve to sustain a pool of skilled and competent pilots, and demonstrates DRIFT Offshore's training capabilities within its wider service offering.

The VALOR ROV technology is among the most up-to-date on the subsea market, bridging the gap between Observation Class and Work Class ROVs by using a network-based operating system and advanced sensor control.

Kyle Pitman, Founder and Director at DRIFT

Offshore, said: "Our partnership with Seatronics gives us a new opportunity to show how our quality training services can support the industry and pilots in achieving their goals. The deployment of the latest technology by competent individuals is key to delivering safe and successful projects, increasing operational efficiency and reducing downtime.

"It is an integrated option for service providers, who can source the VALOR ROV from Seatronics and fully qualified operating personnel from DRIFT Offshore, and a welcome means for pilots to augment their skill set. For DRIFT Offshore it will create a pipeline of pilots trained on the VALOR ROV, broadening our personnel offering which already extends across a wide range of equipment and sectors."

DRIFT Offshore is to lead the training courses in both the UK and USA, utilizing the VALOR ROV and Seatronics test tanks.

Derek Donaldson, Seatronics Group Managing Director, added: "The VALOR ROV offers the market a cutting-edge solution which positively disrupts the observation class market. It is imperative that the operators are fully trained on the system so that they can utilize the built-in technology to its full potential to ensure that they optimise the pilot experience."



» Gary Craigen, ROV Manager at Seatronics (left) and Kyle Pitman, Founder and Director at DRIFT Offshore.



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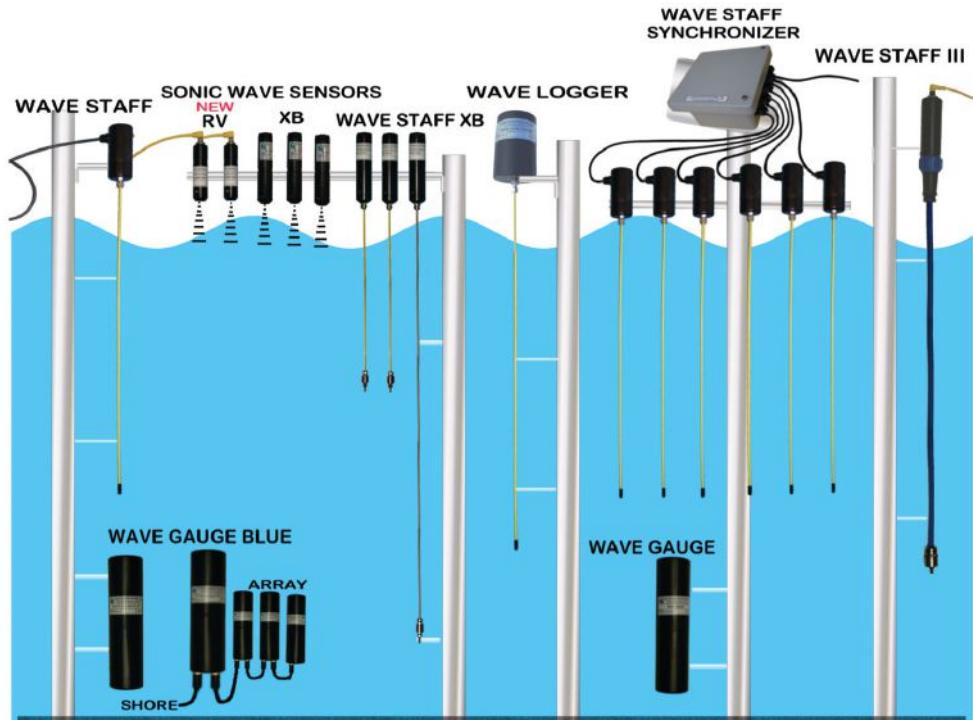
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COLLABORATIVE WAVE POWER PROJECT AIMS TO DECARBONIZE SUBSEA OPERATIONS

A collaborative project to power subsea equipment with wave power and subsea energy storage has taken to the seas in the north of Scotland.

The £2 million demonstrator project, called Renewables for Subsea Power (RSP), has connected the Blue X wave energy converter—built by Edinburgh company Mocean Energy—with a Halo underwater battery developed by Aberdeen intelligent energy management specialists Verlume.

The two technologies have been deployed in the seas off Orkney and have now begun a minimum four-month test program where they will provide low carbon power and communication to infrastructure including Baker Hughes' subsea controls equipment and a resident underwater autonomous vehicle provided by Transmark Subsea.

The project aims to show how green technologies can be combined to provide reliable low carbon power and communications to subsea equipment, offering a cost-effective alternative to umbilical cables, which are carbon intensive with long lead times to procure and install.

The Orkney deployment is the third phase of the Renewables for Subsea Power project. Teams are now testing the entire system at sea at a site 5 km east of the Orkney Mainland, raising the system's technology readiness level (TRL) to 6 – 7 (actual system completed and qualified via test and demonstration).

In 2021, Mocean Energy's Blue X prototype underwent a program of rigorous at-sea testing at the European Marine Energy Centre's Scapa Flow test site in Orkney where they generated first power and gathered significant data on machine performance and operation.

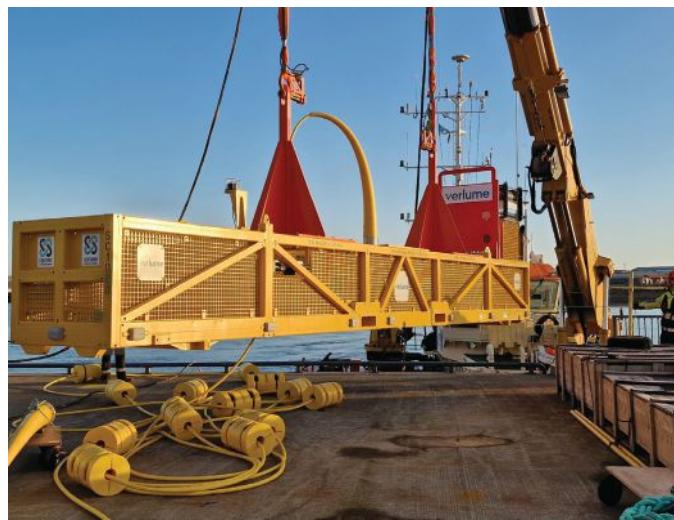
"This is a natural next step for our technology," said Mocean Energy Managing Director Cameron McNatt. "The new test site east off Deerness offers a much more vigorous wave climate and the opportunity to demonstrate the integration of a number of technologies in real sea conditions."

