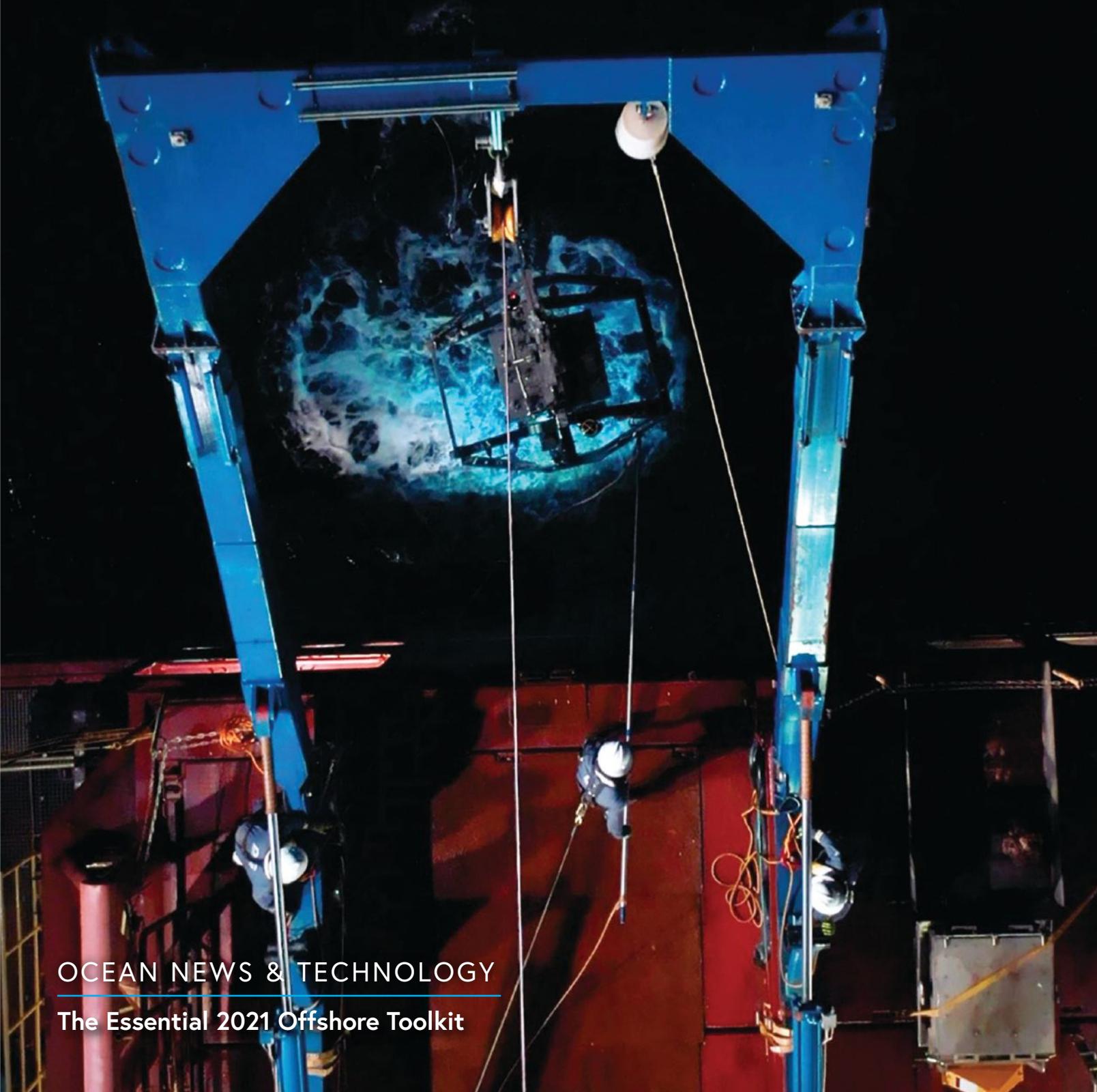


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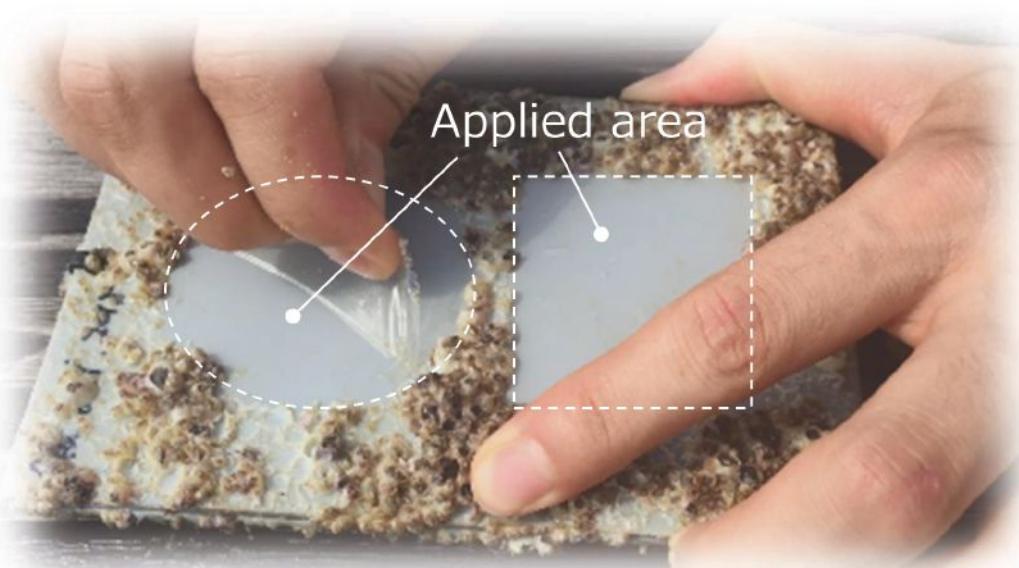
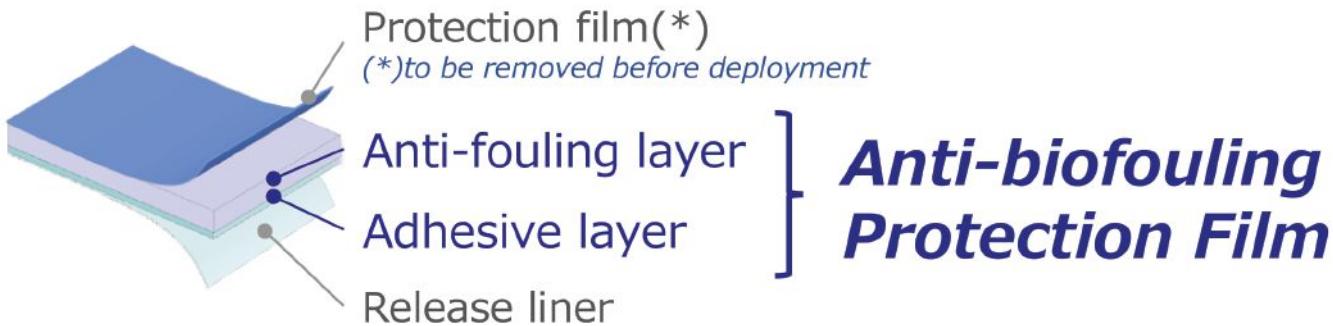
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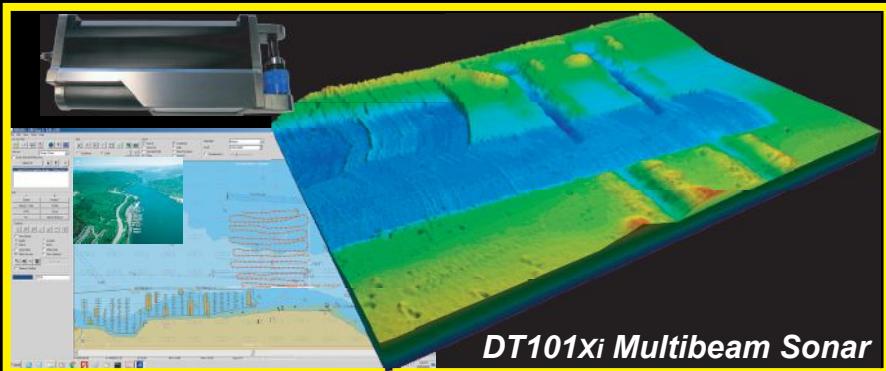


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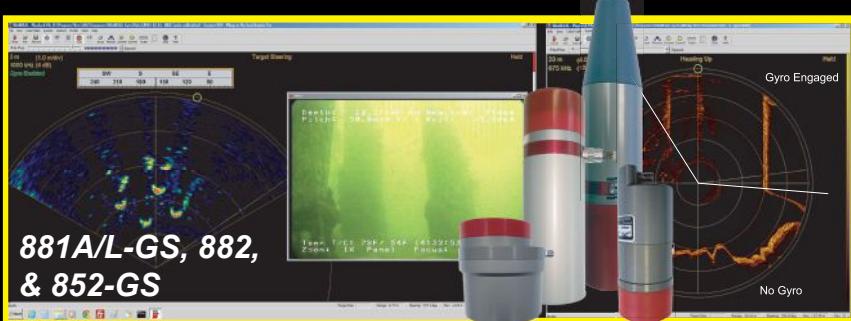
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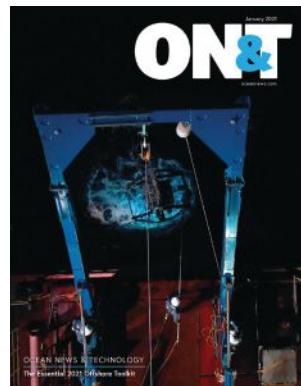
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DeepGreen, Maersk, and Bluefield Geoservices: Recovery of pristine seafloor sample from 4500 m water for extensive geotechnical, biological, and mineralogical assay purposes. (Photo credit: DeepGreen/Bluefield)

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PRINTED IN THE USA



THE FUTURE OF OFFSHORE ENERGY IS AUTOMATED

BY ROD LARSON*President and CEO, Oceaneering*

Oceaneering started over 60 years ago as a small diving company serving the Gulf of Mexico. In the years since, we have grown to a global engineering company providing products and services to the energy, defense, materials handling, aerospace, and entertainment industries.

Over the next decade, we see the future of offshore energy as safer, more integrated, and more remote. With COVID-19, the oil and gas industry had to be both creative and flexible to respond to the challenges of keeping workers safe while also keeping operations running. Advanced offshore communications, automation, machine learning, IIoT (Industrial Internet of Things), and artificial intelligence will have a larger role to play in delivering a higher standard of work for offshore operations in the next 5-10 years.

Oceaneering remains focused on bringing innovative technologies and practices to market to support remote operations. In 2015, Oceaneering launched its first Onshore Remote Operations Center (OROC), which allows subject matter experts (SMEs) onshore to communicate with crews offshore. This eliminates the logistics, costs, and carbon emissions associated with sending these SMEs to far offshore installations around the globe. Advances in satellite and LTE data communications have made it easier than ever to conduct operations with help from shore.

AUTONOMOUS VEHICLES

Additionally, the next generation of remotely operated and autonomous subsea vehicles won't only make work safer, they will help lower our carbon footprint and that of our customers.

One vehicle making a positive impact is our Liberty™ E-ROV system, which is piloted from shore, eliminating the need for an ROV support vessel and attendant personnel to be onsite. Liberty has led to a 75% reduction in topside support vessel and crew support, as well as a reduction of 1,400 tons of CO₂ emissions.

Our next-generation Freedom™ Autonomous Subsea Vehicle combines many of the capabilities of a ROV with the speed, range, and maneuverability of an AUV. Carbon emissions are reduced because Freedom does not need a support vessel to stay nearby. The vehicle is being strenuously tested at our dedicated facility in Norway. It has hit several milestones this year, including autonomously landing on a customer supplied docking station.

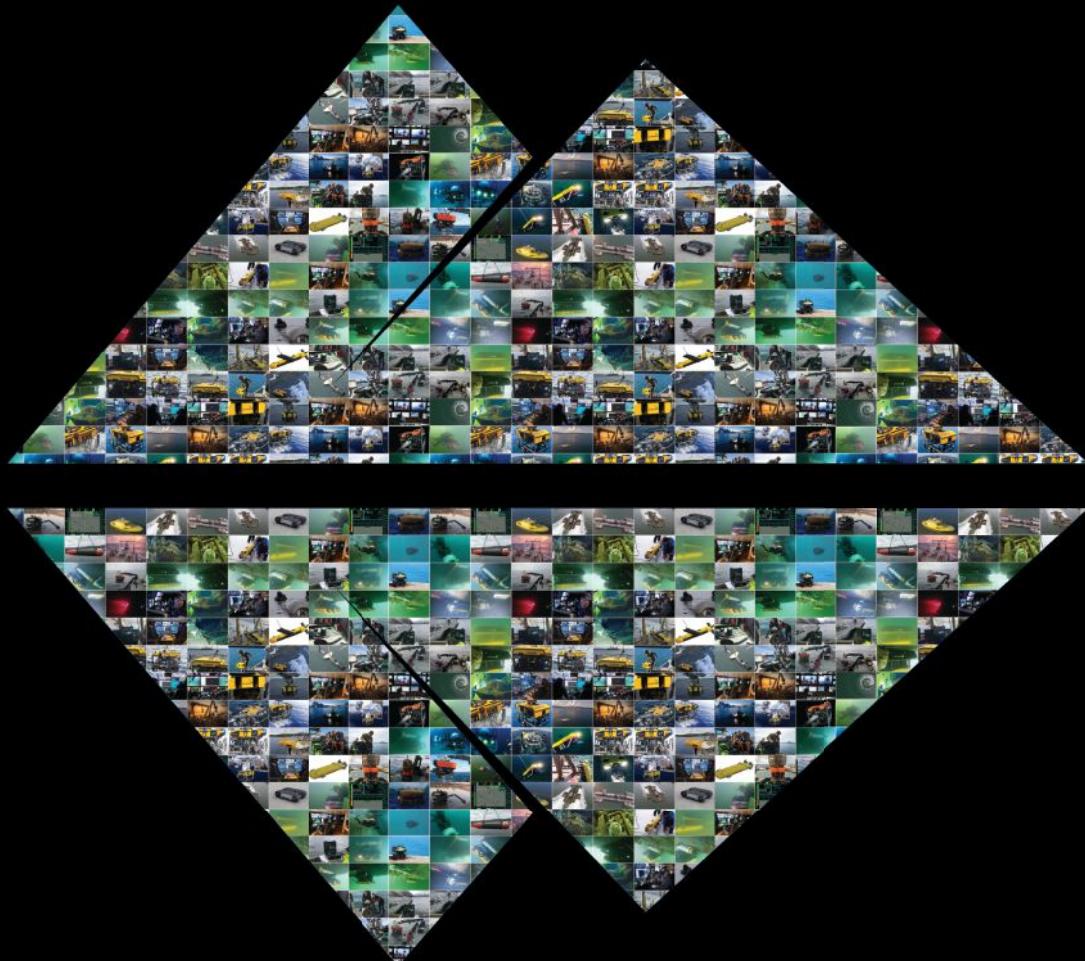
However, we are not only working on next-generation vehicles. We are also implementing new technologies to inspect and manage the integrity of our customer's assets more efficiently and effectively.

INSPECTION TECHNOLOGIES

Our Integrity Management and Digital Solutions (IMDS) group is implementing the latest technological solutions for our customers to provide them with real-time views of their assets. Offshore technicians can use hands-free video technology to relay real-time inspection findings to an onshore auditor. Other important tools for remote inspection will be sensors and EDGE devices.

We also provide cloud data storage, our Oceaneering Media Vault, which allows our customers to access real-time video of their assets and analytics whenever they need it. Oceaneering is also pioneering remote underwater inspections in lieu of dry docking (UWILD) services.

We are excited about the future of offshore energy and how advances in technology will ultimately lead the way to a safer, cleaner, and more sustainable world.



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BLUE FIELD THINKING



By Jim Edmunds
Managing Director, Bluefield
Geoservices UK

The seabed environment has always posed unique challenges for offshore developers, whether in pursuit of O&G reserves, renewable energy, or marine minerals. The build-out of safe and sustainable offshore infrastructure is fundamentally reliant on robust geotechnical analysis of seabed soil and bedrock conditions. While initially born out of onshore geotechnical practices, today, offshore geotechnics is a standalone discipline governed by independent codes and technical standards. After all, offshore assets—which typically tower hundreds of meters above their foundations—are subject to greater environmental lateral loads (moment loading relative to structure weight caused by wind, waves, and currents) and a wider range of location-specific geohazards than their land-based counterparts.

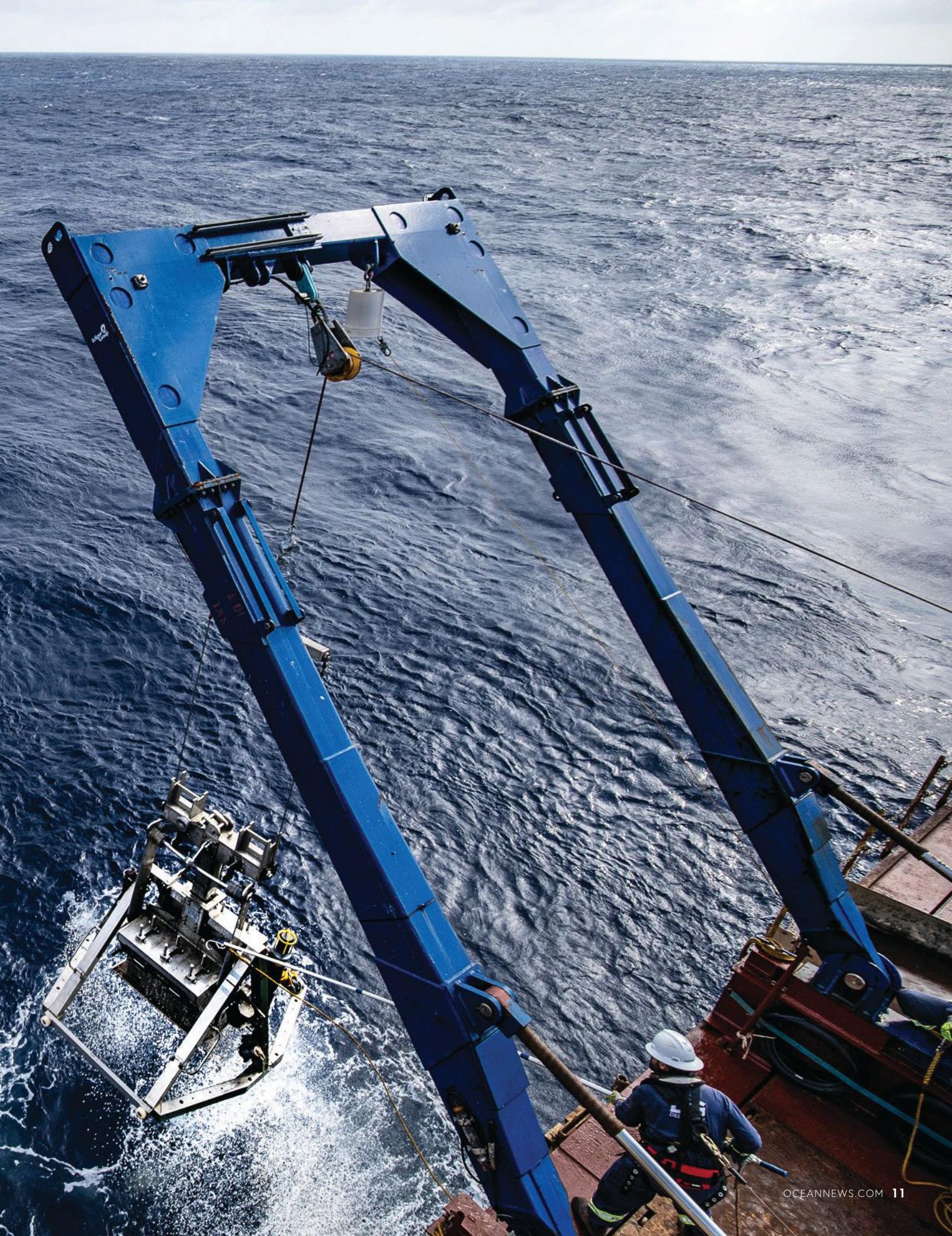
These highly variable and often hazardous marine conditions make thorough *in situ* site investigation a fundamental part of offshore planning, as any significant modification requirements during construction phase are usually unfeasible or financially crippling. Therefore, as offshore operators look to venture into deeper waters, often in the face of mounting environmental concerns, the urgency for highly experienced marine geotechnical expertise has never been greater. And while the offshore geotechnical industry has always been a relatively conservative one—perhaps unsurprisingly so given the stakes—there are signs that recent advances in geotechnical engineering are beginning to rewrite the subsea survey playbook and challenge the long-established order of geotechnical service providers.

GROUND-BREAKING TOOLKIT

Whether for hydrographic, geophysical, or geotechnical analysis, ever smarter instrumentation enables us to render increasingly precise, real-time data. It was an unwavering and shared commitment to data quality that led a select team of pioneering geoengineers to start Bluefield Geoservices in 2018, with a mission to redefine geoscientific frontiers by bringing to market a suite of specialist geotechnical products and services. As well as offering the equipment and personnel for rigorous offshore data acquisition, processing, analysis, QC, and site management, Bluefield Geoservices has made significant investments in proprietary custom geotechnologies, such as the ROVcone and BOXcone, for a range of complex seabed situations.

These innovations are the result of the considerable real-world insight and analysis that the Bluefield team has gleaned while performing *in situ* testing and site investigation around the world, including in the Caspian Sea, the Gulf of Mexico, North Sea, and in offshore regions of Australasia. When it comes to oilfield development, regardless of depth, it is essential to have the right toolkit to perform numerous CPT and sample tests within a tightly defined area. The ROVcone not only allows for precision positioning,

» Bluefield Geoservices, established in 2018 to challenge the established order of offshore geotechnical services, develops and deploys innovative *in situ* seabed investigation methods and custom technologies that ensure best-quality site data and analysis. (Photo credit: Bluefield Geoservices)



but also the ability to fly the ROV to the next survey point without the need to retrieve the equipment between each test, resulting in significant operational efficiency.

