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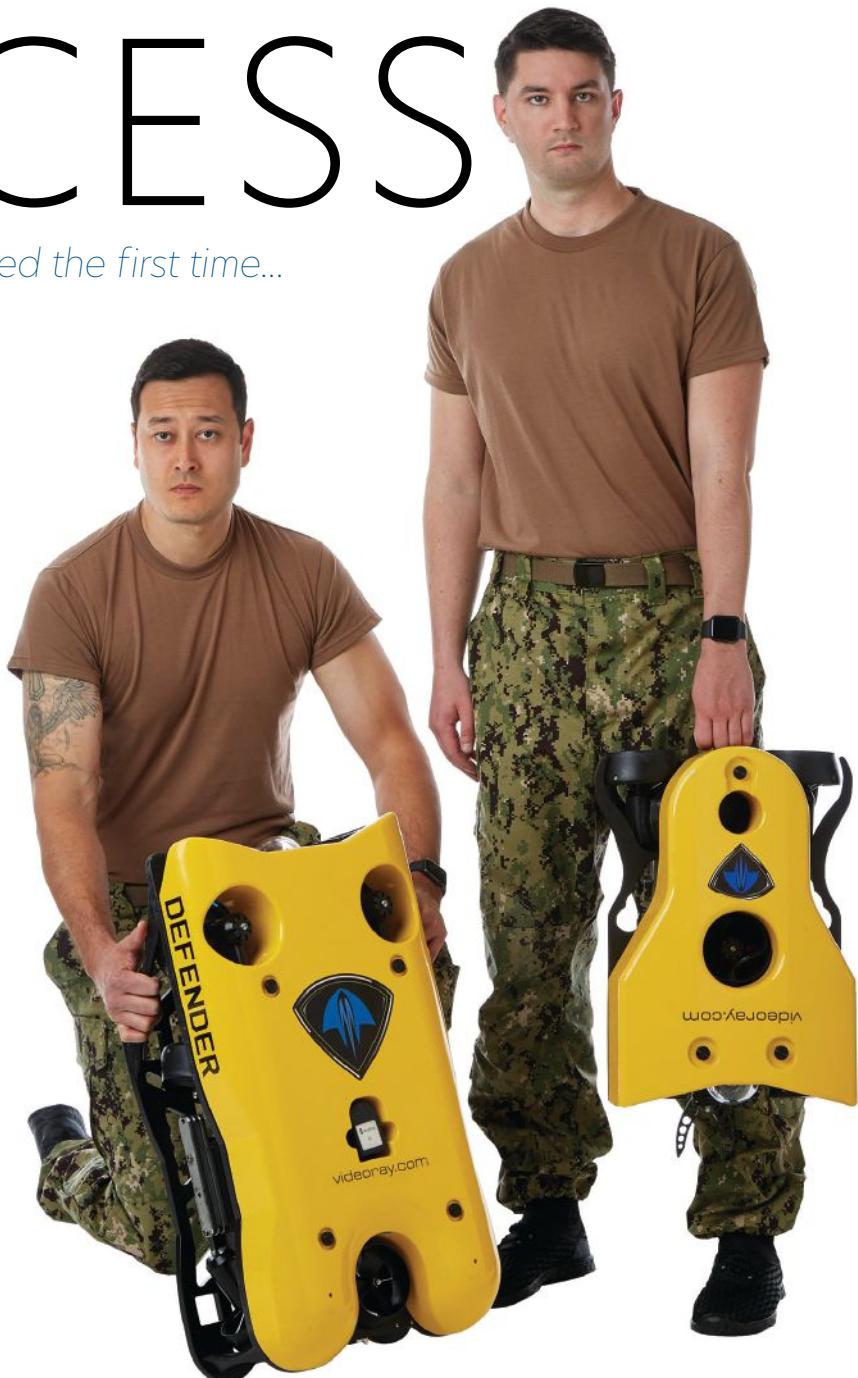


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**ON THE COVER:**

A Huntington Ingalls Industries REMUS 100 unmanned underwater vehicle was launched from a Malloy T150 unmanned aerial vehicle as part of a proof-of-concept demonstration during the Advanced Autonomy Force (AAF) 2 exercise. (Photo credit: HII)

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EDITOR'S NOTE

Across the globe, the marine domain plays a vital role in national defense and security strategy. Today, more than ever, leveraging an at-sea advantage is contingent on the successful integration of breakthrough ocean technologies.

These are the tools—hardware and software—that allow naval forces to learn from past deployments, optimize the performance of present campaigns, and reimagine the future of autonomous operations. In April, we cover it all, and more.

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Published byTechnology Systems Corporation
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Ocean News & Technology ISSN# 1082-6106
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UNMANNED UNDERWATER VEHICLES—ACCELERATING TO THE CREST OF CAPABILITY

BY PAUL DALTON*Vice President, Undersea Systems,
General Dynamics Mission Systems***GENERAL DYNAMICS**

Since the end of the Cold War, the United States' undersea superiority has been one of the greatest differentiators between the US and our near peer adversaries. Deliberate investment in our undersea power, data and sensing networks created the substantial capabilities that continue to play an integral role in our nation's defense strategy. Over the past 15 years, our near peer adversaries have significantly narrowed the capability gap, and the U.S. Navy decided to change the way we thought about our undersea superiority in light of these emerging threats.

UNMANNED SYSTEMS

In recent years we have seen an increased focus on the development and integration of unmanned systems on and under the sea, and this unmanned system capability is integral to the Navy's strategy going forward. From the just released Department of the Navy Unmanned Campaign Framework "Today's global security environment has seen a return to Great Power Competition. This shift has placed the Department at an inflection point, and we cannot continue with a traditional force structure in the face of new warfighting demands...Unmanned systems will increase lethality, capacity, survivability, operational tempo, deterrence, and operational readiness."

The Navy has defined four classes of UUVs scaling from small, or man portable (approximately <9" diameter), to medium (between 9" and 21" in diameter), large (between 21" and 84" diameter) and extra-large (measuring greater than 84" in diameter). The list of mission requirements for these UUVs has continued to expand from expeditionary intelligence preparation of the environment (IPOE) to more advanced missions in support of intelligence, surveillance, and reconnaissance (ISR), mine-countermeasure (MCM), and antisubmarine warfare (ASW).

ENHANCING NAVAL CAPABILITIES

As technology advances and we develop greater undersea communication and data exfiltration capabilities, and higher density power sources, UUVs will act as distributed sensors and payload delivery platforms in contested areas as part of the future undersea constellation and the distributed maritime operations (DMO) architecture. By defining common requirements for unmanned systems such as standard software or hardware interfaces, singular integrated network requirements, common command and control, logistics processes, and training, the operation of and shared intelligence from UUVs will seamlessly integrate across the entire maritime domain. The integration of UUVs and all unmanned systems will aide in the implementation of a comprehensive naval operational architecture and help secure our maritime superiority today and into the future.

INFLECTION POINT

The pace of unmanned systems development has steadily increased over the last decade and we are approaching a pivotal inflection point that will see unmanned maritime systems integrated across naval operations—in the air, on the surface and undersea. The development of autonomous capabilities, networks and major platforms that support distributed unmanned assets, and common processes and policy that underlie their adoption and operation, will allow UxVs to serve as the necessary force multiplier our nation needs to face its current threats. UUVs represent the necessary extension of this transition to our most critical military differentiator in undersea warfare capabilities, and so we must continue to rapidly mature and deploy these capabilities to pace the threat and maintain our undersea superiority.



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HUNTINGTON INGALLS INDUSTRIES' RAPID EXPANSION INTO UNMANNED SYSTEMS



By Duane Fotheringham

*President, Unmanned Systems business group,
Huntington Ingalls Industries, Technical Solutions*

Huntington Ingalls Industries (HII) is well-known as America's largest military shipbuilder. Recognizing the increased importance that unmanned systems will play in the future of defense force structures, HII has expanded its business to become a leader in unmanned systems technology. Through strategic partnerships and acquisitions as well as investment in a new Unmanned Systems Center of Excellence, HII is well-positioned to provide advanced unmanned systems to current and future customers.

ACQUISITIONS, PARTNERSHIPS, AND INVESTMENTS

The increasing significance of unmanned systems has been building for several years, and the recent release of the U.S. Navy's Unmanned Campaign Plan makes it clear that the capabilities and value provided by unmanned systems place them at the forefront of a distributed naval force of the future.

With the acquisition of Hydroid in March 2020, HII became a world leader in unmanned underwater vehicle (UUV) design and manufacturing. More than 600 REMUS and Seaglider® unmanned systems are performing valuable missions for 30 countries worldwide. HII had previous experience with large and extra-large class UUVs through the Proteus dual-mode underwater vehicle and work on Boeing's Orca XLUUV program for

the U.S. Navy. The addition of Hydroid to the portfolio means HII now designs, manufactures and supports UUVs across all class sizes, from small to extra-large. The Unmanned Systems business group was formed under the Technical Solutions division, and HII continues to examine other investments and partnerships that will strengthen its position in the unmanned systems space.

In July 2020, HII announced a minority share investment in Sea Machines Robotics, a forward-looking, autonomous technology company that specializes in advanced control technology for workboats and other commercial surface vessels. This represented HII's entry into the unmanned surface vessel (USV) space and included an agreement to partner with Sea Machines on certain government pursuits.

In September 2020 HII broke ground on a new Unmanned Systems Center of Excellence. This facility is based in Hampton, Virginia, and will provide the infrastructure and capabilities for manufacturing and testing the full spectrum of unmanned systems. When completed and fully staffed, the facility will create approximately 250 new jobs. The Unmanned Systems Center of Excellence complements HII's other unmanned systems production facilities in Massachusetts, Washington and Florida and increases the scale of their manufacturing to meet the needs of their customers now and into the





» The REMUS 100 is a small class, two-man portable UUV that is rated to 100 meters.
(Photo credit: HII)



▲ A REMUS 300 being deployed from a RHIB. DISTRIBUTION STATEMENT A. Approved for public release; distribution unlimited. The appearance of U.S. Department of Defense (DoD) visual information does not imply or constitute DoD endorsement.
(Photo credit: U.S. Navy)



» A REMUS 100 unmanned underwater vehicle being tested off the coast of Cape Cod, MA.



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➤ Rendering of HII's new Unmanned Systems Center of Excellence, due to open in Q4 of 2021. (Image credit: HII)

future. The facility will have a high-tech digital manufacturing infrastructure and include precision machining capabilities, a surface finishing area and a dedicated welding space. The first 22,000 square-foot building opened in December 2020, and the main 135,000 square foot facility will be completed in the fourth quarter of 2021. The Navy's future fleet plan includes an increasing number of unmanned systems, and this facility will help prepare HII to deliver their advanced solutions to customers and meet this increase in demand.

HII's latest acquisition happened on Dec. 31, 2020, and the autonomy business of Spatial Integrated Systems started the new year as part of HII's Unmanned Systems business group. This talented team brings more than 20 years of experience in developing advanced autonomy solutions for unmanned maritime, ground and aerial systems. With positions on several active USV programs, this acquisition gives HII an

even stronger position in the USV space with the ability to support all class sizes, from small to large.

USV SOLUTIONS

HII's autonomy solutions can turn any vessel into a USV. Our modular, scalable software can be integrated on new or existing vessels to increase automation or enable fully autonomous operation. We have advanced autonomy solutions including multi-agent command and control, allowing several USVs to collaborate on missions and perform swarm operations. These solutions have been fielded for more than 6,000 hours on 23 vessel types.

HII provides sensor fusion to integrate high-quality perception capabilities that allow USVs to follow COLREGs, avoid hazards and identify contacts of interest. Examples of perception hardware that can be integrated with HII's autonomy software include radar, infrared cameras,

360-degree cameras and environmental sensors. The integration of a suite of sensors allows safe, autonomous navigation from port to port. These same sensor packages and intelligent autonomy solutions can be coupled with displays on existing manned platforms to provide enhanced situational awareness.

HII USV advanced autonomy behaviors have been field-proven through many demonstrations with the Armed Forces. Recently with the U.S. Coast Guard, HII's autonomy solutions demonstrated the ability to patrol the coasts, detect threats and prevent illegal fishing. HII was also



➤ Four vessels demonstrating a swarm operation outfitted with HII autonomy solutions including perception, autonomous health monitoring and multi-agent commerce and control. (Photo credit: HII)

recently chosen as the autonomy solution for the U.S. Marine Corps Long-Range USV (LRUSV) as a subcontractor to Metal Shark. The LRUSV program will be a network of unmanned vessels traveling for extended ranges, carrying payloads and transporting supplies to the Marine Corps. Other maritime defense and security applications for USVs include intelligence, surveillance and reconnaissance (ISR), high-value unit escort missions, and mine clearance.



➤ HII's USV solutions include sensor fusion, perception and multi-agent command and control. (Image credit: HII)

UVUs

With more than 20 years of continuous development, REMUS and Seaglider UUVs are some of the most robust, reliable and prolific unmanned systems in the world. We're always looking for new, efficient ways to use these systems, including launch and recovery from surface and subsurface vessels of all sizes. All new-generation REMUS UUVs are built on the REMUS Technology Platform, which combines advanced autonomy, open architecture and modularity that can be scaled to any class size or depth rating. Common applications include mine countermeasures, search and recovery, rapid environmental assessment, hydrography and marine research.

The REMUS 300 is the latest addition to the REMUS family of systems and is two-man portable and 305-meter (1,000-foot) rated. This small-class UUV combines advanced modularity and flexibility in a platform that can be deployed from any vessel of opportunity. With the added modularity, the REMUS 300 can be reconfigured in the field for different missions, from a 100-pound expeditionary configuration to a 149-pound long-endurance configuration. The open architecture and modularity of the REMUS 300 facilitates rapid spiral development, ensuring technology flexibility and longevity.

HII also has the Proteus large-class UUV, which is used as a testbed for military concepts of operation. Most recently, in collaboration with our sister division, Ingalls Shipbuilding, Proteus is being used to test autonomous launch and recovery from an amphibious transport dock (LPD) well-deck. The challenge of launching anything from a well-deck is that while the vessel is in motion, there is a significant amount of turbulence. The current design uses a



» The Proteus, large-class UUV can be equipped to launch a REMUS 100 small-class UUV. (Photo credit: HII)



» The new REMUS 300 UUV combines advanced modularity and flexibility in a two-man portable platform. (Photo credit: HII)

sled that will capture the UUV behind the turbulence and pull it back to the ship. This design will also be compatible with launching small and medium USVs from any ship with a well-deck. This cross-divisional collaboration, integrating our skills building surface combatants with our proven UUV launch and recovery experience, will help bring robust solutions to our customers faster.

INTEROPERABILITY—COMMON INTERFACES AND AUTONOMY

Open architecture, modularity and a common system architecture are key to providing unmanned solutions that are robust and reliable while minimizing total cost of ownership. This also extends to the latest generation of operator interface software that is being designed to integrate directly into third-party common control systems.

Rapid upgrades are facilitated by HII's software and hardware modularity, including software and hardware development kits so customers can independently develop autonomy, systems and payloads. All our unmanned maritime systems are being designed to follow common standard interfaces and system architectures such as a data distribution service (DDS) and Unmanned Maritime Autonomy Architecture (UMAA) standards, ensuring commonality across our solutions. Looking forward, we are also making advancements in artificial intelligence, machine learning and autonomous health monitoring.

AI & MACHINE LEARNING

Artificial intelligence (AI) and machine learning (ML) have grown tremendously over the past few years. There are many applications for use with unmanned systems, and we've already begun integrating algorithms into our systems to help optimize operations. We use machine learning to assist with the classification of contacts, like buoys versus ships, based on electro-optical and infrared sensing/perception. Using weather and environmental inputs, ML can help vessels interact better in the environments in which they are operating so they can take on more complex missions. Using AI and ML, sensors and perception can inform autonomous action, like rerouting around a storm or altering a mission due to higher wind and sea states. This facilitates increased survivability for the vehicle and more efficient operations. We are also upgrading hardware on all product lines to increase processing power, speed and modularity to support advanced autonomy and AI algorithms developed both internally and externally.



» Using a 360-degree sensor head, machine learning and artificial intelligence, USVs can detect and classify targets. (Image credit: HII)



❖ Dutch Navy REMUS Team recovers the Autonomous Underwater Vehicle during Trident Juncture 18. (NATO Photo By WO FRAN C.Valverde)

UNMANNED SYSTEMS RESILIENCY

Unmanned systems should be more than just reliable; they should be resilient and able to adjust to harsh weather, currents, sea state, corrosion, operating regulations and complex operations. One way we are increasing the resiliency of our systems is through digital models in conjunction with hardware-in-the-loop simulators. Robust simulation capabilities can ensure new designs will stand up to the challenges of the environment and complex operation. We also focus on improving our processes for integration and manufacturability to ensure quality deliverables. Redundancy in systems and predictive platform maintenance can help in case of system degradation or failure.

By appropriately addressing risk, leveraging spiral development and appropriate design strategies, and utilizing advanced prognostics and health monitoring, unmanned systems can be fielded rapidly with acceptable reliability and resilience.

AUTONOMOUS HEALTH MONITORING

Artificial intelligence and machine learning can be used to integrate autonomous health monitoring into our systems. Our software allows real-time monitoring of sensors and system efficiency to optimize operations. We are continuously developing this capability on board our

platforms to understand the health of electrical, mechanical and sensor hardware. Health monitoring allows us to predict maintenance needs and the overall health of the system. This capability has been fielded on USVs and is being expanded for use on UUVs.

Based on AI and ML inputs, the system can then autonomously alter its mission to be more efficient based on available resources. Mission length, speed, objectives or route may be modified if certain sensors are degraded or endurance is less than what is required for the mission. Autonomous health monitoring increases the opportunity for mission success by allowing the unmanned system to identify onboard sensors that have degraded or failed and refining or replanning its mission based on the capability degradation.

In missions with multiple, collaborating unmanned systems, autonomous health monitoring facilitates re-tasking of individual assets based on the overall health and capabilities of the group. If a USV is lost during combat, another can be automatically re-tasked to complete its objectives. The software provides a summary view into the health of individual vehicles and the fleet, allowing remote operators to manage a larger fleet of vessels more effectively.

ADVANCED AUTONOMY SOLUTIONS

In the not-so-distant future, unmanned systems will be enhancing the capabilities across all our Armed Forces. HII sees significant cross-service opportunities for the Department of Defense to benefit from the commonality of software technology across all domains and mission sets.

Mission planning, navigation, sensor fusion, perception and obstacle avoidance are all features needed in any unmanned system in the maritime, air or ground domains. Swarm algorithms and multi-agent command and control can help enhance the armed forces' reach without the need to increase manning. Reliable, secure communications are also an important factor for unmanned systems and can be streamlined to enable cross-domain communication.

As unmanned systems evolve, we are also working to enable cross-domain collaboration. In this scenario, a UUV may communicate with a USV, which then sends an unmanned aerial vehicle (UAV) to a manned platform to deliver vital information. Using multiple unmanned systems together can help solve difficult defense missions and keep forces out of harm's way. The future applications for unmanned systems are endless and HII is investing in the infrastructure and competencies needed to remain a leader in this field.

EU AND NETHERLANDS JOIN DAMEN TO FIGHT INVASIVE SPECIES IN BALLAST WATER

Climate Investor Two has approved an investment that could amount to 24.5 million euro to support the lease of Damen's portable ballast water treatment solution InvaSave to customers in Africa, Asia, and Latin America.

Climate Investor Two (CI2) is a financing facility mandated to invest in water, sanitation and ocean infrastructure projects in emerging economies. It enjoys cornerstone support from the EU and the Dutch Fund for Climate and Development (DFCD). The consortium that manages the 160 million DFCD also includes World Wide Fund for Nature Netherlands (WWF-NL), Netherlands Development Organization (SNV) and Entrepreneurial Development Bank, FMO.

Climate Fund Managers, the manager of CI2, as well as the DFCD, is pleased to announce the signing of this Development Funding Agreement of 2.8 million euro to finance the start of this project with Damen Financial Services, the newly founded department within Damen Shipyards Group.

Viruses and Bacteria

The project concerns the treatment of ballast water, which is taken on in great quantities by marine vessels to offset unloaded cargo or waste, before being discharged at the ship's next port of call. This discharge typically contains a multitude of viruses, bacteria, and other biological materials, including plants and animals collectively referred to as invasive species. The inadvertent release of non-native and nuisance species in ballast water has already triggered extensive ecological damage, with a knock-on effect on the economy and human health.