Verlume's seabed battery energy storage system, Halo, has been specifically designed for the harsh underwater environment, reducing operational emissions, and facilitating the use of renewable energy by providing a reliable, uninterrupted power supply. Halo's fundamental basis is its intelligent energy management system, Axonn, a fully integrated system which autonomously maximises available battery capacity in real time.

The RSP Halo system is the second variant that has been built for commercial wave power integration and the first to be built at Verlume's 20,000 square foot facility in Dyce, Aberdeen.

Andy Martin, chief commercial officer at Verlume added: "This offshore test program is the pinnacle of the success to date in this project, we are very much looking forward to the Halo being deployed. The testing will provide a great opportunity to gather high quality performance and operational data which will support the further electrification of the subsea sector."

"This is a fantastic opportunity to further test our resident autonomous underwater drone in an open sea environment," said Nigel Money, Managing Director Transmark Subsea Ltd. "We currently run the system in salmon farming nets, which is a more closed environment. Mocean and Verlume's solution fits very well with our product and allows us to demonstrate broader operational capabilities of an off-grid resident AUV. Our dock and drone is designed to be easily deployed anywhere and the RSP project is a great demonstrator of this capability."



» Halo being deployed. (Photo credit: Mocean Energy/Verlume)



» Mocean Energy's Blue X. (Photo credit: Mocean Energy/Verlume)

TDI-BROOKS AWARDED SIXTH OFFSHORE WIND PROJECT ON THE US EAST COAST

TDI-Brooks has been awarded a geophysical, geotechnical, and benthic sampling survey campaigns to study seabed conditions within the project lease area and potential export cable corridors off the US East Coast. The data collected will help determine safe and responsible project design and engineering along with identifying potential geohazards and benthic habitats. This is the sixth offshore wind project awarded to TDI-Brooks in the past 2+ years.

The geotechnical component along cable routes and within lease blocks will involve deploying a variety of tools including the company's Feritech FT550 electric and TDI-Brooks designed pneumatic vibrocoring (pVC) systems along with their Datem Neptune 5,000 (N5K) and 3,000 (N3K) cone penetrometer test rigs (CPT). Upon completion of the geotechnical vibracoring, all samples are sent to the TDI-Brooks' ISO-certified geotechnical and environmental laboratories in College Station, Texas for testing.

With each offshore wind project carried out, the operator contracts representation from the local fishery organization to accompany the survey. This representative is onboard during the duration of the survey to ensure communication and coordination takes place with the local fishermen. The fishery representation ensures the survey vessel remains clear from all fishing gear and fishing areas.

In addition to a fishery representative, a protected species observer (PSO) is deployed to support industry and academic marine activities by conducting monitoring onboard the vessel to minimize any potential impacts on species encountered.



» TDI-Brooks has successfully installed the Starlink Maritime platform on RV Brooks McCall and RV Miss Emma McCall. (Photo credit: TDI-Brooks)

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BAE SYSTEMS DELIVERS FIFTH AND MOST ADVANCED ASTUTE SUBMARINE TO THE ROYAL NAVY

HMS Anson, the fifth Astute class submarine, which BAE Systems has designed and built for the Royal Navy, has headed out to open sea for the first time.

HMS Anson began her maiden journey to His Majesty's Naval Base Clyde, home of the UK's Submarine Service. She will undertake sea trials before joining HMS Astute, HMS Ambush, HMS Artful, and HMS Audacious, in operational service with the Royal Navy.

"HMS Anson will play a vital role in defending the UK, providing a competitive edge for decades to come, and I am proud to see her make her journey up to her permanent home on the Clyde. Supporting tens of thousands of jobs across the UK, our Astute-Class submarines are a leading example of our commitment to defense manufacturing, continuing to boost British industry for decades to come," said Ben Wallace, Secretary of State for Defense.

"It's with enormous pride that we bid farewell to HMS Anson as she departs our site to take up her vital role helping to protect the UK's national security. This is a truly national endeavor, so delivering the most capable attack submarine ever built for the Royal Navy is a tremendous moment for our company, our employees, the Barrow community and the whole of the submarine enterprise, not least our vast and crucially important UK wide supply chain," said Steve Timms, Managing Director of BAE Systems' Submarines.

HMS Anson, which was formally commissioned into the Royal Navy during a ceremony in Barrow last year, is 97 meters long and weighs 7,400-tonnes. The Astute class are equipped with world-leading sensors, carry Tomahawk Land Attack Cruise Missiles and Spearfish heavyweight torpedoes and can circumnavigate the globe submerged, producing their own oxygen and drinking water. BAE Systems has delivered the first four submarines in the Astute class and the sixth and seventh boats are at an advanced stage of construction in Barrow.

The Dreadnought class submarines, which will replace the Royal Navy's Vanguard class, carrying the UK's independent nuclear deterrent, are also being designed and built in Barrow-in-Furness with manufacturing work underway on the first three of four boats.

BAE Systems is also undertaking early design and concept work for the Royal Navy's next generation of submarines which will eventually replace the Astute class, referred to as SSN-Replacement (SSNR).

These programs are supported by BAE Systems Submarines' growing workforce of more than 11,000 people which will be bolstered later this year when more than 600 apprentices and 200 graduates join the business. BAE Systems' Submarines business will also be recruiting more than 2,500 experienced professionals into its workforce to help deliver the three programs of work.