The ROVcone system enables operators to deploy a lightweight unit that still delivers 1,000 kg push force for *in situ* soil testing or sampling and can be paired with any Work Class ROV or similar. The wire-free (acoustic) real-time communications between the penetrometer and the ROV eliminates cabling, reduces snag hazards, and speeds up installation and removal to/from the ROV. The ROVcone can also be operated in a standalone frame as a crane or an A-frame-deployed seabed unit.

The BOXcone system is a specialized *in situ* testing tool designed to interface with a box core sample box. Designed to meet the requirements of a lightweight unit for use on deck, the BOXcone delivers precision-controlled push force and can be deployed on any box core with a removable box. The system is designed for *in situ* testing including CPT, T-bar, ball cone penetrometer, lab vane, and

plate load testing, as well as push-in sub-sampling. Other probes can also be supplied, such as thermal conductivity. It is suitable for use in all soils capable of being sampled by a box core system.

Both the ROVcone and BOXcone are ideal for route surveys, pipeline studies, subsea developments, drill cutting surveys and marine mining site investigations.

SONIC DRILLING TECHNOLOGY

Another recent addition to the exclusive Bluefield Geoservices toolkit is the SWORD, the world's most advanced, heavy duty and remotely operated subsea drilling and geotechnical site investigation system. The SWORD (Sonic Wireline-Operated Remote Drill) incorporates sonic drilling technology into a seafloor sampling tool. The drill rig is powered by a *Sonic-Samp-Drill* (SSD) compact roto-sonic drilling drive, together with full size drill pipe strings, which are automatically assembled at the seabed from a storage carousel. The rig is fully integrated with an A.P. van den Berg (APB) *in situ* CPT testing system and NGI designed



▲ Bluefield's ROVcone is ideal for offshore geotechnical survey in locations which may be problematic for non-ROV conveyed systems to access. (Photo credit: Bluefield Geoservices)

push and piston samplers. It uses high-frequency vibrations to push casing sections, drill rods and sampling tubes into the seafloor.

ENABLING REMOTE OPERATIONS

As developers look to leverage the safety and cost benefits associated with progressively autonomous—or at least crewless—offshore operations, Bluefield Geoservices is also working on a number of new systems designed to streamline resources needed for rigorous *in situ* geotechnical investigation. One such tool is the team's remotely operated CPT platform, depth rated to 3,000 meters, which allows for "over the horizon" control by shore-based technicians. While the device still requires personnel onsite for system calibration, deployment, and the collection of physical samples, the incorporation of automated hardware like this does allow for a significant down-manning of at-sea operations and, subsequently, the reduction of associated carbon emissions.

EXPLORING NEW FRONTIERS

Naturally, site investigation methods are location specific. For example, the compacted sands found in the North Sea require a different approach to the carbonate sediments found offshore Brazil or the ultra-high plasticity soft clays offshore West Africa. This is why offshore geotechnical proficiency and in-field experience is so critical as developers look to explore new frontiers where little or no historical data exist.

Plans for the U.S. offshore wind build-out call for a fresh look at geotechnical service providers. While European nations and operators have spent the past 30-plus years developing their offshore wind capabilities, the U.S. has lagged behind. But recent state pledges—in Maryland, Massachusetts, New Jersey, New York, Rhode Island—have triggered action to scale and develop a local supply chain that will, according to the American Wind Energy Association (AWEA), create up to 83,000 jobs by 2030.

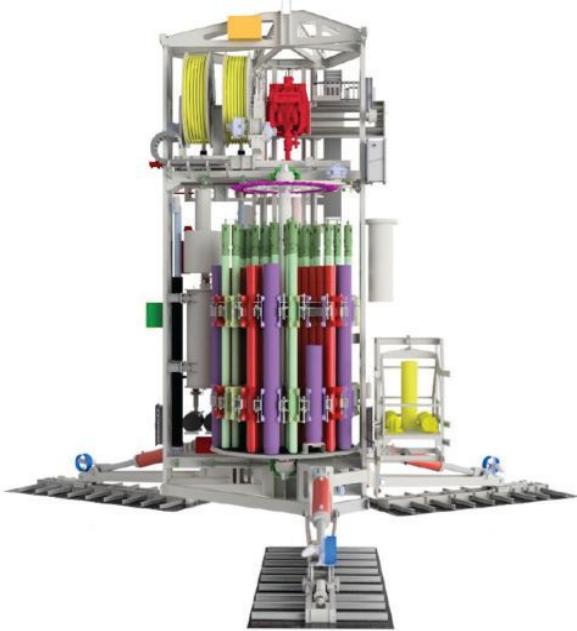
This growing need among operators to explore seabed conditions in greenfield sites spurred on Bluefield Geoservices' expansion from its UK-based HQ to the Americas in late 2019, opening offices in Rhode Island and Florida. The group's technologies are now available for rapid deployment, both in the country's northeast and the Gulf of Mexico.

Ocean mining, an offshore activity that has attracted considerable scientific interest over the decades but negligible commercial progress, is another "new" frontier that is ever reliant on robust deep-sea geotechnical data and know-how. We have long known that the seabed, at depths of up to 6,000 meters, is home to an abundance of rare-earth elements and prized metals—including nickel and cobalt—needed to build-out a more sustainable future. In short, the very inputs needed to invest in future offshore infrastructure.

Generally speaking, the harvesting of polymetallic nodules, while only one method of extraction, looks like the most feasible route to market in the short- to mid-term. The greatest accumulations of these potato-sized rock concretions are found in the Pacific Ocean's Clarion Clipperton Zone (CCZ), where commercial and state-led entities continue to carry out their environmental due diligence and test their nodule collectors. Studies suggest that we are fast approaching a point of both economic and environmental



▲ Bluefield's BOXcone is designed for in situ testing including CPT, T-bar, ball cone penetrometer, lab vane, and plate load testing, as well as push-in sub-sampling. (Photo credit: Bluefield Geoservices)



▲ Bluefield actively bringing to market a new generation of remotely operated subsea drilling and geotechnical site investigation systems. (Image credit: Bluefield Geoservices)

viability with regards to mining seabed deposits on an industrial scale.

In 2019/20, Bluefield staff played an integral role in a number of key ocean mining exploration campaigns in the CCZ, contracted by Canada-based battery start-up DeepGreen Metals Inc. Six team members performed *in situ* data acquisition and on-deck geotechnical analysis for Campaigns 6a and 6b, as well as providing follow up services to assist with the supervision of laboratory work and reporting. Future plans include the deployment of the ROVcone on a deep-water Work Class ROV to gather additional samples.

A CUSTOM ENGINEERED APPROACH

It is an unrelenting urge to advance subsea engineering R&D that unifies a tight team that, collectively, represents a level of subject matter authority that belies headcount. Bluefield's roster is an extensive roll call of projects involving subsea soil sampling, testing, and drilling equipment. It is this hands-on, multi-disciplinary experience that gives Bluefield clients a distinct advantage when seeking to conceptualize, procure, or upgrade their subsea survey capabilities.

The Bluefield approach tends to be project specific, which helps recalibrate R&D efforts towards challenging the status quo; balancing what is possible with what is practical is the first step in redefining how innovative subsea technology can transform site investigation and ultimately guide 21st century offshore construction. By collaborating with industry partners from the offset, Bluefield GeoEngineers are equipped to offer guidance on foundation analyses for subsea structures, offshore platforms, renewable energy infrastructure, pipeline stabilization, mooring systems, and marine mining machinery.

The team is also working on a number of next-generation foundation and anchoring concepts for offshore structures of tomorrow. Current projects include robotically installed foundations for offshore floating wind anchors and pipeline stabilization,



▲ The Bluefield team is currently developing a number of remotely operated systems, such as this CPT platform, for "over the horizon" geotechnical site investigation in the name of down-manning at-sea operations and curbing carbon emissions. (Photo credit: Bluefield Geoservices)

based around micropiling and the use of subsea robotics to provide tensile capacity and lateral restraint. Further in-house capabilities include 3D modelling and analysis of structures and computational fluid dynamics for the development of innovative tooling for jetting and profiling the seabed.

DEALING WITH THE PAST, TOMORROW

However, amid the age of decommissioning, the development of offshore geotechnical products and services will be as much about the past as it is the future. As unprecedented numbers of offshore assets approach the end of their production lifecycle in the 2020s, commentators predict a surge in demand for site investigation services that prioritize the planning of safe, cost-effective, and environmentally responsible decommissioning practices.

Many offshore assets have, over the decades, become integral to their surrounding marine environment; their removal could destroy flourishing marine ecosystems. For this reason, operators are turning to accomplished providers of noninvasive survey technologies to acquire the most comprehensive data and analysis available. Bluefield Geoservices, through strategic partnerships, has also broadened its range of services to incorporate geophysical and environmental survey—including physical sampling; geophysical and hydrographic surveys; offshore O&G EBSs and monitoring; habitat mapping; and Environmental Impact Studies—to serve the international offshore energy markets with a complementary suite of specialist services.



▲ Mining the deep: Bluefield technicians perform in situ data acquisition and on-deck geotechnical analysis for DeepGreen Metals Inc. in the Clarion Clipperton Zone. (Photo credit: Bluefield Geoservices)

Establishing best practice in a time of unprecedented technological advancement will no doubt be a challenge, and one that will require an open and flexible mindset among stakeholders and policymakers. But challenge, and more specifically the task of guaranteeing ever more stringent offshore geotechnical understanding, is what Bluefield Geoservices thrives on.

For more information, visit:
WWW.BLUEFIELDGEO.COM

GAME CHANGING PRODUCT FOR THE OCEANOGRAPHIC INDUSTRY

Mooring Systems, Inc. of Cataumet, Massachusetts has announced the completion of a new game changing product for the oceanographic industry following many years of development and sea trials. GHOST, which stands for Global Hidden Ocean Satellite Telemetry, is a new covert data delivery system for sub-surface moorings. This unique product provides the ability to capture data from subsea instruments and deliver the data to a host computer from any ocean at any depth and virtually without ever being visible.

GHOST attaches to the top of a sub-surface mooring's upper most buoy and travels up and down through the water column. This self-powered automated device transports a satellite antenna to the ocean surface multiple times throughout its pre-defined mission. GHOST consists of two primary components, a motorized vessel referred to as Transporter, and a tethered Transmitter Buoy. Only the transmitter buoy will breach the ocean surface spending less than five minutes to transmit collected instrument data files. Transporter will remain just below the sea surface during the transmission then retract to a safe and hidden park depth.

GHOST is an adaptable tool for existing moored instrument data collection applications and new applications that have historically failed or never perceived possible.

GHOST is a significant breakthrough for the collection and transmission of ADCP data prior to mooring recovery. This benefit provides both early project reporting and assurance that valuable data is not entirely lost if an instrument fails prematurely or the mooring recovery operation is not successful.

NRL'S OCEAN SCIENCES DIVISION CONNECTS RESEARCH WITH INDUSTRY AND ACADEMIA



» An aerial view of sandbar features near Bay St. Louis, Mississippi. Researchers at NRL's Ocean Sciences Division study coastal features to determine how they evolve and impact coastal infrastructure. (NRL photo by Shawn Harrison)

US Naval Research Laboratory's (NRL) Ocean Science Division at Stennis Space Center in Mississippi, has joined a broader Navy effort to connect scientific discovery with civilian industry and universities across the nation and beyond. NRL joins the Naval Surface Warfare Center Panama City Division, and the Naval Meteorology and Oceanography Command, to form the new Gulf Coast Tech Bridge, which spans four states—Florida, Alabama, Mississippi and Louisiana.

"Developing new partnerships with industry and academia will accelerate the transition of our science and technology for the benefit of the Navy, Marine Corps, and the public," said research physicist Joe Calantoni of the Ocean Sciences Division. "We are excited about the long-term potential of this new venture."

The Tech Bridge is future-focused, growing coastal science and unmanned vehicle development, assured maritime access, operational meteorology and oceanography, hosting industry events and expanding strategic partnerships.

"We want to enable our scientists and engineers to transform their discoveries into commercial products," Calantoni said.

NRL's Ocean Sciences Division conducts research in ocean physics, coastal remote sensing, coastal and seafloor sciences, and geospatial sciences. Researchers work to understand the complex interactions between the ocean and atmosphere through a combination of sensing and simulation.

GHOST solves surface buoy vandalism problems experienced with Tsunami detection systems, provides a new method for government organizations to conduct marine security missions, and for conservation applications to identify and alert the presence of marine mammals.

This new TAUV (tethered AUV) product entry marks Mooring Systems as a leader in mooring automation. "Our combined expertise in underwater mooring and buoy system engineering, inductively coupling instruments for data capture, satellite telemetry, and system automation has led our design team to the development of this breakthrough commercially available product that significantly advances oceanographic mooring technology." This product is patent pending.



» The Global Hidden Ocean Satellite Telemetry (GHOST) is a new covert data delivery system for sub-surface moorings.

Since the establishment last year of Tech Bridges under a Navy program called NavalX, the initiative has harnessed collaboration and creativity to address naval concerns and capabilities.

NavalX serves as the Department of Navy's research, development and technology "super-connector" focused on delivering and facilitating rapid implementation of proven technology with high impact and broad applicability. Over the past year, NavalX has expanded the number of Tech Bridges to 15 across the United States and the United Kingdom.



» Research includes the USV Mantas to conduct a detailed survey near Panama City Beach, Florida. (NRL photo by Kara Koetje)



| FEATURE |

AUTOMATING THE FUTURE, TODAY



By Dawn D'Angelillo
Marketing Director,
Greensea Systems, Inc.

▲ SAFE-C2 being field tested under different scenarios and distances up to 5 km. (Photo credit: Greensea)

There is one universal truth that unites every marine business, past, present, and future. This unifying factor is risk. The minute a ship sails or a dive is initiated, the risk to life, limb, and wallet increases substantially. This risk has been true throughout history with fortunes being made, or as likely, lost at sea. This truth is even more apparent during a pandemic. One obvious way to reduce this human element of risk is to keep people out of harm's way. Imagine a future of unmanned ships operating robots offshore that are supervised by operators comfortably seated in an onshore office. Technology advancements have made this possible and Greensea is working to make this future a reality.

Readers of last month's Ocean News & Technology's, *The Future of Ocean Technology*, may have picked up on a recurring theme while reading through the articles—automation. Automation is the tool that many companies are turning to as a solution to reduce risk and improve results. Of the 24 published articles, 33% had autonomy or unmanned in their titles and many more authors mentioned autonomy and unmanned systems as being instrumental to their visions of the future. But in order for a machine to do the dirty, boring, or too difficult work, it must do it **better/faster/safer/cheaper** than a human to become a viable option.

KEEPING TECHNICIANS ONSHORE

There are several technology hurdles that need to be addressed before an ROV can be successfully controlled from a comfortable office in Houston. Greensea is developing a solution called

SAFE-C2, which is agnostic to hardware and communications methods and is open to current and future data transmission and ROV systems. SAFE-C2 is based on EOD Workspace, an operating platform specifically developed for ROVs used in EOD operations that is built on the open architecture platform, OPENSEA.

The first challenge is the unspoken requirement that I mentioned above, the entire solution must be better, faster, safer or cheaper than the current solution. As you may know, the vehicle launch occurs in distinct phases—launch, descent, operation, ascent, recovery. Launch and recovery are by far the riskiest phases, when the vehicle is close to the vessel but not yet attached. Current operations with a crew onboard, there are multiple sets of eyes making sure that everything goes smoothly and the ability to demand a hard hold while problems are solved. A ROV pilot onboard the vessel has instant situational awareness of what is happening as the ship heaves or changes heading and can instantly react accordingly. Recreating this instant situational awareness/feedback is a necessary requirement in order for long range control to become common place. Greensea's SAFE-C2 compensates for this loss of first-hand situational awareness by optimizing the available bandwidth between the ROV and operator and providing the operator an intuitive and comprehensive graphical workspace environment tailored to the current tasking. This helps ensure that the operator maintains a close connection to the entire system offshore. It's not exactly the same as feeling the ship's heading change but it's closer.

DATA MANAGEMENT & TRANSITION

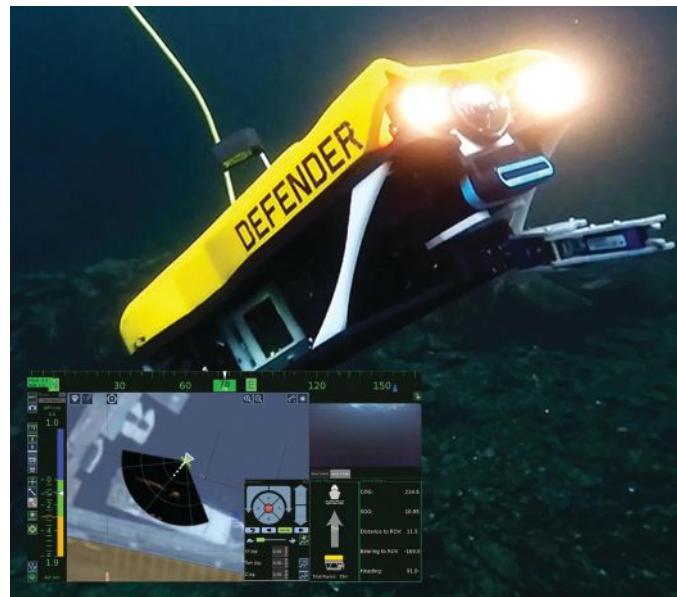
Providing the ROV pilot—which before long will be any available Subject Matter Expert—with as much situational awareness as possible means that another technology hurdle to address is data management and transmission between the standoff operator and the ROV. There are several ways to go about managing and transmitting data. One way is compression—squeeze down the data packets to be as small as possible. Greensea takes another simple approach to data transmission and management: send less data and send only the data needed. This is accomplished by having the ROV perform low-level autonomous functions (stabilization and piloting aids), high-level autonomy (automating common tasks), and automatic target recognition (identify and recognize sonar targets). Commands are only sent when and if it is needed and data is dynamically allocated bandwidth based on task.

To make the future of long-range command and control a reality, the last significant technology hurdle is a solution for tether and vessel management. Greensea's solution predicts the optimal amount of tether to have in the water, managing the deployment vessel, the tether, and the ROV to optimally aid the execution of the task without interference. With awareness of the tether path, the operator can make path planning decisions, define watch circles and exclusion zones for the deployment vessel, and avoid tether entanglement.

Once these technology hurdles are mastered, there is one really large problem looming—how do all the different pieces of hardware (USV, ROV, AUV, LARS and hundreds, if not thousands, of sensors) get integrated together? The Greensea solution is through open architecture. A simple definition of an open architecture software platform is one that is easily updated and modified. All Greensea products are built upon OPENSEA, an open architecture platform for the marine industry. Being an open architecture platform makes it scalable, flexible, and severable. OPENSEA is compatible with



» Keeping technicians onshore: SAFE-C2 is agnostic to hardware and communications methods and is open to current and future data transmission and ROV systems. (Photo credit: Greensea)



» VideoRay MSS Defender is one of several inspection class ROVs suitable for long-range command and control with SAFE-C2. Inset: SAFE-C2 Workspace. (Photo credit: Greensea)

most major marine sensors and vehicles. Adding, swapping, modifying sensors, vehicles, payloads etc. can be done as technology advances.

OPEN ARCHITECTURE AS A CORE VALUE

It's not just OPENSEA that is the open platform, being open is also a core value for Greensea as a company. Greensea's development cycle emphasizes rapid and continuous acceleration of development with our partners. We have developed an SDK available to other manufacturers and developers that will allow them to apply novel concepts to a diverse range of applications. We are developing an open community for developers and engineers across the globe to engage in discussions to move the ball forward in all aspects of marine and subsea technology.

There is no way to entirely remove risk from the work being done at sea, the best that we can do is to manage risk. Within the next year or two the long-range control of an ROV or AUV will become normal operating procedure, reducing the number of personnel required offshore.

For more information, visit:
WWW.GREENSEA.COM

FIRST NEW SEAFLOOR MAP OF THE DECADE COLLECTED IN AUSTRALIAN WATERS

Schmidt Ocean Institute's research vessel Falkor has collected the first public seafloor data of the New Year, as part of a global effort to map the entire ocean floor by 2030. Australian scientists aboard the ship literally "Pinged in the New Year" as they sent sonar waves down to the ocean floor at midnight on December 31 and throughout New Year's Day, flying the first official flag of The Nippon Foundation-GEBCO Seabed 2030 Project. This also marks the start of the United Nations Decade of Ocean Science for Sustainable Development.



» Schmidt Ocean Institute's RV Falkor.

The expedition is a collaboration between Schmidt Ocean Institute, Seabed 2030, and Australian research institutions, and seeks to map significant seafloor features in the Tasman and Coral seas, offshore Eastern Australia. Seabed 2030 aims to facilitate the complete mapping of the global ocean floor by 2030, and will make this data freely available.

"We are still learning a lot about the complexity of the seafloor and are always discovering new features," said Co-Chief Scientist Dr. Helen Bostock, from the University of Queensland. "These features provide information about the evolution of the ocean, while features like volcanic seamounts commonly support vulnerable

marine ecosystems and are nurseries for deep sea fish. It is important that we improve the map of the seafloor to help manage the oceans and their resources sustainably into the future."

Jamie McMichael-Phillips, Seabed 2030 Project Director said: "We now have just under a decade to reach our target of mapping the world's entire ocean floor. Partnering with organizations such as Schmidt Ocean Institute will greatly help us in achieving this ambitious initiative, and this expedition is an excellent testament to how we intend to use this time we have left until 2030."

The high-resolution seafloor mapping is a continuation of Schmidt Ocean Institute's year-long 2020 campaign in Australia, which has resulted in new discoveries, including a 45-meter siphonophore, believed to be earth's longest sea creature, and a new 500-meter tall detached coral reef. The current expedition to the Tasman and Coral seas will provide detailed maps that give scientists insight into the formation of the Australian continent.