The International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) came into force in 2017, with the goal of ending the spread of harmful aquatic organisms from one region to another. As of July 2020, 87 out of 217 countries have signed the higher standards and procedures for

the management of ships' ballast water, representing more than 80 percent of the world's merchant shipping tonnage.

240 New Jobs

The Damen containerized ballast water treatment system InvaSave offers a port-based solution to ships ill-equipped to treat their ballast water or wishing to supplement their existing treatment capabilities to meet higher standards. In addition, the system is currently the only one to be certified by the International Maritime Organization, which is responsible for the implementation of the BWM convention. During the commercial phase, it is estimated that the systems will treat up to 36,000 m³ of ballast water per day.

Tarun Brahma, CFMs Head of Investments, stated: "The Damen project represents an exciting opportunity to get ahead of the growing demand for ballast water treatment, whilst also contributing toward climate adaptation and preserving the future of marine ecosystems. In addition, we estimate this project to create 240 new jobs locally."

Jan Willem van Helden, managing director Damen Financial Services, added: "Thanks to the lease construction made possible through our partnership with Climate Investor Two, this eco-friendly solution will be within reach of many more companies and governments in Africa, Asia, and Latin America."



» InvaSave, Damen's containerized ballast water treatment system.
(Photo credit: Damen)

FUGRO COMPLETES GEOTECHNICAL INVESTIGATION FOR WORLD'S LONGEST IMMERSSED TUNNEL

Fugro has completed a nearshore geotechnical investigation for the Fehmarnbelt Tunnel, the world's longest immersed tunnel that will connect Denmark and Germany by road and rail.

The client was Femern Link Contractors, the consortium building the 18 km tunnel that will reduce travel time between the two countries and contribute to a greener transport system.

Fugro has been involved in the Fehmarnbelt Tunnel project for the last 10 years,

from early site investigation work up to the current geotechnical study. This latest phase included geotechnical site characterization of the sub-seabed soil at both tunnel entrances and, on the Danish side, the production facility where the hollow concrete tunnel elements are being made. Fugro deployed their Skate 3 jack-up platform, a custom-designed geotechnical spread, and a specialist data acquisition team to perform core drilling and downhole cone penetration tests. The resulting data were then analyzed to determine subsurface uncertainty to reduce the contractor's and

client's ground risk exposure by providing secured geotechnical design input parameters.

Michael Neuhaus, Strategic Sales and Marketing Manager for Fugro in Germany, said: "We are proud to play a significant role in this iconic project. Detailed knowledge of the subsurface soil properties has helped Femern Link Contractors to improve cost and time management during the preconstruction and design phases, and to meet their engineering objectives."

UNDERSTANDING WAVE CONDITIONS AND CLIMATE CHANGE IN THE ARCTIC WITH ACOUSTIC TECHNOLOGY

Major changes are occurring in the ocean. Climate change and subsequent melting sea ice are not necessarily good changes. Why are acoustic Doppler current profilers an invaluable tool to get a complete picture of the Arctic's changing wave conditions in the context of climate change?

In the Arctic, the end-of-summer sea ice extent in 2020 was the second-lowest in the last 42 years.

"The ice used to melt out in June or July. Now it melts out in May. It used to come back in September or October. Now the ice comes back in November or December," says Professor Jim Thomson, Senior Principal Oceanographer at the University of Washington's Applied Physics Lab and a Professor in the Department of Civil & Environmental Engineering.

Melting Ice Exposes Coastlines to Harsh Erosion

The implications of the Arctic's changing sea ice are many. On a global scale, sea ice influences global climate. Within the region, activities such as commercial shipping and naval operations may find life easier with the decline. For local communities, however, the loss of sea ice means the loss of a protective barrier that shelters their homes from harsh waves driven by storms that would otherwise batter and erode coastlines that are not resilient to their impacts.

In a twist, waves along the coast and further offshore may become a more prominent feature as the sea ice continues to decline.

Sea Ice And The Impact of Waves

While sea ice lies on the ocean surface, there is less space for waves to form. Any waves that do so find their energy scattered and dissipated by the ice. Historically, winter waves might reach just over half a meter in height, but today they far exceed this. In September 2012—the year with the lowest recorded end-of-summer sea ice extent—Thomson and colleagues detected waves some 5 m high with a 600 kHz acoustic wave and current profiler (AWAC) mounted on a subsurface mooring in the Beaufort Sea.

Waves can do several things that can expedite ice's decline. First, waves can erode the ice edge. Second, they can break the ice up.

"Imagine there is a nice big flat sheet of ice, and the waves break it up into lots of bits. Once it's broken up, it has more surface area exposed to the ocean, and if the oceans warm, the pieces of ice are more likely to melt," Thomson explains. "There's a potential feedback mechanism wherein you lose a little bit of ice and make some waves, and those waves eat away at the ice edge or break it up, and so you lose more ice, and then you make bigger waves, and now you're off and running."

Thomson's research in the Arctic has continued. Recently, he and his team paired Nortek Signature500 acoustic Doppler current

profilers (ADCPs) mounted on fixed moorings with drifters equipped with Signature1000 ADCPs to get a complete picture of the Arctic's changing wave conditions.

Long-Term Data Collection

"The moorings [equipped with upward-facing Signature500 ADCPs] provide us with a long time series of data. They sit at one place, and watch the world go by," Thomson says. The instruments, which collect data on the waves, currents and sea ice when it is present, are duty-cycled to record data every hour. "They have been great for power management. It's really good to be able to have the instruments reliably collecting data for a whole year and retain robustness in the data collection," Thomson says.

The Signature1000s have also been attached to moorings to assess waves in shallower waters. In the Chukchi Sea, Thomson and Dr Lucia Hošeková captured a four-day-long wave event near the Alaskan coast, allowing them to explore how sea ice dampens the wave's energy.

Next-Generation Acoustic Profiler

Thomson's Arctic investigations are continuing, with much of the research being conducted largely made possible by the technical advances being made in the equipment. "The Signature instruments, in general, have been nothing short of a game-changer," Thomson says, noting the ability of the instrument to capture multiple different types of measurements. "We have a next-generation acoustic profiler that really moves things forward. The data are much cleaner, much higher quality than they used to be."



» The R/V Sikuliaq during a cruise to research sea ice in the Beaufort Sea. (Photo credit: Onpoint Outreach)



» The Signature 500 ADCP's ability to be left to collect data every hour for a year was vital for Thomson's research. (Photo credit: Onpoint Outreach)

SEICHE AND DEEP VISION TO DEVELOP REAL-TIME CAMERA SYSTEM TO MONITOR MARINE MAMMALS

Seiche Ltd and Deep Vision Inc. have signed a Memorandum of Understanding (MoU) to establish a collaborative relationship in support of their respective business interests.

Seiche has expertise in the field of maritime environmental monitoring; in particular, Seiche has developed a unique camera system, as implemented in their Mini Dual Camera, that has been specifically designed to aid the observation and monitoring of marine mammals (and other surface, and near surface objects).

Deep Vision has expertise in the field of computer vision and unsupervised machine learning; in particular, Deep Vision has developed a highly advanced, unique, passive EO/IR technology that provides robust, real-time detection and tracking of marine mammals, vessels and other maritime assets on, or near, the surface of the water.

Under this MoU, the two companies will advance collaborative efforts to develop a real-time camera-based system that can automatically detect, geo-locate, and quantify the presence of marine mammals and other maritime assets. The system will be resilient under all weather conditions and operable at both surface level and above,

e.g., mast mounted for ships. By leveraging state-of-the-art unsupervised machine learning techniques, the system will be truly autonomous.



» Great Whales: North Atlantic right whale blowing. (Photo credit: NOAA)

Both Seiche and Deep Vision have strongly aligned environmentally focused business goals and feel that this partnership will be mutually beneficial both for their respective organizations and for their key stakeholders.

Mark Burnett, CEO of Seiche Ltd, said: "We are excited to be working with Deep Vision and their cutting-edge technologies, particularly their software capabilities that can rapidly assess changes in the environment and automatically tune detection algorithms to optimize performance. Our Seiche camera systems are currently providing environmental monitoring to clients around the world, and this is an important next step in the provision of this technology to further protect marine life."

Alan Parslow, CEO, Deep Vision, added: "We are thrilled to be working with Seiche, one of the most respected and forward-looking environmental monitoring companies on the planet. We are confident that the proposed system, once realized, will become a significant tool in protecting marine life. We are certain that such a tool is crucial for the ultimate survival of the North Atlantic right whale."

An illustration of a yellow submarine-like vehicle, possibly a towed array sonar, swimming in dark blue water. It is emitting several curved lines representing sonar beams. The background shows a sandy ocean floor with some aquatic plants.

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MAKING "SENSE" IN THE MARITIME DOMAIN



By Ronald M. Carvalho Jr.
Director, BAE Systems FAST Labs™



and Julia F. Allen
Director, BAE Systems FAST Labs™

With today's geo-political conflicts developing on a worldwide scale provoking the need for timely and accurate information by decision makers, the requirement for maritime Intelligence, Surveillance and Reconnaissance (ISR) has never been greater. Maritime ISR by itself is difficult due to the vast distances, dispersed activities and limited high-bandwidth communications involved. As the continuum of conflict advances into grey zone or active hostilities, maritime operations become more difficult.

Limited access to denied areas, constrained reliable communications availability, and the need for quickly detecting developing patterns of behavior all place significant demands on maritime platform operations. Fielding of large numbers of naval surface vessels and submarines able to survive in this environment is costly and schedule prohibitive. The need for lower cost unmanned platforms to fill the gap has been well documented, however a rigorous analysis of optimal numbers, types, and Concepts of Operation (CONOPS) remains an open area of research.

There are some physical attributes that these unmanned maritime platforms share including the need for *Persistence* to operate in an area for long periods of time, *Endurance* to transit long distances and *Reliability* to continue functioning with some loss of component failure. There are also operational attributes these platforms share including autonomous *sensing, processing* and *communications* required to fulfill mission requirements. BAE Systems has been exploring this mission area from a platform and mission systems perspective with a particular focus on "sense making" from gathered information. The key objective is maximizing the amount

of information produced with the minimum cost of force structure while also providing a degree of resiliency to loss of operational units through attrition or hostile action. In this article we draw comparisons to a neural network analogy for situation-dependent force deployment.

ESSENTIAL INFORMATION

Within the information processing / intelligence domain, the term "Essential Elements of Information" (EEI) is typically used to describe information needed to satisfy the operational commander's priorities of intelligence requirements. Gleaning these EEIs benefits from persistence to gather the information as well as the sensing modalities required to obtain that information. Access to the information in contested areas, at great distances, can be overcome by the use of intrusive platforms (i.e. UUVs). Due to the distances involved and the limited number of platforms available, it is our belief that a heterogeneous mix of multi-modal sensors is most effective for covering the acoustic, RF and optical environments. EEI's change over time and the UUV platform requires both short-term mission level sensor planning and autonomy as well as long term platform sensor and geographic (spatial) placement planning. The ability to make sense of what is being observed and communicating that to a Mission Operation Center (MOC) drives the requirements for processing and communications subsystems.

Borrowing from UAV operations, if high-bandwidth communications channels are available, processing can take place remotely (at the MOC for instance), however in constrained communications environments, processing has to take place forward at the edge. UUVs inherently have very limited high-bandwidth communications

▼ BAE Systems Riptide 9" Class UUV during at sea testing. (Photo credit: BAE Systems)



opportunities, thus energy efficient onboard processing is extremely important. This processing needs to address the fundamental questions of "Who? Where? and When?" implying the need for precise geo-positioning, timing and some means of Automated Target Recognition (ATR) acting on the sensor products.

A LAYERED NETWORK OF UUVs

To cover an area of interest we need multiple UUV platforms with sufficiently overlapping sensor fields of regard to achieve the persistence necessary to observe activities that may take place over long (days or more) periods of time. We can think of these forward-based sensing elements as nodes in a graph or input layer of a neural network. These sensing elements have tasking that may change over time (*who, where, when*) with each sensor modality having a *weight* applied to it. These weights could be scheduling of particular sensor modes or sensor prioritization schemes for instance. How these weights change by mission tasking could be assigned back at the Mission Operations Center (MOC) manually, or autonomously through the use of a middle layer of UUV platforms. This middle layer becomes important as its platforms are physically distant from the forward based sensor nodes, but have the time advantage to maneuver to add additional observations and data to the network.

As an example, if the forward sensor UUVs (nodes) are tasked to monitor the channels into a port facility, upon detection of a potential vessel of interest they can Tip and Cue the middle layer UUV(s) to intercept and provide additional information on *who, where and when*. This more fully refined information is then sent back to the output layer (Mission Operations Center) to answer *why* this behavior is occurring and what does it imply?

In summary, we have a layered network of UUVs working together to meet wide area coverage rates and long temporal duration collection requirements. EEI's are satisfied through use of forward based sensor collection platforms and fine grain analysis of suspect platforms through middle layer of UUVs which collectively provide situational awareness to an operational center (output layer node). Different layers (UUVs) have different operational properties. Forward UUVs may only need to provide sufficient information to cue intercepting platforms (middle layer of UUVs), and can be configured with payloads accordingly. The middle layer needs the ability to perform some level of fine grain sensing and higher level of information processing (sense making) and communications. This offers the possibility of a High-Low mix of platforms where forward based sensor platforms are relatively inexpensive and middle layer platforms may have more expensive processing and communications capabilities.

ACTIVITY BASED INTELLIGENCE

As data is collected, Pattern of Life (PoL) analysis is performed over time at the MOC, abstracting detections and single-vehicle activities into higher-echelon threat behaviors, posture, and objectives. Information needs identified by PoL algorithms back propagate value into the weights of the multi-layer sensing network, geared toward gathering mission EEIs to refine threat estimates. For example, drug manufacturing, weapons smuggling, troop movements, and oil smuggling all have different precursor activities (Indications and Warnings or I&W) associated with them. A self-annealing autonomous UUV network and PoL engine could potentially self-cue or adjust weights and activity functions to determine what is taking place and how best to adjust the network to confirm the behavior, similar to neural network feed forward and back propagation techniques. Thus, the middle layer of UUVs may place emphasis (weight) on processing and communications over multi-modal sensing of the forward based sensing UUVs. The use of artificial intelligence / machine learning (AI/ML) to discover patterns of behavior through widely dispersed (temporally and spatially) activities is essential to future success. UUVs that can be reconfigured during a mission are also necessary to enable this dynamic unmanned systems self-annealing networked vision.

This framework of Activity Based Intelligence has been proven in the past. Ideally the first two layers of the network would operate autonomously



» Mass modeling of an RF sensor array on 9" class UUV. (Photo credit: BAE Systems)



» Host UUV carrying Micro Class UUVs as payload. (Photo credit: BAE Systems)

and discover illicit behaviors on their own. A fully autonomous UUV neural network could potentially self-cue or adjust weights and activity functions to determine what is taking place and how best to adjust to confirm the behavior reducing the workload on analysts and operational planners at the MOC. As bad actors adjust or camouflage their behaviors, AI/ML techniques may provide a higher likelihood of detecting associations in a timely manner over traditional human analytics-based approach. Camouflaged behaviors also drive the need for multi-modal sensing approaches and clandestine approach/ proximity to the behavior itself.

ENABLING TRUE UUV AUTONOMY

The end state is to build a self-annealing network of UUV platforms that autonomously adapt their behavior to satisfy a mission role with minimal human intervention. The issues of energy regeneration and available communications means have not been addressed in this article. These requirements are being addressed through current navy programs. However, the need for forward based platforms to survive (maintain situational awareness and ability to react to perceived threats) and operate reliably through some means of energy regeneration needs to be addressed as part of the overall operational concept. Communications may be conducted asynchronously or within a window of availability, maintaining shared common operating pictures with imperfect information is another enabling technology.

BAE Systems is currently conducting research in Maritime System of Systems architectures through a physics-based modeling and simulation environment and Model Based Systems Engineering approach. In addition to being a platform provider we are also a mission payload provider with ongoing research in wideband apertures, acoustic, optical and RF sensing, UMAA compliant autonomy systems, tracking and fusion, and AI/ML algorithm development for maritime applications. Lastly, BAE Systems has proven pattern of life capabilities for a wide range of threats and data modalities. Collectively, with key enabling partnerships within government and industry, we are ready to develop and deploy layered sensing networks to achieve persistent, reliable, and intelligent situational awareness in contested environments.

FUNDING TO DELIVER ENHANCED MARINE AUTONOMY IN COASTAL WATERS



» Autosub Hover One, a new NOC-developed hover-capable UUV.
(Image credit: NOC)

An ambitious new project being led by the National Oceanography Centre (NOC) to improve the autonomy and perception of robotic underwater vehicles in challenging coastal environments has been awarded funding from the UK's Defence and Security Accelerator (DASA). The project will be delivered in partnership with tpgroup, whose Northstar AI software will be used to better understand how to safely navigate through congested coastal waters.

Operating unmanned underwater vehicles (UUVs) in coastal and littoral waters requires enhanced autonomy and perception to enable them to navigate in a cluttered and often-changing environment,

above and beyond what is required for deep sea operations. The new project will develop and demonstrate sensor-agnostic processing tools for a range of acoustic sensors to gather detailed bathymetry information which will be fused with the Northstar software, a backseat autonomy engine, running the sonar-based Simultaneous Localization and Mapping (SLAM) system and an advanced path planning algorithm to enable precise localization and collision-free navigation.

The system will enable autonomous vehicles to operate in environments with a high concentration of obstacles and hazards including ports and harbors; will reduce the time required for pre-mission

planning and de-risking activities; and removes the need for people to work directly in high-risk marine environments. The new capability will be demonstrated during in-water trials using a new NOC-developed hover-capable UUV, known as Autosub Hover One.

The NOC's Marine Autonomous and Robotics Systems team will work in partnership with tpgroup, whose Northstar software system will be used to enable autonomous distributed robotics. The Northstar platform exists as a modular set of software components which will provide 'backseat' autonomy to the existing 'frontseat' control system fitted to the vehicle, to enable operation in littoral and congested waters without the requirement of operators—or the need to surface to acquire GPS fixes. This will deliver a significant step forward in marine autonomous systems capability for operating in littoral and coastal settings.

In the short term, the SLAM system will enable UUVs to navigate and survey locations where the bathymetry is either non-existent, low resolution or is not dependable. Further down the line it will be possible to fuse the data from several technologies. For example, sonar imaging can be used for longer distance SLAM, while vision imaging can then take over to deliver more precise near-field localization when

the vehicle is within vision range. This opens up the possibility of using the system for more complex intelligence, surveillance and reconnaissance tasks, as well as environmental monitoring and subsea infrastructure interventions.

DASA announced the funding call in 2020, and the NOC led project has been awarded £400,000 of the £2 million that was available under Phase 2 of the Autonomy in Challenging Environments Program, which aims to deliver next generation autonomous and semi-autonomous technologies to drive revolutionary change in both defense and wider societal applications. The project will be managed by the NOC's Marine Autonomous Systems Development Group and will be the first opportunity to work with NOC Marine Robotics Innovation Centre partner tpgroup through their Autonomy and Spatial Modelling team.

In August 2020, the NOC, Royal Navy, and Dstl renewed and expanded their Memorandum of Understanding (MoU) within the underwater environment and collaboration in trials and testing of Marine Autonomous Systems (MAS) and novel sensors for the collection of marine data. The MoU will broaden the Navy's capability in the utility and deployment of autonomous and robotic underwater systems.

WAM-V 16 ASV DELIVERED TO NIWC

Marine Advanced Robotics recently announced the delivery of a WAM-V 16 ASV to NIWC Pacific to support multi-domain unmanned maritime system autonomy. The WAM-V technology is particularly well suited for subsurface, surface and air sensor deployments in real world ocean conditions where asset recovery is critical in less-than-ideal conditions.

"WAM-V stability and portability are unmatched and together with NIWC and our industry partners, we demonstrated the multi-domain (air, surface and subsurface) capabilities of the

WAM-V during the Citadel Protect Autonomous Security Demo at NAVBASE San Diego where we launched a Teledyne Seabotix ROV and a Planck Aerosystems UAV," said Mark Gundersen, President & CEO of Marine Advanced Robotics.