» HMS Anson, the fifth Astute class submarine departs the Company's shipyard in Barrow-in-Furness. (Photo credit: BAE Systems)



» BlackFish HMS protects ships from submarines, moored mines, underwater threats. (Image credit: DSIT)

DSIT SOLUTIONS TO EQUIP A NATO NAVY WITH ASW SYSTEMS

DSIT Solutions Ltd. (DSIT) has entered into a contract with a leading European shipyard to supply and integrate the entire ASW sonar suite, to include DSIT's BlackFish HMS and WhitePointer UCS systems, and acoustic dome, with the customer's designated combat management system.

BlackFish HMS is an advanced medium frequency system designed for the self-protection of medium-to-large surface vessels engaged in both littoral and deep-water Anti-Submarine Warfare (ASW) operations.

The BlackFish system provides modern, sophisticated underwater search, detection, tracking and classification capabilities. Implementing cutting-edge electronics and acoustic technologies, machine learning, automation, and signal processing, the BlackFish system protects surface ships from submarines, moored mines, underwater obstacles and torpedoes.

Its exceptionally high acoustic performance enables a high probability of detection as well as a long-distance detection range of submarines and approaching torpedoes. Open architecture allows easy integration with any existing C4I systems and other sensors.

WhitePointer, an Underwater Communication System (UCS), enables reliable voice and data transmissions between surface vessels, submarines, and other underwater platforms such as SDVs, DPVs, AUVs UUVs, and divers. Both BlackFish and WhitePointer will be installed in a single dome.

The BlackFish system's advanced algorithms developed by DSIT to reduce operator load, combined with alerting capabilities for a wide range of underwater threats, offer precise location and classification of underwater threats.

FORCYS LAUNCHES NEW OPERATION IN AUSTRALIA

Forcys, a maritime defense company, recently launched Forcys Australia with Sean Leydon appointed as Regional Manager for the Asia Pacific region.

Covering a range of maritime operations including asset protection, littoral strike, mine warfare, submarine rescue, and submarine and anti-submarine warfare, Forcys seeks to transform the underwater domain by enabling increasingly distributed and automated operations.

This is made possible by integrating and bringing to market world-changing solutions from leading technology partners Chelsea Technologies, EIVA, Sonardyne, Voyis, and Wavefront Systems.

Commenting on the launch of the company's operations in Australia, Ioseba Tena, Commercial Director of Forcys, said: "I am excited, Australia is taking bold decisions in the underwater domain. There's been a realization that uncrewed systems take a lot of the risk out of the conflict, they afford higher levels of attrition and deliver higher coverage rates. The sense of urgency is palpable and there is an appetite to work with industry experts to support the transition. We are keen to support a sovereign, sustainable capability."

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US & UAE NAVAL FORCES COMPLETE BILATERAL UNMANNED SYSTEMS EXERCISE

US Naval Forces Central Command (NAVCENT) concluded a weeklong unmanned systems and artificial intelligence integration exercise with the United Arab Emirates Navy in the Arabian Gulf on February 20.

Five unmanned surface vessels (USVs) from the Emirati navy and NAVCENT's Task Force 59 operated off the coast of the UAE. Cameras and sensors aboard the USVs captured imagery and video of vessels sailing nearby. The visuals were then transmitted to operational centers ashore where artificial intelligence platforms helped detect, identify and classify the data.

"This exercise allowed us to further train our artificial intelligence platforms to sort through new data sets, which will ultimately enhance our detection capabilities," said Lt. Jay Faylo, Task Force 59's lead exercise planner. "It has been a tremendous opportunity doing this with our Emirati partners who are at the leading edge of technology in the region."

NAVCENT established Task Force 59 in September 2021 to integrate new unmanned systems and artificial intelligence into US naval operations across the Middle East. This was the unit's first bilateral exercise with the United Arab Emirates.

Participating USVs from Task Force 59 included an L3 Harris Arabian Fox MAST-13, Ocean Aero Triton, and two Saildrone Explorers.

Since its launch, Task Force 59 has operated a suite of new unmanned systems based at operational hubs in Bahrain and Aqaba, Jordan. The Middle East region's unique geography, climate and strategic importance offer an ideal environment for unmanned innovation.



» 5 USVs participated in Task Force 59's first bilateral exercise with the UAE. (Photo credit: NAVCENT)

KONGSBERG TO SUPPLY EQUIPMENT PACKAGE TO ITALIAN NAVY'S SPECIALIZED RESCUE SHIP

Kongsberg Maritime will provide a suite of equipment to a newbuild ship named *SDO-SuRS* (Special and Diving Operations - Submarine Rescue Ship) to be built by the Italian shipyard T.Mariotti for the Italian Navy.

Crucial to this important order is a pair of KONGSBERG Elegance propulsion pods. Kongsberg's Elegance pod system aboard the *SDO-SuRS* combines the direct electric permanent magnet

motor driven pods, matched with a KONGSBERG electric power system, including batteries and power management system. These Elegance pods provide propulsion for precise and efficient vessel operation. The permanent magnet electric motor provides optimal efficiency over a large speed range, combined with an excellent hydrodynamic design developed in Kongsberg's Hydrodynamic Research Centre.

Additionally, the order includes three KONGSBERG tunnel thrusters, Mcon propulsion control system, DP3 system, and single and multibeam echo sounders.

The vessel build program offers further potential opportunities for Kongsberg Maritime in the shape of Autonomous Underwater Vehicles.

The 120 m vessel will replace *Nave Anteo*, which has now reached the end of its operating life after over forty-five years of use. While the new ship fulfils the need for a specialized unit for the search and rescue of damaged submarines, it will also offer support to a wide spectrum of military and civil underwater activities, and special operations.



» The new *SDO-SuRS* will be built by the Italian shipyard T.Mariotti. (Image credit: KONGSBERG/T.Mariotti)

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WRECK SITE IDENTIFIED AS USS ALBACORE

Naval History and Heritage Command (NHHC) has confirmed the identity of a wreck site off the coast of Hokkaido, Japan, as USS *Albacore* (SS 218).