Globally so far, 19 percent of the seafloor has been mapped according to the Seabed 2030 initiative. "Schmidt Ocean Institute is proud to partner with and fly the flag of Seabed 2030 to advance this critical work," said Executive Director Dr. Jyotika Virmani, "Open sharing of information is one of our core values, and seafloor maps are fundamental to understanding our ocean. Better seafloor maps will improve tsunami prediction and will also give scientists insight into ocean circulation which controls the marine environment, including where nutrients and pollutants such as microplastics accumulate."

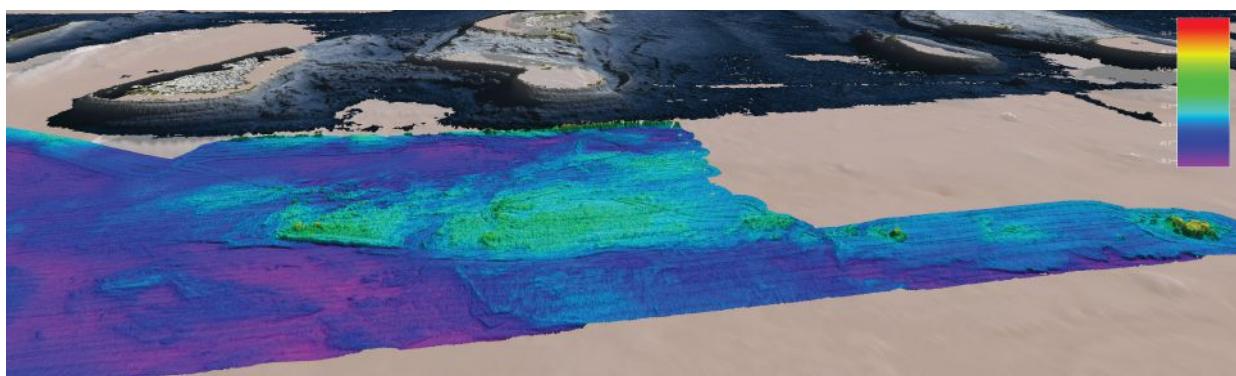
"It's an honor for us at Schmidt Ocean Institute to collect the first seafloor mapping

data of 2021 as we greet this UN Decade of Ocean Science," said Wendy Schmidt, Schmidt Ocean Institute co-founder. "With the tools we have today, we are able to 'see' the deepest, darkest ocean floor. As we explore more areas, there's no telling what discoveries await, but we fully expect to identify new areas of high biodiversity that need protection, and to help develop comprehensive ocean floor maps that can guide the world in sustainably developing the Blue Economy."

The expedition will continue mapping the Tasman and Coral seas through to January 26. The maps created will aid in the understanding and management of the Coral Sea Marine Park, which sits outside the Great Barrier Reef UNESCO World Heritage Site, and is one of world's largest marine parks, spanning nearly 1 million square kilometers of the ocean. The new mapping data will be made publicly available through The Nippon Foundation-GEBCO Seabed 2030 and the AusSeabed Marine Data Portal.



» Seafloor mapping from the control room aboard Falkor.



» Seafloor map of Sykes Reefs.

INTELLIAN'S LARGE VSAT PRODUCTS GAIN APPROVAL FROM ANATEL

Intellian has received approval for its v240MT 2, v240M 2, v240M and v150NX antennas from the Brazilian National Telecommunications Agency, ANATEL. These powerful, high-throughput antennas are widely used in the energy industry, so this approval opens the door for Brazil's extensive oil and gas market to adopt Intellian's leading antenna technology.

According to Brazilian Regulations (Federal Law 9472/97), telecommunications products to be sold and used in Brazil must have a Certificate of Conformity issued by a Designated Certification Body (OCD), indicating that they comply with Brazilian regulatory

requirements. This certificate must also be approved by ANATEL.

Intellian's innovative v240MT 2 antenna combines C, Ku and Ka band communications on a single reflector to enable auto-switching between all three bands, together with both GEO and MEO satellite tracking. The v240M 2 and v240M do the same for the C and Ku bands, while the v150NX antenna works across multiple orbits and can be easily converted between operation on the Ku and Ka bands. This flexibility to change band and orbit places the choice of operator firmly with the customer and ensures that the antennas are ready



for the development of future, non-geostationary (NGSO) networks.

Approval for the antennas extends to include a range of BUC options, to allow customers to tailor their antennas' output power and hence their uplink bandwidth.

Sam McKee, General Manager Americas, Intellian Technologies, concludes: "We are delighted to receive this approval. The Brazilian oil and

gas markets are ideally placed to benefit from the award-winning technology and best-in-class RF performance of our v240MT 2, v240M 2, v240M and v150NX antennas. These products are ready for the next generation of satellite networks, so by choosing Intellian, customers are safeguarding their connectivity for the future and guaranteeing a seamless and cost-effective pathway to new services as they come online."

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WAVE POWER: STABALIZING THE FUTURE CLEAN ENERGY MIX



By Patrik Moller
CEO, CorPower Ocean

Wave energy has not yet experienced the same curve of acceleration as offshore wind and solar. However, the technology is now fast evolving and edging ever closer to widespread commercialization. CorPower Ocean CEO Patrik Moller explains how wave power can play a crucial role in the future clean energy mix helping stabilize energy production through combined wind-wave-solar arrays.

The ocean forms one of the largest yet least explored energy sources on earth—and the successful conversion of wave energy is likely to play a crucial factor in our transition to an entirely renewable world. Wave energy is particularly valuable in the broader clean energy mix because its consistency and predictability. As waves are built up from weather systems over several days the energy content is concentrated and smoothed, delivering a regular power profile to our coasts.

Essentially, wave energy can fill the gaps when it is not windy or sunny. This adds stability to the electricity system in a reliable and competitive way. By producing electricity at times when it is most needed, wave energy offers natural grid balancing that both reduces the need for over-capacity of wind and solar and reduces the need for storage capacity in zero carbon electricity systems. Ultimately, this lowers overall system costs and unlocks greater value

for farm owners and grid operators.

It also works hand-in-hand with hydrogen production, with a wind-solar-wave electricity mix offering a more constant operation with higher load factors and higher profitability for electrolyze operators. In the lowest cost zero-carbon scenarios, renewable hydrogen will be used primarily for industry and transport, while wave energy and other complimentary electricity sources help balance the electricity system without requiring as much long-term storage capacity.

STORMPROOF ENERGY EFFICIENCY

CorPower's unique WEC (Wave Energy Converter) technology took inspiration from the pumping principles of the human heart, which pumps in a singular direction, using stored hydraulic pressure to provide force for the return stroke. CorPower's devices—which come in the form of heaving buoys connected to the seabed through a tensioned mooring system—mimic this action harnessing the upward force of a wave swell and storing pressure to provide return force driving the buoy downwards. This results in equal energy production in both directions. The device harnesses energy from both the rise and fall as well as the back-and-forth motion of waves. When stimulated, the light, composite buoy initiates a 'Power Take Off' in the form of a drive train located inside which converts the mechanical energy into electricity.

Historically, wave energy devices have either broken in storms or simply not produced enough electricity to make it a viable business prospect. CorPower is addressing those two main challenges head on, firstly by using new technology to protect its devices making them transparent and resilient to the most aggressive storm waves. This function is similar to wind turbine technology where blades will pitch to protect from overspinning in fierce conditions. This sort of protective function has been missing in wave energy to date.

The second key development is advanced phase-control technology, which strongly amplifies the response to regular waves in terms of the motion and power capture. For instance, in a one-meter wave, CorPower's buoys may move three meters up and down, due to the resonance phenomena. Its devices have been shown to produce five times more electricity per ton than any other known wave technology. On average the devices generate 10Mwh per ton of equipment installed in the ocean, which is in line with leading floating wind developments.

HARVESTING BIG ENERGY

CorPower's relatively small and low-cost WEC device have been designed to harvest large volumes of energy due to their high structural efficiency. The devices are engineered to generate the same AEP from a buoy with 1/10 volume compared to conventional point absorber WECs. In terms of dimensions, the devices measure 9 by 19 meters and weigh 60 tons—dwarfed by the size of other wave energy prototypes some of which are thousands of meters in dimension and weigh several thousand tons yet have the same capacity. Securing large amounts of electricity from a small device significantly reduces CAPEX, while the compact lightweight devices are also less costly to transport, install and service, bringing down OPEX.

The device concept is optimized for 10MW clusters, where the electricity is collected from an array of WECs into a collection hub. Each 10MW hub delivers grid quality electricity with standard 33/66kV electrical connection commonly used in offshore wind, with a single control and data acquisition interface over fiber and radio-link to the hub. A programmable logic controller located inside the devices enables them to operate autonomously.

RACE TO COMMERCIALIZATION

The firm is now entering the final stages of its journey to commercialization, after modifying and refining this technology for more than a decade. In 2020, CorPower announced a major 16 MEUR expansion in Viana do Castelo, northern Portugal, where it aims to complete the final demonstration phase branded Hi-Wave 5. The broader project will see the development of an R&D, Manufacturing and Service Centre laying foundations for future high-volume operations.

The team is currently in the process of fabricating its first commercial scale system before undertaking dry testing in a bespoke test rig with simulated wave loading in Stockholm before ocean deployment during the second half of 2021. The full-scale device will need to demonstrate it can survive the harshest ocean conditions through a rigorous testing process. CorPower will then complete one more design update before unveiling the final commercial stage technology in the form of its C5 machines. A total of three C5 machines will be installed in the ocean in 2023 running for a little of over a year to secure type certification. The longer-term future will see CorPower positioning itself as a leading global OEM (Original Equipment Manufacturer) building devices, completing final assembly and also offering operations and maintenance contracts to customers operating the wave farms worldwide.



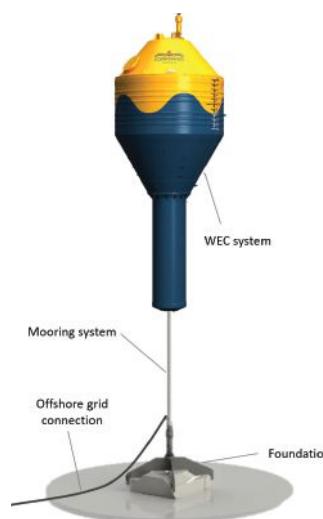
» A CorPower WEC at the EMEC Scapa flow test site in Orkney, Scotland. (Photo credit: CorPower Ocean)



» CorPower's HiWave-3 demonstration project involved a large scale (1:2) WEC system which was designed, manufactured and tested in two steps between 2015 and 2018. (Photo credit: CorPower Ocean)



» Example wind-wave array. CorPower's WEC technology has resulted from a decade of product development and three decades of research on wave hydrodynamics. (Photo credit: CorPower Ocean)



» WEC system overview: CorPower's WECs measure 9 m x 19 m and weigh 60 tons. (Image credit: CorPower Ocean)

MAAP ADOPTS KONGSBERG DIGITAL'S K-SIM ELEARNING SOLUTION

Kongsberg Digital reports that the Maritime Academy of Asia and the Pacific (MAAP) has adopted its new K-Sim eLearning solution, as well as commissioning installation of a cutting-edge K-Sim Safety firefighting simulator at its premises in the Philippines.

Kongsberg Digital is heading the digitalization of the maritime training industry and is continuously adding new simulation-based training applications to its digital platform, K-Sim Connect. Already adopted by many training institutes, K-Sim Connect has provided more than 23,000 cloud-based simulations to customers worldwide this year.

MAAP—a leading institution of excellence for maritime education and training in the Asia-Pacific region—has for decades been a pioneer in the use of new simulation-based training tools. Now, the Academy has started using Kongsberg Digital's K-Sim Engine eLearning solutions to deliver cloud-based tuition to its student engineers, consolidating its position as a leading adopter of the new digital technology.

Designed to provide highly realistic representations of real engine models, this cutting-edge eLearning tool allows students to practice and prepare for their exams anytime, anywhere and at their own pace, whilst providing a comprehensive simulation resource.

"The K-Sim Connect platform with its applications and services is a timely and cost-effective solution for the limitations posed by the recent global coronavirus pandemic on maritime education and training in the Philippines," said Admiral



» Kongsberg Digital's K-Sim Connect platform enables MAAP to provide online volume training to its students, who can then efficiently train and prepare for exams anytime and anywhere. (Photo credit: Kongsberg Digital)

Eduardo Ma. Santos, President at MAAP. "MAAP signed up for 100 simultaneous user licenses that will provide our students continuing access to simulation-based engine room exercises online, without the need for face-to-face collaboration with the instructor-facilitator."

Engr. Gerardo Ramon Galang, Director for IT and Simulator Support, added: "Our new normal now consists of combining video conferencing and other collaboration apps with the K-Sim Connect eLearning solutions during the actual conduct of simulation exercises, enabling a seamless transition from the traditional mode of learning while maintaining the same high standards in delivering quality maritime simulator training services to our students and customers."

"We're very pleased to see how well received our digital solutions for the maritime training market have been since we started rolling them out earlier this year," says Andreas Jagtøyen, VP, Kongsberg Digital. "As a leading educational establishment in Asia, MAAP have always been among the first to adapt to the latest training methods. Their choice to add our cloud-based simulation solutions to their physical KONGSBERG simulators is a welcome endorsement of our new digital simulation services."

Also included in the latest contract with MAAP is Kongsberg Digital's new full-mission K-Sim Safety simulator, which will deliver the ability to carry out safe, realistic advanced firefighting and onboard search and rescue procedures in a cost-efficient manner. Using a replica of the layout on board a real crude oil carrier, an interactive 3D environment combines precise object and equipment models with immersive visuals, exposing trainees to a broad range of situations related to preventing and dealing with onboard fires. As with all Kongsberg Digital's simulation solutions, K-Sim Safety is designed to conform with relevant STCW regulations.



» Magellan 725 ROV

GLOBAL OCEANS ACQUIRES 6000-METER ROVS AND TOWED SONAR SYSTEM FROM OCEANEERING INTERNATIONAL

Global Oceans, a US-based nonprofit corporation focused on mobilizing commercial sector resources for ocean science, has acquired through a donation from Oceaneering International, Inc. three deep-sea exploration vehicles: the Magellan 725 ROV, the Ocean Discovery ROV, and the Ocean Explorer 6000 Towed Sonar System.

The parties have agreed to jointly operate and technically support the ROVs on future Global Oceans projects. The relaunched two-body ROVs will be designed for ease of maintenance in the field and will offer a complement of interchangeable sampling tools, storage, CTD, high-resolution video and extensible lighting.

These vehicles will contribute significant capacity for deep-sea biophysical sampling, seabed mapping, exploration, habitat surveys, and scientific research for several Global Oceans projects, and will be made widely available to the international ocean science community for research and for training the next generation of ocean scientists.

Jim Costopoulos, CEO of Global Oceans stated: "These vehicles and systems will support Global Oceans' mission of expanding capacity for ocean and atmospheric science, which includes the development and acquisition of scientific vehicle and instrument platforms that can be efficiently deployed through Global Oceans' innovative MARV strategy for configuring time-chartered offshore service vessels (OSVs), modular laboratory and workspace systems, and global logistics support for scientific research worldwide."

Nitto

Innovation for Customers

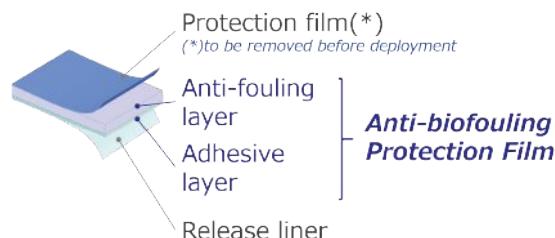
MARINGLIDE™: ANTI-BIOFOULING PROTECTION FILM

Nitto Denko Corporation (Nitto) was founded in 1918 as Nitto Electric Industry Co. in Osaki, Tokyo and today is a leading supplier of highly specialized products that serve a broad range of industries within the global electronics, transportation, construction and healthcare sectors. Nitto's unique product portfolio centers around one core area of product engineering: the development and manufacture of multi-functional adhesives and advanced coatings.

One of Nitto's most recent breakthroughs is an innovative anti-fouling solution. Nitto's MARINGLIDE™ Anti-biofouling Protection Film can be easily applied to an array of surfaces and can effectively prevent the build-up and growth of marine organisms, such as barnacles, for sustained periods of time. The film is biocide-free and eco-friendly.

LAYERED DESIGN

The film consists of four layers: a protective film, an anti-fouling layer, an adhesive layer, and a release liner. Thanks to the *self-adhesive layer*, use of the film is not hindered by any curing time. It can be easily applied by hand, after which your marine asset or instrument is protected from biofouling. The *anti-biofouling layer* is pre-coated and gives the film a uniform thickness which has no significant influence on the accuracy of the results gathered by several tested underwater acoustic instruments and provides long-lasting antifouling performance.



» MARINGLIDE™ film's innovative layered design.

The anti-biofouling layer rejects the adhesion of micro-organism proteins without the need for biocide substances. The top *protective blue layer* is used to guard the special anti-fouling layer from dust, dirt and atmospheric particles, and must be removed before application. After use, the film can be peeled off by hand, meaning there is no need for the use of any high-pressure water cleaning or abrasive brushes.

PROVEN RESULTS

MARINGLIDE™ film has been subjected to rigorous testing, in different parts of the world, and to date has delivered impressive anti-biofouling performance.

While barnacles were attracted to the PVC surface, there was zero evidence of biofouling on the area protected by film. MARINGLIDE™

film can be used on a variety of marine instruments, including ADCPs. In testing, in cooperation with Nortek Japan, the film was applied to ADCP transducers which were then subject to ocean waters for four months. Again, the film kept the transducers free of any biofouling and had no impact on the ADCP's capacity to gather the necessary data.

PICTURE PERFECT PERFORMANCE

Underwater cameras, whether for the aquaculture or marine survey, can also be protected by MARINGLIDE™ film. Underwater cameras typically undergo frequent cleaning to rid them of biofouling, but the use of a protective film eliminates the costs and inefficiencies of such maintenance operations.



» MARINGLIDE™ film can be used on a variety of marine instruments, including ADCP.



» MARINGLIDE™ film extends the operability of underwater cameras.

Therefore, the team at Nitto ran a series of tests to see if the Anti-biofouling Protection Film could not only prevent the accumulation of marine organisms but also help with clear images. The camera window was covered with the film and the camera was deployed in Tokyo Bay, Japan for three months. As a result, the camera was able to take high-resolution images of the fishes for at least for 45 days without the need for (normally required) maintenance: the film kept the lens clear of biofouling.

For more information, visit: www.nitto.com/us/en/products/surface/maringlide001



» A pilot-test of Ramboll's True Digital Twin technology at the Wikinger offshore wind farm has revealed a significant analytical potential to increase lifetime of offshore wind structures. (Image credit: Ramboll)

RAMBOLL'S TRUE DIGITAL TWIN DEMONSTRATES ITS POTENTIAL TO INCREASE LIFETIME OF OFFSHORE WIND STRUCTURES

Ramboll has reached an impressive milestone in the ROMEO project, demonstrating the great potential of its innovative True Digital Twin technology through a pilot-test that has been conducted at the Wikinger offshore wind farm in the Baltic Sea.

The pilot-test—based on a measurement campaign using Structural Health Monitoring (SHM) solutions—revealed a significant potential for lifetime extension for the offshore

substation and the offshore wind turbine foundations.

"Our goal with this project is to demonstrate the feasibility and impact of data-driven O&M strategies by having the True Digital Twin continuously deliver instantaneous insights on the physics of the assets that are being monitored. The results from this pilot-test are stunning, revealing significant potential for lifetime extension and cost reductions in operating and maintaining

offshore wind structures," says Ursula Smolka, Lead Consultant Asset Management Wind, Ramboll.

The results of the pilot-test have been summarized in two reports which Ramboll has delivered to its ROMEO project partners. According to the reports, the full power of a True Digital Twin lies within the continuous monitoring of the factors that can affect the structural integrity of a wind turbine over its entire lifetime. The monitoring process can be done at all possible locations using SHM solutions, cloud computing and advanced mathematical calculations.

Based on only a few sensors at easily accessed locations, the patterns of movements are captured to let the True Digital Twin undergo the full history of loads. The True Digital Twin can detect structural integrity issues like failure of jacket braces, excessive scour or corrosion. Extensive simulation studies showed that monitoring modal properties like natural frequencies and mode shapes not only can detect anomalies but can also identify the type of anomaly if combined with a design model database.

"The concept of the True Digital Twin makes detailed design models available for predicted

lifecycle management and provides the framework to incorporate measurement findings of a specific turbine into the simulation world. We can track the history of exposure of an individual structure or detect damages and replace the extensive instrumentation of traditional methods with mathematical calculations," Smolka added.

During the next phases of the ROMEO project, Ramboll and its partners will continue exploring the added value of continuously monitoring offshore wind structures. The project partners anticipate a reduction of human offshore time for annual inspections and a reduction in the number of planned time base offshore visits.

"The benefits of the True Digital Twin are very clear to us and this pilot-test has now reinforced our initial expectations. Ramboll has made great progress in the ROMEO project and we look forward to collaborating with them during the next phases of the project where we will look at True Digital Twin's potential of reducing human offshore time and number of offshore visits," says Mark Paine, Offshore Asset Integrity Manager, Iberdrola Renewables.

THOMA-SEA MARINE CONSTRUCTORS TO BUILD TWO OCEANOGRAPHIC SHIPS FOR NOAA

NOAA's effort to recapitalize its aging fleet of research ships took a major step forward with the U.S. Navy's award of a \$178,082,877 contract to Thoma-Sea Marine Constructors LLC, Houma, Louisiana, for the detailed design and construction of two new oceanographic ships for the agency. NOAA is acquiring the vessels through an agreement with the Naval Sea Systems Command, a leader in building, providing and procuring large research ships for the nation's research fleet.

"We can all be proud that these two new NOAA ships will be built in the United States by highly skilled workers, and to the highest standards," said U.S. Secretary of Commerce Wilbur Ross. "The nation will benefit greatly from the information these state-of-the-art vessels will collect for decades to come."

The first ship, to be named *Oceanographer*, will be homeported in Honolulu. The second ship, to be named *Discoverer*, will be assigned a homeport at a future date. Both vessels will continue the legacies of their namesakes. The first *Oceanographer* served in the NOAA fleet from 1966 to 1996 and her sister ship, *Discoverer*, served from 1967 to 1996.