In addition to providing a stable platform for UAV, ROV and AUV launch and recovery, the stability of the WAM-V has proved invaluable in sensor deployments, like multi-beam echosounders, where the quality of the data is greatly improved by the WAM-V stability. www.wam-v.com

NOAA LAUNCHES TWO COASTAL MODELS FOR MARINER SAFETY

NOAA has announced two new coastal condition forecast models that will enhance critical decision making for mariners along the West Coast and Northern Gulf of Mexico. The models provide continuous quality-controlled data on water levels, currents, water temperature and salinity out to 72 hours.

Forecasts from both models are used by commercial and recreational mariners, fishermen, emergency managers, search and rescue responders, and National Weather Service marine weather forecasters.

"The West Coast model will help the Coast Guard with search and rescue and has implications for other stakeholder groups, such as navigation, shipping, and fisheries," said Nicole LeBoeuf, acting director of NOAA's National Ocean Service. "The Gulf model improves the safety of marine navigation in an area vital to the safe movement of energy resources and other shipping."

These two new models join a network that now totals 15 such models in coastal waters around the United States. The models—located in critical ports, harbors, estuaries, Great Lakes, and coastal waters—are part of a larger national backbone of real-time data, tidal predictions, tide and lakes datums, and operational modeling that enables users to make the best decisions for their needs.

NOAA's Satellite and Information Service supports a key role in developing the West Coast Operational Forecast System, providing near-real-time satellite observations, including temperature, sea-

surface height and coastal currents.

"The West Coast operational system is the latest example of NOAA's commitment to bringing its expertise and data resources together to improve the way Americans live, work and do business," said Steve Volz, director of NOAA's Satellite and Information Service.

The Northern Gulf of Mexico model combines three models into one and extends the model to include coverage up the Mississippi River to Baton Rouge, Lake Pontchartrain and Barataria Bay in Louisiana, and along the Corpus Christi waterways of Texas, as well as south to the Mexico border. The seaports covered by this model are some of the busiest in the nation in terms of tonnage, energy, value and other measures.



» Vessels can now use NOAA's new coastal conditions forecast in the Northern GOM to plan safer trips in and out of port.

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GREENSEA AND GRi SIMULATION TO DEVELOP SIMULATION ENVIRONMENT FOR OPENSEA

Greensea Systems, creator of OPENSEA®, the universal open architecture software platform for the marine industry, has partnered with GRi Simulations, creators of real-time simulation, modeling, and visualization for critical marine activities to develop a simulation environment for OPENSEA and OPENSEA-enabled control systems. The partners' objective is to further develop virtual training standards that will provide operators, technicians, and other subject matter experts the experience and practice needed to be successful in critical subsea environments using OPENSEA control systems.

Greensea contracted GRi to develop a back-end simulation environment for OPENSEA that provides a virtual environment constructed of custom scenes and a physics engine based on actual subsea vehicle models. The GRi system provides OPENSEA raw sensor data as well as



» Greensea and GRi will develop a back-end simulation environment for OPENSEA based on actual subsea vehicle models. (Image credit: Greensea)

AUTONAUT UNCREWED SURFACE VEHICLE SELECTED BY PLYMOUTH MARINE LABORATORY

An AutoNaut uncrewed surface vehicle (USV) equipped with a range of scientific sensors has been acquired by Plymouth Marine Laboratory. The state-of-the-art 5-meter craft is powered entirely by renewable energy and will be the first USV to regularly run scientific missions off the coast of the UK.

PML's Dr James Fishwick, Head of Smart Sound Plymouth and Head of Technology for the Western Channel Observatory commented: "We are thrilled to be working with AutoNaut. The PML Pioneer, as our AutoNaut will be known, represents PML's investment in marine science technology and will go ahead of the rest of our fleet in a pioneering journey of scientific discovery. It will be deployed extensively to deliver ground-breaking scientific research to the Western Channel Observatory and form a critical part of Smart Sound capabilities."

The USV is outfitted with a range of meteorological and oceanographic parameters including: weather station, CTD, pH, nitrate, phosphate, irradiance, Chl, CDOM, turbidity, dissolved Oxygen, pCO₂ and photosynthetic efficiency and rates. High-definition cameras will also be installed on the mast and sub-surface on the hull.

The AutoNaut USV uses no carbon fuel and is able to independently survey at sea for many weeks at a time. It is propelled by wave energy, using unique wave-foil technology, and has solar PV panels and battery pack to power onboard systems and sensors. The USV is pre-programmed to complete missions whilst carefully overseen from facilities in Plymouth.

Phil Johnston, Business Development at AutoNaut added: "PML have been huge supporters since our earliest prototypes so

raw sonar data so that an existing OPENSEA-enabled control system can work as-is within the simulation environment. This architecture enables training on current production-release OPENSEA systems. Greensea is currently providing the simulator for EOD Workspace, Greensea's software environment for maritime robotics working in Explosive Ordnance Disposal operations, RNAV2, Greensea's diver navigation system developed and marketed with STIDD Systems Inc., and Greensea's Professional ROV Workspace, sold as OEM software to several ROV manufacturers.

"Training is vital to developing and maintaining proficiency. While always challenging in the subsea industry, COVID-19 restrictions made getting offshore time more challenging over the past year. An accurate simulation environment that utilizes the exact software operators will use in the field is a meaningful and effective training system," says Ben Kinnaman, Greensea CEO. "The realism provided by the GRi system is spectacular. Since it provides raw sensor data to OPENSEA, operators can train on the entire software stack prior to going offshore."

This partnership represents a significant milestone for GRi. As CEO Russell Pelley puts it, "Developing simulator projects involving such top shelf vehicle hardware designs and leading edge control software represented by Greensea's innovative products is both a pleasure and privilege and we are gratified by the improvement in competency and operational safety to be gained by our clients. GRi is looking forward to the prospect of simulating a wide range of advanced marine systems through our partnership with Greensea Systems."

Greensea is offering a standard simulation environment for sale to its OEMs and direct to End Users for a variety of different navigation and control products, including the RNAV2 and EOD Workspace.

it's a real pleasure to now deliver our latest cutting-edge USV to them."

The AutoNaut USV will help to support the testing and development of a wide range of new products and services for the marine sector. PML Pioneer will work alongside PML's existing research vessels (Plymouth Quest and PML Explorer), a new Mobilis data buoy and will soon be joined by four ecoSUBs AUVs.

PML's AutoNaut USV is funded by Natural Environment Research Council / UK Research and Innovation (NERC / UKRI).



» The AutoNaut-5m USV PML Pioneer. (Photo credit: AutoNaut)



» The Mayflower Autonomous Ship carries a Porpoise recorder to listen for marine mammal activity and processes the data using cutting-edge AI models developed by IBM. (Photo credit: IBM)

INTEGRATING PASSIVE ACOUSTIC RECORDERS INTO ROBOTIC SYSTEMS

By Ryan Mowat, Director of Fisheries & Research, RS Aqua

In 2016, RS Aqua launched the multichannel Orca passive acoustic recorder, and the single channel Porpoise followed in 2018. Both recorders are very broadband, sampling at up to 384 kHz, and carry up to 4 TB of internal memory. They have proved successful in multiple sectors with almost 100 Orcas and 200 Porpoises being sold, with a high proportion into defence applications.

VERSATILITY AT DEPTH

Two things set the recorders apart. One is their versatility—the internal PCB stack, which forms the heart of each recorder, is made available by RS Aqua for custom integrations. This was demonstrated when the Orca recorder was drafted into the DSTL sponsored MASSMO (Marine Autonomous Systems in Support of Marine Observations) 4 project at the last minute in 2017. In the space of a few days, the project engineers integrated an Orca recorder into a Teledyne Marine



» RS Aqua launched Porpoise in 2018 and has already sold over 200 units worldwide. (Photo credit: RS Aqua)

Slocum Glider. The Orca was controlled remotely by the glider pilots and successfully recorded 6 days of broadband acoustics for the entirety of the Slocum's deployment. The study site was the deep-water Faroe Shetland Channel and the soundscapes recorded were

some of the most detailed RS Aqua had ever seen, with sperm whales, common dolphins, several unknown whales, seismic shots and a range of anthropogenic noise all obvious in the data, sometimes at the same time!

REAL-TIME DATA

The other key capability that both recorders have is the ability to stream data, which means they are particularly suited to applications which require acoustic analysis in real time. An on-going high-profile example of this is the integration of a Porpoise recorder into the Mayflower Autonomous Ship, or MAS for short (<https://mas400.com>). In commemoration of the original Mayflower crossing to north America 400 years ago, MAS will be the first full size unmanned ship to cross the Atlantic. It carries a Porpoise recorder to listen for marine mammal activity within listening range of the vessel and processes the data using cutting edge AI models developed by IBM for the project. MAS will provide unique insights into the population and distribution of marine mammals in the Atlantic, and for the first time inform scientists back on land about those findings in near real time.

THE FUTURE

Both projects demonstrate how RS Aqua recorders can be integrated into a range of surface and subsurface autonomous systems, and how they can be used for real time monitoring and underway decision making. RS Aqua currently has several projects underway developing these capabilities further for the research, commercial and defence sectors, with the aim of making real-time acoustic analysis on unmanned systems even more accessible in future.

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Tel: +44 (0)23 9400 4540



INTERIOR JOINS GOVERNMENT-WIDE EFFORT TO ADVANCE OFFSHORE WIND

Secretary of the Interior Deb Haaland recently joined the Secretaries of Energy, Commerce, and Transportation in a White House forum to meet with representatives from states, the offshore wind industry, and members of the labor community to identify solutions to the greatest challenges facing the development of this new industry. Interior is working with agencies across the federal government to advance the Biden-Harris administration's goal of increasing renewable energy development on federal lands and waters.

The event included a commitment by Interior, Energy and Commerce to establish a target to deploy 30 gigawatts (30,000 megawatts) of offshore wind by 2030, creating nearly 80,000 jobs.

"For generations, we've put off the transition to clean energy and now we're facing a climate crisis. It's a crisis that doesn't discriminate—every community is facing more extreme weather and the costs associated with that. But not every community has the resources to rebuild, or even get up and relocate when a climate event happens in their backyards. The climate crisis disproportionately impacts communities of color and low-income families. As our country faces the interlocking challenges of a global pandemic, economic downturn, racial injustice, and the climate crisis—we must transition to a brighter future for everyone," said Secretary of the Interior Deb Haaland.

At the event on March 29, Interior announced the final Wind Energy Areas (WEA) in the New York Bight—an area of shallow waters between Long Island and the New Jersey coast. The goal of the Department's Area Identification process is to identify the offshore locations that appear most suitable for wind energy development, taking into consideration coexistence with ocean users. As part of this process, Interior removed areas of highest conflict from consideration. The Department received input from the public and other governmental agencies through the Call for

Information and Task Force meetings. The WEAs are adjacent to the greater metropolitan Tri-State area of New York, New Jersey, and Connecticut, which is home to more than 20 million people, representing the largest metropolitan population center in the United States and a significant energy demand.

Additionally, the Department is initiating the environmental review of the third commercial scale offshore wind project by announcing a Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS) for Ocean Wind, LLC's proposed project offshore New Jersey. Ocean Wind has proposed an offshore wind project with a total capacity of 1,100 MW, enough energy to power 500,000 homes across New Jersey. The Department previously announced environmental reviews for Vineyard Wind (MA) and South Fork (RI) and anticipates initiating the environmental reviews for up to ten additional projects later this year.

"The offshore wind industry has the potential to create tens of thousands of family-supporting jobs across the nation by 2030, while combating the negative effects of climate change. These new jobs will cover a wide range of sectors, including manufacturing, installation, operations and maintenance and support services," said Bureau of Ocean Energy Management Director Amanda Lefton. "We are committed to active engagement with all stakeholders and partners to ensure the responsible development of renewable energy resources in federal waters."

At the forum, leaders discussed key opportunities and challenges to ensuring domestic economic and employment benefits of aggressively expanding offshore wind. The event helped gather input from diverse stakeholders who will contribute to a comprehensive strategy to establish domestic offshore wind manufacturing capabilities, a robust supply chain, and a domestic service industry to support offshore wind installation and maintenance on the U.S. Outer Continental Shelf.

TECHNIPFMC AND BOMBORA TO DEVELOP FLOATING WAVE AND WIND POWER PROJECT

TechnipFMC, a global leader in the energy industry, and Bombora, a leading wave energy technology company, recently formed a strategic partnership to develop a floating wave and wind power project in support of a more sustainable future.

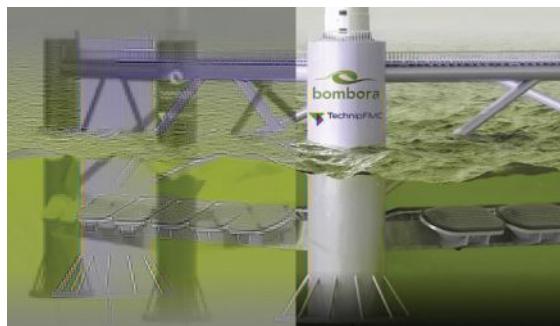
The relationship brings together TechnipFMC's unique technologies and experience delivering complex integrated Engineering, Procurement, Construction and Installation (EPCI™) projects offshore with Bombora's patented multi-megawatt mWave™ technology that converts wave energy into electricity.

The partnership will initially focus on TechnipFMC and Bombora's InSPIRE project. With engineering work initiated in November 2020, the partnership is developing a hybrid system utilizing Bombora's mWave™ technology. The

hybrid system demonstrator will deliver 6 megawatts of combined floating wind and wave power, followed by Series 1 and Series 2 commercial platforms which are expected to deliver 12 and 18 megawatts, respectively.

Jonathan Landes, President Subsea at TechnipFMC, commented: "Our core competencies and integration capabilities make us an ideal system architect and partner in developing renewable energy solutions alongside Bombora's experience and unique, patented mWave™ technology. We are delighted to work on a project that advances our commitment to the environment while contributing toward a more sustainable future."

Sam Leighton, Bombora's Managing Director, said: "Bombora is collaborating with TechnipFMC to accelerate



development of our floating integrated mWave™ platform solutions for commercial wind farms. With TechnipFMC's extensive track record of delivering large-scale projects to the energy sector and Bombora's innovative mWave™ technology, we are confident InSPIRE will play a key role in the offshore energy sector."



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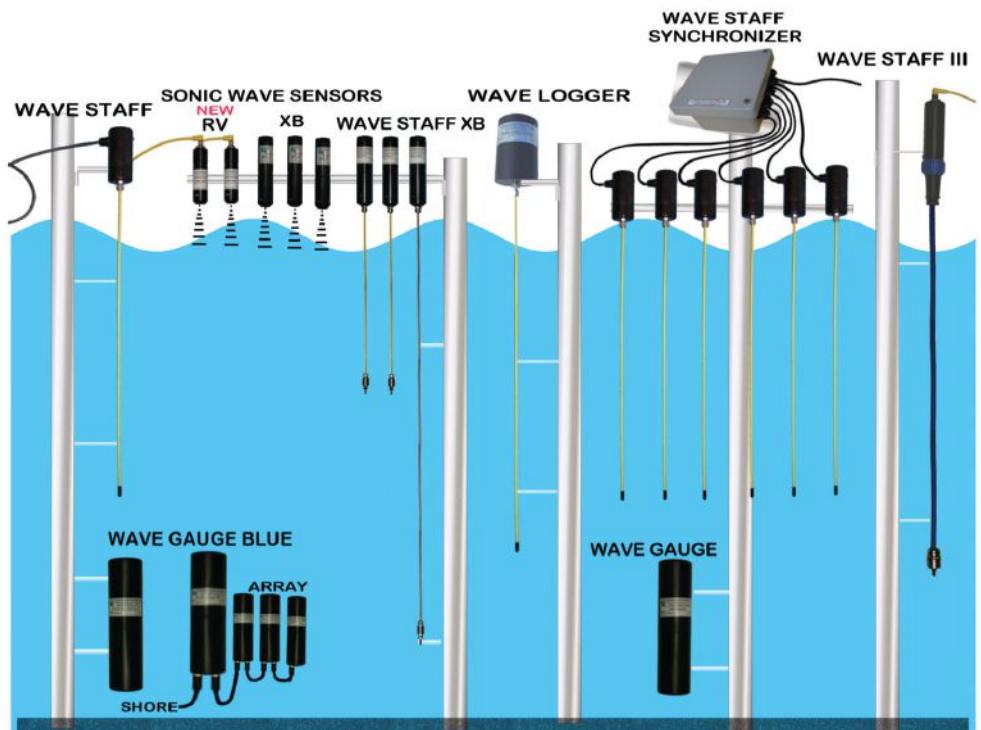
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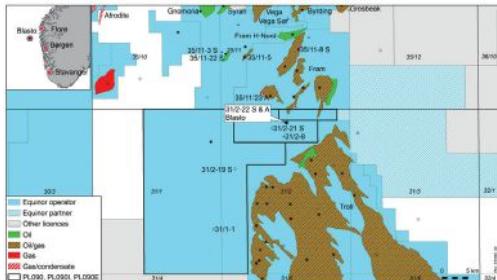
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» Exploration wells 31/2-22 S and 31/2-22 A in the Blasto. (Image credit: Equinor)

EQUINOR AND PARTNERS MAKE SIGNIFICANT OIL DISCOVERY IN THE NORTH SEA

Equinor and partners Vår Energi, Idemitsu Petroleum and Neptune Energy have made the biggest discovery so far this year on the Norwegian continental shelf (NCS). Preliminary estimates place the size of the discovery between 12 and 19 million standard cubic meters of recoverable oil equivalent, corresponding to 75-120 million barrels of recoverable oil equivalent.

"The discovery revitalizes one of the most mature areas on the NCS. With discoveries in four of four prospects in the Fram area during the past 18 months, we have proven volumes that in total will create considerable value for

society," says Nick Ashton, Equinor's senior vice president for exploration in Norway.

Exploration wells 31/2-22 S and 31/2-22 A in the Blasto prospect of production licenses 090, 090 I and 090 E were drilled about 3 kilometers southwest of the Fram field, 11 kilometers northwest of the Troll field and 120 kilometers northwest of Bergen.

Based on the quality of the resources and the proximity to existing infrastructure the discoveries can be developed and produced in line with Equinor's climate goals. The company's ambition is to reduce greenhouse gas emissions from operated fields and onshore plants in Norway by 40% by 2030, compared to 2018.

"Equinor is already an industry leader in low-carbon production. The discoveries in the Fram area will help us reach our goal of a further 40% reduction by 2030 while maintaining the current production level," says Ashton.

Exploration well 31/2-22 S struck a total oil column of around 30 meters in the upper part of the Sognefjord formation and an oil column of around 50 meters in the lower part of the Sognefjord formation. The oil-water contacts were proven at 1,860 and 1,960 meters respectively.

Exploration well 31/2-22 A struck high-quality sandstone in the Sognefjord formation, but the reservoir is filled with water and the well is classified as dry.

Regarding the discovery to be commercially viable, the licensees will consider tying it to other discoveries and existing infrastructure in the area.

The wells were not formation tested, but extensive data acquisition and sampling have been carried out.

These are the first and second exploration wells in production license 090 I. The license was awarded in the 2017 awards in predefined areas (APA 2017) licensing round.

Well 31/2-22 S was drilled to a vertical depth of 2,282 meters below sea level and a measured depth of 2,379 meters below sea level. Well 31/2-22 A was drilled to a vertical depth of 2,035 meters below sea level and a measured depth of 2,207 meters below sea level.

Water depth in the area is 349 meters. The wells have been permanently plugged and abandoned.

The wells were drilled by the West Hercules drilling rig, which is proceeding to drill exploration 34/6-5 S in production license 554 in the northern North Sea sector.

"The offshore wind sector is flourishing, and we see huge potential across the world for our solution! Floating offshore wind is going to thrive in the next twenty years and so wind developers will need a trusted solution that can provide data for these deeper water depths. It's a very exciting time for our team and the industry."

EOLOS' robust floating buoy uses LiDAR technology to gather high-quality wind and ocean data from any offshore location. The solution provides developers with an accurate forecast of the wind energy potential for the wind farm, while minimizing both CAPEX and OPEX of offshore wind measurement campaigns to reduce overall project cost.