NHHC's Underwater Archaeology Branch (UAB) used information and imagery provided by Dr. Tamaki Ura, from the University of Tokyo, to confirm the identity of *Albacore*, which was lost at sea on November 7, 1944.

"As the final resting place for Sailors who gave their life in defense of our nation, we sincerely thank and congratulate Dr. Ura and his team for their efforts in locating the wreck of *Albacore*," said NHHC Director Samuel J. Cox, U.S. Navy rear admiral (retired). "It



» An ROV was instrumental in obtaining comprehensive images of the wreck. (Photo credit: NHHC)

is through their hard work and continued collaboration that we could confirm *Albacore*'s identity after being lost at sea for over 70 years."

Japanese records originating from the Japan Center for Asian Historical Records (JACAR) covering the loss of an American submarine on November 7, 1944, guided Dr. Ura's missions. The location mentioned in the records matched a separate ongoing effort by UAB volunteers to establish the location of the shipwreck.

Dr. Ura's team collected data using a remotely operated vehicle to confirm the historical data. Strong currents, marine growth, and poor visibility on site made it challenging to fully document the wreck or obtain comprehensive images. However, several key features of a late 1944 Gato-class submarine were identified in the video.

Indications of documented modifications made to *Albacore* prior to her final patrol such as the presence of an SJ Radar dish and mast, a row of vent holes along the top of the superstructure, and the absence of steel plates along the upper edge of the fairwater allowed UAB to confirm the wreck site finding as *Albacore*.

The wreck of *Albacore* is a US sunken military craft protected by US law and under the jurisdiction of NHHC. While non-intrusive activities, such as remote sensing documentation, on US Navy sunken military craft is allowed, any intrusive or potentially intrusive activities must be coordinated with NHHC and if appropriate, authorized through a relevant permitting program. Most importantly, the wreck represents the final resting place of sailors that gave their life in defense of the nation and should be respected by all parties as a war grave.

JFD SUPPORTS NATO SUBMARINE RESCUE SYSTEM AIRCRAFT LOADING EXERCISE

JFD recently released details of the company's participation in a successful Flying Fish exercise, a NATO Submarine Rescue System (NSRS) aircraft loading evolution, with the US Air Force in September 2022.

Held at Royal Air Force Mildenhall in Suffolk, the exercise was conducted to ensure the submarine rescue system equipment can be loaded and transported using the US Air Force's C5 Super Galaxy aircraft type in the event of a submarine rescue operation.

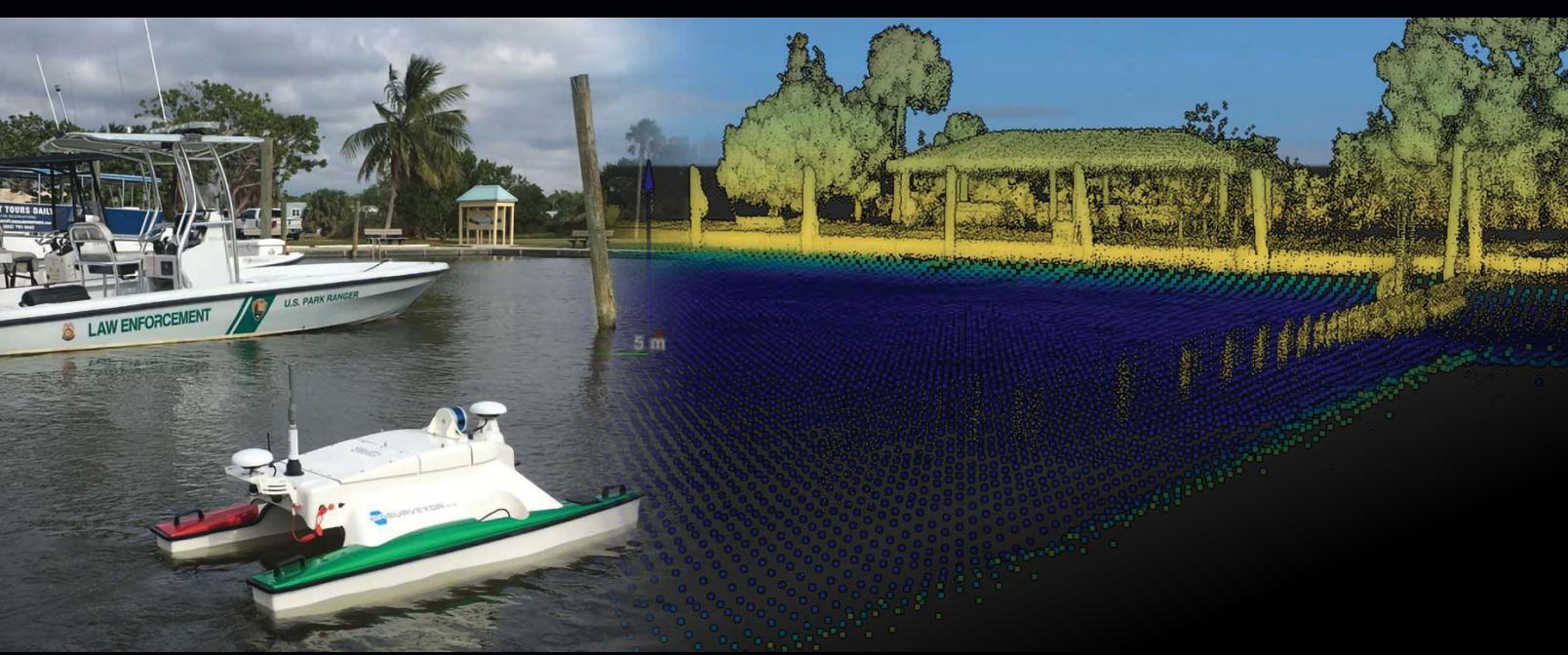
This Flying Fish exercise has significantly improved the options for NSRS air movement because the C5 aircraft is similar in capacity and range to the NSRS' other prime carrier, the Antonov AN124 aircraft. The AN124 fleet availability had been in some doubt due to the war in Ukraine and therefore proving the C5's viability as an alternative NSRS carrier was seen by the NSRS participant nations as a very positive enhancement to air mobility of the system.