The new ships will support a wide variety of missions, ranging from general oceanographic research and exploration to marine life, climate and ocean ecosystem studies. These missions include

shallow coastal, continental shelf, and worldwide ocean survey and data collection. Designed as single-hull ships, *Oceanographer* and *Discoverer* will be built to commercial standards. They will incorporate the latest technologies, including high-efficiency, environmentally friendly EPA Tier IV diesel engines, emissions controls for stack gases, new information technology tools for monitoring shipboard systems, and underwater scientific research and survey equipment.

"These state-of-the-art ships will play a vital role in collecting high-quality data and leading scientific discoveries," said Neil Jacobs, Ph.D., acting NOAA administrator. "The science missions aboard these vessels promise to push the boundaries of what is known about our still largely undiscovered ocean."

The ships will be equipped to launch work boats, perform maintenance on buoys and moorings, deploy scientific instruments to collect weather and water column data, and conduct seafloor mapping surveys. Each vessel will operate with a crew of 20 and will accommodate up to 28 scientists.

"This contract award represents a major step forward in the process to recapitalize NOAA's ship fleet," said NOAA Rear Adm. Michael J. Silah, director of the NOAA Commissioned Officer Corps and NOAA Office of Marine and Aviation Operations (OMAO). "We thank the Navy, our valued partner, for its assistance with this acquisition."

The NOAA ship fleet is operated, managed and maintained by OMAO, which is composed of civilians and officers with the NOAA Commissioned Officer Corps, one of the nation's eight uniformed services.



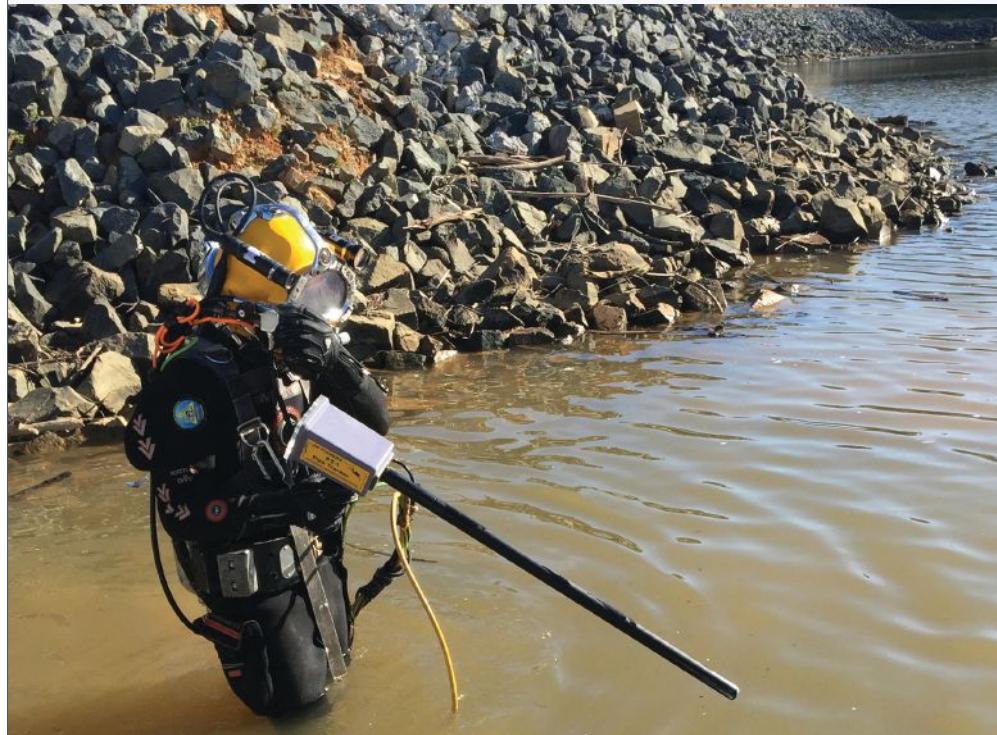
» *Oceanographer* and *Discoverer* will join NOAA's ship fleet, which includes NOAA Ship *Ronald H. Brown*, the agency's largest research vessel. (Photo credit: Wes Struble/NOAA)

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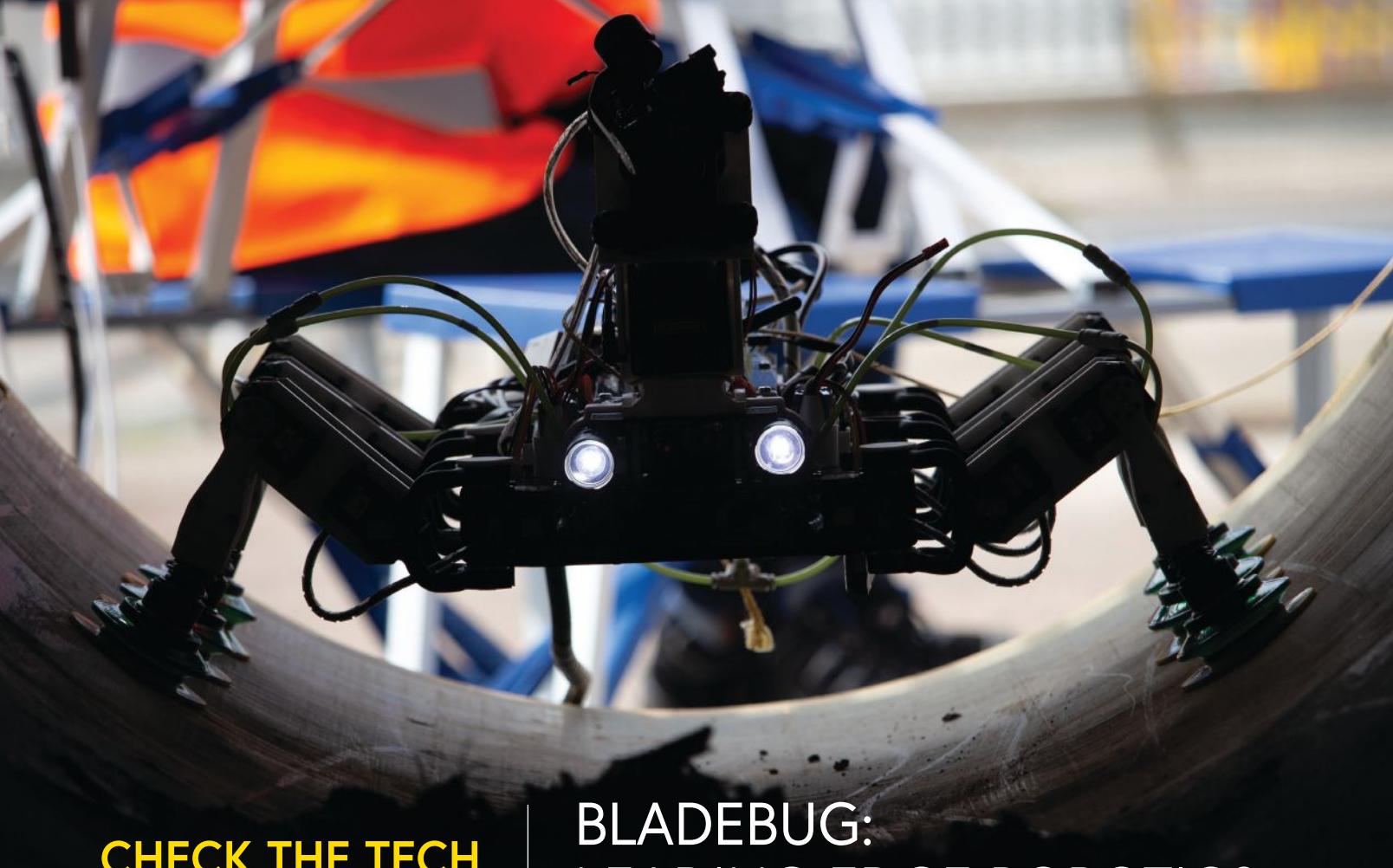


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CHECK THE TECH

BLADEBUG: LEADING EDGE ROBOTICS

Could robots replace manual operations for offshore wind turbine inspection and maintenance? (Photo credit: BladeBUG)

As advanced marine robotics continue to transform the way we work at sea, the team at BladeBUG is on a mission to revolutionize offshore wind turbine inspection and maintenance. Standard O&M work, including any necessary repairs, is typically performed by rope-access technicians, often working in extreme conditions and during restricted weather windows. While this approach encompasses a range of well-established practices, it also results in a number of inefficiencies, including extended turbine downtime and the expensive use of crew transfer vessels.

BladeBUG represents a game changing feat of engineering, one which proposes a safer and more scalable solution to turbine optimization. The six-legged inspect-and-repair robot is the brainchild of Chris Cieslak, an experienced turbine blade designer, who believes that the field of unmanned robotics holds the key to

unlocking previously unimagined offshore wind farm efficiencies.

Conceptualization began in 2014, from Cieslak's shed, before he settled on a unique hexapod design. Funding followed and further steered development toward the present-day modular form, a remotely operable platform capable of deploying interchangeable plug-and-play tools to carry out a particular task at hand; these include: the inspection of blade surfaces

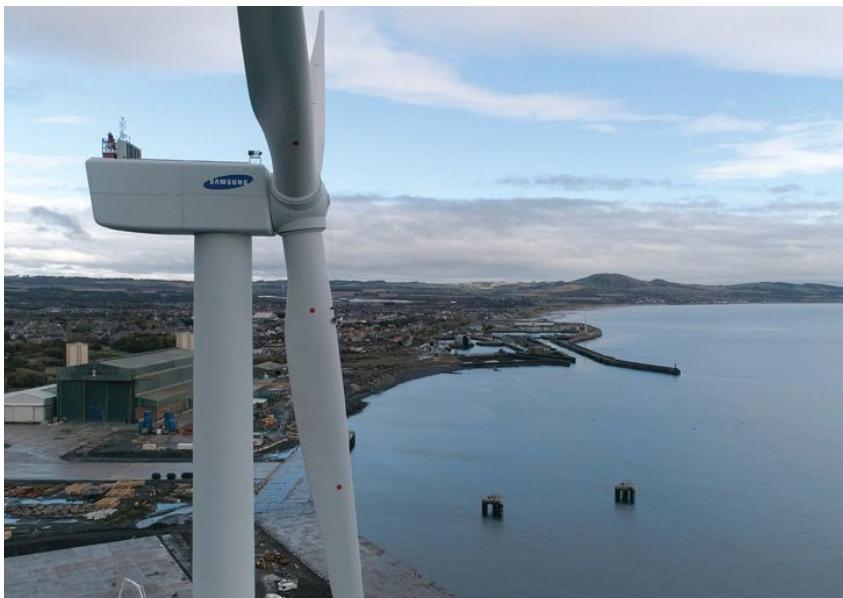


The six-legged modular robot is capable of deploying a range of interchangeable plug-and-play tools to carry out various O&M tasks. (Photo credit: BladeBUG)

for emergent cracks and imperfections; the transmission of data relating to their condition back to mission control in real-time; and the resurfacing of blades when necessary.

COST REDUCTIONS

The most recent version of BladeBUG is the result of a £1 million project supported by The Offshore Renewable Energy Catapult (ORE Catapult) and partly funded by Innovate UK. Studies suggest that BladeBUG could lead to a 30 percent cost reduction on current blade inspection techniques, with a measurable knock-on effect to the levelized cost of energy (LCOE). (Cost savings could reach as much as 50 per cent for next generation turbines, according to ORE Catapult.) Efficiencies on this scale will come as welcome news to offshore operators looking to ramp up investment in renewable energy infrastructure in deeper waters where sea conditions and faster tip speeds will inevitably exacerbate turbine damage.



▲ BladeBUG completed sea trials at ORE Catapult's 7MW Levenmouth Demonstration turbine in late 2020, using its vacuum-powered feet to navigate the varying curvature of blade surfaces. (Photo credit: BladeBUG)

SUCCESSFUL SEA TRIALS

In October 2020, BladeBUG successfully completed sea trials at ORE Catapult's 7MW Levenmouth Demonstration turbine, off the coast of Fife, Scotland. By scaling a vertically positioned blade, BladeBUG was able to use its vacuum-powered feet to navigate the varying curvature of blade surfaces and transmit real-time data and live video feeds to technicians. In short, the sea trials served to validate Cieslak's principal assertion: robots can replace manual operations for lengthy deployments in authentic offshore conditions.

Speaking exclusively to ON&T, BladeBUG's now CEO said: "The results of our latest test represent an historic moment both for us as a company and for the wider offshore wind sector. The use of robotics is the next natural step for offshore wind maintenance and repair and represents a huge opportunity in areas from health and safety to O&M maintenance costs."

INDUSTRY COLLABORATION

BladeBUG is also a key component of a broader technology initiative, the £4.2 million MIMRee (Multi-Platform Inspection, Maintenance and Repair in Extreme Environments) project, an ambitious cross-sector program that seeks to pool expertise in robotics, AI, marine and aerial engineering, nanobiotechnology and space mission planning to prove that offshore wind maintenance missions can be conducted by unmanned robots.

During these trials, BladeBUG will work in collaboration with an autonomous vessel and teams of drones, using a robotic arm to clean and resurface damaged blades. The final MIMRee system technology trials are set to take place in mid-2021.

For more information, visit:
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ENVIRONMENTAL MONITORING OF WAVE ENERGY DEVICES IN PORTUGAL

WESE project has announced the completion of further environmental monitoring of wave energy devices, this time in Portugal.

The WESE project is devoted to the collection, processing, analysis and sharing of environmental data from wave energy devices currently operating at sea, representing different types of technologies and locations (onshore, nearshore, and offshore), therefore, acting on different types of marine environments that can potentially be affected by wave energy projects.

Following the Monitoring Plans developed earlier in the project (see Deliverable 2.1, report available at the project website), a two-day monitoring campaign was undertaken by WavEC Offshore Renewables around the WaveRoller device of AW-Energy (Finland) in Peniche (Portugal).

On the first day (October 16, 2020), acoustic monitoring was performed simultaneously to the decommissioning of WaveRoller (for maintenance purposes) to assess the noise emitted during the activities. Underwater sound emissions were monitored



» WavEC's ROV setup and team at the WaveRoller test site.
(Photo credit: WavEC)

by means of static underwater measurements for a period of 9-10 hours. Static measurements consist in the deployment of a passive acoustic sensors moored in a specific location and for a long period of time. Salinity and water temperature profiles were performed as complementary data of underwater noise measurements.

On the second day (October 17, 2020), a ROV campaign was undertaken for the seafloor integrity monitoring to allow evaluating possible alterations of the seafloor by the presence of the device and by mooring cables. WavEC's ROV was used to collect videos (each about 30 minutes long) along five transects/areas near to the WaveRoller. It included the device and its foundation, mooring cables and the electrical cable.

The analysis of the data collected will support the development of models for the analysis of potential cumulative pressures and environmental impacts of future larger scale wave energy deployments.



» WavEC's ROV moving towards the WaveRoller device. (Photo credit: WavEC)

MCDERMOTT AWARDED OFFSHORE ENGINEERING CONTRACT FROM QATARGAS

McDermott International, Ltd has completed the KG-D6 R Cluster subsea field development project and achieved pre-commissioning and ready for startup for Reliance Industries Ltd., in the Krishna Godavari Basin, located off the east coast of India.

McDermott built a yard facility in India for the fabrication of risers, jumpers and marine logistics support. The project comprised two offshore campaigns.

During the first campaign, the DLV 2000 completed McDermott's first piggy-back pipelay in S-lay mode (18-inch plus a four-inch) in 4,265 feet (1,300 meters) water depth. It also included the installation of the first ever ultra-deepwater structure, weighing 343 tons, for the DLV 2000. Several six-inch pipelines, PLETs and manifolds were installed in water depths up to 6,447 feet (1,965 meters). In addition, McDermott installed India's longest dual riser.

The second campaign included installation of manifolds, manifold piles, flowlines, PLETs (S-mode and J-mode), in-line structures, jumpers and umbilicals in ultra-deepwater depths, together with major brownfield modifications to Reliance's control and riser platform. Successful flowline and umbilical installation were completed in 6,561 feet (over 2,000 meters) water depth using McDermott vessels: DLV 2000; Lay Vessel 108; North Ocean 102.



» The proposed South Fork Wind Farm site (Image credit: South Fork Wind)

BOEM RELEASES DRAFT ENVIRONMENTAL ANALYSIS FOR SOUTH FORK WIND FARM

The Bureau of Ocean Energy Management (BOEM) has announced that it will publish a draft environmental analysis of the proposed South Fork Wind Farm and is requesting public comment. The draft environmental analysis, referred to as the Draft Environmental Impact Statement (EIS), analyzes the potential environmental impacts of the proposed action described in the South Fork Wind Construction and Operations Plan and reasonable alternatives to the proposed action.

"BOEM remains committed to a permitting process that reduces potential conflicts with other important uses of the ocean, such as fishing, while establishing a strong foundation for wind projects moving forward," said BOEM Acting Director Walter Cruickshank. "The feedback provided by our many stakeholders will help inform the Final Environmental Impact Statement and provide invaluable insight to decision makers."

South Fork Wind is proposing to construct up to 15 wind turbines with a capacity of 6 to 12 megawatts per turbine that will be located offshore approximately 19 miles southeast of Block Island, Rhode Island, and 35 miles east of Montauk Point, New York.

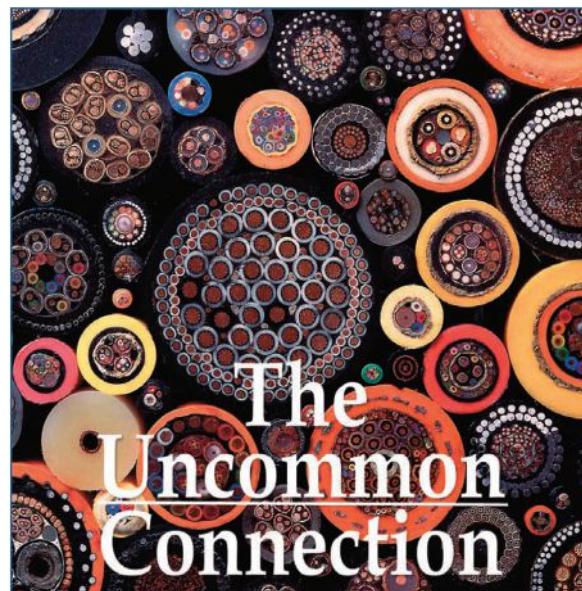
The Notice of Availability (NOA) for the Draft EIS will publish in the Federal Register on Jan. 8. NOA publication opens a 45-day public comment period. During this time, BOEM will conduct three virtual public meetings and accept comments on the Draft EIS. The input received via this process will inform preparation of the Final EIS. Comments on the Draft EIS should be submitted or postmarked no later than Feb. 22. Once the EIS is finalized, BOEM will use the findings to inform its decision on whether to approve South Fork Wind's proposed project.

For more information on public meetings and comments, access BOEM's website: <https://www.boem.gov/renewable-energy/south-fork-wind-farm-virtual-meetings>

CGG SATELLITE MAPPING COMPLETES BARENTS SEA SEEPS STUDY

CGG's Satellite Mapping group recently completed an innovative high-resolution hydrocarbon seeps study commissioned by the Norwegian Petroleum Directorate (NPD). The aim of the study was to increase petroleum system knowledge across a relatively data-poor area of the northern Barents Sea.

CGG Satellite Mapping has over twenty-five years of experience in the detection and characterization of offshore seeps and slicks based on its expert remote sensing processing and analysis of Synthetic Aperture Radar (SAR) satellite imagery. To meet the requirements of the study, CGG Satellite Mapping custom-tasked next-generation SAR satellites to acquire a large collection of high-spatial-resolution SAR imagery at a high revisit frequency. Subsequent advanced processing and analysis by its experts identified the presence of small-scale naturally occurring seepage slick features, unlocking valuable subsurface intelligence.



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U.S.-EUROPE OFFSHORE WIND KNOWLEDGE EXCHANGE

The Business Network for Offshore Wind added to its suite of innovative programming by organizing and hosting a two-day virtual event connecting local government officials with European industry experts. The Offshore Wind Knowledge Exchange, which took place in late December, allowed Maryland legislators, agency personnel, and other stakeholders to deepen their understanding of the offshore wind industry and directly ask questions to European industry experts. Maryland officials were briefed on key aspects of offshore wind project development, including, radar interference, tourism, supply chain development, grid and transmission and the next areas of innovation: hydrogen and floating offshore wind.

"With the State of Maryland's new focus on regional collaboration through SMART Power partnership, we knew state officials were eager to jumpstart their understanding of the industry that would benefit their local jurisdictions," said Liz Burdock, president and CEO of the Business Network. "This unique format lets local stakeholders learn valuable lessons directly from those already working in the field. This is exactly the kind of exchange we need to support robust offshore wind development here in the United States."

Maryland stakeholders were able to hear from and converse with offshore wind energy industry representatives from Scotland and the rest of the United Kingdom, Norway, and Germany about the issues and they faced, and lessons learned when first embarking on offshore wind development. Of particular interest to the Maryland officials, was a segment on how the construction of a nearby windfarm spurred tourist activity at popular beachside communities located south of London. A new education center is a popular draw among the public and nearby schools, and tour boat companies find constant demand to take the beachgoers closer to



the windfarm. The Maryland officials also learned how Scotland's government developed their local supply chains through innovating programs, some of which parallel efforts by the Business Network for Offshore Wind here in the U.S.

The Business Network added the Knowledge Exchange program to its line of innovative services for both officials and companies interested in entering the offshore wind industry. In the first quarter of 2021, the Network will also launch its OSW Market Dashboard, a one-stop platform for companies to access information on all current and pending U.S. offshore wind energy projects. The Market Dashboard hosts articles, contracts, legislation, specifications on each U.S. project, contractor details, and ports and vessels. The Dashboard is searchable by project, state, and region. The Network also will expand its *Foundation 2 Blade* Industry Training offerings to help companies who want to diversify into the growing offshore wind industry.