Mikel Lasa, CEO of EIT InnoEnergy Spain, added: "EOLOS is a prime example of what EIT InnoEnergy sets out to do with its expertise and investments—take them from a start-up to a global business, ready to make an impact on how the energy transition rolls out. It's impressive to see EOLOS grow so substantially from its roots in Spain to supplying its solution to wind projects all over the world. And this is only the beginning of their journey."

EOLOS EYES US AND APAC OFFSHORE WIND EXPANSION

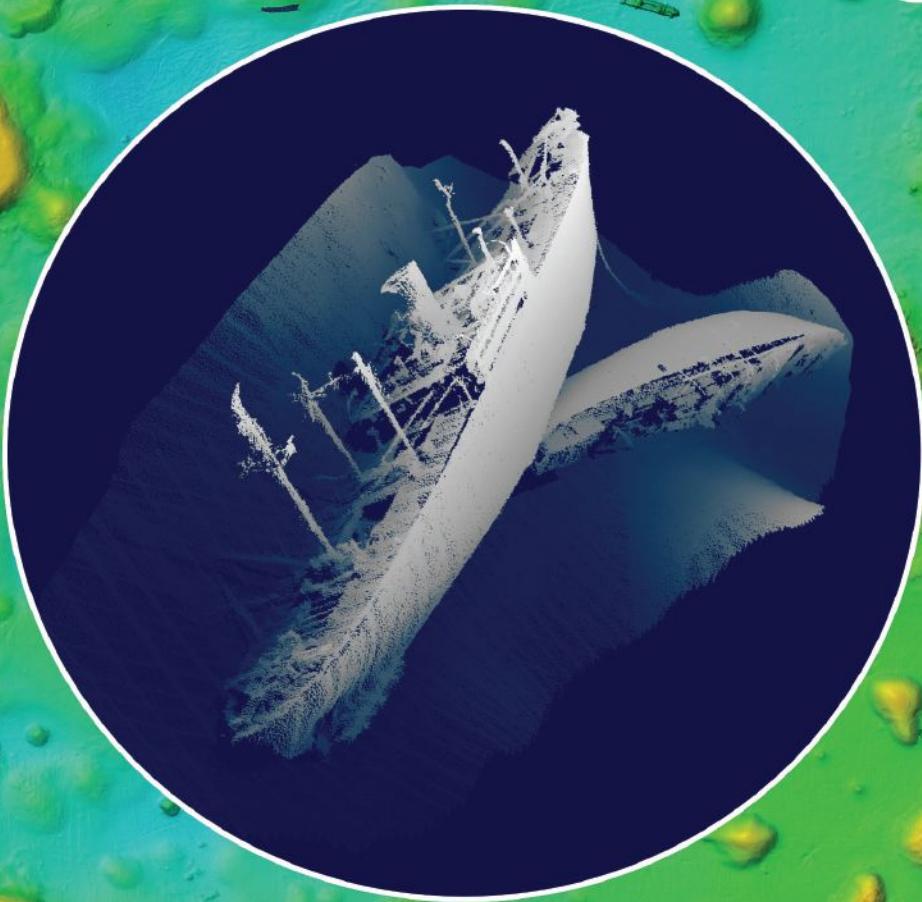
EOLOS, the Spanish turnkey provider of offshore wind and ocean data for the wind industry, recently announced a 30% growth in revenue as it laid out ambitious plans to expand its offering in the US and Asia Pacific markets.

The announcement follows a successful five years for EOLOS, which has seen the company deploy a fleet of 15 buoys on projects around the world, including the Hesselø wind farm in Denmark, Moray West in the UK and off the coast of Ulsan in South Korea for Shell. Since inception, EOLOS has been backed by EIT InnoEnergy, the world's largest sustainable energy engine, which has provided funding, brokered partnerships and consulted on strategic decisions. Now, due to increased demand, EOLOS has doubled its current workshop capacity in Spain, tripled its workforce, and formed strong alliances in both the U.S. and the U.K.



» The EOLOS FLS200 has been designed exclusively for the offshore wind industry. (Image credit: EOLOS)

Rajai Aghabi, CEO of EOLOS said: "To date we have tripled our workforce and we are grateful for all the support we have had from partners, suppliers and our specialist team to make this growth possible. In particular, without EIT InnoEnergy's knowledge and contacts in the offshore wind market, its commercial support and years of expertise in providing counsel to energy entrepreneurs, we wouldn't be accelerating at the pace we are today."



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BOEM COMPLETES ENVIRONMENTAL ANALYSIS OF VINEYARD WIND I

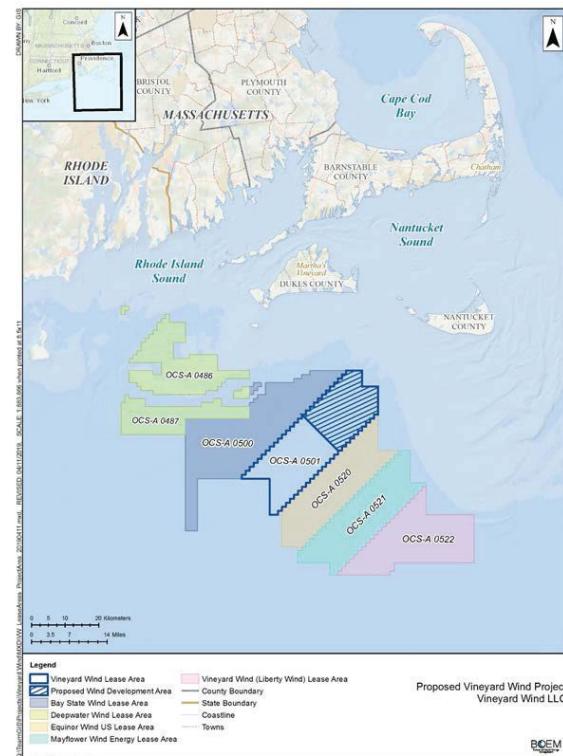
The Department of the Interior has announced that the Bureau of Ocean Energy Management (BOEM) has completed the environmental analysis of the proposed Vineyard Wind I offshore wind project. This represents major progress in the Biden-Harris administration's goal to accelerate responsible development of renewable energy on public lands and waters as a key component of tackling the climate crisis and creating jobs.

"The United States is poised to become a global clean energy leader," said Principal Deputy Assistant Secretary—Land and Minerals Management Laura Daniel Davis. "To realize the full environmental and economic benefits of offshore wind, we must work together to ensure all potential development is advanced with robust stakeholder outreach and scientific integrity."

Vineyard Wind is proposing what is expected to be the first project developed in their lease area, an 800-megawatt wind energy project offshore Massachusetts. The proposed project would be located approximately 12 nautical miles offshore Martha's Vineyard and 12 nautical miles offshore Nantucket in the northern portion of Vineyard Wind's lease area. If approved, it would be the first commercial scale offshore wind project in the United States.

"Offshore energy development provides an opportunity for us to work with Tribal nations, communities, and other ocean users to ensure all decisions are transparent and utilize the best available science," said BOEM Director Amanda Lefton. "We appreciate everyone's participation in the process and look forward to continuing to work with stakeholders on the future analysis of offshore wind projects."

On June 12, 2020, as a result of comments received during the National Environmental Policy Act process and in coordination with cooperating agencies, the Draft EIS was supplemented with additional analysis. Additional areas of analysis included reasonably foreseeable effects from an expanded cumulative activities scenario for offshore wind development, previously



➤ Vineyard Wind is proposing an 800-megawatt wind energy project offshore Massachusetts.

unavailable fishing data, a new transit lane alternative, and changes since publication of the Draft EIS to the proposed project.

Following a 45-day comment period and five virtual public meetings, BOEM incorporated comments received on the Draft EIS and the supplemental analysis into the Final EIS.

BOEM is working with the appropriate parties to finalize the Section 106 process, consistent with the National Historic Preservation Act, and to issue a record of decision whether to approve, disapprove, or approve with modifications the proposed project.

The U.S. Army Corps of Engineers and the National Marine Fisheries Service will sign this joint record of decision for their respective authorization decisions. The Final Environment Impact Statement is available at <https://www.boem.gov/vineyard-wind>.

LYTT LAUNCHES REAL TIME WELL DATA DASHBOARD

LYTT, a software and analytics company delivering actionable insights to inform optimized energy operations, has launched spotLYTT™, a new cloud-based visualization dashboard that gives operators unprecedented visibility into the production performance and health of each asset in their portfolio in real time.

spotLYTT™ livestreams reservoir insights from acoustic and temperature

data sourced from fiber optic sensors alongside time-series data to users anywhere in the world via the cloud. It provides O&G companies with an intuitive, secure and continuous way to see exactly what is happening downhole. These insights enable asset managers to identify immediate threats and opportunities to inform their operational decision making without needing to spend time handling and interpreting data.

LYTT's solution has been designed to fill this critical technology and operational gap, giving instant oversight to the

engineers and operations teams working to refine and optimize a global asset base.

Prad Thiruvenkanathan, LYTT's co-founder, said: "spotLYTT™ is a cloud-based web interface that provides users with a complete, dynamic view of production insights displayed alongside other contextual sensor information—allowing petroleum engineers to see the impact on production profiles within wells resulting from operational changes."

DEEP PURPLE PILOT PROJECT GETS SUPPORT FROM INNOVATION NORWAY

TechnipFMC is moving ahead with a pilot project for the Deep Purple™ green hydrogen offshore energy system, which is a key component of the company's energy transition offering.

TechnipFMC is leading the consortium to construct and test the system, with Innovation Norway recently announcing its contribution to this 9 million euro pilot project.

Deep Purple uses offshore wind energy to produce hydrogen from seawater. The hydrogen can be stored subsea for later use to provide renewable energy on-demand. Deep Purple overcomes one of the challenges of storing energy generated from renewable sources. Deploying these systems is critical to accelerating the energy transition.

The consortium consists of leading industrial partners Vattenfall, Repsol, ABB, NEL, DNV GL, UMOE and Slättland, and is further supported by academia, research companies and clusters.

The pilot will allow the consortium partners to prepare the system for large-scale offshore commercial use. The scope also includes the development and testing of an advanced control and advisory system and a dynamic process simulator.

Jonathan Landes, President Subsea, said: "Deep Purple is another example of our commitment to working with clients and industry to develop transformative technologies, leveraging our industry know-how and subsea expertise to serve the energy transition. Securing the approvals and funding to proceed with a scale pilot is a critical step in the path to commercialization. We are grateful to our partners and to Innovation Norway for collaborating with us as we advance sustainable renewables production."



» Deep Purple uses offshore wind energy to produce hydrogen from seawater. (Image credit: TechnipFMC)



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THE LOST 52 PROJECT: BRINGING HISTORY BACK TO LIFE



By Tim Taylor,
President & Founder,
Tiburon Subsea Research / Lost 52 Project

The suggestion that we know more about the lunar surface than what lies beneath our oceans is something of a cliché these days. It is also somewhat of an unfair assertion. Throughout history, civilizations have gazed upon the moon in wonderment and curiosity, mesmerized by its phases and cratered appearance. When attentions turned to the oceans, however, people were mostly presented with a featureless expanse of waves and weather—a place where sealife dwelled and monsters laid in wait. The small glimpses our ancestors had into the unknown depths became a rich source of legend and myth.

Today, this is no longer the case because over time our collective imagination became piqued by what really was beneath the waterline. This imagination has led us to successfully engineer highly advanced subsea technology, and within the next few decades we and various stakeholders from the ocean industries will be able to map the oceans that, unlike the moon, have eluded past generations.

IN SEARCH OF HISTORY

The Lost 52 Project is one such initiative that is already charting previously unexplored areas of the planet's seabed. Utilizing advanced deep-water autonomous underwater vehicles (AUVs), the Project has set out in search of archeological knowledge and understanding. World War II, although only 75 years ago, is accountable for more underwater historical wreck sites than any other time in human history, and the Lost 52 Project has set its goal to discover and document the 52 US submarines lost in battle.

To date, we have made numerous discoveries. These sites are the final resting place of 288 sailors. This is a monumental task and a search that, admittedly, may never be fully accomplished. That said, the search is the key. The ability to cover ground and put in the time is often a thankless task. Typically, when conducting commercial underwater surveys, the goal is to collect detailed coverage of an area; in our case, we are looking for relics of warfare.



▲ The bow section of the USS Grunion, 1/4 mile up the sloping front the main wreckage. (Image credit: Lost 52 Project)



AUV DEPLOYMENT

For this project, we are deploying AUV systems equipped with synthetic aperture sonar and magnetometers enabling us to efficiently and effectively collect high-quality scans with 120% coverage. Generally speaking, collecting data is a simple process of filling in the designated search boxes in a consistent and methodical process and dealing with mechanical, equipment, and environmental obstacles as part of the process. The Lost 52 expeditions operate under the same process but more often than not, based on our research and 75-year-old data sets, we are tasked with searching a large area with insufficient time to cover the entire site. This creates a new dynamic for our entire team.

In preparation, our research is compiled into a master book that is printed and distributed to the team of archeologists, AUV technicians, and merchant marines. Each day we add new survey set data as the crew negotiate the local conditions, currents, weather that the fallen sailors experienced 75 years ago. This *in situ* connection with the past is an intangible but very real part of our exploration. Every day presents the challenge of selecting our next search area, knowing full well that our time and coverage may be limited. There is always the chance we may miss our target by a mere 50 meters, like we almost did when we discovered the USS *Grayback*, off Okinawa.

CREATING 4D REALITIES

Filming our discoveries is an obvious next step. The project aims to do more

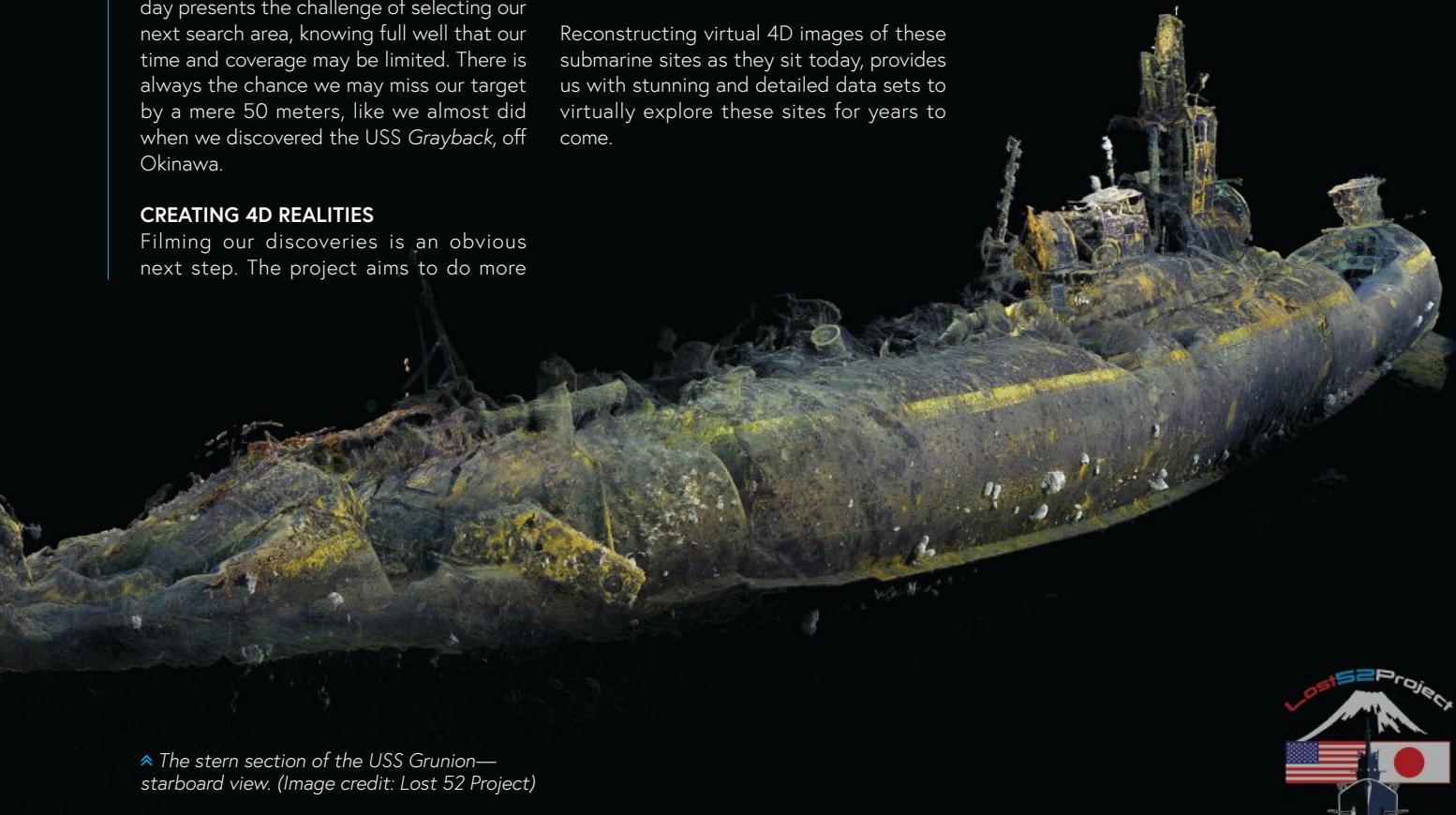
than just capture an image; we want to generate the most comprehensive image scan possible to enable us to create a 4D immersive experience. From the start, it was not enough to just locate these lost submarines; we had to document and share their story with the world. It was important to apply the latest technology, but we still had to deal with budgets, lead times, and priorities. Access to the latest technology is often cost prohibitive, and in our case, LiDAR was not a viable option. This led us to seek out and deploy the developing technology of underwater photogrammetry.

With navigation, accuracy is always an issue, and the collection of underwater data for 4D image creation has its challenges. It should be noted 3D data is what we are collecting using our sonar and multibeam payloads. Creating images using authentic video, as well as still images, allows us to add the 4th element of true *in situ* color, unlocking a truly 4-dimensional representation of the wreck that can be manipulated, studied, and explored. The added ability of utilizing our current ROV HD cameras with no additional equipment requirements is a game-changer.

Reconstructing virtual 4D images of these submarine sites as they sit today, provides us with stunning and detailed data sets to virtually explore these sites for years to come.

Not only does this enhance our educational STREAM (Science-Technology-Robotics-Art-Mathematics) programs, but it will also pay homage to the brave Navy Submariners of WWII. Modern-day technology is transforming how we see the underwater world. Just like with the moon, seeing will lead to knowing, and knowing will lead to wisdom.

This technology, in large part, was historically pursued to enhance defense and military capabilities. Ironically, this very same technology is now being used to explore and enhance our understanding of the world. Maybe if it was the other way around, we would be treading forward with greater wisdom. Ultimately our greatest test will be whether we have the ability to use that wisdom to harmoniously inhabit and sustain this planet. Until then, it should be mandated that those who seek exploration and understanding of our marine environments leverage breakthrough technology to tell the stories of what lies beneath.



▲ The stern section of the USS Grunion—starboard view. (Image credit: Lost 52 Project)





» Baker Hughes' solution can extend flexible pipes contracted service life by at least 50%, with the potential of 2.5x life extension. (Photo credit: Baker Hughes)

NEW PIONEERING SOLUTION TO OVERCOME FLEXIBLE PIPE STRESS

Baker Hughes, an energy technology company, has reached a significant technology milestone in pioneering a solution to overcome flexible pipe stress corrosion cracking (SCC) tendencies in high CO₂ content fields, such as those found in Brazil's pre-salt offshore developments.

The inspection, verification and assurance body, Lloyd's Register, issued Baker Hughes a design appraisal document (DAD) certification, validating the company's flexible pipe testing program and results. This follows an extensive three-year testing campaign by Baker Hughes—featuring more than 120 test setups, methodologies and characterizations, including dissection of pipes recovered from field operations—and marks a step towards a viable flexible pipe solution for the most demanding high CO₂ offshore fields. The certification verifies that on top of the standard 25-30-year equipment service life, Baker Hughes can extend flexible pipes contracted service life by at least 50%, with the potential of 2.5x life extension.

In 2017, the Brazil National Petroleum Agency issued a failure mode alert when it first identified flexible pipes used in high-pressure, high-CO₂ content fields caused broken tensile armor wires on a flexible pipe installation with potential environmental impacts and production losses. The DAD offers a path forward for the growth of flexible pipes to meet the safety and regulatory requirements in the oil and gas industry.