Gary Lindhofer, Head of Defense Services, JFD, said: "Success in response to any potential submarine rescue incident is reliant on the timely delivery of equipment and personnel to the incident location. Access to a range of proven and heavy lift aircraft from

multiple sources is essential, and the achievements and learning gained from this exercise are vital towards the combined efforts of the NSRS Participant Nations and United States Navy in assuring the continued safety of its submariners."



» The exercise, the first time that this had been done, saw the successful culmination of weeks of planning between JFD and its trusted supply chain. (Photo credit: JFD)



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<https://2023.otcnet.org>

Global Energy Transition

New York, NY » June 7-8
<https://events.reutersevents.com/energy-transition/global-energy-transition-new-york>

H2O Conference

Halifax, Canada » June 12-14
<https://www.h2oconference.ca/>

Suriname Energy, Oil, and Gas Summit

Paramaribo, Suriname » June 19-22
<https://suriname-energy.com/welcome>

US Offshore Wind

Boston, MA » July 11-12
<https://events.reutersevents.com/renewable-energy/offshore-wind-usa>

Dredging Summit & Expo

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

OCEANS Gulf Coast

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

OTC Brasil

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

EUROPE

Ocean Business

Southampton, UK » April 18-20
www.oceanbusiness.com

WindEurope

Copenhagen, Denmark » April 25-27
windeurope.org/annual2023

Deep Sea Mining Summit

London, UK » May 3-4
www.deepsea-mining-summit.com

Undersea Defence Technology (UDT)

Rostock, Germany » May 9-11
www.udt-global.com

All-Energy

Glasgow, UK » May 10-11
www.all-energy.co.uk

EEGR Southern North Sea

Norwich, UK » May 24-25
[https://eeegr.com/events/sns23-vision-2030/](http://eeegr.com/events/sns23-vision-2030/)

OCEANS Limerick

Limerick, Ireland » June 5-8
www.limerick23.oceansconference.org

Renewable Energy Cyber Security Forum

Berlin, Germany » June 6-7
[https://www.leadventgrp.com/events/renewable-energy-cyber-security-forum/details](http://www.leadventgrp.com/events/renewable-energy-cyber-security-forum/details)

Seawork

Southampton, UK » June 13-15
[https://seawork.com/](http://seawork.com/)

Underwater Technology Conference (UTC)

Bergen, Norway » June 13-15
[https://www.utc.no/](http://www.utc.no/)

Seanergy

Paris, France » June 20-21
www.seanergy-forum.com/en/seanergy2023

OTHER REGIONS

ICCOE

Shandong, China » April 14-16
www.iccoe.org

Int'l Conference on Ocean, Offshore & Arctic Engineering

Melbourne, Australia » June 11-16
<https://event.asme.org/OMAE>

Autonomous Robotics and Unmanned Systems for Offshore Infrastructure

Virtual » June 28-29
<https://www.leadventgrp.com/events/autonomous-robotics-and-unmanned-systems-for-offshore-infrastructure/details>

Australia Wind Energy

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

Gastech

Singapore » September 11-14
www.gastechevent.com

Mozambique Gas & Energy Summit

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

ADIPEC

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

Eastern Mediterranean Conference

Cyprus » November 28-30
www.emc-cyprus.com

2023

MONTH & DEADLINES	EDITORIAL FOCUS & CONFERENCES	CONTENT
JAN/FEB Editorial: Jan. 20 Ad: Feb. 10	» OFFSHORE EXPLORATION US Hydro / March 12-16 CUCÉ / March 26-28 Int'l Partnering Forum / March 28-30	Editorial Topics: Offshore Infrastructure Development, Exploration of Deep-Sea Resources, ESG, Geotechnical Services Product Focus: Submersibles, AUVs, Lights, Cameras, Deck Handling Equipment, Research Vessels, Samplers
MARCH Editorial: Feb. 20 Ad: Mar. 10	» UNCREWED VEHICLES Ocean Business / April 18-20 OCEANS Limerick / June 6-8	Editorial Topics: Remote Marine Survey, Seafloor Mapping, Harbor Security, Long-Range Ocean Research, Coastal Monitoring Product Focus: USVs, AUVs, LARS, UAVs, Sonars, Propulsion and Positioning Systems
APRIL Editorial: Mar. 20 Ad: Apr. 7	» MARITIME DEFENSE & SECURITY UDT / May 9-11	Editorial Topics: Coastal Surveillance, Mine Countermeasures (MCM), Anti-Submarine Warfare (ASW), Search & Rescue, Submarine Cable Infrastructure & Protection Product Focus: USVs, XLUUVs, AUVs, ROVs, Amphibious Vehicles, MCM, ASW
MAY Editorial: Apr. 14 Ad: May 5	» GREEN ENERGY TRANSITION US Offshore Wind / July 11-12	Editorial Topics: Offshore Wind Infrastructure & Supply Chain, Subsea Batteries, Wave Energy Systems, At-Sea Automation, CCS Systems, Hydrogen Product Focus: Offshore Turbines, Supply Vessels, Underwater Batteries, Subsea Connectors, Submarine Cables, Renewable Energy Systems
JUNE Editorial: May 22 Ad: June 9	» UNDERWATER SENSOR TECHNOLOGY & IMAGING	Editorial Topics: Underwater Navigation, Marine Archaeology, Environmental Coastal Monitoring Product Focus: ROVs, Lights, Cameras, Manipulators, Towed Arrays
JULY Spotlights: June 27 Ad: July 7	» UNCREWED VEHICLES BUYERS' GUIDE	Editorial Topics: Special Edition
AUGUST Editorial: July 24 Ad: Aug. 11	» OCEAN OBSERVATION, DATA, & COMMUNICATIONS OCEANS Gulf Coast / September 25-28	Editorial Topics: Oceanography, Meteorology, Remote Sensing, Telemetry, Data Processing, Seafloor Mapping, Cloud-Based Data Storage Product Focus: Marine Observation Systems, Buoys, Drifters, Marine Research Vessels, Subsea Nodes, CTD, Acoustics, Biosensors
SEPTEMBER Editorial: Aug. 21 Ad: Sept. 8	» REMOTE MARINE OPERATIONS Ocean Energy Europe / October 25-26 Offshore Energy / November 28-29	Editorial Topics: Subsea Inspection, Maintenance, Repair (IMR), Seabed Residency, Subsea Intervention, Oil Spill Response, Remote Operations Centers, Professional Development & Training Product Focus: Inspection AUVs, ROVs, USVs, Work-Class ROVs, Pipeline Pigs, Ultrasonic Imaging
OCT/NOV Editorial: Sept. 18 Ad: Oct. 6	» THE OFFSHORE DEVELOPER'S TOOLKIT	Editorial Topics: Offshore IoT, Asset Integrity Monitoring, Autonomous Control Systems, Digital Twin Technology, Decommissioning Services Product Focus: Predictive Maintenance Solutions, Electric Workboats, USVs, Untethered ROVs
DECEMBER Editorial: Oct. 30 Ad: Nov. 10	» THE FUTURE OF OCEAN TECHNOLOGY	Editorial Topics: Special Edition