TOTAL E&P AND EXXONMOBIL SELECT STROHM FOR TCP TESTING

Strohm has announced it has secured a contract with Total and ExxonMobil for a qualification testing program for a high pressure, high temperature Thermoplastic Composite Pipe (TCP). The qualification project will create a foundation for further development of this TCP technology for riser applications.

Under the agreement, Strohm will execute a qualification testing program for a TCP Jumper for permanent subsea application, for hydrocarbon service. The TCP Jumper is designed and fabricated using carbon fiber and PVDF polymer to provide a powerful combination for subsea high pressure and high temperature applications.

"This project for Total and ExxonMobil demonstrates our success in the subsea

market with our TCP technology on the basis of a compelling business case, fit-for-purpose materials and a clear endorsement of the technology from key clients," said Henk de Boer, COO at Strohm.

He continued: "Total and ExxonMobil have previously qualified our materials and products for water injection and have an extensive and deep understanding of composite materials and TCP. We are delighted they have agreed to start this qualification project, which aims to extend our growing qualified product portfolio for Total and ExxonMobil to include hydrocarbon service."

Strohm has the largest track record for TCP in the world. The Netherlands' headquartered company offers a wide



» Strohm will execute a qualification testing program for a TCP Jumper for permanent subsea application, for hydrocarbon service. (Photo credit: Strohm)

range of products based on a variety of fibre and polymer materials, to provide the best solution depending on the needs, pressure, service and temperature. The robust PVDF polymer is already a fully proven material in subsea flowlines; the carbon fiber is insensitive to long term effects such as corrosion, fatigue and creep.

COVID-19 AND ELECTRIFICATION BRING HYDROCARBON DEMAND PEAK FORWARD TO 2027

Aggregate fossil fuel demand is set to peak in 2027—with oil peaking in 2029 and gas in 2037—partially due to the impacts of COVID-19, according to new research by McKinsey & Company.

The Global Energy Perspective 2021 report finds that while coal demand peaked already, peaks in demand for oil and gas are not far behind — falling in 2029 and 2037, respectively.

The research suggests that demand for fossil fuels will never return to its pre-pandemic growth curve.

Christer Tryggestad, Senior Partner at McKinsey, commented: "While the pandemic has certainly provided a substantial shock for the energy sector across all fuel sources, the story of the century is still a rapid and continuous shift to lower-carbon energy systems."

While energy systems around the world will shift to renewables, which are able to compete with the marginal cost of fossil power already today in most places, by 2050 more than half of all global energy demand continues to be met by fossil fuels in McKinsey's Reference Case scenario.

As a result, while the earlier peak of hydrocarbon demand means a substantial reduction in forecasted carbon emissions, the world remains significantly off of the 1.5°C pathway and will run out of its carbon budget for 2100 in the early 2030s.

Tryggestad concludes: "According to our estimates, annual emissions would need to be around 50 per cent lower in 2030 and about 85 per cent lower by 2050 than current trends predict to limit the global temperature increase to 1.5°C."

The report presents specific outlooks per fuel type such as natural gas, oil, coal and hydrogen. It also discusses carbon emissions and offers a detailed perspective on the McKinsey 1.5°C pathway. This includes a look at the implications for business leaders and policy makers, comprising a view on value pools and an energy investment outlook.



MENCK TO PROVIDE HYDRAULIC PILEDRIVING HAMMER FOR OFFSHORE WIND FARM IN THE NETHERLANDS

MENCK, a specialist hydraulic piledriving solutions and project management company and part of marine and subsea solutions group Acteon, recently signed a contract with Seaway 7, the renewables business unit of Subsea 7, to provide an MHU 3500S hydraulic hammer and spread for the installation of 140 monopile foundations for Vattenfall's Hollandse Kust Zuid I-IV (HKZ) offshore wind farm project, located between 18 and 36 km off the Dutch coast. The wind farm will be operated by Vattenfall. With an installed capacity of 1,500 MW of green energy when it is commissioned in 2023, this is the first offshore wind project worldwide to be developed without government subsidies.

MENCK's scope of work includes the manufacture, preparation and operation of one of its renowned and reliable MHU 3500S hammers, which will have the largest piling adaption to date and be capable of installing monopiles with a 7.5-m outer diameter. The offshore operations phase is expected to take eight months and will be split into two installation campaigns.

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REMOTE SURVEY: A NEW NORMAL FOR OIL & GAS

Oil and gas industry interest is surging in using remote survey technologies for more cost-efficient, safer, and lower-carbon certification, verification and inspection of assets and operations. Amid COVID-19 travel restrictions in 2020, DNV GL has conducted more than 4,000 remote surveys for the sector. These have provided the supply chain with the assurance it needs to keep projects and operations running safely and on schedule.



» Remote imaging in Aker BP's Skarv Field in 2020.

Remote surveys involve fixed and mobile cameras (e.g., smartphones) giving customers instant access to DNV GL experts worldwide for verification, classification and certification of assets, verification of materials and components, inspection, and marine assurance.

The growing track record for remote survey technology could soon make it the method of choice for inspections in some places and circumstances, according to a senior expert at one leading oil and gas exploration and production company.

DNV GL led a pilot project with Aker BP to remotely perform inspections of the operator's offshore cranes on the Norwegian Continental Shelf (NCS) as part of annual surveys due during the pandemic. Based on an agreed checklist of selected safety functions, crane operators and specialized crane technicians used intrinsically safe smartphones to take close-up video and pictures for sharing with DNV GL's onshore inspectors.

On the normally unmanned Valhall Flank West platform, the survey of a one-year-old box boom pedestal crane featured auto-testing of the automatic overload protection system. It was the first time this crane was inspected by Aker BP. A similar inspection program was performed on two knuckle boom cranes on a floating production, storage and offloading (FPSO) vessel in Skarv, Aker BP's most northerly producing field. The latest evolution of remote inspection was completed in week 48 on Valhall drilling platform, where the inspector from DNV GL participated live via video.

"Aligned with our 'Remote First' philosophy, remote survey should, where feasible, become the new base case in the offshore oil and gas industry after COVID-19 travel restrictions are lifted," said Stig Sund, Digital Operations Manager, Aker BP.

BUILDING TRUST IN REMOTE SURVEY

Opting for remote survey for the Valhall Flank West and Skarv cranes has been useful as both Aker BP and DNV GL prioritize safe working for personnel during the pandemic. The tactic also aligns with Aker BP's goal to minimize its operational carbon footprint.

The industry has historically sent personnel out by helicopter to perform inspection work, but coronavirus increased the risk associated with travelling offshore. "Now we are moving people out of harm's way, and this may subsequently reduce risk level on the NCS to an even lower level than before the pandemic," Sund suggested. "We also see remote inspection as an enabler for improved work-life balance as experts are becoming location agnostic."

Aker BP had no reservations about remote survey but wanted to see proper management of both the risk and the change process, he added: "DNV GL brought appropriate experience from the maritime and oil and gas sectors and showed an immediate willingness to explore new ways of working."

While remote survey could become "the new normal" post-COVID, both operators and vendors will have to build trust in the technology and adapt to change, he observed: "By playing an active role in updating frameworks and standards, certification bodies can help to promote uptake of remote survey."

With the pilot project having proved that the remote survey technology worked for inspecting the cranes, Aker BP is working towards establishing a best practice and will drive continuous improvement as part of the trust-building process.

"Ultimately, the new normal has to be mutually beneficial for both parties, and the change may trigger the need for business model innovation," Sund concluded. Other DNV GL collaborators and customers are already considering innovations including making more use of real-time monitoring, so that the company's experts can perform more witness inspections from wherever they are.

IDENTIFYING BEST USES FOR REMOTE SURVEY

As experience with remote survey grows in the sector, operators are forming a clearer picture of where and how it might work best. For example, some regard it as good for hazardous areas, such as in electrical inspection, where inspectors can zoom in a remote camera to examine junction boxes and electrical glands and see nameplates and serial numbers on equipment and components.

Barriers to remote survey include the fact that not all locations for oil and gas production are served equally well, or at all, by good wireless communications. There are also change-management issues for potential users with varying degrees of comfort and expertise in using information and communication technologies.

That said, remotely collecting high quality digital images, streaming video, and other data aligns neatly with the industry's increasing use of data and data analytics, and with ongoing research into automation that could one day lead to robots taking a camera to where an inspection is needed. Together with software company Cognite, Aker BP has recently been testing robotics systems for remote control on Skarv. The systems include a four-legged robotic 'dog' enabled with sensors and cameras.

"Deploying and relying on digital technology to remotely perform the inspection and survey of safety critical equipment has already been here for a while and has been accelerated by the constraints imposed by the pandemic," said Astri Haukerud, Global Service Area Leader - Technical Assurance Verification, DNV GL - Oil & Gas. "Although some projects are at the pilot stage, we are seeing more companies, depending on the

type of projects, now using remote inspection as an accepted method and the 'go to' technology. It will be interesting to see when it will be fully considered as the equivalent of being physically onsite."



» Stig Sund, Digital Operations Manager, Aker BP.

ROTECH SUBSEA CLINCHES ADDITIONAL CONTRACT FOR TAIWAN OFFSHORE WIND FARM

Rotech Subsea has clinched a contract for a follow-on phase of sandwave clearance and seabed levelling work at a state-owned Taiwan offshore wind farm. The scope of works will bring the number of active jobs for the subsea excavation pioneer in the Asia region to four when it commences in March 2021.

In Q3 2020 Rotech Subsea mobilized its state-of-the-art TRS2 Controlled Flow Excavation (CFE) and Suspended Jet Trenching tool, setting sail from Aberdeen to Taiwan. There, the TRS2 completed a sandwave clearance scope for a new client won on the back of Rotech's unrivalled European track record in renewables.

After the vital infrastructure works at the state-owned wind farm were successfully completed, the client requested to retain the equipment on stand-by in the region to ensure its availability for potential second phase work early in 2021. That second phase of work has now been confirmed, with work set to commence in March.

The initial scope of works saw Rotech Subsea provide its TRS2 CFE tool to complete sandwave clearance operations at the offshore wind farm. Phase 1 of the works was carried out in late 2020 with the recently announced second phase set to kick off in early 2021.

The TRS2 was selected by the client because of its high volume output performance. The tool was mobilized on the Topaz Installer operating in water depths of 5 to 10 meters.

Phase 1 was a success. The tool was used to carry out 25 grid line excavations, lowering the seabed to allow vessel access to the work site during spring tides. The sections to be

levelled varied in height ranging from 0.4 to 18 m. Rotech Subsea carried out excavations at speeds of between 4 m/min and 10 m/min.

FOUR 2021 ASIAN ENGAGEMENTS AND COUNTING FOR ROTECH SUBSEA

The new contract win came on the back of Rotech Subsea's December 2020 announcement that it had been engaged for a follow-on scope at another state-owned offshore wind farm in Taiwan, where its TRS1 suspended jet trencher had been deployed in Q2/3 2020 to carry out an inter-array and export cable trenching scope for a major long term tier 1 client. Rotech Subsea has also been engaged on another wholly new scope in Taiwan for the same client as well as mobilizing for a recently won umbilical post trenching scope offshore Melbourne, Australia.

"We have gained real traction in the Asian market in the last 12 months," said Director of Subsea, Stephen Cochrane. "In common with four other tenders we have recently won in Asia, our state-of-the-art tools were selected for this phase 2 sand wave clearance work over other tools available in the region due to the safe, non-contact method and productive trenching speeds.

"In recent years we have seen the RS range of Controlled Flow Excavation (CFE) and Suspended Jet Trenching tools become the method of choice for IRM scopes. Increasingly our Suspended Jet Trenchers are being chosen as a primary method for trenching, over other contact trenching systems and ploughs due to our teams' unrivalled experience and our tools' unrivalled performance.

"The enhanced capabilities of our RS tools mean they can provide deeper and narrower



» Rotech Subsea mobilizes its TRS2 Controlled Flow Excavation.

trenches than ever before, with trenching speeds more than double that of competing Mass Flow Excavation tools."

Rotech Subsea's in-house research, development and engineering team has created a suite of 14 tools that has established Rotech Subsea as market leader in providing non-contact Controlled Flow Excavation (CFE), Suspended Jet Trenching technology and related subsea services. The dedicated in-house R&D team continue develop their technology, with further game changing enhancements to CFE due to be unveiled in 2021.

Rotech Subsea's patented RS technology provides capabilities not available through traditional mass flow excavation. They offer solutions in controlled flow trenching, excavation, burial / backfill, deburial and seabed debris clearance for: Cable array and export, trenching / deburial; Cable joint burial / IRM; Pipeline trenching / deburial; Backfilling for cable / pipeline protection; Jack-up leg / spud can clearance; UXO deburial / access; Freespan correction / seabed rectification; Harbor / pontoon seabed clearance; Sand wave clearance / cable and pipeline route clearance; Umbilical and flowline trenching / deburial; Salvage deburial / access; Access to subsea structures / IRM / decommissioning; Drill cuttings removal; Cable / pipeline umbilical recovery; Rock removal / relocation; and Rock dump dispersal.

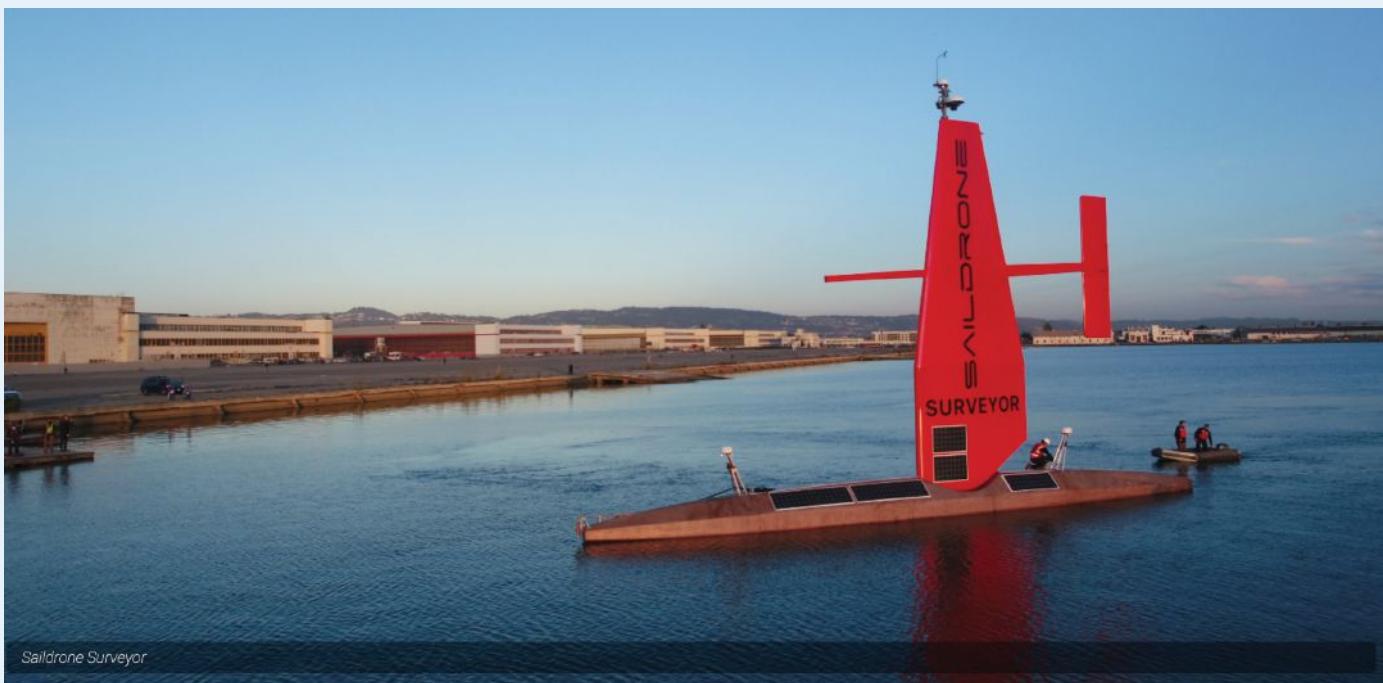
MAGSEIS FAIRFIELD AWARDED MULTIYEAR OBN CONTRACT ON THE NCS

Magseis Fairfield has been awarded a contract for the provision of Reservoir Monitoring Source Services related to Permanent Reservoir Monitoring (PRM) and 4D OBN monitor surveys, by ConocoPhillips Skandinavia AS on the Norwegian continental shelf.

In addition, Magseis Fairfield has been awarded a further contract by ConocoPhillips Skandinavia AS or the provision of OBN services. Both contracts have a nominal five (5) year duration, with options to extend for further durations of up to five (5) years. The initial surveys are

anticipated to start in the second quarter of 2021.

"These contracts ensure continuity of our Reservoir Monitoring and Source business segment combined with annual or bi-annual 4D OBN surveys. We are very pleased to provide these services on the back of these long-term contract awards," said CEO Carel Hooijkaas.



72-FOOT SAILDRONE SURVEYOR REVOLUTIONIZING OUR OCEANS

Saildrone, Inc. has launched a 72 foot (22 m) version of its uncrewed surface vehicles, known as saildrones. Powered by wind and solar energy, saildrones are capable of extreme-duration missions of up to 12 months in the open ocean. This latest and largest version, the first in the Surveyor class of USVs, is called the Saildrone Surveyor, and carries sonar equipment capable of seafloor mapping down to 7,000 m.

Enhanced seabed mapping is vital for the security, safety, and economic health of nation states, and is critical to the growth of the "Blue Economy," which, according to the Organization for Economic Cooperation and Development (OECD), is valued at \$1.5 trillion a year and creates the equivalent of 31 million full-time jobs.

Coinciding with the start of the United Nations Decade of Ocean Science for Sustainable Development, the launch of the Saildrone Surveyor presents a paradigm shift in enhanced seabed mapping, which is currently done with

very large and expensive manned ships. The Surveyor, uncrewed and powering its robust sensor suite by harvesting renewable energy, delivers an equivalent survey capability, but at a fraction of the cost and carbon footprint of a traditional survey ship.

With less than 20% of our oceans mapped, we know more about the topography of the Moon and Mars than we do about our own planet. Yet, the shape of the seabed is critical to understanding ocean circulation patterns—affecting climate and weather patterns, tides, wave action, sediment transport, tsunami wave propagation, underwater geo-hazards, and resource exploration.

"We are excited to see the launch of the Saildrone Surveyor," said Alan Leonardi, director of the NOAA Office of Ocean Exploration and Research. "NOAA is supporting the development and testing of this new uncrewed system because we are confident it will expand the capability of our existing fleet of ships to help us accelerate in a cost-effective way our mission to map, characterize and explore our nation's deep ocean territory, monitor valuable fisheries and other marine resources, and provide information to unleash the potential of our nation's Blue Economy."

The development of this innovative vehicle has been a true partnership. In 2019, NOAA provided a three-year grant through the National Oceanographic Partnership Program to the University of New Hampshire, in partnership with the Monterey Bay Aquarium Research Institute and Saildrone, to integrate and test

sensors on the Saildrone Surveyor for mapping the seafloor and revealing life in the water column. While conducting the mapping, samples of DNA, referred to as "environmental DNA," will be collected to reveal the genetic composition of organisms inhabiting the water.

"The launch of the Surveyor is a huge step up, not just for Saildrone's data services but for the capabilities of uncrewed systems in our oceans," said Richard Jenkins, founder & CEO of Saildrone. "For the first time, a scalable solution now exists to map our planet within our lifetime, at an affordable cost."

The Saildrone Surveyor leverages the same patented wind-powered technology as the 23 foot (7 m) Saildrone Explorer. The impressive capabilities of Saildrone's autonomous vehicles have been proven in numerous operational missions for science, ocean mapping, and maritime security, covering over 500,000 nautical miles from the Arctic to the Antarctic. The Saildrone fleet has logged more than 10,000 days at sea in some of the most extreme weather conditions on the planet.

Saildrone is hoping to accelerate many of the global mapping initiatives seeking to give us better insight into our own planet, efforts like The Nippon Foundation-GEBCO Seabed 2030 Project, a collaboration that aims to produce a definitive map of the world ocean by 2030, and the 2019 White House Memorandum on Ocean Mapping that calls for a national strategy for mapping, exploring, and characterizing the US exclusive economic zone.



» Saildrones are capable of extreme-duration missions of up to 12 months.

TELEDYNE MARINE INTRODUCES NEW ULTRA COMPACT ACOUSTIC MODEM

Teledyne Marine is pleased to announce the launch of its new Ultra Compact Modem (UCM). Sized at just 60 x 50 mm, and weighing in at just 55 grams, the OEM version of the UCM is the smallest acoustic modem ever designed by Teledyne Benthos.

The UCM is based on Teledyne Benthos' proven signal processing technology to address the need for reliable wireless underwater acoustic communications onboard the growing number of autonomous micro vehicles and other subsea instruments. As the size of these micro vehicles continues to decrease, Teledyne Marine has responded with lightweight, low power, proven sensors and systems to expand the usefulness of these platforms, increasing the number of tasks they can perform.

The self-contained UCM is rated to 700 m; OEM versions are available with multiple remote transducer options for greater depths. The UCM boasts increased transmit power resulting in increased range and improved data reliability, as well as a decreased power draw, both of which are critical for autonomous vehicles and extended subsea instrumentation deployments.

As with Teledyne's ATM series modems, the Ultra Compact Modem is compatible with the feature-rich UTS-9400 Universal Top Side (UTS), and the soon to be launched CE marked UTS-9500 and is fully compatible with the NATO Janus underwater communication interoperability standard.



» Sized at just 60 x 50 mm, and weighing in at 55 g, the OEM version of the UCM is the smallest acoustic modem ever designed by Teledyne Benthos.

SAFE INFLUX RECEIVES PATENT APPROVAL FOR AUTOMATED WELL CONTROL TECHNOLOGY

Safe Influx Ltd, a provider of Automated Well Control solutions, has been granted a patent by the United Kingdom Patent Office covering its Automated Well Control technology. The patent secures key elements of Automated Well Control technology, including a wide range of modules using the same technology.