"As an energy industry, we must constantly share lessons learned to ensure safe, reliable and environmentally sound operations. Baker Hughes applied its technology expertise to pioneer a solution to solve this challenge," said Domenico Di Giambattista, vice president for flexible pipe systems at Baker Hughes. "While the SCC-CO₂ phenomenon was not something we experienced with our flexible pipes, it threatened the viability of certain offshore fields that require flexible pipe for development. This certification is an important step as we invest for growth to fully deploy flexible pipe systems in tough offshore environments."

The DAD confirms that the combination of advanced materials and state-of-the-art manufacturing processes produces a flexible pipe that can withstand the most severe operating conditions while still retaining advantages including flexibility in field layout, simplified FPSO balcony configuration, and reduced time to first oil. Moving forward, all installed flexible pipes by Baker Hughes in Brazil will be covered by the DAD and offer operators extended operating life before replacement. In addition, the DAD enables Baker Hughes to assess and predict the integrity of flexible pipes operating for several years.

Baker Hughes is committed to future flexible pipe testing to further advance its unique technology.

RECORD BREAKING DEEP OCEAN SALVAGE OF MH-60S HELICOPTER NEAR OKINAWA, JAPAN

Phoenix International Holdings, Inc. (Phoenix), under the direction of the U.S. Navy's Supervisor of Salvage and Diving (SUPSALV), located and recovered the fuselage of a downed MH-60S Seahawk helicopter in the Pacific, near Okinawa, Japan, from a record-breaking depth of 19,075 feet. This equates to just over 3.6 miles beneath the sea and is 266 feet deeper than the previous salvage record, also set by Phoenix and SUPSALV during an operation in 2019. The helicopter was located in March of 2020 using the U.S. Navy's Autonomous Underwater Vehicle "Trondheim" and then, a year later, Phoenix and SUPSALV returned to the site and recovered the helicopter on March 21, 2021 using the U.S. Navy's Remotely Operated Vehicle "CURV 21" and Fly Away Deep Ocean Salvage System. Both Trondheim and CURV 21 are rated to operate down to 20,000 feet.

Phoenix is an employee-owned, ISO 9001-2015 Management System certified marine services contractor providing manned and unmanned underwater solutions, design engineering, and project management services to a diverse set of clients worldwide. Expertise is available from seven regional offices in the areas of wet and dry hyperbaric welding, Nondestructive Testing, (NDT), subsea engineering, conventional and atmospheric diving, Autonomous Underwater Vehicle (AUV) and ROV operations. Company capabilities are directed to underwater inspection, maintenance, and repair; deep ocean survey, search and recovery operations; submarine rescue; construction; subsea tieback; plug and abandonment; subsea mining; archaeological; and documentary projects.



» Record Breaking Deep Ocean Salvage of MH-60S Helicopter Near Okinawa, Japan

MARINE-I SUPPORTS WORLD-FIRST GEO-TECHNICAL SUBSEA VEHICLE

Marine-i has agreed to support marine engineering specialist, Feritech Global, in its plan to create the world's first autonomous subsea vehicle specially designed for geotechnical survey work. Such a design would result in safer, more efficient and cost-effective seabed survey operations.

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

Based in Falmouth, Cornwall, Feritech Global carries out geotechnical survey work for marine industry clients around the world, using specialist equipment designed and operated by their own team.

Feritech's Managing Director, Rob Ferris, explained:

"Globally, offshore assets require an increasing number of detailed subsea surveys, which often have to be carried out in extremely challenging sea conditions. This is particularly true for the growing floating offshore wind sector, where installation has to take place in very deep waters."

"Using autonomous vessels to carry out geophysical survey work is an area that is already gaining traction. We now want to design an autonomous solution for geotechnical surveys. Such a vessel would need to be large in size to accommodate equipment for taking core samples of the seabed and for carrying out activities such as cone penetration testing and heat flow testing. Once developed, this new solution would have a global impact in reducing the risks and costs associated with seabed surveys."

Feritech engaged with the Marine-i project to get expert help in researching and designing the new vehicle. Marine-i and Feritech are collaborating on a structured development program to define the industry standards that the

new vehicle must meet, specify the tool requirements, and create a design solution. This will result in the construction of a pre commercialization prototype for sea trials.

Marine-i Program Director, Prof Lars Johanning, said:

"This is exactly the kind of innovative, disruptive technology that Marine-i was set up to support. Feritech's concept could revolutionise the way in which geotechnical survey work is carried out. By helping reduce risk and costs for developers, it will help accelerate the growth of floating offshore wind in the Celtic Sea, generating a positive economic impact on the local supply chain. Globally, it would attract interest from clients in a wide range of offshore activities."



» Marine-i and Feritech Global plan to make geotechnical survey workers safer, more efficient and cost-effective. (Photo credit: Feritech Global)

It is another great example of how Cornish businesses are spearheading new, 21st century solutions in marine technology."

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FET'S COMANCHE 38 ROV COMPLETES SEA TRIALS TO SUPPORT ARCTIC RESEARCH

Forum Energy Technologies recently announced that its light work-class remotely operated vehicle (ROV), Comanche 38, has successfully completed sea trials with Amundsen Science (Université Laval, Canada). The ROV was sold to the scientific research organisation last year and will be supporting exploration of Arctic and Sub-Arctic seafloor ecosystems. The vehicle was installed onboard the Canadian research icebreaker vessel, CCGS Amundsen.

The ROV's deployment procedures and versatile capacity trials included undertaking video surveys, high-resolution still photography of benthic habitats, the collection of coral and other benthic fauna samples, as well as sediment sampling using precisely positioned sediment push cores.

Kevin Taylor, FET's Vice President – Subsea Vehicles, said: "It is vital to the success of this research project that an operationally resilient ROV was chosen to ensure a reliable performance in the harsh environment and depths found in the Arctic. Our Sub-Atlantic Comanche ROV system has passed its sea trials, with its high thrust-to-drag ratio enabling it to operate in strong currents and its high specification with a seven-function manipulator arm successfully achieving complex underwater procedures."

"This is the second ROV we have delivered to Université Laval and we are thrilled it has passed its sea trials and the organisation is now in a position to begin studying the deep-water corals and cold deep eco-systems of the northern Labrador Sea and Baffin Bay."

The new Comanche ROV was manufactured at FET's facility at Kirkbymoorside, Yorkshire and replaces FET's previously utilized Super Mohawk ROV.

Since 2003, CCGS Amundsen has spent over 2,500 research days at sea and accommodated over 1,800 scientists, technicians, students, and professionals from over 20 different countries. The coronavirus pandemic has postponed some of its current work until next year.

Primarily funded by the Canada Foundation for Innovation through Université Laval, the first multidisciplinary expedition of the new ROV this year will allow a contingent of scientists from national research teams to study the marine and coastal environments of the Canadian and Greenlandic waters.

"The Comanche 38 will become a flagship equipment of the CCGS Amundsen for many years to come. We anticipate that it will be used in support of several cutting-edge research projects that aim to better understand the biodiversity and productivity of fragile Arctic marine ecosystems," said Alexandre Forest, Executive Director of Amundsen Science.



» Comanche 38 ROV, manufactured by Forum Energy Technologies. (Photo credit: Amundsen Science)



» The ROV, owned by Amundsen Science, will be supporting exploration of Arctic and Sub-Arctic seafloor ecosystems. (Photo credit: Amundsen Science)

WORKSTRINGS ASSIST IN RECORD-BREAKING GOM FLOWLINE CLEANOUT OPERATION

Workstrings International, a leading provider of quality drilling and tubular handling equipment, recently provided the 4 in. CTM26 drill pipe used in a record-breaking 28,789 ft flowline cleanout operation in the Gulf of Mexico.

Workstrings was called upon to supply the CTM26 drill pipe as an alternative to coiled tubing in the multi-phase project to decommission approximately 29,000 ft of 10 in. x 6 in. insulated pipeline in the Gulf of Mexico. The project, deployed in the Ozona Garden Banks 515 location, set a new offshore snubbing unit/hydraulic workover world record last month, onboard the Q4000 vessel.

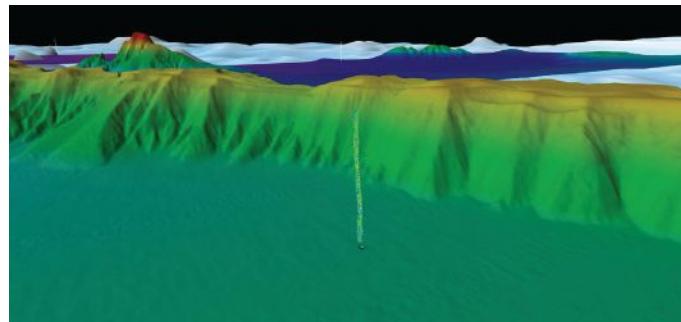
The project was completed in 22 days, ahead of incoming Hurricane Laura, and consisted of retrieving and removing a Pipeline End Termination (PLET) to surface of a DP3 drilling intervention vessel. To date, this is the longest subsea flowline cleanout conducted via this method, with the previous snubbing record depth of 23,800 ft set in 2006 on the Q4000 during the Mariner Energy Pluto pipeline clean out. Workstrings' drill pipe and engineering string design was used for this operation as well.

FUGRO CONDUCTS SEEP SURVEY AND GEOCHEMICAL CAMPAIGN IN SURINAM

Fugro is conducting a seep survey and geochemical campaign in Block 48, offshore Suriname, for PETRONAS Suriname E&P B.V. (PSEPBV). PSEPBV is a subsidiary of PETRONAS, a global energy and solutions partner ranked amongst the largest corporations in the Fortune Global 500.

The work for PSEBV is being conducted from the survey vessel MV Fugro Brasilis and involves geophysical data collection, heat flow measurements, core sampling and onboard geochemical analyses, which aim to optimise future exploration activities in this frontier area. The fieldwork for the campaign will run through Q1 2021 with subsequent geochemical analyses and final reports delivered in May 2021.

As a global leader in hydrocarbon seep mapping, Fugro maintains a multidisciplinary team of geophysicists, geoscientists and geochemists skilled in seeps data collection, processing and interpretation. Over the past 10 years, this group has performed more than 3 million km² of seep studies. A key component of Fugro's success is their capacity to perform all screening geochemical analyses at sea and share project data with shore-based clients in near real time. This approach, which is unique to



» 3D bathymetry rendering showing a water column anomaly indicative of active gas seepage from Fugro's 2019 seep hunting project for PETRONAS offshore Sarawak, Malaysia.

Fugro, enables rapid identification of high potential cores, thereby streamlining the project schedule and minimising impact on the marine environment. The ability to perform onboard analyses and remote data sharing also reduces travel and shipping requirements, contributing to more efficient and sustainable survey operations.

Brian Hottman, Fugro's Director for Caribbean and Pacific South America, said: "The Suriname-Guyana Basin is shaping up to be a world-class petroleum system, and PSEPBV is poised to be a major player in this region, as demonstrated by their successful results from the Sloanea-1 exploration well located in Block 52. We look forward to supporting their continued success in the region by defining high-potential areas within Block 48 and helping develop Suriname's vital resources in a safe and responsible manner."

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MVI is a small business, multifaceted solutions provider working with a wide variety of industries and government agencies whose project needs are in the fields of ocean observing systems, engineering and development, subsea communications, ROV operations and training, environmental consulting, marine mammal observation, offshore field operations and sampling, and the provision of Subject Matter Experts (SMEs) to address marine environmental challenges.





▲ VICTA is designed to offer defense markets with strategic asset for inconspicuous and rapid mission deployment. (Image credit: Subsea Craft)



▲ Subsea Craft's new DDU is almost ready for launch. (Photo credit: Subsea Craft)

CHECK THE TECH

VICTA: WHERE INNOVATION, TECHNOLOGY AND EXPERIENCE COALESCE

It was at DSEI 2019, in a pre-COVID-19 world, that the ocean industries were first introduced to VICTA, SubSea Craft's cutting-edge Diver Delivery Unit (DDU). Eighteen months on, the revolutionary hybrid vehicle is ready for launch.

Designed for rapid deployment from road, sea or air, VICTA is capable of transporting a crew of up to eight (two pilots and six divers) to a target drop-off from up to 250 NM out. The DDU's seamless transition from surface craft to submersible, enabled by an innovative fly-by-wire control system, makes it a compelling prospect for worldwide defense markets. The unit's impressive surface speed (c. 40 kts) is matched by its equally striking subsea performance, where four hours endurance is sufficient to navigate for 25 NM, fully submerged. Furthermore, compatibility with a standard ISO shipping container means that it is both globally deployable—without recourse to costly strategic platforms—and is relatively inconspicuous in terms of at-range mission insertion / extraction.

ALLIED FORCES

Subsea Craft's partnership with BAR Technologies has proven instrumental to R&D progress, and the two companies recently bolstered their alliance by signing

a new five-year product development contract. The deal will see SubSea Craft co-locate with BAR Technologies, moving production to a purpose-built facility in Portsmouth, UK.

VICTA AT A GLANCE

Control System: VICTA's is fully fly-by-wire, supported by an advanced control system developed in-house by BAR Technologies.

Command System: Developed by SCISYS, a Human-Machine Interface presents all vital performance, diagnostic and crew indicators.

Hull: The hull (carbon fiber and Diab core to yield an efficient strength-weight ratio) is capable of achieving a surfaced planning speed in excess of 40 kts and a cruise speed of 30 kts.

Surface Propulsion: Powered by a Seatek 725+ diesel engine which outputs 725 bhp, surface propulsion is provided by Kongsberg (Rolls-Royce) Kamewa Water Jet series.

Subsea Propulsion: Two 20 kW electric thrusters provide forward propulsion, with pitch and roll control through forward and aft hydroplanes. Four Copenhagen thrusters ensure precise speed depth control.

Battery: subC tech Li-ion SmartPowerBlocks™ with built-in battery management systems provide 140 kW of power dedicated to subsea operation.

Life Support: Onboard open circuit air system provides eight operators with four hours of air (breathing rate of 18 lpm with a reserve of 20%).

Seating: Ullman Dynamics molded seats with advanced shock-absorbing systems are mounted on a rail attachment system. Reconfigurable based on mission.

Certification and Safety Case: Alongside DNV-GL certification, VICTA has Lloyd's Register certification, and the safety case is developed in conjunction with BMT.

FUTURE PLANS

Plans are for VICTA to incorporate increased autonomous capabilities, both on the surface and below. This will inevitably broaden the maritime appeal of the craft for executing intelligence, surveillance, reconnaissance, and target acquisition missions, but this continued focus on automation will also extend the applicability of VICTA as a digital platform, with the potential to harness and exploit data from across a myriad of onboard systems and sensors.

SONARDYNE DELIVERS FIRST FUSION 2 REMOTE SURVEY OPERATIONS

Sonardyne has successfully provided remote Fusion 2 survey operations capability on a live subsea construction campaign in the US Gulf of Mexico. Using its new Remote Operations Access Module (ROAM), Sonardyne surveyors based in the UK were able to remotely access and operate the Fusion 2 survey and construction software onboard Subsea 7 vessels in the Gulf of Mexico.

By using the ROAM, potential limitations on operations posed by international travel restrictions were mitigated and the decision to upgrade from Fusion 1 to Fusion 2 was de-risked.

Fusion 2 streamlines offshore field development operations by reducing the time and capital expenditure needed to undertake survey and construction tasks. It combines traditional Long BaseLine (LBL) and inertial navigation system (INS) techniques in one, unlocking significant benefits, not least being able to perform real-time simultaneous location and mapping (SLAM) calibration of sparse seabed transponder arrays. Real-time SLAM calibration capability means far less hardware has to be deployed on the seafloor, significantly reducing vessel time, environmental impact and equipment inventories.

ROAM is a rugged, portable communications link in a box which can operate over satellite or any other available network, such as 4G/5G and vessel Wi-Fi, providing secure access between Sonardyne engineers and any vessel needing remote expert assistance.

The remote operations service was provided last summer during a deepwater campaign on the Mad Dog Phase 2 project in the US Gulf of Mexico. Subsea 7 onboard surveyors were able to undertake remote training in Fusion 2 prior to deployment. Then, using the ROAM, Sonardyne surveyors working onshore in the UK were able to work shifts alongside their counterparts onboard the vessel in Fusion 2, supporting live positioning operations and taking secure control if required.

Edward Moller, Head of Energy at Sonardyne, said: "Facilitating remote operations is just one of the many steps we're taking

towards meeting the industry's and our own digitalization, environmental and safety goals. While this is the first time, we've provided a remote operational support for Fusion 2, it's just the latest remote capability we routinely offer across our business, from data harvesting using uncrewed surface vessels to Ultra-Short BaseLine system verification tests on vessels of opportunity."



» The Harvey Intervention, used during the Mad Dog project. (Photo credit: Subsea7)



» Structures being installed during the Mad Dog construction campaign. (Photo credit: Subsea7)

FILM-OCEAN ACQUIRES SCHILLING HEAVY DUTY WORK CLASS ROV

ROV specialist Film-Ocean Ltd, based in Aberdeenshire, recently invested a six-figure sum in a Schilling Heavy Duty Work Class ROV and plans to expand its workforce to support the company's ambitious growth plans.

The Schilling Heavy Duty Work Class ROV is capable of operating at depths

of up to 4000 m and is supported by an Active Heave Compensation Launch and Recovery Systems (AHC LARS). The HD Work Class ROV is well known within the industry as a high specification vehicle, making it an ideal system for IRM, construction support and decommissioning work scopes especially in deeper waters.

Of late, Film-Ocean's ROV fleet has been deployed across the world with recent operations in UKCS, Mediterranean, West Africa including Angola, Ghana and Ivory Coast where the ROVs have been deployed on UWILD (Under Water Inspection in-Lieu of Dry Docking), construction and IRM (Inspection, Repair and Maintenance) operations supporting both oil and gas and offshore wind projects.

BV AND NEXANS PARTNER ON OWF PROJECT/RISK MANAGEMENT

Bureau Veritas (BV), a world leader in testing, inspection, and certification, and Nexans, a global player in electrification, have signed a partnership agreement to reduce risk and promote best practices for turnkey deliveries of high voltage power cables used for connecting offshore wind farms (OWF) to onshore grids.

Currently, the energy transition and the role of offshore wind is a critical concern for society. The offshore wind sector is developing rapidly, and substantial growth is expected for decades to come. At the same time, insurers' studies confirm that high voltage power cables are among the most critical elements of offshore wind farms. Reliability of high voltage power cables end-to-end solutions, including installation, becomes an essential enabler for the current and the next generation of cables required to capture energy in deeper water. Bureau Veritas and Nexans will partner to address this challenge and build trust for all stakeholders.

Nexans provides high voltage cables to transfer the energy generated by offshore wind farms. Nexans is at the forefront of best practice in the industry with end-to-end solutions and has an extensive track record of projects delivered to the offshore wind industry—including the first commercial floating wind farm. As offshore wind farm installations are further away from shores and in deeper waters, the risk of failures could increase making reliability on quality of cables and their installation key. The partnership builds on Bureau Veritas' maritime expertise and extensive experience in risk management to help the offshore wind sector reduce operational risk.



With thorough risk management and compliance with industry best practices, Bureau Veritas can offer its assurance on Nexans end-to-end Engineering, Procurement, Construction and Installation (EPCI) operational model. Effectively managing risk provides operational assurance and reliability with less downtime, reduced repair and replacement costs, and increased trust.

Nexans CEO, Christopher Guérin, said: "I'm happy to announce that we have entered into a long-term partnership with Bureau Veritas. Together, we will certify the Nexans "Way" of managing EPCI projects and risks, develop new standards for the offshore wind farm and interconnection industry, reduce the risk profile of such projects and develop improved standards."

Matthieu de Tugny, Executive Vice President Marine & Offshore at Bureau Veritas, said: "At Bureau Veritas, we help shape a world of trust. By creating standards and verifying all criteria are met, we can help Nexans build further trust. Our marine expertise and experience in risk management and subsea to surface connections combined with state-of-the-art software tools will make this collaboration a success."