MACARTNEY APPOINTS NEW PRESIDENT TO LEAD US OPERATIONS

MacArtney, a world leader in underwater technology, has announced David Marchetti as successor to retiring President Lars Hansen.

Houston-based Marchetti comes from a Senior Director position at Ocean Power Technologies, where he headed the company's regional (Americas) business development activities. He previously held leading positions with Hawboldt Industries, Forum Energy Technologies, FMC Technologies Schilling Robotics, and GE Vetco Gray.

Marchetti will be the focal point in the continued growth of the largest MacArtney entity outside headquarters in Denmark. He is seen as a vital strategic sparring partner contributing to the company's global development.

Speaking about the appointment, Group

CEO Niels Peter Christiansen says: "In David, we have found a successor with all the right credentials, network and ability to expand the business, supporting the strategy and growth goal for the Americas. Furthermore, his engaging leadership style and personality fit the MacArtney culture, both with regards to our customer-centric approach and our focus on the most valuable asset; our staff!"

Marchetti is well-versed in the underwater market and technology sectors, with demonstrated expertise in oil & gas subsea production systems, ROV/AUV systems, and wave energy.

"MacArtney has a long-standing reputation of providing reliable solutions and has set the bar as the technology leader in multiple market segments," David Marchetti said. "I am excited to lead the great MacArtney Inc. team and further advance the growth

that the organization has experienced while continuing the tradition of delivering outstanding customer service."

Lars Hansen will partake in the transition, ensuring a smooth handover, with David joining MacArtney in January and taking the helm in April.



» L-R: David Marchetti appointed new President for MacArtney's US operations and retiring President Lars Hansen

FUGRO OPENS REMOTE OPERATIONS CENTER IN ST. JOHNS, CANADA

Fugro celebrated the launch of the company's new remote operations center (ROC) in St. John's, Canada, on February 21. The high-tech communications hub will allow Fugro experts to control offshore survey operations remotely for safer, more efficient and more sustainable projects. The milestone was marked by an open house event, giving clients and government officials the opportunity to tour the state-of-the-art facility and experience first-hand the innovative technologies on offer.

The St. John's ROC will serve offshore energy and other marine-based clients whose work in Canada often involves harsh operating conditions and/or long-distance mobilizations. By limiting the number of crew required to work offshore, remote survey technologies will help clients minimize project risk while significantly reducing their carbon emissions. Clients will also benefit from improved project timelines as data processing takes

place in near-real time, allowing faster access to critical project information.

Fugro built the ROC with support from the federally funded Newfoundland and Labrador Offshore Oil and Gas Industry Recovery Assistance Fund. The fund was created to maximize employment among Newfoundland and Labrador residents and support the recovery of the local offshore oil and gas industry.

"Digitization has become synonymous with innovation in the offshore sector," said the Honourable Andrew Parsons, Minister of Industry, Energy and Technology. "For companies such as Fugro, this technology allows it to take advantage of new and emerging technologies, while generating environmental benefits as we navigate the energy transition. That was the intent of the fund, and it is great to see this international firm open a state-of-the-art facility in St. John's as a result."



» L-R: Todd Ralph, Denis Charland, Pat Byrne, Minister Parsons, Fionnuala Richard and Rodney Spurway.

"Fugro's St. John's office has been a regional employer for nearly three decades. In that time, we've introduced some remarkable - even award-winning - innovations, but none so transformative as the digitally-based solutions we can now provide from the Canada ROC," said Pat Byrne, Marine Asset Integrity Manager for Fugro in Canada. "The ability to perform remote operations, provide processing and data management services, all from our control facility in St. John's, represents a pivotal moment for this region. It's exciting to consider the benefits this shift will bring, not only to our clients but also to our workforce."



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SAAB UK CONTINUES FAREHAM GROWTH

Saab UK's Fareham-based Seaeye business hosted local MP, Suella Braverman, February 24, 2023, as she visited their new site that is bringing jobs and investment to Fareham.

Saab Seaeye, a world leader in underwater robotics, has been expanding rapidly recruiting skilled jobs locally. The new site in Segensworth sees Saab's presence grow to 8,400 m² (83,000 ft²) as part of a multi-million-pound investment and more than 100 new jobs being created.