This patent recognizes the ability of the Automated Well Control to detect the presence of a fluid influx condition in a wellbore, make a decision against criteria to shut-in, and then automatically initiate an initial well control protocol that results in the well being safely shut-in.

The Safe Influx Automated Well Control system enables fast identification, decision-making and reaction to well control events. This revolutionary technology is capable of reducing the size of an influx compared to conventional techniques, and this means a reduction in delays, costs and operational issues in getting back to drilling. Additionally, the confidence obtained with reliably smaller influxes can lead to much more efficient well designs, leading to an estimated 15-20% saving in well costs.

"We are very pleased that Safe Influx has been granted this patent for our Automated Well Control, which reinforces our position in the industry," said Bryan Atchison, Co-founder and Managing Director at Safe Influx. "With the technology behind this patent, we are able to provide a system with unique capabilities unavailable from any other company." www.safeinflux.com



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2020 HIGH IMPACT EXPLORATION AND 2021 KEY WELLS TO WATCH

High impact exploration has weathered a perfect storm of a pandemic, an oil price crash and an accelerating energy transition, and enters 2021 with a substantial drilling program that should at least match 2020.

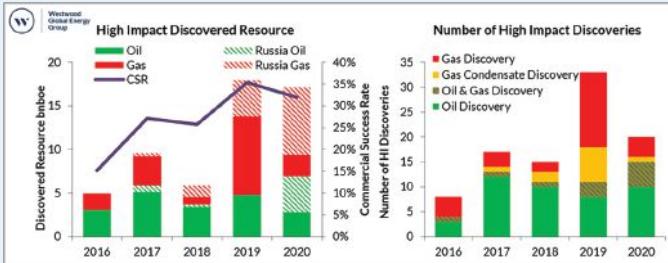
High impact exploration started well in 2020 with the first quarter seeing the highest number of wells completed since Q4 2014 and commercial success rates above 30%. It was not to last.

The world changed in Q2 with the COVID-19 pandemic taking hold, seeing oil prices crash and exploration budgets slashed. The impact of the pandemic became apparent in Q3 2020, with just seven high impact wells completed, the lowest quarterly figure since Westwood's records began in 2008.

HOW DID HIGH-IMPACT EXPLORATION FARE IN 2020?

The year closed with 72 high impact wells completed, down from 99 in 2019, but at a similar level to that seen between 2016 and 2018. Westwood estimates that ~17bnboe was discovered from high impact exploration in 2020, down slightly from 2019 but still more than 2017 and 2018 put together. Discovered oil volumes were the highest seen in the last five years (6.8bnbbl) with 10bnboe of gas also discovered. Commercial success rates remained above 30%, more than double that of 2016.

The three largest discoveries of the year were all claimed by Rosneft in the Kara Sea and West Siberia, with Russia accounting for ~70% of the discovered volume, up from ~10-30% in 2017-2019 based on the figures reported by Rosneft.



» High Impact exploration discovered resource and commercial success rates, 2016-2020 alongside number of High Impact discoveries, 2016-2020. (Image credit: Westwood Wildcat)

WHAT CAN THE INDUSTRY LOOK FORWARD TO IN 2021?

Current projections for 2021 suggest that activity should at least match the 70 wells in 2020 with the potential to be higher and up to 100. Drilling plans are still fluid and will firm up in Q1.

Exploration hot spots for 2021 are mainly in the Americas, particularly offshore Mexico, the Suriname-Guyana Basin and offshore Brazil. Africa is expected to have another quiet year, with only a handful of high-impact wells being drilled, however this does include the much anticipated multi-billion barrel Venus prospect in Namibia. Northwest Europe should see 10-15 high-impact wells drilled which is a similar number to 2020.

An estimated ~26bnboe is being tested by 76 wells that are considered 'probable' in 2021, weighted 75:25 oil to gas. This drops to ~8bnboe split



» 20 exploration wells expected in 2021 highlighted by Westwood as 'key wells to watch'. (Image credit: Westwood Wildcat)

65:35 oil to gas when the chance of success is considered, reflecting the higher risk nature of some of the oil prospects being targeted. As in previous years, additional discoveries may be announced in countries where drilling plans are less transparent, especially in Russia and the Middle East.

Total, Shell and Exxon are expected to be the most active high impact explorers in 2021. Total has the widest geographic spread with wells possible in more than 10 countries. Shell is expected to have a focus in Mexico, although is also planning two high impact wells in the UK and a frontier test in Sao Tome. Exxon is focused on just Brazil and Guyana, and CNOOC is focused on Guyana, Canada and Mexico. Previously active companies such as Repsol and Tullow have cut high impact drilling significantly in response to strategy changes.

Westwood has highlighted 20 wells in 2021 as key wells to watch. The wells selected fall in to four categories:

- Two are frontier basin tests which, if successful, can open multi-billion barrel plays (Venus offshore Namibia, Perseverance offshore Bahamas)
- Seven are testing new plays in proven basins, or testing extensions of proven plays into deeper water that offer benefits of large volumes with follow on potential (e.g. Silverback in the GoM, Rencong in N Sumatra)
- Six are testing extensions to proven commercial deepwater plays with significant potential albeit at some risk (e.g. Ondjaba offshore Angola, Bulletwood offshore Guyana, Nemo offshore Brazil)
- Five are large prospects in proven plays which will be high value if successful (e.g. Edinburgh offshore UK, Dan Day offshore Vietnam)

High impact exploration may have taken a few hits in 2020 from the ravages of a global pandemic, a crash in the oil price and the acceleration of the energy transition, but in no way is the game over.

Full details of Westwood's Key Wells to Watch are available in a report published in December 2020 with commentary and analysis on the play, prospectivity, risks and implications of success.

For more information, visit:
WWW.WESTWOODENERGY.COM

CORETRAX CELEBRATES FIRST DEPLOYMENT OF EXPANDABLE DRILLING LINER IN NORWAY

Coretrax, a global well integrity and production optimization leader, has marked a significant milestone with the first deployment of its expandable liner technology in Norway since acquiring Mohawk Energy.

The move has allowed the business to deliver and deploy novel technology and specialist personnel from local bases, significantly reducing the logistics, cost and carbon footprint of travelling from the U.S.



» ReLineDL open-hole expandable liner brings old well back to life. (Image credit: Coretrax)

The ReLineDL is a hydraulic expansion system which enables operators to isolate low pressure or thief zones which can be encountered while drilling. This provides a significant inner diameter (ID) advantage

when compared to a conventional liner string, enabling the safe and effective passage of larger completion strings, and maximizing production.

Planned and supported from Aberdeen, the expandable drilling liner was mobilized when a major Norwegian operator needed to isolate the gas cap in a lateral well during a drilling campaign.

Compared to conventional methods, the tool enabled the operator to kick-off much deeper in the well, eliminating the need to drill a section of the wellbore and install a tie back. The system was fully expanded within six hours and the entire project was completed in less than 40 hours. This saved 14 days rig-time and delivered significant project efficiencies.

The ReLineDL system also provides the operator the option of adding a casing string in either planned or contingency scenarios with minimum loss of wellbore diameter.

John Fraser, COO at Coretrax said: "As the industry slowly emerges from the significant challenges that the COVID-19 pandemic presented, having local bases where we can



deploy our technology delivers substantial benefits to our clients with reduced logistics and faster deployment. Maximizing oil recovery as cost efficiently as possible is a key priority for operators and our expandable technology is ideally placed to support, delivering operational efficiencies and allowing greater economic results to be garnered."

"Our expandable systems have already built a strong track record in North America and the Gulf of Mexico and we're thrilled to see their value fully realized in Europe. We've entered 2021 with a strong pipeline of projects and look forward to continuing the growth of our operational footprint in the UK and Norwegian sector."

Coretrax acquired expandable tubular well specialist Mohawk Energy in May 2019 and Churchill Drilling Tools in November 2019.

OCEANEERING SUPPLYING FIRST-EVER 20,000 PSI-RATED SUBSEA HYDRAULIC CONNECTION HARDWARE

Oceaneering International (Oceaneering) has been awarded a contract from OneSubsea, a Schlumberger company, for the supply of the first-ever 20,000 psi-rated subsea hydraulic junction plates and associated connection hardware.

Oceaneering will oversee the design, engineering, and production of the hydraulic connection hardware along with integrated flying lead assemblies and installation equipment.

The hardware is destined for the first-ever 20,000 psi-rated field to be developed in the Gulf of Mexico. A portion of the order has already been delivered to OneSubsea.

"The Chevron Anchor project—awarded under the 20-year subsea master services agreement for the Gulf of Mexico—is Industry's first fully integrated subsea production system rated up to 20,000 psi," said Sebastian Hennings, Plant Supply Chain Manager, OneSubsea. "Considering the broad and extensive business partnership between Oceaneering and OneSubsea, it is a pleasure awarding the stab plate and flying lead package of this technically challenging project to one of the leaders in the market. I am absolutely confident this project will be a success for both of our companies and even strengthen the collaboration in the future."

"We are thrilled to work with OneSubsea to take subsea production to the next level," said Nuno Sousa, VP, Manufactured Products, Energy,

at Oceaneering. "This 20,000 psi-rated subsea hydraulic connection hardware solves one of the industry's biggest challenges in developing high pressure fields and allows operators to explore deeper depths more safely. The new design provides a highly-reliable and robust solution based on our field-proven M Series junction plates of which there are more than 6,000 in operation globally."

The plates meet API 17F and have been thoroughly tested to meet all project and field requirements.



» The hydraulic hardware connection is destined for the first-ever 20,000 psi-rated field to be developed in the GOM.



» Illustration of Van Oord's latest cable ship.

VAN OORD ORDERS GREEN CABLE-LAYING VESSEL

Van Oord has ordered a next-generation custom-built green cable-laying vessel. The vessel will be delivered from VARD in Norway and equipped with the latest sustainable technologies. The vessel will be fully operational in 2023.

This investment is part of Van Oord's strategy to strengthen its leading position in the growing offshore wind market. Van Oord has a leading role in the laying and burying of offshore wind power cables. It highlights Van Oord's drive to continuously reinforce its market position by investing in state-of-the-art sustainable technology. Van Oord has a dedicated cable unit to support all its cable projects.

The new vessel has been designed with the latest sustainable technologies in order to

reduce the carbon footprint during operations and port standby. Apart from the possibility to run on bio fuel, this hybrid vessel has future fuel ready engines with built-in flexibility to anticipate e-fuels. It will have a large battery pack, a shore supply connection and a state-of-the-art energy management system. This sustainable set-up will result in a more energy-efficient vessel in order to reduce CO₂, NOx and SOx emissions.

"Van Oord is committed to reducing CO₂ emissions to become carbon-neutral by 2050, in line with the Paris Agreement. This investment emphasises our commitment to net-zero emissions," said Pieter van Oord, CEO of Van Oord.

"We highly appreciate the close and excellent cooperation that has been established between Van Oord and VARD's project teams to enable this innovative vessel within the renewable segment. Our ambition is to contribute to our customers' achievements, through environmentally friendly vessels and technological solutions focusing on safety,

sustainability and efficiency performance, and we are looking forward to developing this cable-layer together with Van Oord," said Mr. Alberto Maestrini, CEO of VARD.

The new DP2 vessel will be equipped with a below-deck cable carousel and a second carousel on deck, with total cable-carrying capacity of 8,000 tonnes. The vessel will mainly be deployed on inter-array grid and export cables of offshore wind projects. The vessel is also able to install High Voltage Direct Current cables. Van Oord's highly innovative cable trenchers can also be operated from this vessel.

This new vessel is Van Oord's second cable-laying vessel in addition to the Nexus. Its intelligent cable lay control system will be a further evolution from Nexus. It measures 130 meters in length and 28 meters across the beam and will be Dutch flagged.

For more information, visit:
WWW.VANOORD.COM

SUBCABLEWORLD REPORT ON THE SUBMARINE MARKET COMING SOON

2020 was the year that everything changed, except for the submarine fiber optics market. If you could look at this market's performance in 2020, somehow without knowing about the year's turmoil, and compared it to the other six years of the current boom, you would not see any reason to think that 2020 was unusual in any way. Projects moved along at the same pace as years that didn't experience pandemics. Investment flowed in at

the same rate as years that didn't experience economic turmoil. Projects already underway continued without interruption. In terms of most measurements, 2020 was right in the middle.

Yet this industry has been highly susceptible to global uncertainty. How could its performance in 2020 be seemingly disengaged from the turmoil around it?

This is the question that our sister publication, *SubCableWorld*, will be asking in its upcoming report on the submarine fiber optics market. Watch for more about this coming soon.

N-SEA, SMD DEBUT NEW CABLE SURVEY TECHNOLOGY

Soil Machine Dynamics (SMD) has partnered with Dutch subsea contractor N-SEA to successfully prove ground-breaking new subsea technology that could change the future of cable construction.

ARTEMIS Survey is the new high-frequency electromagnetic cable and pipeline survey system tested in live environments by N-SEA and SMD in the North Sea in November 2020. During the offshore sea trial on a buried live cable, the data produced by ARTEMIS Survey when compared with pre-existing data successfully proved the location of this power cable, buried to a depth of 2 m below the seabed and at an overall distance of 4 m from the cable, in line with offshore survey standards.

This is a significant step-change in the detection performance for unpowered and abandoned cables, a capability which will revolutionise cable construction and maintenance activities carried out during low wind productivity or when cable failures have occurred.

Commenting on the ground-breaking technology, Stephen Wilson, Strategic Business Development Manager from SMD, said, "The live trials were the culmination of a two-year journey to develop this new equipment. Along with our partner Optimal Ranging, the research and development team has focused on applying the unique nature of high-frequency electromagnetic fields to produce an easy-to-use, operationally ready survey system that can be fitted to any ROV. The fact it works on dead or faulty cables - something that has never been achieved before - has huge implications for the future of the cabling industry. We are very excited to see where ARTEMIS leads."

SMD has worked with several early-adopter offshore survey teams to test and improve the system and has now agreed on

an ongoing development partnership with N-SEA to test ARTEMIS Survey across its full range of power, telecom cables and pipeline applications.

Paul van Waalwijk, Managing Director from N-SEA, said, "We were an early adopter of the ARTEMIS technology and are proud to have been a part of this journey so far. We completed a trial on a live cable and are excited to continue the exploration, together with SMD and Optimal Ranging. The detection of a buried cable in both horizontal and vertical directions has been one of the biggest challenges in the last decade. This system will disrupt the subsea cable and pipeline survey market."

Once available, surveillance and cable repair companies that have the ARTEMIS Survey system are guaranteed to detect any broken or abandoned cables, without the need for power or tone generation. What's more, this can all be done in real-time and at deeper depths than current technology allows.

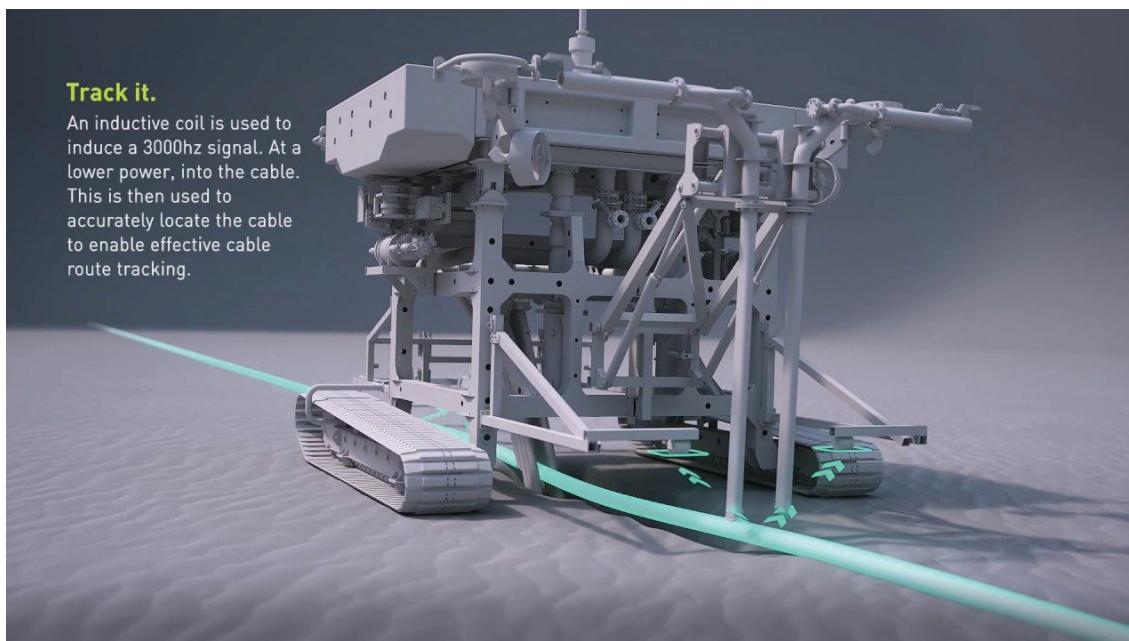
According to Pradeep Pandey, CEO of Optimal Ranging, "We have a proven record of innovating and delivering sensor systems and software based on modelling and measuring electromagnetic fields. SMD and Optimal Ranging share a common vision and goal of providing solutions to challenging problems related to the offshore utility grid. The breakthrough performance of ARTEMIS is a result of our close cooperation and diligence. We look forward to working together to continue to develop and deliver solutions."

SMD and N-SEA are now seeking asset owners and contractors that are interested in using this new technology.

For more information, visit:

WWW.SMD.CO.UK

WWW.N-SEA.COM



» Image of the ARTEMIS cable tracker.

DLM MONITORING, LOGGING SYSTEM FOR WIN DFARM ARRAY CABLES

Dynamic Load Monitoring (DLM) has manufactured two bespoke monitoring systems that have been installed by dive teams on subsea bend stiffeners at an offshore wind farm.

The equipment has been commissioned, with the first round of data due to be collected in March 2021.

The bespoke products were delivered to Darlington, UK-based Subsea Innovation, a manufacturer of subsea equipment, which was challenged by the end user to provide a system to prevent array cables—cables that connect the site's turbines together—from breaking. Subsea Innovation's Dynamic Bend Stiffener (DBS) is a retrofit assembly that is installed onto turbine cables of an offshore wind farm, which are subject to tidal loads that have been causing the power cables to prematurely fail or reduce in efficiency.

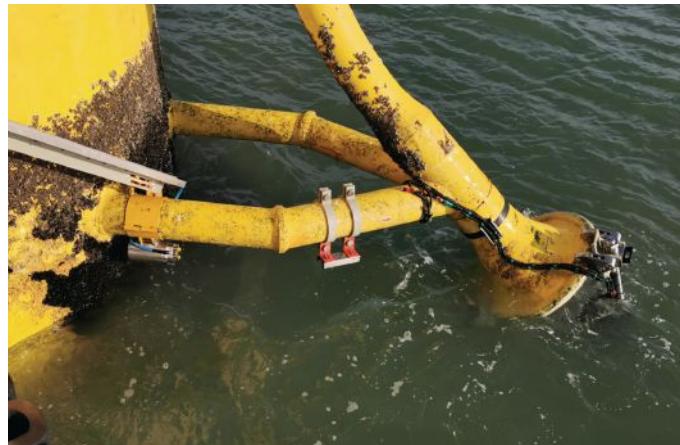
Subsea asked DLM to devise a method to monitor forces on the cables and the movement they experience over time; log the data over the course of a year; and make it periodically accessible. The system comprises three dual axis shear pin load cells, two accelerometers, and a programmable logic controller (PLC). The shear pin load cells are dual axis shear pins that measure forces across two planes in the positive and negative directions. The working load limit (WLL) of each plane is 50kN, in both the positive and negative direction.

Mike Brend, project manager at Subsea Innovation, said: "The DBSs connect directly to the turbine bell mouth and encapsulate the cable at the J-Tube exit, and restrain the cable at the point of failure. The cables are exposed to undesirable bending without a DBS and beyond the expected MBR [minimum bending radius], hence the solution is required to combat such occurrences."

Martin Halford, managing director at DLM, said: "We do regularly put systems together like this for projects, incorporating load cells with other instrumentation and sensors; we probably do two or



» The system comprises three dual axis shear pin load cells, two accelerometers, and a programmable logic controller (PLC).



» Subsea Innovation's Dynamic Bend Stiffener (DBS) is a retrofit assembly that is installed onto turbine cables of an offshore wind farm.

three projects a year of this kind, but the functionality and use is always different. In this case, we reviewed what off-the-shelf instrumentation and sensors were available, but in the end opted for our recently designed DL-3.0 data-logger, and integrated it into bespoke subsea enclosures."

There are eight DL-3.0 data loggers per system (two for each load pin and two for the accelerometers). The logged data is collated and logged again as a package in a PLC enclosure mounted further up on the turbine platform. From this enclosure, there is an ethernet port on the side that enables a user to plug in a PC to download the data periodically when the platform is accessed. Each system also includes a stainless steel subsea junction box.

Halford said: "The development of the new data logger came at the right time as it just so happened that it met both the angular measurement requirements of the system, but also logged this data along with load data. To collate all the information and make it accessible, we decided to use a Siemens [ET200SP] PLC as we have extensive experience using controllers with other offshore projects, noting their reliability and robustness."

He added: "I love these kind of projects—and our engineers do too. It is really what we are geared up to do as a company and it differentiates us from some of our competitors."



» The first round of data is due to be collected in March 2021.

JAN DE NUL ACQUIRES OCEAN YIELD'S CABLE SHIP CONNECTOR

Jan De Nul Group has signed on 4 December 2020 an agreement for the purchase of the offshore construction and cable-lay vessel *Connector* from Ocean Yield ASA. This marks a further investment in the offshore installation capacities of the Luxembourg based maritime contractor. The vessel will be officially transferred during the fourth quarter of 2020.

With a focus on delivering the next generation offshore energy projects, Jan De Nul Group invests strategically in its offshore installation fleet. With the acquisition of the cable-lay vessel *Connector*, Jan De Nul Group further specialises in this offshore energy market as part of a running investment programme following the order in 2019 of the new-build offshore jack-up installation vessel *Voltaire* and floating crane Installation vessel *Les Alizés*.