PRYSMIAN FINALIZES CONTRACT FOR WIND FARM CABLE

Prysmian Group recently announced a finalized contract agreement with RWE Renewables, one of the world's biggest offshore wind farm developers, for the development of the turnkey high voltage submarine and land export cable connection worth over €200 million for the 1.4 GW Sofia Offshore Wind Farm project. The Group previously announced the preferred bidder agreement in November 2020.

"This is a prestigious project for Prysmian, and we are delighted to have been selected by RWE to provide our state-of-the-art cable technology for the transmission of green energy from Sofia Offshore Wind Farm to supply enough power to meet the needs of 1.2 million UK households each year," commented Alberto Boffelli, COO Project BU, Prysmian Group.



» The Leonardo da Vinci, Prysmian's new cutting-edge cable laying vessel. (Image credit: Prysmian)

Prysmian Group will be responsible for the design, supply, installation and commissioning of an HVDC symmetrical monopole cable system that will connect Sofia's offshore converter station with the onshore converter station in Teesside. The project involves more than 440 km of ±320 kV submarine export cables with XLPE insulation, and 15 km of ±320 kV land cables with P-Laser insulation.

The offshore cable operations will be carried out using the Leonardo da Vinci, Prysmian's new cutting-edge cable laying vessel that is the most capable in the market and is

able to offer enhanced project versatility. Commissioning of the project is scheduled by the end of 2026.

Sven Utermöhlen, CEO, Wind Offshore Global of RWE Renewables, said: "Our signing of the contract with world leading cable supplier Prysmian shows RWE is once again driving innovation as Sofia will be the first project to employ their latest HVDC cable technology and the first to use the brand new Leonardo da Vinci. Today's signing is another tangible step for the project that is now officially in its construction phase."



» Kevin Parker, OceanTools

OCEANTOOLS SUPPORTS TSUNAMI DETECTION PROJECT

OceanTools is supporting a Tsunami Detection Project in Southeast Asia, successfully delivering their first shipment of Tsunami Detection Housings to a client in Indonesia.

Depth rated to 7,500 m, the housings will be utilized for early detection of tsunami threats, which will provide the authorities the opportunity to efficiently evacuate people living in its path, therefore, reducing the number of fatalities.

The OceanTools housings are designed to contain various sensors, including seismometers and extremely accurate pressure sensors, to measure earthquakes and the resultant tsunamis. The housings are linked together using telecommunications cable that carry the data great distances, from the sensors over fiber optic to shore based monitoring stations. The OceanTools Tsunami Detection Units have been created with a modular design, therefore, highly configurable to suit client's individual requirements.

"Nearly 230,000 people lost their lives in the Indian Ocean Boxing Day earthquake and tsunami of 2004," stated Kevin Parker, OceanTools, Managing Director. "Being involved in a project that has the potential to save human lives on this scale is deeply rewarding for us. As a result of developing such technology, we now sit on a UNESCO Joint Task Force that uses our technology, not just for tsunami detection, but may also be used to monitor the effects of climate change on the world's oceans."

RN TO BUILD CABLE PROTECTION VESSEL

The UK is synonymous with submarine communications cables. The nation pioneered the technology and London's importance as a financial hub makes it a critical link in the global network. This makes the UK reliant on submarine cables and means that cable disruption is a real threat. This was highlighted by the chief of the British defense staff in 2017, who said Britain and NATO needed to prioritize protecting these lines of communication.

The recent annual *Defence Review* called for the building a ship specifically to protect cables. The Royal Navy described it as a new "multi-role ocean surveillance ship." It will carry "remotely-operated and autonomous undersea drones to gather information on potential threats lurking in the water."

This could be the beginning of a trend towards specially designed vessels using such drones for cable protection in many other countries as well. It will be worth watching to see how quickly this trend develops.

Ocean Monitoring

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» The 350 kilometers of array cables will be installed by cable-laying vessel Nexus. (Image credit: Van Oord)

VAN OORD WINS CONTRACT FOR SOFIA OFFSHORE WIND FARM

Following the announcement that RWE has reached a financial investment decision for Sofia Offshore Wind Farm, Van Oord has confirmed that it has been contracted for the engineering, procurement, construction and installation (EPCI) of array cables and the monopile foundations for this project.

The 1.4 GW Sofia Offshore Wind Farm is one of the world's largest offshore wind projects.

Sofia is sited on Dogger Bank in the central North Sea, 195 kilometers from the North East coast of the UK. Through its UK branch MPI Offshore, Van Oord will create a logistics hub to deliver the comprehensive scope of work. The 350 kilometers of array cables will be installed by cable-laying vessel Nexus.

"RWE and Van Oord know each other well having worked together on four UK projects prior to the signing of this most recent EPCI contract for foundations and array cables. At 1.4GW, Sofia is our largest and most ambitious offshore wind development to date. We look forward to leveraging our vast experience and learnings as we progress into the construction of this flagship project, and to realizing its potential in terms of contributing to the UK's net zero energy ambitions," said Sven Utermöhlen, Chief Operating Officer Wind Offshore Global of RWE Renewables.,

The project will be executed by Van Oord Offshore Wind UK from their MPI Offshore office in Stokesley Teesside. With the onshore converter station located near the village of Lackenby in Teesside and the recent announcement by the UK government of Freeport status for the Tees Valley, the area is expected to receive a boost. This will deliver opportunities for the local supply chain and create new jobs.

"Our project team is busy preparing for this great offshore wind project. Now that the contract is signed, the design phase will be started and the project team will commence its activities from our Stokesley office. The recent announcement of Freeport status for the Tees Valley will further stimulate the regional development of the offshore wind sector in this area. In the coming period, we will be actively marketing our supply chain opportunities and vacancies with a focus on sourcing well-trained staff," said Arnoud Kuis, Managing Director Van Oord Offshore Wind.



» Sofia is located 195 kilometers from the North East coast of the UK. (Photo credit: Van Oord)



» Earlier this year, Sandia scientists connected a distributed acoustic sensing interrogator system to Quintillion's existing fiber optic cable network along the seafloor of Oliktok Point. (Image credit: Sandia)

SANDIA LABS PARTNERS WITH QUINTILLION ON ARCTIC RESEARCH

Warming at roughly double the rate as the rest of the world, the Arctic is disproportionately affected by climate change, yet the region remains one of the least understood.

Sandia National Laboratories scientists are working to gain understanding of the area by capturing and analyzing data pulled from the depths of the Arctic Ocean.

In early February, a team of Sandia scientists, led by geophysicist Rob Abbott, connected a distributed acoustic sensing interrogator system to Quintillion's existing fiber optic cable network along the seafloor of Oliktok Point. This is the first time distributed acoustic sensing has been used to capture data on the seafloor under sea ice in the Arctic Ocean. The system captured and recorded cable vibrations 24 hours a day for a full week to identify the natural and human activity taking place within the data-starved ocean.

This new monitoring method holds the potential to persistently capture a wide variety of Arctic phenomena in a cost-effective and safe manner in a fragile environment, Abbott said. The team expects to identify climate signals, such as the timing and distribution of sea ice breakup, ocean wave height, sea ice thickness, fault zones and storm severity. Shipping, whale songs and breaching may also be recorded.

"This is a first-of-its-kind data collect, and as far as what national laboratories do, this is exactly the type of high-risk, high-reward research that could make a huge difference in how we're able to monitor the Arctic Ocean," said Sandia Manager Kyle Jones. "This really is on the cutting edge of seismology and geophysics, along with climate change and other disciplines."

"Quintillion's fiber optic cable is in a favorable place on the North Slope of Alaska," Abbott explained. "This technology works for this project for several reasons. We are not sending a boat out to plant monitors; we're not traipsing over the sea ice trying to install sensors. This cable will exist for decades and we can take good data on it. It's a very safe way of taking this measurement in a hazardous environment."

The team is beginning to analyze the first 168 hours of data, and researchers are encouraged by their findings. They have identified data indicative of ice quakes, ocean tides, currents and even a low flying hovercraft.

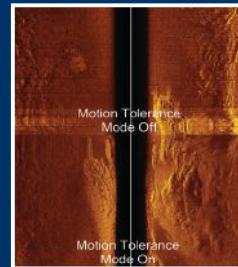
"The opportunity to work with some of the most knowledgeable geophysicists and data scientists in the country is exciting and an honor," said Michael McHale, Quintillion's Chief Revenue Officer. "Supporting the work of the scientific community has long been a goal of Quintillion's. Accomplishing that goal with a client as highly regarded as Sandia Labs exceeded our expectations."

This collect was the first of eight week-long data collects that will happen over the next two years across all four Arctic seasons: ice-bound, ice-free, freezing and thawing. A third year will be spent further analyzing data.

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A NEW IMPERATIVE FOR OCEAN OBSERVATION



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

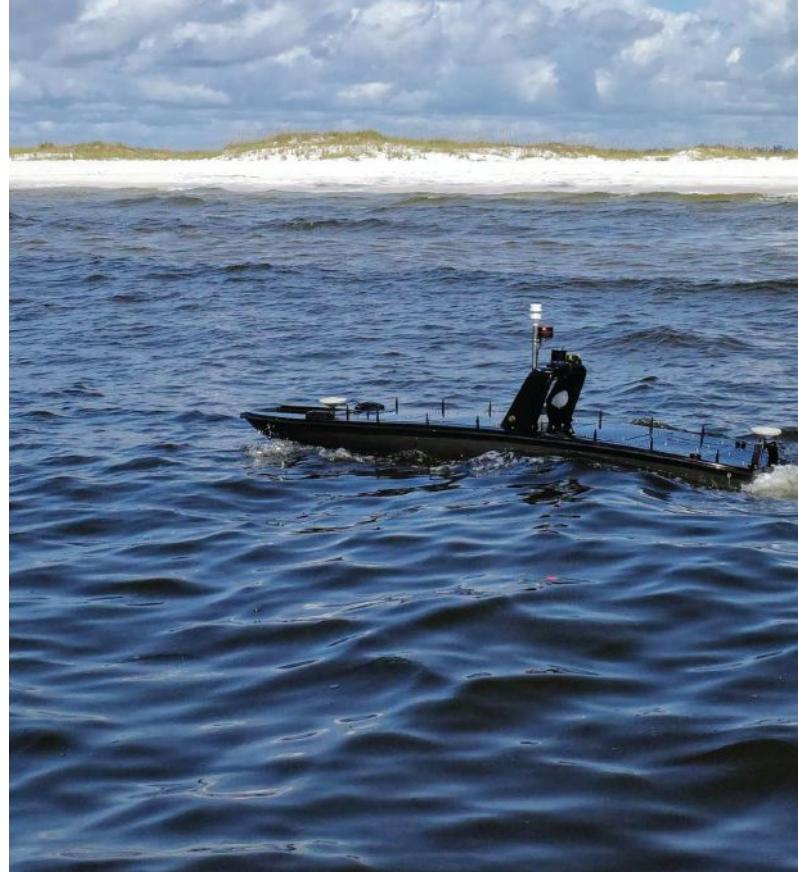
As readers of *ON&T* know, it is the oceans that sustain the planet. A number of streams, most notably accelerating climate change, have come together in 2021. Collectively, they highlight the continuing importance of comprehensive ocean observation and making data-driven decisions based on these observations. Making these decisions depends on collecting the right data, at the right place, at the right time. This is not a trivial undertaking.

However, where those with stewardship for various aspects of ocean sustainment cannot find an affordable way to collect this data, it will not be obtained. These gaps lead to an incomplete picture of the ocean's health, and with it, sub-optimal solutions to achieving long-term ocean sustainment. Today, due to rapidly emerging technologies such as commercial-off-the-shelf (COTS) unmanned maritime vehicles, there now exist new, innovative ways that this real-time cataloging of oceanic phenomena can be conducted at relatively low cost.

In the past, there have been some tentative attempts, such as employing sea gliders, to leverage unmanned maritime vehicles to collect such data, but there have been few comprehensive evaluations of such a capability. Under U.S. Navy-NOAA stewardship, a months-long test has been completed, and now the oceans community can build on the results of this demonstration to evolve a more-comprehensive oceans observation regime.

NEW DATA COLLECTION PARTNERSHIP

The National Oceanic and Atmospheric Administration (NOAA) and the U.S. Navy have formed a partnership to obtain and utilize unmanned maritime systems and to codify their policies that govern their operations. As reported previously in *ON&T* in an article entitled, "NOAA, U.S. Navy Will Increase Nation's Unmanned Maritime Systems Operations," this cooperative effort was driven by the need to enhance ocean observation to address pressing environmental and national security concerns.



A major part of this effort involves the two organizations expanding the development, acquisition, fielding and operations of unmanned maritime systems in coastal and ocean waters. The U.S. Navy's Naval Meteorology and Oceanography Command is leading the Navy-NOAA effort, one that formalizes the Commercial Engagement through Ocean Technology Act of 2018 that directs NOAA to coordinate with the U.S. Navy on a wide range of functions including research of emerging unmanned technologies.

This NOAA-U.S. Navy partnership is an important initiative that underscores the vital nature of robust data collection that is critical to ensuring the health and vitality of the world's oceans. Both organizations have previously sought ways to collect more data at lower cost. For both the U.S. Navy and NOAA, a major appeal of unmanned systems is that they can provide an affordable and persistent sensor picture.

UNMANNED SYSTEMS

Unmanned systems have a strong appeal. Due to the prohibitive costs of using manned air or sea craft to conduct these observations, as well as the dangers of using these vessels in bad weather or in turbulent waters, the only effective solution may be to proactively pursue a substantial investment in unmanned surface vehicles to conduct these observations.

In support of NOAA and U.S. Navy objectives for ocean observation, the Commander Naval Meteorology and Oceanography Command (CNMOC) invited one U.S. corporation, Maritime Tactical Systems Inc. (MARTAC) to demonstrate the use of commercial-off-the-shelf unmanned surface vehicles to conduct a comprehensive environmental monitoring evaluation. Under CNMOC's stewardship, an Advanced Naval Training Exercise (ANTX) was conducted in the Gulf of Mexico.

CNMOC scientists outfitted a commercial-off-the-shelf MANTAS unmanned surface vehicle with an environmental monitoring system



▲ MARTAC's MANTAS T12 is a commercial-off-the-shelf USV ideally suited for environmental monitoring evaluation. (Photo credit: MARTAC)



▲ Equipped with an environmental monitoring system and outfitted with solar panels, the MANTAS T12 is able to operate at sea uninterrupted for 30-day periods. (Photo credit: MARTAC)



▲ MANTAS T38 DEVIL RAY, using a surveying speed up to 10-15kts, can stay underway for up to 8-10 days. (Photo credit: MARTAC)

which was carried by this USV in order to provide a one-vehicle solution to important environmental sensing. Key to the success of this ANTX was the fact that the catamaran-hulled, compartmented MANTAS was outfitted with solar panels which enabled it to remain at sea for thirty continuous days.

CNMOC equipped the MANTAS with seven state-of-the-art sensors. This sensor data was communicated in real-time to the CNMOC control station. A second unmanned surface vehicle (another MANTAS), this one equipped with a different suite of ocean monitoring systems and sensors, was employed to conduct a second round of testing.

As testing continued with both USVs, CNMOC scientists and engineers provided vital feedback and suggested several enhancements to these vessels. This iterative process between developers, operators and engineers was inspired, in part, by past Office on Naval Research work in the area of user-centered design. Additionally, the ability to conduct surveys in higher sea states that had thwarted other unmanned surface vehicles in the past was one of the highlights of this months-long event. The catamaran-hull MANTAS was able to operate in low Sea State 3 during the ANTX.

SUSTAINABLE OCEAN OBSERVATION TAXONOMY

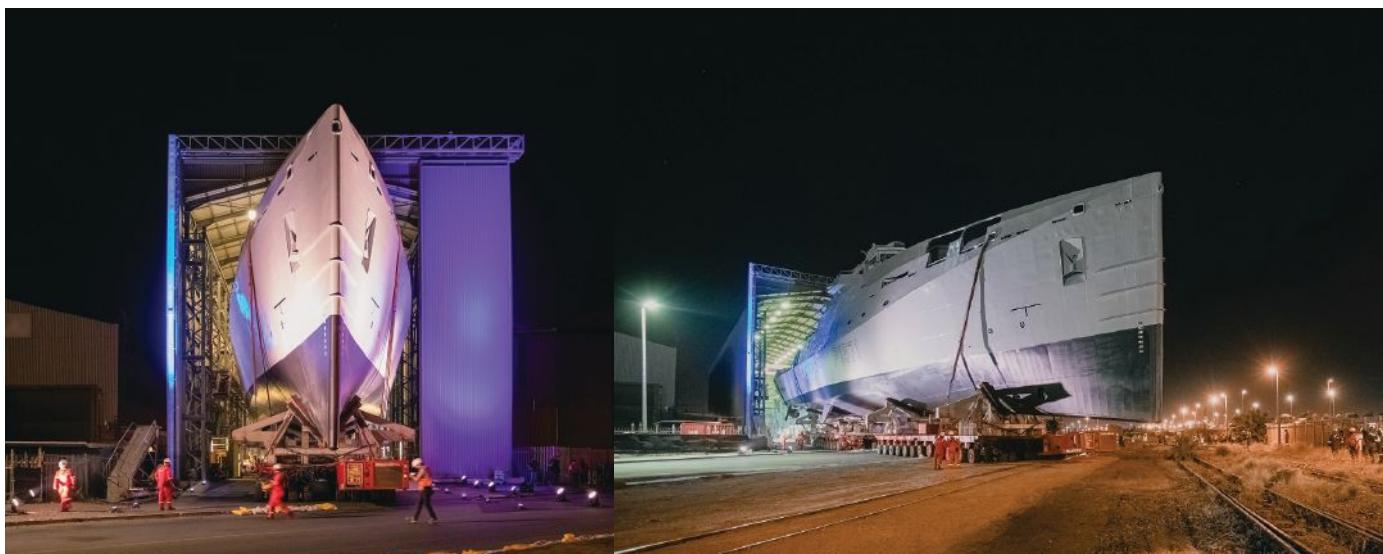
The informed readers of ON&T know that it is not hyperbole to say that dying oceans could imperil humanity. Ocean health cannot be sustained absent a robust, affordable and sustainable oceans observation regime so that data-driven decisions can be made to take steps to address the well-being of the oceans.

The use of commercial-off-the-shelf unmanned surface vehicles successfully employed during this ANTX can be readily "scaled-up" in oceans, seas, bays, rivers and other waterways and can lead the way to enhanced data collection, transmission and evaluation of water conditions. The results will help sustain a healthier ocean.

As one step forward in this effort, U.S. Navy officials encouraged MARTAC, to scale-up the 12-foot MANTAS used for this ANTX and produce larger vehicles. This was accomplished last year and a larger, 38-foot DEVIL RAY T38 USV, was deployed during U.S. Navy exercise Trident Warrior 2020 with positive results.

These larger vessels will be ideal USVs to conduct ocean observation due to their ability to carry considerably more sensors and remain at sea for longer periods. As one example of what this increased size provides vis-à-vis ocean observation, the T38 DEVIL RAY, using a surveying speed up to 10-15kts, can stay underway for up to 8-10 days.

The U.S. Navy, NOAA, and many other stakeholders recognize the critical need to understand the ocean environment. Therefore, we envision a tremendously increased demand for unmanned systems prototyping and experimentation to support robust and continuous ocean observation



» The MMIPVs are built according to the patented Damen Axe Bow design. (Photo credit: DSCT)

DAMEN SHIPYARDS CAPE TOWN LAUNCHES FIRST MULTI-MISSION INSHORE PATROL VESSEL

On March 25, 2021, Damen Shipyards Cape Town (DSCT) launched the first of three Multi Mission Inshore Patrol Vessels (MMIPV) procured by ARMSCOR for the South African Navy (SAN).

The vessels will augment South Africa's maritime security by enhancing the country's capability to respond effectively, rapidly and cost-effectively to threats such as illegal trafficking and fishing.

DSCT Project Manager, Ian Stewart said that the launch is an important milestone for the shipyard: "This is the culmination of three years of hard work by a dedicated team of people. Ultimately, more than one million man-hours of work will be invested in the construction of the three MMIPVs."