In November 2021 Saab UK's Seaeye business, a world leader in underwater robotics, secured a contract from Ocean Infinity for their new electric work remotely operated vehicles (eWROV) which are being developed and built in Fareham. The new eWROV product, is the world's most capable and intelligent all-electric, work-class underwater robot. This is the latest addition to the Seaeye underwater portfolio used across a variety of offshore energy sectors, ocean science and defence. Its electrification is the key to its improved performance and sustainability-related attributes.

The Rt Hon Suella Braverman KC MP, said: "It was a pleasure to be back with Saab in Fareham and to see first-hand how this local success story continues to grow. There are so many exciting job opportunities being offered for a wide variety of skillsets, doing meaningful and interesting work both here at home and abroad."

Dean Rosenfield, Managing Director of Saab UK, added: "The success of Seaeye has seen us grow here over the years and I expect this to continue with further expansion to come as we increase our UK production activities."

» Saab UK's new facilities in Fareham, UK. (Photo credit: Saab)

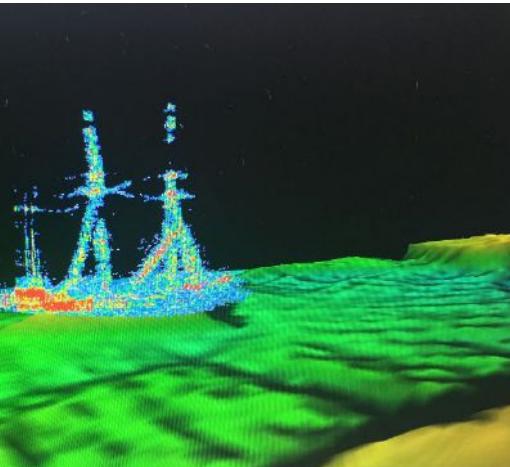
LOST SHIPWRECK IRONTON DISCOVERED BY NATIONAL MARINE SANCTUARY RESEARCHERS

Researchers from NOAA, the state of Michigan, and Ocean Exploration Trust have discovered an intact shipwreck resting hundreds of feet below the surface of Lake Huron. Located within NOAA's Thunder Bay National Marine Sanctuary, the shipwreck has been identified as the sailing ship *Ironton*. Magnificently preserved by the cold freshwater of the Great Lakes for over a century, the 191-foot *Ironton* rests upright with its three masts still standing.

Uncrewed assets, including a 12-foot ASV equipped with a high-resolution multibeam sonar and a ROV, proved instrumental to locating and confirming the wreck.

"The discovery illustrates how we can use the past to create a better future," said Jeff Gray, Thunder Bay National Marine Sanctuary superintendent. "Using this cutting-edge technology, we have not only located a pristine shipwreck lost for over a century, we are also learning more about one of our nation's most important natural resources—the Great Lakes. This research will help protect Lake Huron and its rich history."

» The sonar images provided clear detail of the *Ironton*'s three masts still standing (left) before ROV footage confirmed the wreck. (Image credits: Ocean Exploration Trust/NOAA/Undersea Vehicles Program UNCW)