Thanks to these investments, Jan De Nul Group operates a very modern and balanced offshore fleet now comprising three offshore jack-up installation vessels, three floating crane installation vessels, three cable-lay vessels, five rock installation vessels and two multipurpose vessels.

The *Connector*, built in 2011, is a DP3 ultra deepwater multipurpose subsea cable- and flex-lay construction vessel. The vessel has a proven track record of installing power cables and umbilicals using its dual turntables with a combined total pay-load capacity of 9,000 tonnes, as well as risers using its two heave-compensated 400 mt and 100 mt offshore cranes. The *Connector* is also fitted with two built-in WROV's which can work in water depths of up to 4,000 meters.

The *Connector* has superior manoeuvrability and a high transit speed for worldwide operations. Thanks to her excellent station keeping and stability capabilities, she can operate in the harshest environments.

Finally, the vessel has a very large deck area and crane coverage, turning it into the ideal platform to perform cable repairs.



» The cable-lay vessel *Connector* joins Jan de Nul's fleet.
Photo credit: Christopher Petersen



» Artist's impression of the new Orange Marine cable ship.

COLOMBO DOCKYARD WINS CONTRACT FOR ORANGE MARINE CABLE SHIP

Colombo Dockyard PLC (CDPLC), the leader of the shipbuilding industry in Sri Lanka and one of the most competitive shipyards in South Asia, secured a contract to build a cable laying and repair vessel for Orange Marine France.

Orange Marine is a French company specializing in the field of submarine telecommunications; from the initial design and engineering, to the installation of intercontinental and regional links, as well as the maintenance of existing cables. The Orange Marine's fleet is one of the most experienced in the world and represents 15% of the world fleet.

The proposed vessel is a modern, high technology vessel which is specially designed and equipped for subsea cable lay and repair operation duties with a high focus on good sea keeping qualities, excellent station keeping performance and low fuel consumption.

The vessel has been designed by Vard Design AS of Norway and an optimized hull form and bow shape developed by Vard has been incorporated in the design, enabling the vessel to achieve high speeds and minimize its carbon footprints, to be a highly eco-friendly vessel.

The vessel's primary activities shall be to carry out cable operations, including laying, repair and ROV inspection. The vessel is able to mobilize power cable lay spread to perform subsea inter array cable laying. The vessel is 100 m in length with a beam of 18.8 m and a depth of 7.15 m and shall have a deadweight capacity of 1800 DWT. The vessel can achieve an impressive speed of 14.5 knots and has accommodation facilities for 76 persons. The vessel has three cable tanks to carry fiber optic and power cables. One of the three tanks is fitted with a carousel.

The vessel shall be fitted out with a diesel-electric propulsion plant. The power plant shall consist of four generator sets for electrical propulsion power. The vessel's propulsion shall be by two main azimuth propellers in the aft and two tunnel thrusters in the forward and the system will be run and monitored by an integrated automation system and power management system.

This vessel shall be built to Bureau Veritas classification society standards and shall meet the regulatory requirements of the French Flag Authority. The vessel is scheduled to be delivered in the early 2023.

A NEW ARCTIC STRATEGY FOR AN EMERGING MARITIME DOMAIN

By Dr. Joshua Tallis,

research scientist at the Center for Naval Analyses and an adjunct professor at the George Washington University (VIA CIMSEC)

Coming on the heels of the new tri-service maritime strategy ("Advantage at Sea"), the Department of the Navy has now released an updated framework for the Arctic region—"A Blue Arctic: A Strategic Blueprint for the Arctic." The document is a marked improvement on the brisk 2019 Navy version. It is particularly innovative (as strategies go) in including the Marine Corps in a "Blue/Green" approach to the region and in its navigation of cooperative themes in a moment dominated by great power competition. Yet it also has room for growth, in particular on how to connect loftier concepts with operational realities.

As the title implies, the strategy leans into framing the Arctic as "blue" (as opposed to "white"). The "Blue Arctic" conceit is likely to be among the document's most enduring legacies. Coming on the tail end of a Trump presidency, the strategy may not be officially in force for long. As a result, its rhetorical contributions could outlast any specific policy proposals. On that score, the Blue Arctic push might be a success. Given the realities of climate change, the real novelty that the Navy, Marine Corps, and U.S. policymakers must wrestle with in the Arctic's future is how rapidly its maritime character is changing. It makes sense to grapple with that reality directly, and to give it a moniker that the bureaucracy can grab hold of.

That maritime focus does not displace the long-term role of aerospace defense in the Arctic, as attested by the enduring U.S.-Canada partnership through the North American Aerospace Defense Command (NORAD). Yet going back to documents from the Obama administration, like the 2016 implementation framework for the 2013 national strategy, it was clear (via tasking to the Coast Guard and National Oceanic and Atmospheric Administration) that the maritime angle was rising in importance. Similarly, the Blue Arctic framing well highlights emerging challenges—climate change is the central factor reshaping Arctic geopolitics. Coming with an opening seascape is the greater likelihood for accidents at sea and the prospect of miscalculation that accompanies rival navies operating near one another. So, as a framework for thinking about what is strategically salient in the Arctic today, the Blue Arctic is a helpful construct.

Similarly innovative is the strategy's authorship. Although the document is not fully tri-service like its recent partner, it is notable as the first modern joint Navy/Marine Corps Arctic strategy. This is not just a bureaucratic feat. The Marine Corps has long-standing operational requirements in the



Arctic—as evinced by High North amphibious exercises off Alaska and Norway.

Integrating Navy and Marine Corps operations is part of a bigger trend, as seen in the commandant's planning guidance and the release of new operational concepts like Expeditionary Advanced Basing Operations and Littoral Operations in Contested Environments (LOCE). Some of these, particularly LOCE, also feature in the Arctic strategy. Yet considering those operational concepts were developed for a potential crisis in the Pacific theater, their reapplication to the Arctic warrants some further scrutiny.

Where the document is at its best, however, is in the focus on the U.S.'s objectives in the Arctic. The document should be lauded—in a moment dominated by great power competition—for foregrounding stability, governance, and peace as the main political objectives guiding U.S. engagement in the Arctic. The invocation of peace through strength is vague and opens the potential for a more confrontational approach to the Arctic, but it does not require that interpretation.

This pivot to stability can also be seen, if subtly, in the document's treatment of Russia and China. The Department of Defense's 2019 Arctic strategy, by comparison, references Russia and China in near equal measure. The new Department of the Navy strategy leans slightly more to Russia, which makes sense for an Arctic document. Qualitatively, the document probably also does better differentiating between the two countries compared to the DOD document. That is most evident in its treatment of the theme of cooperation with Russia, where feasible. The strategy is shy about saying so out loud sometimes, but such is evidently the subtext behind the "new partners" section on page 16, for example.

The recent Air Force and the Space Force Arctic strategy offers another useful comparison. That document is forward leaning on the theme of cooperation—but mostly in the context of allies and partners (it names Greenland and Thule frequently to reinforce the Arctic equities of the two services). The Navy/Marine Corps strategy names names too, but with a savvy eye towards domestic readers. Alaska is an obvious hallmark of US Arctic strategies and the Alaska delegation is the key constituency on the Hill for Arctic products. But the Navy document also elevates Maine to new heights, likely given the state's burgeoning economic emphasis on ties to Greenland and Senator King's co-chairing of the Arctic caucus.



▲ Crewmen walk across the ice toward the U.S. Coast Guard icebreaker USCGC POLAR STAR (WAGB 10). The POLAR STAR, first Coast Guard icebreaker to circumnavigate the Antarctic continent, has paused during its journey to give crewmen "ice-liberty." (U.S. Coast Guard photo by PA1 Ed Moreth)



▲ The amphibious dock landing ship USS Comstock arrives in Kodiak, Alaska, as part of the Arctic Expeditionary Capabilities exercise, Sept. 10, 2019. The exercise brings together sailors and Marines to test joint readiness in the Arctic environment. (Photo by Navy Petty Officer 2nd Class Nicholas Burgains)

The move to focus on stability and engagement is not a full pivot from competition. In fact, as in the new tri-service maritime strategy, day-to-day competition is a notable undercurrent throughout the Arctic document. As I've written previously, the question of what it means to compete day-to-day for maritime services can be split along two axes: positional and political competition.

Positional competition means posturing forces to deter a conflict or, failing that, creating the conditions for success in the event of a fight. That boils down to a persistent need for basing, access, and allies.

Political competition is about continued US security and economic leadership of an international order that reflects its interests and values. That invites a competition over global agenda setting, defending maritime norms, and not strictly a perspective on winning the big fight.

The new Arctic framework hints strongly at political competition when it talks about the need to compete in "a way that protects vital national interests and preserves regional security without undermining trust and triggering conflict." That is, I believe, the right approach, and those responsible for implementing the strategy should look to the new tri-service document for its extended treatment of the idea of day-to-day competition.

Presence typically rhymes with competition for the Navy, and it is no surprise that the strategy emphasizes that issue at length. As others have noted, the strategy takes a big picture view of the Arctic as one space for policy-making (a circumpolar perspective). That is understandable for a document that lives at the high altitude of strategy, but it challenges building connective tissue between the idea of presence and specific operational recommendations on where presence is most useful to pursue stability, peace, or rule of law. Strategy is ultimately about helping shape hard choices on the application of finite resources, and when it comes to where presence is most needed, an implementation framework is particularly critical to help translate the broad (and standardly Navy) idea into practice.

Then there is the question of presence with what? In the Arctic, that question has implications for whether the Navy buys different kinds of assets (ice hardened vessels?) or how it plans to compete day-to-day in an austere domain. Submarines commonly operate in the Arctic, but they are high demand, low density assets and are famously bad at overt signaling (by design). Aircraft carriers have gone north (see exercises Northern Edge or Trident Juncture) but are even scarcer and can be quite provocative. Destroyers are versatile platforms but constrained in operational range by the presence of ice in some regions at some times of year. Because service strategies can most directly influence service activities—staffing, training, and equipping the fleet—the issue of platforms is also one that an implementation plan should tackle directly.

There is a lot more to the new blueprint. It laudably addresses the need to plug data gaps for issues of weather modeling, for example, and it emphasizes the role of the professional military education complex in better preparing future military leaders for the Arctic's political and strategic character. Yet its greatest innovations may be the ones that require the least digging. The subtle but evident broadening of cooperation, to occasionally include Russia, is a key feature of addressing stability in the Arctic and managing China's rise. Most evidently, the framework clearly stakes a claim to the Arctic as fundamentally maritime and littoral. Following on that geography, it invites the Navy and Marine Corps to collaborate strategically where so far they have mostly done so operationally. That marriage necessitates more critical analysis about how Blue/Green operational ideas translate to the Arctic, but the underlying shift the framework represents is a notable achievement in its own right.

METOCEAN TELEMATICS ANNOUNCES U.S. COAST GUARD CONTRACT AWARD

MetOcean Telematics (MetOcean) recently announced that it has been awarded a five-year blanket purchase agreement (BPA) to supply the United States Coast Guard (USCG) with its world-renowned search and rescue buoy, the Iridium Self Locating Datum Marker Buoy, also known as the iSLDMB.

MetOcean Telematics has supported and supplied Coast Guards (CG) around the globe with a cost-effective and reliable search and rescue (SAR) buoy for over two decades. The United States Coast Guard, a core-user of the iSLDMB, has experienced first-hand the numerous operational advantages of this SAR buoy. During an active SAR event, the MetOcean iSLDMB allows Coast Guards to quickly travel to the event location via aircraft and then deploy the buoys by air in the region of interest. This ability significantly reduces overall search time and as a result, it assists in saving lives at sea. The SLDMB also aids in reducing overall SAR operational costs

and adds additional safety and protection for Coast Guard personnel. By deploying several buoys in a suspected event location, it reduces the number of Coast Guard SAR vessels, aircraft, and personnel required to travel to the event location. The iSLDMB simply does the work. Each buoy provides vital real-time data at the top 1 meter of the ocean surface. The first 1 meter of the ocean is a critical measurement parameter when accurately detecting a person or asset lost at sea.

The iSLDMB is a true "smart-buoy". Each buoy is equipped with an Iridium satellite transceiver, GPS, light flasher, air, and sea surface temperature sensor. The suite of sensors enables the buoy to provide critical real-time lifesaving data through the Iridium satellite network. The Iridium transceiver also allows SAR operators to communicate via satellite with the buoys during an active SAR event. Bi-directional over-the-air commands can be sent by operators through

MetOcean's secure LiNC data management system. This is a critical ability, if the buoy enters a region of particular interest or if a SAR event is prolonged and there is a need to conserve battery life to prolong buoy operating life.

"We are pleased to be in a position to support the search and rescue efforts of the United States Coast Guard. This partnership has spanned several decades, and it is a true testament of the reliability and steadfastness of the MetOcean iSLDMB. We look forward to supporting the USCG and other Coast Guards with their SAR buoy operational requirements for many years to come," said Tony Chedrawy, CEO of MetOcean Telematics.

The MetOcean iSLDMB is not only utilized by Coast Guards; Navies, oceanographic institutes, environmental agencies, and oil and gas companies around the globe have also incorporated the MetOcean iSLDMB into their safety and logistical operations.

metOcean
telematics

METOCEAN AWARDED SEARCH & RESCUE BUOY CONTRACT BY UNITED STATES COAST GUARD

iridium® connected



» MetOcean's iSLDMB allows Coast Guards to quickly travel to the event location via aircraft. (Image credit: MetOcean Telematics)

OFFICIAL KICK-OFF OF THE EDIDP-FUNDED "SEA DEFENCE" PROJECT

Following the selection last June of the SEA Defence project by the European Commission (EC) within the European Defence Industrial Development Program (EDIDP 2019), the consortium is proud to announce the official start of the project. The EDIDP, which paves the way for the European

Defence Fund, focuses on strengthening the European defense technological and industrial base, as well as on increasing the EU's autonomy and technological leadership.

The SEA Defence kick-off took place on December 14th and was attended

by representatives of the consortium, of the EC and of the participating EU Member States. Earlier last week, the Grant Agreement, worth a total of €14.29M, was signed by the EC, marking an important step in EU naval cooperation. SEA Defence is a collaboration of SEA Naval, including Damen, Naval Group, Navantia, SAAB Kockums, thyssenkrupp Marine Systems, Lürssen Defence, TNO, MARIN, Odense Maritime Technology, CTN, and still to

be completed by key partners who took place in the proposal preparation phase. SEA Naval is the naval working group of SEA Europe.

SEA Defence is a feasibility study, which aims to provide a roadmap of technologies to be included in next generation of naval platforms and pursued in further European development programs.

SAAB DELIVERS UPGRADE GOTLAND-CLASS SUBMARINE TO SWEDEN

On Wednesday, December 16, 2020, Saab delivered the second submarine of Gotland-class to the Swedish Defence Materiel Administration (FMV) after a mid-life upgrade.

Saab has conducted a mid-life upgrade of *HMS Uppland*. Taking all necessary measures to ensure the submarine's operational availability, the upgrade includes new sensors and navigation systems, giving the vessel enhanced capabilities. The delivery of *HMS Uppland* was conducted today at a ceremony in Karlskrona, Sweden.

HMS Uppland is the second submarine in the Gotland-class to have gone through major changes and is now operational again.

"The Gotland-class submarines have an international reputation that many other submarines would wish for, with a stealthy ability and endurance beyond the ordinary. Sweden's ability to develop world-class submarines is a result of the close cooperation between industry, the Swedish Defence Materiel Administration and the Swedish Royal Navy. We at Saab are proud that the latest cutting-edge underwater technology is now operational on-board both *HMS Uppland* and *HMS Gotland*," said Lars Tossman, head of Saab business area Kockums.



» *HMS Uppland*

HMS Uppland has had 50 new systems installed or modified, of which 20 are new systems that in the future will be used in the next generation of submarines, the Blekinge-class. This means, for example, new possibilities to analyze the boat's surroundings with a so called Optronic Mast, replacing the traditional periscope and associated management system.

The Gotland-class submarines were built in 1990-1997. The submarine class consists of three submarines, all which have gone through minor modifications during the first part of their lifetime. *HMS Gotland* was the first boat to go through a mid-life upgrade. The submarine was split into two parts to be able to carry out larger changes.

GDMS RECEIVES \$13.5M CONTRACT FOR U.S. NAVY KNIFEFISH UUV

General Dynamics Missions Systems (GDMS) has received a \$13.5 million contract modification for further work on delivering Knifefish unmanned undersea vehicles to the U.S. Navy.

The effort is part of the navy's surface mine countermeasure unmanned undersea vehicle (SMCM UUV) program, which aims to equip ship with the ability to detect and classify buried, bottom and volume mines in high-clutter environments.

The latest contract is for engineering support for ongoing development, test and production of the Knifefish. It provides funding to support a number of efforts, including test and evaluation, engineering change proposal development and upgrade initiatives. Work is expected to be completed by September 2021.

GDMS first received a low-rate initial production (LRIP) contract in September

last year, for the delivery of five Knifefish systems (10 total UUVs) plus support equipment as part of the LRIP.

A full-rate production decision is expected in fiscal year 2022 after additional testing of LRIP systems. The U.S. Navy plans to procure 30 Knifefish systems in all, 24 in support of LCS MCM packages and an additional six systems for deployment from vessels of opportunity.

The Knifefish UUV is based on the General Dynamics Bluefin Robotics Bluefin-21 deep-water Autonomous Undersea Vehicle. The medium-class mine countermeasure UUV is intended for deployment from the navy's littoral combat ship and other navy vessels of opportunity. Knifefish will reduce risk to personnel by operating in the minefield as an off-board sensor while the host ship stays outside the minefield boundaries.



» GDMS is further supporting the U.S. Navy's surface mine countermeasure unmanned undersea vehicle (SMCM UUV) program. (Photo credit: GDMS)



» Bollinger will build and deliver four more Fast Response Cutters (FRCs) for the United States Coast Guard

FOUR ADDITIONAL FAST RESPONSE CUTTERS TO BE BUILT AT BOLLINGER SHIPYARD

The President of the United States signed into law the omnibus spending bill for Fiscal Year 2021, which included funding for four more Sentinel-class Fast Response Cutters (FRC), allowing Bollinger to build and deliver four more FRCs to the United States Coast Guard. This increases the total number of funded boats to 64.

"It's a great honor to have the confidence of the U.S. Congress to continue the work we're doing in support of the U.S. Coast Guard," said Bollinger Shipyards President & CEO Ben Bordelon. "The Fast Response Cutter program is something we're all proud of here in Louisiana. Delivering vessels on schedule and on budget to the Coast Guard during these challenging times shows the determination and resiliency of our workforce."

All four of the newly appropriated FRCs will be built at Bollinger's Lockport, La. facility.

Earlier this month, Bordelon authored an opinion piece on how an expanded U.S. Coast Guard presence around the globe can "help further the regional partnerships and alliances necessary to curb the creeping influence of America's strategic competitors and adversaries." Bordelon argues that the Coast Guard has the opportunity to establish itself as the preferred regional partner through its work with Patrol Forces Southwest Asia (PATFORSWA), Operation Aiga and elsewhere. Bordelon concludes that "white hull diplomacy should be looked to more and more as a complementary arrow in the whole-of-government quiver."

The FRC program has had a total economic impact of \$1.2 billion since inception and directly supports 650 jobs in Southeast Louisiana. The program has indirectly created 1,690 new jobs from operations and capital investment and has an annual economic impact on GDP of \$202 million, according to the most recent data from the U.S. Maritime Administration (MARAD) on



the economic importance of the U.S. Shipbuilding and Repair Industry. Bollinger sources over 271,000 different items for the FRC consisting of 282 million components and parts from 965 suppliers in 37 states.

"We're proud that Bollinger continues to be an economic pillar and job creator in south Louisiana," Bordelon said. "More than 600 of our 1,500-plus employees have important roles related to the FRC program. Without the support of the Coast Guard and Congress for the continuation of this critical program, the security of these jobs would be thrown into question."

The FRC is one of many U.S. Government shipbuilding programs that Bollinger is proud to support. In addition to construction of the FRC, Bollinger is now participating in industry studies for [five] programs, including the U.S. Coast Guard's Offshore Patrol Cutter (OPC) program, the U.S. Navy's Common Hull Auxiliary Multi-Mission Platform (CHAMP) program, the U.S. Navy's Auxiliary General Ocean Surveillance (T-AGOS(X)) program, The U.S. Navy's Large Unmanned Surface Vehicle (LUSV) program and the U.S. Navy's Light Amphibious Warship (LAW) program.

ABOUT THE FAST RESPONSE CUTTER PLATFORM

The FRC is an operational "game changer," according to senior Coast Guard officials. FRCs are consistently being deployed in support of the full range of missions within the United States Coast Guard and other branches of our armed services. This is due to its exceptional performance, expanded operational reach and capabilities, and ability to transform and adapt to the mission. FRCs have conducted operations all over the globe and embarked on journeys as far as 10,620 nautical miles from its port of origin. Measuring in at 154-feet, FRCs have a flank speed of 28 knots, state of the art C4ISR suite (Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance), and stern launch and recovery ramp for a 26-foot, over-the-horizon interceptor cutter boat.

For more information, visit:
WWW.BOLLINGERSHIPYARDS.COM

ELBIT SYSTEMS TO PROVIDE SEAGULL USV SYSTEMS FOR ASIA PACIFIC NAVY

Elbit Systems Ltd. has been awarded a contract to supply Seagull™ USVs to the Navy of a country in Asia-Pacific. The contract, that is in an amount that is not material to Elbit Systems, will be performed over a 17-month period.

Under the contract, Elbit Systems will provide Seagull USV systems that are specifically configured to perform Mine Counter Measures (MCM) missions while facilitating the option to add technology modules needed for Anti-Submarine

Warfare. The Seagull USVs to be supplied will integrate Side-Scan and Forward-Looking sonars, Mine Identification and Destruction Remotely Operated Vehicles. The USVs also will be equipped with the Company's autonomous suite, Combat Management System and Satellite Communication capability. The Seagull USVs will enable the customer's Navy to execute end-to-end MCM operations, handling bottom, moored and drifting sea mines. The Seagull USV offers endurance

of four days, sea-keeping missions of up to Sea-State 5 and the flexibility to control several vessels from the same Mission Control System.