The more than 600-ton vessel was transported from the DSCT shipyard on the evening of 23 March 2021 to the Transnet National Ports Authority (TNPA) synchrolift at the Victoria & Alfred (V&A) Waterfront Basin. The move was conducted by Mammoet South Africa, using 48 axle lines of SelfPropelled Mobile Transporters (SPMTs) to provide precision movement. Mammoet Project Manager, Uzayr Karimulla, says while moving the vessel at night meant less impact on traffic, the reduction in light came with its own challenges. "Through careful planning, close collaboration, and the teamwork between DSCT and Mammoet South Africa, our team

made this move a success. We are very happy to have been part of the project, contributing to the advancement of safer waters in Southern Africa."

Once the vessel was raised onto the synchrolift, the team waited for high tide to come in before moving it out of the V&A Basin via TNPA tugs towards the Elliot Basin. The testing of the ship systems will now commence before the vessel will officially be delivered to ARMSCOR/SAN, before the end of the year.

The MMIPVs are built according to the patented Damen Axe Bow design, which ensures low resistance, high sustained speed in waves and superior sea keeping characteristics in the toughest conditions.

As vertical accelerations are reduced significantly and bow slamming almost eliminated, the safety of the vessel and crew increases considerably, reducing operational risks. The multi mission deck is used for supporting diving, search and rescue and anti-piracy operations.

DSCT HR & Transformation Manager, Eva Moloi, commented that DSCT is particularly proud of the many years it has invested in local South African skills transfer, training, and entrepreneurship development and collaboration, which have resulted in a strong South African pool of scarce trade skills and supplier partnerships:

"Our local skills transfer and Enterprise and Supplier Development (ESD) initiatives mean that we are not only contributing to the South African economy but ensuring that our local South African maritime market is less reliant on imports from international suppliers. DSCT fully supports the transfer of technology, inclusion of local companies in the execution projects, and stimulation of export transactions under the Defense Industrial Participation (DIP) program, which particularly focuses on benefiting SMMEs, Military Veteran (MV) Owned Entities and Broad-Based Black Economic Empowerment (BBBEE) Compliant Entities. The partnerships formed during this project have led to the successful launch of the MMIPV. One can truly state that the MMIPVs have been built in South Africa, by South Africans for South Africa," she adds.

The engineering of the vessel commenced in 2018 and the keel was laid in February 2019. "Despite the COVID-19 lockdown period, our local skills and partnerships, resilient production schedule and advanced planning capabilities of our Cape Town team, allowed the different subcontractors and teams to work on the vessel in a safe manner," added Moloi.

L3HARRIS TO BUILD UPGRADED COMMUNICATIONS SYSTEM FOR ROYAL NEW ZEALAND NAVY

The New Zealand Ministry of Defense has awarded L3Harris Technologies a prime systems integration contract to design, build and install an upgraded communications system to help confront the evolving challenges faced by the Royal New Zealand Navy (RNZN).

The upgrade will provide the amphibious sealift ship HMNZS Canterbury and the Offshore Patrol Vessels HMNZ Otago and Wellington with an advanced, adaptive, and cyber-resilient communication system that is seaworthy, reliable, and mission-ready. The upgrade will be led by the L3Harris project team in Melbourne, Australia, in close collaboration with New Zealand defense contractors Beca Applied Technologies and McKay.

"This contract represents L3Harris' ongoing commitment to support the Royal New Zealand Navy and the strategic importance of supporting sovereign industry development throughout Australasia," said Alan Titheridge, Managing Director, Australia, L3Harris. "The strategic relationship with Beca and McKay allows us to provide customers with more efficient and effective local installation services and sustainment support."



» The upgrade will provide the amphibious sealift ship HMNZS Canterbury and the Offshore Patrol Vessels HMNZ Otago and Wellington with an advanced cyber-resilient communication system.

The contract follows on the company's successful role as electronic systems integrator on the Royal Australian Navy OPV SEA-1180. It also reinforces L3Harris' commitment to integrated maritime systems and strengthens the company's global reputation as a leading naval communications systems integrator.

A composite image illustrating marine robotics. It includes a white and green Autonomous Surface Vehicle (ASV) on the water, a yellow ROV for hull and tank cleaning, a 3D bathymetric map of a riverbed, and a control panel for marine robotics.

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This innovative approach involves adapting controls that are usually used in fly-by-wire aircraft and applying them in a marine environment. The complete Active Vehicle Control Management (AVCM) system will oversee all major aspects of the submarines' maneuvering capability to the highest levels of safety and reliability, similar to existing systems on modern air transport platforms.

"With over 50 years of avionics experience, we already have great understanding of how to develop complex control systems for hi-tech platforms. However, taking our technology underwater brings exciting new challenges and we are proud to support the



» The Active Vehicle Control Management (AVCM) system will oversee all major aspects of maneuvering capability. (Image credit: BAE Systems)

NETHERLANDS ROYAL NAVY APPOINTS RTSYS FOR 7 ASW TRAINING TARGETS

RTSYS recently announced a multi-million-euro contract with the State of the Netherlands for the supply of 7 SEMA.

SEMA is an autonomous, recoverable, acoustic target dedicated to ASW training and torpedo firing exercise and is widely recognized as one of the most intuitive Autonomous Underwater Vehicles on the market to operate. It is operable from all kinds of platforms such as surface ships, submarines, helicopters and ASW aircraft. Easy to deploy even from a RHIB, the navigation route is plotted with either waypoints or segments. Users can program different types of training modes, such as passive, active and combined acoustics.

SEMA offers a wide range of acoustic training capabilities: acoustic echo-

repeater (1 to 33 kHz); 5 bands for active sonar frequency; 2 bands for active homing torpedo; 6 narrowband (200 Hz to 38 kHz); 2 broadband (450 Hz to 8 kHz and 10 to 23 kHz); and an acoustic recorder with data encryption.

These acoustic features will enable both Dutch and Belgium Forces to train in real-world conditions and simulate the localization and tracking of a submarine. The navies will join a growing list of SEMA operators around the globe, and the announcement marks a significant milestone for RTSYS as a preferred defense supplier.



» SEMA can be rapidly deployed from surface or air. (Photo credit: RTSYS)



» RTSYS' SEMA will allow Dutch and Belgian forces to simulate combat conditions. (Photo credit: RTSYS)

Dreadnought Program and play an important part in national security effort," said Jon Tucker, Director for Maritime Controls at BAE Systems Controls and Avionics.

Similar to how fly-by-wire works for aircraft—whereby electronic systems are used to control the movement of aircraft—the Company's engineers are developing electronics that control the heading, pitch, depth and buoyancy of the Dreadnought class among other critical elements with added safety benefits.

Work has already begun, supporting more than 130 highly skilled jobs in Rochester, UK, with the number expected to grow. The program is one of the largest development projects taking place at the Rochester site and we have made significant investments at the site to create new labs and workspaces to support this exciting program.

The project marks the first time that major Royal Navy work has taken place in the Medway Towns since the Chatham Dockyard closure more than 25 years ago. The Dockyard itself was synonymous with the building of ships and submarines for centuries, up to the Royal Navy Submarine, HMS Ocelot, being built there in 1962.

The innovation has been developed in Rochester with engineers in our Electronic Systems business working closely with colleagues across the Company's Maritime and Air sectors to develop a world-class system as part of our Active Vehicle Control One-Team. Our engineers will continue to develop the technologies with a view to expanding its applications to both other underwater and surface vessels.

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FUNDAMENTALS CATCHING UP TO SENTIMENT, BUT CLOUDS STILL HAUNT THE OUTLOOK

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

CRUDE OIL:

Crude oil prices are treading water, but that is not surprising given their significant rise since late last year. While momentum helped propel prices up earlier this year, seldom does it continue in a straight line. Just like runners, price moves need to stop and take a breath at times. Sometimes that breath occurs as some market news causes oil prices to drop, scaring people that the price rise is over. Price corrections are positive, if the long-term trend is up, which appears to be the case now.

The question for oil prices now is whether supply growth overwhelms the demand increase. The corollary is rising demand rapidly shrinking inventories and spiking prices higher. That is a less desirable scenario for OPEC+ members who wish to see a sustained increase in oil prices, but not at a pace or to a level that chokes off demand growth. To gauge the future for oil prices, we need to pay attention to the two primary sources of global oil supply – OPEC+ and the United States.

The outcome from the recent OPEC meeting signals that the accommodation between Russia and Saudi Arabia seems to be working. By allowing Russia to slowly increase its exports, Saudi Arabia has solidified market prices. The new agreement enables Saudi Arabia to begin adding additional supply to the market, but at a measured pace that should not depress prices. Adding 350,000 barrels per day of new supply in May and June, and 450,000 barrels in July, when demand will be seasonally strong, should sustain global oil prices around current levels.

The OPEC plan reflects Saudi Arabia's concern over global oil demand. The third major lockdown by France to fight the pandemic reflects the potential for a wildcard in balancing oil supply and demand. Mobility measures show some

countries back at pre-pandemic activity levels. As more countries reach that point, oil exporters will feel more comfortable increasing their output. The new OPEC plan is a test.

The recent Dallas Federal Reserve survey of U.S. oil industry conditions shows more optimism about the future. Capital spending should increase slightly in 2021, but much more in 2022. The survey also shows new well profitability targets below \$50 per barrel. That means we could see more drilling. OPEC will be closely watching the U.S. rig count for signals about future U.S. oil production. For the moment, improved economics are not driving a wild activity increase, suggesting oil prices should remain in the low \$60s, until we see greater demand this summer.

NATURAL GAS:

The farther we move away from the horrific mid-February arctic weather that caused the Texas power freeze-off, as well as other regional electricity blackouts, the memory of \$20+ per thousand cubic feet of gas prices fades. As the gas market has settled down, traders will be watching weather, gas production and LNG exports for indications of what will move prices in the near-term. Recently, people in different parts of the nation have experienced extremely warm temperatures, only to suddenly find themselves reaching for winter coats. It's Springtime! The result has been a volatile phase for natural gas prices.

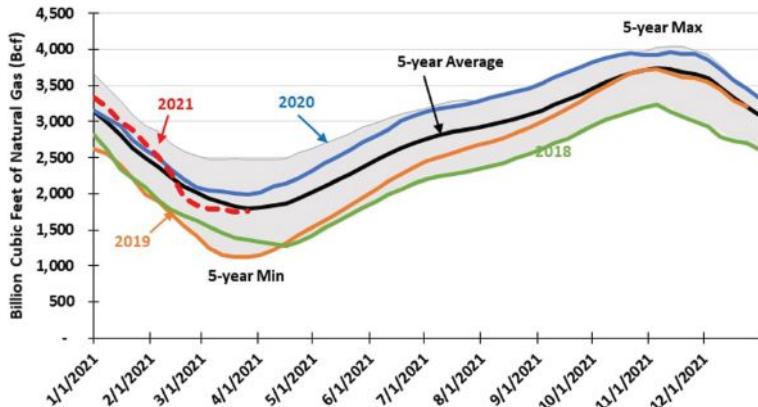
Immediately following the polar vortex in mid-February, gas prices averaged close to \$3/Mcf. Since then, they have fallen into a range slightly above \$2.50/Mcf. Natural gas production continues above 90 billion cubic feet per day, albeit down from year-ago. At the same time, gas consumed in power generation and for residential heating is down. That has

allowed LNG shipments to max out, as international prices have improved. These market dynamics look to be locked in for the foreseeable future as we transition to summer with increased electricity demand to handle air conditioning.

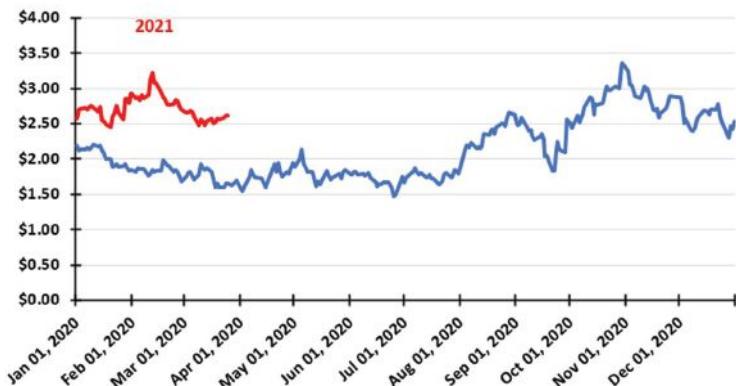
The price action suggests traders are not bullish long-term. That is not surprising given the sustainability of gas production. Last week's first storage injection and LNG cargos maxing out, suggest supply is not a concern. Looking out, the first futures contract with a \$3/Mcf price does not occur until January 2022, and then not again until January 2029! There are some intervening winter months with gas prices approaching that \$3/Mcf price, but the tone of the market is dull.

In other words, as far as one can reasonably look out, traders view the era of low gas prices continuing. This supply/demand complacency is somewhat surprising given the lack of oil and gas industry spending to find new gas reserves. This pricing trajectory may be signaling that markets anticipate the push for a green energy environment will depress long-term gas demand, such that we do not need higher prices to bring forth future supply. That sentiment could change, but it is dominating gas pricing now.

Gas Storage Helped By Extreme Cold Has Entered Warming Period



1Q2021 Gas Prices - Better Than Last Year; Not As Strong As In 4Q2020



With \$50 The New Floor - Could \$60 Be Next?





AMERICAS

US Offshore Wind

Virtual » May 25-27

www.reutersevents.com/events/offshore-wind

SIPEX

Virtual » June 1-3

<https://surinameoilexpo.com>

H2O Conference

Virtual » June 7-10

www.h2oconference.ca

Int'l Conference on Ocean, Offshore & Arctic Engineering (OMAE)

Virtual » June 21-30

<https://event.asme.org/OMAE>

Floating Wind Solutions

Houston, TX » June 28-29

www.floatingwindsolutions.com

AUVSI XPONENTIAL Atlanta

Atlanta, GA » August 16-19

www.xponential.org/xponential2021

Offshore Technology Conference (OTC)

Houston, TX » August 16-19

<http://2021.otcnet.org/>

International Partnering Forum (IPF)

Richmond, VA » August 24-26

www.offshorewindus.org/2021ipf

International Telecoms Week

Washington D.C. » August 29 - September 1

www.internationaltelecomsweek.com

Offshore Well Intervention LATAM

Rio de Janeiro, Brazil » September 8-9

www.offsnet.com/latam

Global OCEANS

San Diego, CA » September 20-23

www.global21.oceansconference.org

EUROPE

Seanergy

Nantes, France » June 8-11

<https://www.seanergy-forum.com/en/seanergyforum>

Seawork

Southampton, UK » June 15-17

www.seawork.com

Underwater Technology Conference (UTC)

Virtual » June 16-17

www.utc.no

All-Energy

Glasgow, UK » August 18-19

www.all-energy.co.uk

Deep Sea Mining Summit

London, UK » August 25-26

www.deepsea-mining-summit.com/

Submarine Networks EMEA

London, UK » September 1-3

www.terrapinn.com/conference/submarine-networks-world-europe/index.stm

SPE Offshore Europe

Aberdeen, UK » September 7-10

www.offshore-europe.co.uk

Ocean Business

Southampton, UK » October 12-14

www.oceanbusiness.com

Undersea Defence Technology (UDT)

Rostock, Germany » December 14-16

www.udt-global.com

OTHER REGIONS

Offshore Well Intervention APAC

Kuala Lumpur, Malaysia » May 18-19

www.offsnet.com/owi-apac

Telecoms World Middle East

Virtual » June 15-16

www.terrapinn.com/conference/telecoms-world-middle-east/index.stm

PHILMARINE

Manila, Philippines » June 23-25

www.philmarine.com

Submarine Networks World

Singapore » September 29-30

www.terrapinn.com/conference/submarine-networks-world/

Mediterranean Offshore Conference

Alexandria, Egypt » October 12-14

www.moc-egypt.com

ADIPEC

Abu Dhabi » November 15-18

www.adipec.com

Telecoms World Asia

Bangkok » November 16-17

www.terrapinn.com/conference/telecoms-world-asia/index.stm

MONTH & DEADLINES	EDITORIAL FOCUS & SHOW DISTRIBUTION	TECHNOLOGY & INDUSTRY FOCUS	2021 EDITORIAL CALENDAR
JANUARY Editorial: Dec. 28 Ad: Jan. 14	» The Essential 2021 Offshore Toolkit	Technologies: ROV tooling & control, Subsea cables, Remote inspection, Supply vessels, turbines, tethers, and more. Industry Focus: Offshore Energy & Renewables, Marine Survey, Scientific, Defense	
FEBRUARY Editorial: Jan. 25 Ad: Feb. 11	» Ocean Observation	Technologies: Buoys, ADCP, Data Software, Sensors, Drifters, Gliders, and more. Industry Focus: Marine Survey, Scientific, Offshore Energy & Renewables	
MARCH Editorial: Feb. 22 Ad: Mar. 11	» Unmanned Vehicles & Marine Robotics » Distribution: Oil Connect □ / May 11-14 GIPEX □ / June 28-30	Technologies: USVs, AUVs, ROVs, Aerial drones, Control systems, Seafloor residency, and more. Industry Focus: Offshore Energy, Marine Survey, Defense, Academic, Subsea Infrastructure	
APRIL Editorial: Mar. 22 Ad: Apr. 08	» Defense & Security	Technologies: Autonomous Navigation, Comms & Telemetry, Magnetometers, GIS, Sonar, and more. Industry Focus: Subsea Defense, Government, Offshore Energy, Subsea Infrastructure	
MAY Editorial: Apr. 19 Ad: May 06	» Marine Renewables » Distribution: SIPEX □ / June 1-3 Floating Wind Solutions / June 28-29 Int'l Partnering Forum / Aug. 24-26 H2O Conference □ / June 7-10	Technologies: Turbines, Subsea Cables, Inspection Drones, Subsea Batteries, Grid Integration, Connectors, and more. Industry Focus: Offshore Wind, Wave Energy, Tidal Energy, Alternative Offshore Energy	
JUNE Editorial: May 17 Ad: June 03	» Bathymetric Mapping & Hydrographic Survey	Technologies: Oceanographic Equipment & Instrumentation, Sensor Suites, ADCP, Buoys, ROVs, and more. Industry Focus: Marine Survey, Academic, Geotechnical Services	
JULY Editorial: July 01 Ad: July 15	» Unmanned Vehicles Buyers' Guide □	Technologies: ROVs, AUVs, USVs, Towed & Bottom Crawling Vehicles, and Gliders. Company Focus: Exclusive company/product spotlights and editorial features available	
AUGUST Editorial: July. 26 Ad: Aug. 12	» Deep-Sea Exploration Global OCEANS / Sept. 20-23	Technologies: Seabed samplers, Mining machines, Geotechnical tooling, Seafloor imaging equipment, and more. Industry Focus: Offshore Energy, Marine Mining, Scientific	
SEPTEMBER Editorial: Aug. 23 Ad: Sep. 09	» Offshore Build, Inspection & Maintenance » Distribution: Ocean Business / Oct. 12-14 Offshore Energy / Oct. 26-27 ACP Offshore Windpower / Oct. 13-15	Technologies: Inspection drones, Turbines, Subsea cables, Power substations, Battery technology, Grid integration, Connectors, and more. Industry Focus: Offshore Operations & Maintenance, Offshore Energy & Renewables	
OCTOBER Editorial: Sep. 20 Ad: Oct. 07	» Submersibles » Distribution: Ocean Energy Europe / Dec. 6-7 UDT / Dec. 14-16	Technologies: Manned submersibles, Navigation systems, ROVs, Submarines, Resident Subsea Vehicles, and more. Industry Focus: Offshore Energy, Defense, Academic, Marine Mining	
NOV./DEC. Editorial: Oct. 18 Ad: Nov. 11	» Subsea Engineering & Infrastructure	Technologies: Subsea drills, Prospecting tools, Deck handling equipment, and more. Industry Focus: Offshore Energy, Defense, Marine Mining, Government	
SPECIAL ISSUE Editorial: Nov. 18 Ad: Dec. 1	» The Future of Ocean Technology	Tech and Industry Focus: Our Special Edition unites an exclusive roll call of industry thought leaders to discuss the innovative breakthroughs set to redefine how we work in marine environments over the coming decade.	



JAMES FISHER LAUNCHES JAMES FISHER RENEWABLES

James Fisher, a leading provider of innovative marine solutions and specialized engineering services, has launched James Fisher Renewables, which sees consolidation of the group's extensive capabilities into a comprehensive solutions provider.