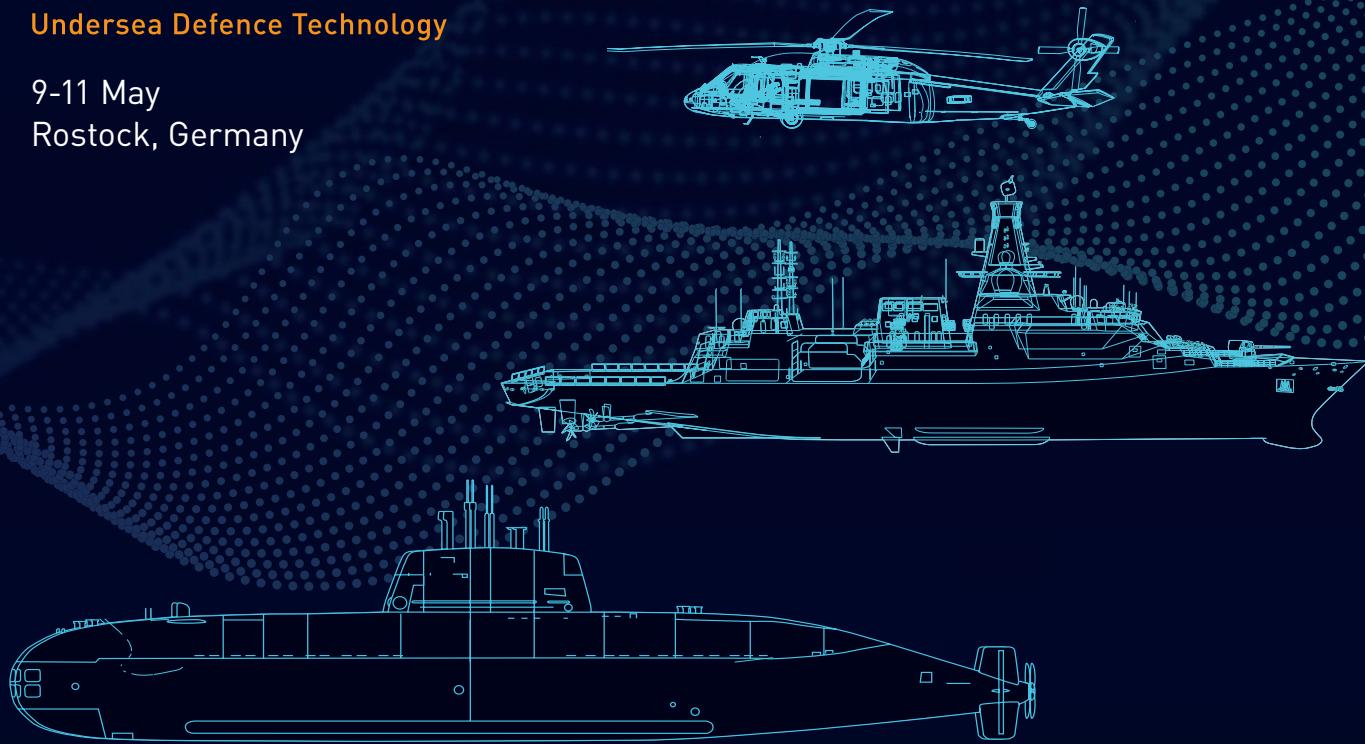




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| ADVERTISERS INDEX |

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www.advancednavigation.com.au		www.oceanspecialists.com	
Airmar	23	Oceaneering Int'l	05
www.airmar.com		www.oceaneering.com	
Blueprint Subsea.....	27	OCEANS 2023 Limerick.....	59
www.blueprintsubsea.com		limerick23.oceansconference.org	
CSA Ocean Sciences	71	Okeanus Science & Technology.....	69
www.csaocean.com		www.okeanus.com	
EdgeTech	39	RBR.....	72
www.edgetech.com		www.rbr-global.com	
EvoLogics	07	Remote Ocean Systems	49
www.evologics.de		www.rosys.com	
Exail	25	RTsys	9
www.exail.com		www.rtsys.eu	
Greensea	37	Saab Seaeye.....	33
www.greensea.com		www.saabseaeye.com	
GRI Simulations.....	31	SeaRobotics.....	55
www.grisim.com		www.searobotics.com	
Imagenex.....	15	SubCtech GmbH	51
www.imagenex.com		www.subctech.com	
International Partnering Forum (IPF)	59	Subsalve USA	45
www.offshorewindus.org/2023ipf		www.subsalve.com	
J.W. Fishers Manufacturing, Inc.	17	Teledyne Marine	19
www.jwfishers.com		www.teledynemarine.com	
MacArtney.....	03	Terradepth	41
www.macartney.com		www.terradepth.com	
MetOcean Telematics.....	53	Undersea Defence Technology	61
www.met ocean.com		www.udt-global.com	
Ocean Business.....	67	VideoRay	02
www.oceanbusiness.com		www.videoray.com	
Ocean Sensor Systems	47		
www.oceansensorsystems.com			



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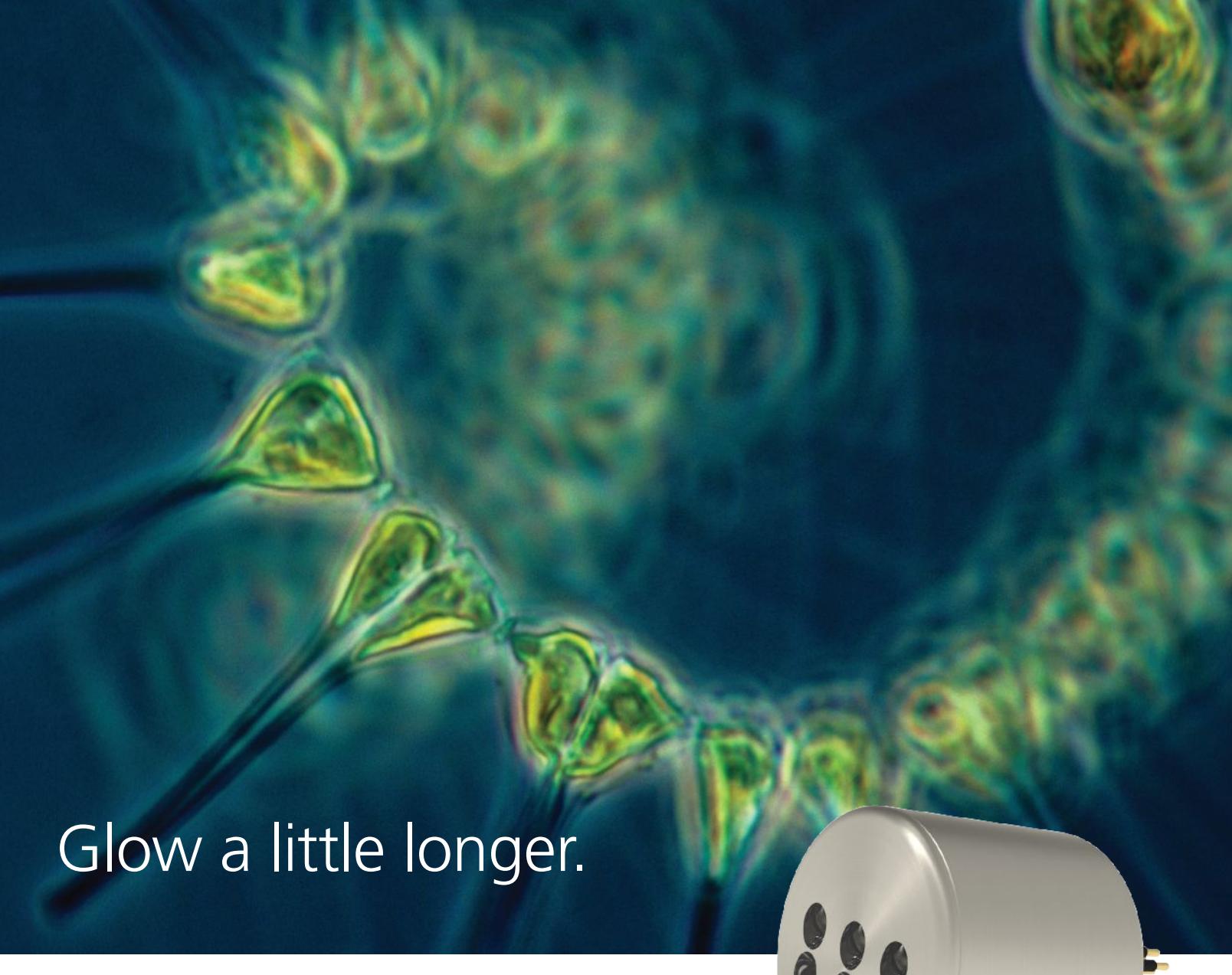
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