Recognizing significant growth opportunities in the renewables sector, the new structure will see James Fisher leverage its specialist expertise working in extreme environments. The move will support pure-play renewables developers, marine civil constructors and oil and gas majors alike in pushing the boundaries of what is possible to accelerate the energy transition, while maintaining existing energy infrastructure. Bringing together capabilities from across the group, JF Renewables will offer services through the project lifecycle including site preparation, UXO EOD, noise attenuation, cabling and HV commissioning management, operations and maintenance, and digital solutions. Clients will also benefit from seamless provision of James Fisher Subtech's newly consolidated subsea capabilities, also announced on March 22.

Giovanni Corbetta, Managing Director of James Fisher Marine Contracting Division said: "Accelerating trends within the energy industry, particularly the energy transition brought on by the climate emergency, present an opportunity for the group to focus on what it does best—providing expertise for the extremes. Complexity

is where we excel, helping to deliver the world's most complex, technically demanding, and environmentally challenging energy projects in construction and operations and maintenance. By realigning our business, revitalizing the leadership team and reinvigorating our culture of trust, integrity and operational excellence, there will be no project too complex for us to deliver on."

Established in 1847, James Fisher has operated in the offshore wind sector for 14 years, from supporting clients on those initial pilot projects through to today; developing further offshore and into deeper waters. Rooted in its experience in Europe, James Fisher continues to grow its service into emerging markets including the USA, Taiwan, Japan and South Korea. The company's realignment, along with its network of trusted industry partners, will unlock new synergies to position James Fisher as a comprehensive solutions provider. Clients will also benefit from enhanced cost, risk and schedule management underpinned by streamlined supply chain management and professional services.

Talking of the opportunities in the energy sector, Jonathan Parkes, Divisional Strategy, Sales & Commercial Director of James Fisher Marine Contracting Division remarked: "As demand for offshore wind increases to meet nation states' global net zero goals and energy independence, the volume and scale of viable sites will

need to increase. This will give rise to more offshore wind developers needing specialist capability to execute complex, technical energy projects in harsh environments.

"There is also a marked increase in renewable investments being made by oil and gas supermajors which makes a compelling case for us to position James Fisher to serve across the energy space. All complex infrastructure projects share the need to be delivered, operated, maintained and decommissioned in a way that is safe, on time and to budget while taking advantage of the latest technologies and digital innovation. James Fisher is here to do just that, delivering excellence in execution at every stage in the project lifecycle with pioneering spirit."

Alongside providing expertise for the construction of infrastructure projects, JF Renewables and JF Subtech will also bring its specialist expertise to bear to optimize operations and maintenance in extreme environments. With social distancing due to COVID-19 ongoing, the group will continue to support clients to innovate new ways of working safely including remote working, digital twin and Internet of Things capabilities, digital asset integrity techniques and upskilling of technical and local content teams.

SeaState

THE ON&T PODCAST

SEASON 2 / EPISODE 4

DEEP OCEAN EXPLORATION, WITH DR.CHRIS GERMAN



» Dr. Chris German

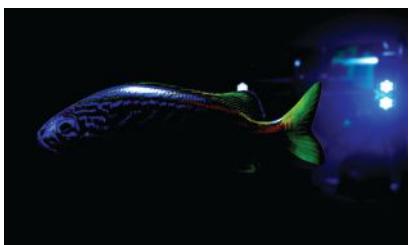
SeaState is an entertaining and educational podcast that covers a broad range of topics relating to the ocean industries and features an exclusive line-up of expert guests.

In our April episode of SeaState, we chat with Dr. Chris German, a marine geoscientist that has over 30 years' experience studying Earth's oceans, and who has spent more than 3 years of his life at sea over 60 deep-sea expeditions. Dr. German has dived to the seafloor using research submersibles in the Pacific, Atlantic, and Indian Oceans and used robotic systems to investigate submarine hot springs, from the Arctic to the Antarctic.

Born in the UK, Dr. German earned a BA in Natural Sciences and a Ph.D. in Marine Geochemistry at the University of Cambridge, followed by 2 years as a Post-Doctoral Research Fellow at MIT (Massachusetts Institute of Technology). After 15 years of working as a government research scientist in the UK, he returned to the United States to join Woods Hole Oceanographic Institute (WHOI) in 2005 where he provided scientific oversight for what became the biggest overhaul to the Alvin submersible during its 50-year history.

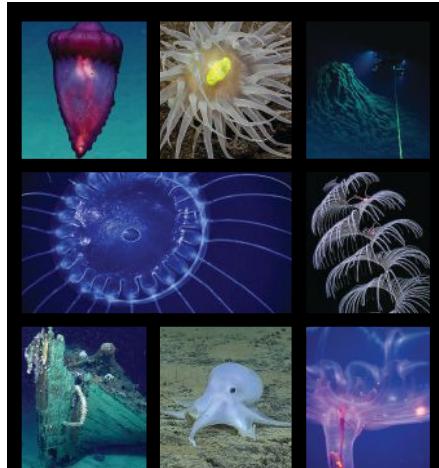
At that time, Dr. German became increasingly interested in the use of autonomous marine robotics and the use of telepresence to direct deep ocean exploration remotely. In recent years, he has begun to investigate how advanced deep ocean expertise could be harnessed in support of future exploration pertaining to the search for evidence of life in space.

Dr. German received the Research Prize from the Alexander Von Humboldt Foundation in Germany in 2014 and in 2010 won the Excellence in Research Award from the Petersen Foundation, in Germany. He received an MBE for Services to Marine Research, in the UK in 2002, and the Edward A Flinn Award - International Lithosphere Panel in 2000.



Visit www.oceannews.com/seastate listen to the latest episode of SeaState, Deep Ocean Exploration.

Also, be sure to tune into our next episode of SeaState (available May 1), Ocean Observations, with guest Jake Kritzer from NERACOOS.



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NEW SURVEY COMPANY NICOLA OFFSHORE OPENS FOR BUSINESS

Nicola Offshore GmbH, a new company specializing in turnkey services for the most challenging marine survey campaigns and on-demand missions in and around Europe started operations from its HQ in Hamburg today (March 15, 2021).

Working from an agile logistics and technology platform, Nicola Offshore was established to service the more complex and specialist aspects of marine surveying, including underwater object detection, unexploded ordinance (UXO), and subsea cable investigations, as well as pre- and post-dredging reports.

The company is a joint venture between Nicola Engineering GmbH, a German marine survey provider with over 40 years' experience and ProMarine BV, a well-known and highly regarded Dutch workboat manufacturer.

Fulfilling its laser-sharp focus of providing fast-turnaround surveys for offshore oil & gas, and renewable energy clients, Nicola Offshore has developed an advanced marine data acquisition platform based on ProMarine fast workboats fitted with the unique integrated Hydrographic Survey System (iHSS) from marine data acquisition specialist, Subsea Europe Services GmbH.

Andres Nicola, CEO of Nicola Engineering said: "We have noticed a significant upturn in requests for unplanned multibeam echo sounder-based surveys especially around offshore wind farms, and are confident that establishing a team to specialize in producing high quality data in these challenging conditions is the most effective way to meet the specialized needs."

HPR ROV SIGNS EXCLUSIVE AGREEMENT WITH I-ENERGY IN SAUDI ARABIA

Leading ROV specialist, HPR ROV, has signed an exclusive two-year agreement with Saudi-based Intelligent Energy Services (i-Energy).

The agreement, which reflects the Aberdeenshire company's international growth strategy, will see i-Energy act as exclusive agents for HPR ROV in the region, enabling the firm to offer its full suite of specialized ROV systems to the Middle East marketplace.

Offering a catalogue of ROV systems and predominantly known for its unique micro ROV capabilities, HPR ROV has worked on an array of projects with tier one operators and service companies for inspection scopes in the North Sea, Central Asia and West Africa. Its cost-effective solutions have also seen the company complete a number of late life asset management work scopes within the UK decommissioning sector.

The agreement with i-Energy, a leading provider of drilling tools, completion equipment, and plug and abandonment solutions, provides HPR ROV with 12,000 m² premises that includes office warehouse and yard facilities in Dammam's second industrial city.

Business Development Manager for HPR ROV, Christian Hingley, said: "The partnership with i-Energy is a great fit for HPR ROV, as the region is an area of growth for us, especially for our expertise in underwater inspection in lieu of dry docking (UWILD).

"i-Energy has a fantastic reputation in the region for providing innovative products and services to the energy sector. This agreement is a mutually beneficial collaboration that brings together two ambitious companies, enhancing our respective capabilities."



» Nicola Offshore will offer specialist marine survey services, including UXO and dredging reports. (Photo credit: Nicola Offshore)

Daniel Esser, Managing Director of Nicola Offshore added: "We are building capabilities to tackle the toughest survey projects that demand speed and agility to collect high quality data while meeting strict deadlines, often under extreme conditions. The team we have put together has the drive, expertise and experience to respond to the most daunting challenges in marine survey."

Dick Duin, CEO of ProMarine concluded: "The combination of fast vessels and cutting-edge survey technology positions Nicola Offshore as a unique resource for offshore clients that need gap-filler surveys actioned quickly and effectively. We're looking forward to saying yes to the jobs that many would decline and are confident that our team, equipment and methods will deliver the results our clients demand."

Mr. Abdulrhaman Algosaibi, Managing Director of Intelligent Energy Services. Co. Ltd, said: "We are delighted to have HPR ROV as part of the team at i-Energy Saudi Arabia, and look forward to a successful future working together."



» Deputy Managing Director for i-Energy, Waleed Batarfi, with Business Development Manager for HPR ROV, Christian Hingley. (Photo credit: HPR ROV)

OCEAN ENERGY EUROPE APPOINTS NEW CO-PRESIDENTS

Ocean Energy Europe (OEE) has appointed **Simon De Pietro** (DP Energy, Ireland) and **Patrik Möller** (Corpower Ocean, Sweden) as its new Co-Presidents. This pairing brings together both technology and project development perspectives, and a wealth of experience in ocean energy.

The appointments come at a crucial time for the ocean energy sector, as the push to scale up and industrialize intensifies, and the shift towards 100% renewable energy sources picks up pace. Together with the OEE board of directors, the Co-Presidents will steer the sector's course over the coming years, as ocean energy positions itself as a key part of decarbonizing the world's energy supply.

The board also welcomes seven new directors, elected this morning by the OEE membership. This election ensures that the association's board continues to represent a diverse cross-section of the industry across Europe and maintains its high-level orientation.

The newly elected directors are:

- **Matthew Finn**, Commercial Director, European Marine Energy Centre (EMEC)
- **Marlène Kiersnowski**, Manager, SENEOH Tidal Test Site
- **Tony Lewis**, Beaufort Professor Emeritus, MaREI
- **Patrik Möller**, CEO, Corpower Ocean
- **Pablo Ruiz Minguela**, Head of Wave Energy, Tecnalia
- **Britta Schaffmeister**, CEO, Dutch Marine Energy Centre (DMEC)
- **Oliver Wragg**, Commercial Director, Orbital Marine Power

Patrik Möller, CEO of Corpower Ocean, Sweden, said:

"I'm delighted to be appointed Co-President of OEE, representing the largest network of ocean energy professionals in the world."

OEE plays a hugely important role, engaging at the highest political level and raising awareness of ocean energy, as one of the largest untapped sources of clean energy on earth.

The next three years will be particularly exciting as we transition to commercial operations with several technology suppliers entering the market with bankable products."

Simon de Pietro, Managing Director of DP Energy, said:

"I'm genuinely excited to have been re-elected as Co President of the OEE Board. We are entering a period that will prove to be the defining moment for ocean energy, as it takes its place within the broader renewables sector alongside wind and solar."



» **Simon de Pietro**,
MD of DP Energy



» **Patrik Möller**,
CEO of Corpower Ocean



Whilst the term 'ocean energy' covers a range of technologies, it is notable that both wave and tidal technologies have taken major steps forward in recent years. Both are progressing towards commercial readiness—as standalone projects, but also as part of hybrid renewable technology deployments, co-located with shared infrastructure.

For example, hybrid offshore floating wind and wave generation could, and should, be a game-changer for our shared ambition of a reliable and flexible electricity network in a carbon-neutral world."

Rémi Gruet, CEO of Ocean Energy Europe, added:

"It is a great pleasure to welcome Simon and Patrik as Co-Presidents of OEE. Both have been long-standing figures of the ocean energy sector and have already contributed greatly to its development. Their experience and projects put them in a great position to grasp the challenges and opportunities ahead, and to guide the sector towards success. I look forward to working with them over the next 3 years."

JAN DE NUL GROUP INSTALLING 72 OFFSHORE WIND TURBINES OFFSHORE DENMARK

For the largest offshore wind farm in Denmark, Jan De Nul Group is installing a total of 72 wind turbines of 8.4 MW each on behalf of Vattenfall Denmark. All together, these turbines will produce enough green electricity for the annual needs of approximately 600,000 Danish households.

On January 27, Jan De Nul, Siemens Gamesa and Vattenfall successfully installed the very first wind turbine for the Kriegers Flak offshore wind farm. The last turbine is scheduled to be installed in mid-June, approximately four and a half months after the start of this installation campaign.

This offshore wind farm will become the largest in Denmark and will increase Denmark's offshore wind production by no less than 16 percent.

Bert Reynvoet, Project Manager of Jan De Nul Group for the Kriegers Flak offshore wind farm, said: "We are proud that we can tick off this milestone nicely on schedule. All 72 wind turbines must be installed within a period of 4 and a half months. Our customer's wishes are paramount and despite the challenging winter weather conditions in the Baltic Sea, COVID-19 and challenging soil conditions for our jack-up installation vessel, we have managed until today to strictly adhere to the installation schedule. Thanks to the commitment, flexibility and professionalism of our co-workers!"

Roenne as Marshalling Harbor

For the first time since its expansion in 2018, the port of Roenne on the Danish island of Bornholm is serving as marshalling harbor for the construction of an offshore wind farm.

The components of the Siemens Gamesa wind turbines are delivered from Denmark's mainland. In Roenne, the various parts are assembled. In sets of four wind turbines, they are loaded on board Jan De Nul's jack-up installation vessel Vole au vent, after which the vessel sails to the offshore installation site off the Danish east coast.

SUCCESSFUL RIG TRIAL OF INTEGRATION OF MPD AND AUTOMATED WELL CONTROL SYSTEMS

Safe Influx recently announced the completion of the industry's first ever integration of Managed Pressure Drilling (MPD) and Automated Well Control technology. Following months of preparation by Weatherford, Safe Influx and Finesse Control Systems (who build the Safe Influx equipment and develop the logic programming), a series of pre-agreed tests were successfully performed on Weatherford's test rig in Houston, to demonstrate and verify the integration and functionality of both systems.

The combination of Weatherford Victus™ intelligent MPD and Safe Influx Automated Well Control systems provides automated

Bert Reynvoet: "When a large installation vessel like the Vole au vent enters a port for the first time, it is always a bit exciting. Moreover, it was new for everyone involved, but thanks to the top service of the port and our local partners, Roenne turns out to be a perfect marshalling harbor. An absolute boost in these challenging times."

Long-term Cooperation

In 2017 and 2018, Jan De Nul Group already designed, built and installed two large Gravity Based Foundations for the offshore high-voltage substations of this new offshore wind farm.

Jan De Nul built both concrete structures of 8,000 and 10,000 tons on a floating pontoon in the port of Ostend (Belgium) and then tugged them to Denmark. In the Baltic Sea, the crane vessel Rambiz installed both foundations on the seabed with the utmost precision.



» Construction of Kriegers Flak offshore wind farm is on schedule for complete by June 2021.

secondary well control which will allow wells to be drilled and constructed with the highest level of efficiency and integrity.

As a standalone application, the MPD system can detect, control and circulate out an influx which is within the well's operational envelope.

If the parameters within the well's operational envelope are exceeded, the Weatherford MPD system sends a series of real time signals to the Safe Influx Automated Well Control system which then commences the Automated Shut-in sequence: Space

out -> Shut down the Top Drive -> Shut down the Mud Pumps -> Shut-in the BOP.

"We are delighted to have successfully completed the rig trial of the integration of MPD and Automated Well Control systems. The combination of the Safe Influx patented technology with Weatherford's comprehensive portfolio of MPD products provides a game changer for the industry. We are confident that this is a reliable tool which has the ability to mitigate risks and enhance efficiency and safety in well operations, to prevent the loss of life, minimize environmental impact, deliver substantial cost savings and protect company reputation," said Bryan Atchison, Managing Director at Safe Influx.

Fraser Dunphy, Managing Director at Finesse Control Systems, commented: "It's been great to work with Safe Influx and Weatherford on this ambitious and innovative combination of technologies. We have been involved with this project since its initial phase and we are thrilled to see this integration working on the rig trial. The successful results reveal the value of combining technologies, knowledge and experience to create a cutting-edge solution to the oil and gas industry."

The rig trial is part of the Memorandum of Understanding (MoU) signed by Weatherford and Safe Influx in September 2020. Under the MoU, the companies will cooperate globally to focus



» Automated secondary well control allows wells to be drilled and constructed with the highest level of efficiency and integrity. (Photo credit: Safe Influx)

on revolutionizing well integrity during the construction phase by bringing to market the integration of MPD solutions and Automated Well Control technology. This integrated offering will automate the mitigation of drilling hazards, while drilling in the most efficient manner possible.



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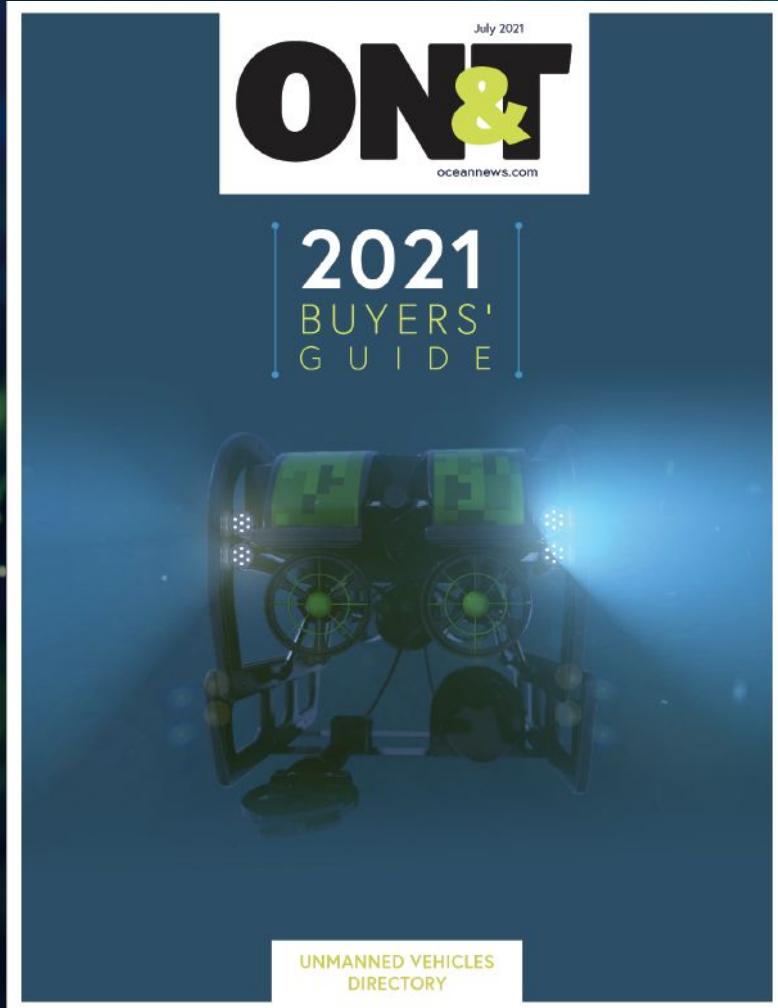
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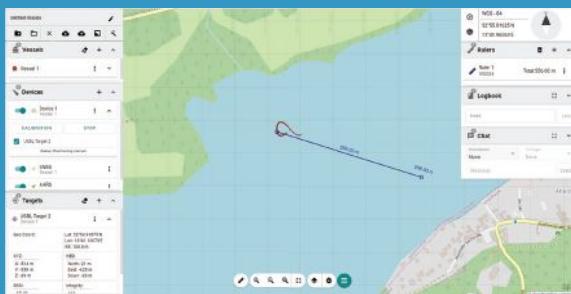
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