Elad Aharonson, General Manager of Elbit Systems ISTAR, commented: "There is a growing recognition of the essentiality of autonomous capabilities to perform a range of maritime missions, especially Mine Counter Measures and Anti-Submarine Warfare. The Seagull USV has proven, since 2017, its capability to perform such missions, providing Naval forces with increased mission effectiveness, reduced risk and better cost-efficiency."



» Seagull™ Multi-Mission USV System.
(Photo credit: Elbit Systems)



» Seagull USV systems can be configured to perform Mine Counter Measures (MCM) missions. (Photo credit: Elbit Systems)

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SAAB SEAEDGE



VICTA – THE WORLD'S MOST ADVANCED DIVER DELIVERY UNIT

BAR Technologies, an innovative simulation-driven marine engineering consultancy, has announced that it has been chosen to support British advanced maritime technology business, SubSea Craft Ltd, in the design and build of VICTA—the world's most advanced diver delivery unit.

As the principal partner, BAR Technologies has been integral to the shape and form of VICTA—designing and optimizing the hull and control system to enable truly remarkable performance both on the surface and submerged.

BAR Technologies and SubSea Craft began collaborating on the VICTA development in 2018, progressing the build over the previous 14 months. The vessel is currently in 'finishing' where the carbon fiber hull is completed prior to receiving a synthetic, colored outer 'wrap'. This crucial step provides VICTA's streamlined shape, reduces the acoustic signature and assures watertight integrity. These are essential components for a craft designed to operate at speed on the surface before submerging rapidly to transit, discreetly, below the surface.

Working together, SubSea Craft and BAR Technologies are currently focused on completing this phase of activity to prepare VICTA for successful trials and testing next year.

In partnering with SubSea Craft, BAR Technologies has used its expertise in computational fluid dynamics to help deliver a performance envelope for the vessel that will enable it to hit circa 40kts and 250nm endurance on the surface, matched by an equally impressive underwater specification where four hours endurance can navigate two crew and six divers for 25nm.

At the heart of this is VICTA's fully fly-by-wire advanced control system, ensuring the safe management of the dive and surfacing evolutions and propulsion controls.

This advanced technology, enabling reliability, resilience and availability, combined with an ability to operate at speed over range and with rapid transition and sub-surface navigation, marks VICTA out as presenting remarkable capabilities. This is further complemented by the operational flexibility—with the vessel able to be delivered into a theatre of operations from a road trailer, by surface vessel, helicopter or air-transport aircraft.

John Cooper, Chief Executive Officer, BAR Technologies, said: "At the heart of this project is crew and diver safety, and we knew that nothing less than world-class design and build would suffice.

"Drawing on our racing team heritage, we have been able to bring some of the most innovative, advanced techniques in computational fluid dynamics to bear, with our leading in-house simulation capabilities. The ability to scale a solution to provide an agile response to a complex brief is testimony to the breadth and versatility of maritime technology, and we are proud to be supporting on such an important project."

Scott Verney, CEO at SubSea Craft, added: "VICTA represents the beginning of a new line of next-generation diver delivery units, which will transform operation capabilities for above and below surface transit.

"We collaborate with the world's leading specialist engineering consultants such as BAR Technologies, blending best in class industry advancements with an

BAR  TECHNOLOGIES



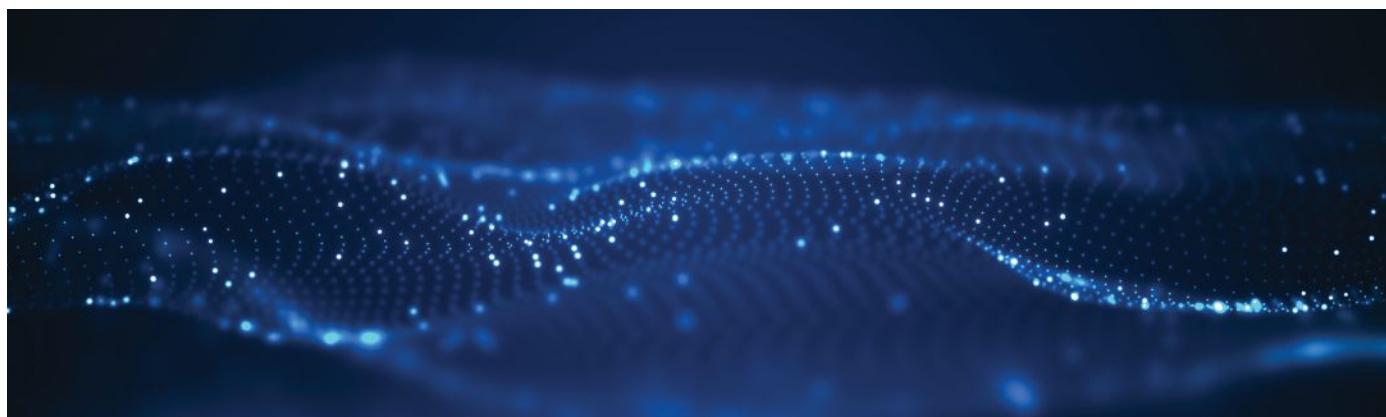
agile business mind-set to influence the development of our craft.

"It's pivotal to achieving VICTA's technical edge and we are confident that with BAR Technologies' expertise, the vessel's advanced specifications make it the superior choice for inconspicuous insertion and extraction tactics across the spectrum of specialist maritime operations."

VICTA is a unique and innovative craft—the world's most sophisticated Diver Delivery Unit (DDU). Its distinctive form combines the characteristics of a Long-Range Insertion Craft (LRIC) with those of a Swimmer Delivery Vehicle (SDV). Over the past two years SubSea Craft has harnessed novel, market-leading technology to bring the vessel to life and VICTA is now in final fit-out ahead of comprehensive trials and testing, which will take place in 2021.

Primarily aimed at the defense market, this unique British maritime technology provides significant operational capability, broadening the options for commanders of Maritime, Joint and Special operations. Although focused on defense, there is potential utility elsewhere in the leisure, research and security sectors.

For more information, visit:
WWW.BARTECHNOLOGIES.UK
WWW.SUBSEACRAFT.COM





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TURNING THE CALENDAR HASN'T CHANGED COMMODITY MARKET CHALLENGES

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

CRUDE OIL:

The fundamental driver for oil activity is price, which reflects both current assessments of supply and demand, but more importantly, the product's future. The past six weeks have been a lesson in watching how a free-market struggles to determine what the future holds for oil in a period of increasing uncertainty. As we exited November, the world was watching what OPEC would do at its semi-annual get together—virtually rather than in Vienna. The focus was on implementing the next step in the grand compromise that emerged last spring to deal with the collapsing market in the face of the spreading pandemic. The compromise necessitated the largest production cut in history—10 million barrels per day—with a plan to restore supply in the second half of 2020 and further in 2021.

The first supply increment—2 million barrels per day—was added in the fall. Another large slug was to be added in January. Would it be another 2 million barrels, or something less? Would it come at once, or be staged over time? A tense negotiation session between OPEC+ leaders Russia and Saudi Arabia resulted in an agreement to add back 500,000 barrels a day January 1, with monthly market assessments determining future supply increments.

Then came another virus uptick, with governments retreating on unlocking their economies. Future oil demand projections slumped. Russia argued more oil should be added as demand would eventually return; Saudi Arabia wanted to maintain the status quo. Saudi Arabia won, at least for the next two months. But then, surprisingly, it announced a unilateral production cut of 1 million barrels per day. A sign of OPEC+ weakness, or a desperate ploy to lift prices before flooding the market? Understanding the rationale for this move will be crucial to guessing the trajectory of oil prices.

While people cheered oil prices reaching a new milestone—\$50 a barrel—will it become the new ceiling or floor? The answer won't be known for months, or until vaccinations and a retreating virus allow economic activity to expand, lifting oil demand. The initial clue to market clarity will be the trajectory of the U.S. oil rig count. If American producers can now earn healthy margins, expect more rigs and more supply, compounding the dilemma OPEC+ faces in managing its output.

NATURAL GAS:

The "I don't get no respect" natural gas market is struggling to put air back into its deflated bubble. Heading into the winter, optimism grew that fundamentals were rebalancing the market and \$3+ per thousand cubic feet gas prices would prevail. With gas supply falling, the storage surplus would soon shrink. Although higher gas prices would result, for LNG exporters, the reality of winter would force Asian and European customers to add to their supplies. An early bout of cold temperatures in the U.S. further encouraged gas suppliers and traders. As we moved toward mid-November, \$3/Mcf gas prices arrived.

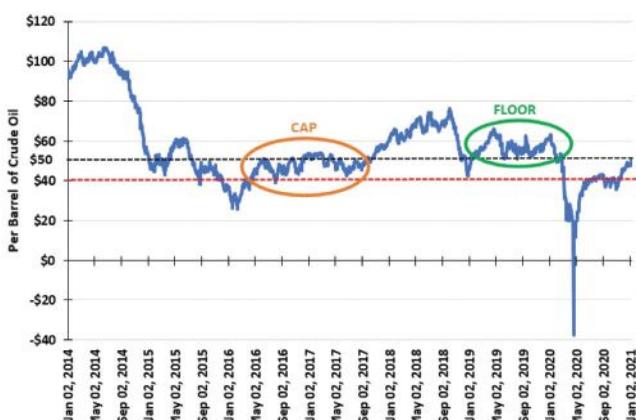
Then came a wave of warmer weather, coupled with forecasts for more warm temperatures. Early winter weather in northern Asia boosted the JKM gas price to mid double-digit levels, something not seen for over half a decade. LNG cargoes began steaming to Asia. Congestion at the Panama Canal added nearly two weeks to travel times—as much additional time as is necessary to go the long route around Africa. Shipping costs soared, adding as much as \$2/Mcf to delivered LNG prices, causing the rise in Asian prices to slow.

The good news for American gas producers was the recovery of LNG exports, and the start-up of a new terminal, pushing export

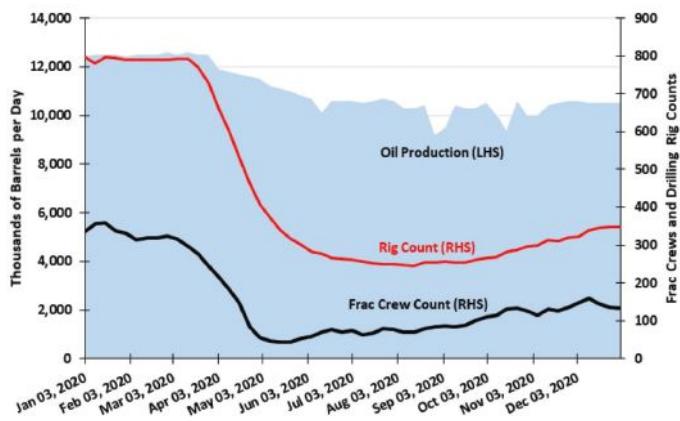
volumes to record levels. However, the anticipated decline in gas production due to low oil prices (less associated gas output from oil wells) hasn't occurred. With oil prices ticking up, more associated gas is on the horizon, mitigating the supply/demand rebalancing pace. Suddenly, domestic gas prices were all about weather. Through the end of December, cumulative population-weighted heating degree days were more than 10% lower than for the same period last year. This led to weekly storage withdrawals being worse than the most bearish forecasts, pressuring gas prices. Although November and December are not indicative of an entire winter, the balance of this winter must be substantially colder for gas prices to rise materially.

As markets are wont to do, high Asian LNG prices encouraged supply changes. Southern Asian countries started burning coal for power while shipping their gas north for profits. LNG cargoes destined for Europe were diverted to the more profitable Asian trade. This will help the U.S. LNG business, as Europe draws down its bloated gas storage, eventually making room for new U.S. supplies at higher prices. Unfortunately, the future isn't helping current gas prices. Although forecasts earlier called for gas prices of well over \$3/Mcf in 2021, prices fell below \$2.50 with warm weather. A little cool weather has boosted them to \$2.70+. However, the gas futures strip barely breaks the \$3/Mcf barrier next winter, and then never again. Commodity prices are seldom right, but they reflect perceptions of the future. More importantly, price forecasts influence the actions of the industry's players. Natural gas is the new Rodney Dangerfield of commodity markets, and thus will be boring for some time.

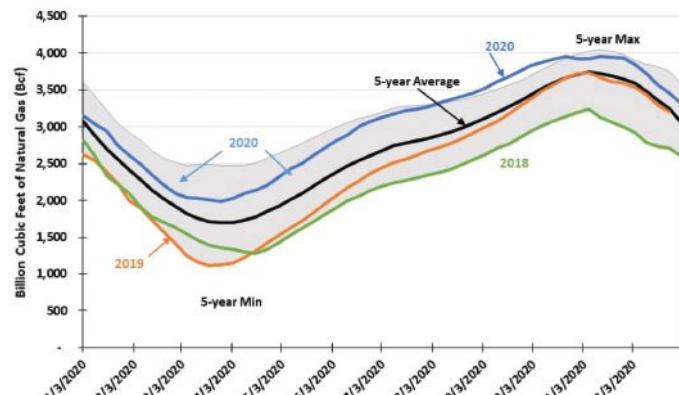
Moving Forward:
Will \$50 Become Cap
or New Floor?



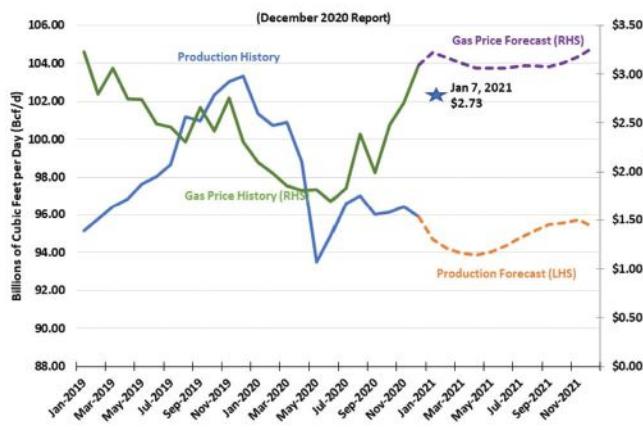
2020 U.S. Oilfield Recovery vs. Weekly Production



Gas Storage Remaining High Keeps Pressure on Gas Prices



EIA STEO Natural Gas Production and Forecast





AMERICAS

Int'l Conference on Ocean Energy (ICOE)

Virtual » April 28-30
www.icoe2021.org

US Offshore Wind

Virtual » May 26-27
www.reutersevents.com/events/offshore-wind

International Telecoms Week

Washington D.C. » June 1-4
www.internationaltelecomsweek.com

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

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

Offshore Well Intervention LATAM

Rio de Janeiro, Brazil » September 8-9
www.offsnet.com/latam

EUROPE

Conference for Wind Power Drives

Virtual » March 9-11
www.cwd.rwth-aachen.de/konferenz/cwd-2021/

Seabed Mapping & Inspection

Virtual » March 10
www.tekna.no/en/events/seabed-mapping-and-inspection-2021-40154/Start/

DECOM

Aberdeen, UK » March 29-30
www.sut.org/event/decom-2021-3rd-international-conference-on-the-decommissioning-of-offshore-subsea-structures/

OCEANS Europe

Porto, Portugal » May 17-21
www.oceansconference.org/porto-2021/

Subsea Expo

Aberdeen, UK » May 25-27
www.subseaexpo.com/

Deep Sea Mining Summit

London, UK » May 27-28
www.deepsea-mining-summit.com/

Seanergy

Nantes, France » June 8-11
www.seanergy-forum.com/en/seanergyforum/Seanergy-2020

Ocean Business

Southampton, UK » July 6-8
www.oceanbusiness.com

OTHER REGIONS

Offshore Well Intervention AUS

Virtual » February 8-12
www.offsnet.com/owi-aus

Underwater Technology (UT)

Virtual » March 2
www.ut2021.org

Int'l Conference on Coastal and Ocean Engineering (ICCOE)

Tokyo, Japan » April 3-5
www.iccoe.org

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 15-17
www.philmarine.com

Submarine Networks World

Singapore » September 29-30
www.terrapinn.com/conference/submarine-networks-world/

MONTH & DEADLINES	EDITORIAL FOCUS & SHOW DISTRIBUTION	TECHNOLOGY & INDUSTRY FOCUS
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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	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	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 » Distribution: Ocean Business / July 6-8	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	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	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	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

BOSKALIS ACQUIRES REVER OFFSHORE SUBSEA SERVICE BUSINESS

Boskalis has announced the acquisition of all the shares of Rever Offshore's subsea services business ('Rever'). Rever, formally known as Bibby Offshore, offers a broad range of solutions in the area of subsea construction, inspection, repair and maintenance.

Rever has historically operated in the North Sea out of Aberdeen (United Kingdom) and holds a strong track record. Through this transaction, Boskalis will obtain two diving support vessels of which one is fully owned (*Rever Polaris*) and a second chartered (*Rever Topaz*). The group employs an onshore staff of around 130 in addition to approximately 220 offshore workers. The 2020 annual revenue is approximately EUR 90 million, most of which is generated through numerous framework agreements. Based on projected cost synergies, the acquisition payback period is expected to be less than three years.

Through this acquisition, Boskalis strengthens its current position in the subsea services market in Northwest Europe, Africa and the Middle East and its capabilities to serve both the traditional oil & gas market and the rapidly expanding offshore wind market. On the important North Sea subsea market, Boskalis is now a solid top three player opening up ample opportunities for operational efficiencies and synergies.



EX-CENTRICA AND BP BOSS IAIN CONN JOINS OXFORD FLOW BOARD



» Iain Conn

Oxford Flow, a flow control equipment specialist for oil, gas, water and industrial process industries, has appointed Iain Conn as non-executive director as the company embarks on further growth and diversification.

Energy industry veteran Conn brings 35 years of experience to the post, including 29 years with BP, 10 of which were on BP's Board, latterly as CEO Downstream. Most recently, Conn was the Group CEO at Centrica where he pioneered repositioning its portfolio towards distributed, lower-carbon technologies, services and solutions.

Conn joins another energy stalwart, Shell's former CFO Simon Henry, who already has an advisory role with Oxford Flow's board. Conn is also an advisor to Oxford Sciences Innovation and its Deep Tech Portfolio.

Neil Poxon, CEO at Oxford Flow commented: "We have developed an ambitious roadmap for growth and diversification. Iain's extensive experience from a strategic and operational perspective will enable us to penetrate into new sectors, like oil and gas, at a faster rate. As we see the energy and water industries face mounting challenges like tackling emissions and reducing non-revenue water, his steadfast guidance will prove invaluable.

"What's really powerful is the combination of Iain and Simon together—we're incredibly proud to have such impressive industry



names as part of our board and advisory. With Simon's commercial expertise, Iain's technical track record and their joint strategic experiences, we believe we can maximize value for all stakeholders."

The company, which develops a range of innovative pressure reducing valves and gas regulators, has already carved a remarkable growth story in the last 12 months. In early February 2020, Oxford Flow opened its first US office in Houston, TX and in mid-March announced a strategic investment from GF Piping Systems, a division of Georg Fischer. In addition, Oxford Flow secured another £9.1m investment in July to support its expansion across the utility and industrials markets, as well as oil and gas product development.

JANICE YASUI JOINS TELEDYNE RD INSTRUMENTS

Teledyne Marine recently announced the addition of Janice Yasui to Teledyne RD Instruments' team in San Diego, CA. Janice will put her extensive experience to work in the role of Subject Matter Expert, where she will work collaboratively with engineering, sales and marketing to advance the technology and market applications for Teledyne RDI's full line of acoustic Doppler products, including inland and oceanographic Acoustic Doppler Current Profilers (ADCPs) and Doppler Velocity Logs (DVLs).

Janice has a wealth of directly applicable experience that includes a B.S. in Environmental Science and Oceanography from Oregon State University, as well as an extended tenure at Sontek (Xylem) in roles that included Technical Sales and Support and Global Product Manager. Janice has also served as a Quartermaster in the U.S. Coast Guard and as a Hydrographer at NOAA. This impressive mix of skills and experience will prove incredibly valuable to Teledyne RDI, their customers, and the larger Teledyne Marine group.

Yasui added, "I'm excited for the opportunity to apply my expertise in underwater acoustic Doppler systems to Teledyne RDI's impressive product offerings and unparalleled breadth of applications. Helping customers use technology to address important challenges in marine and water resources is what motivates me, and I'm pleased to find myself in great company here at RDI."



» Janice Yasui



THE ON&T PODCAST

SEASON 2 / EPISODE 1

INNOVATIONS OF UNMANNED AND AUTONOMOUS DEEP-SEA TECHNOLOGIES

In season 2 of SeaState we were able to sit down with Dr. Jyotika Virmani. Dr. Virmani is the first Executive Director of the Schmidt Ocean Institute, a philanthropic organization dedicated to advancing oceanographic research and exploration. Prior to this, she was the Executive Director of Planet & Environment at XPRIZE, where she led the Shell Ocean Discovery XPRIZE to spur innovations in remote and autonomous, rapid, high-resolution sea floor mapping technologies, which included a Bonus Prize from NOAA for technology that could detect an underwater biological or chemical signal and autonomously track it to its source. Dr. Virmani joined XPRIZE in 2014 as the Technical Director for the Wendy Schmidt Ocean Health XPRIZE, a competition for pH sensor development to measure ocean acidification. Before joining XPRIZE, Dr. Virmani was the Associate Director of the Florida Institute of Oceanography, a Senior Scientist at the UK Met Office, and Executive Director of the Florida Coastal Ocean Observing System.

She has a Ph.D. in Physical Oceanography from the University of South Florida. As a Rotary Foundation Ambassadorial Scholar, she earned a M.S. in Atmospheric Science from SUNY at Stony Brook. She also has a B.Sc. in Physics from Imperial College London and is an Associate of the Royal College of Science.

She serves on the U.S. Integrated Ocean Observing System Federal Advisory Committee, the National Geographic Executive Committee for Research and Exploration, and Catch the Next Wave Steering Committee. She is an External Advisor to the Seabed 2030 Ocean Frontiers Mapping Committee, a member of the WEF Global Future Councils and a Fellow of the Royal Meteorological Society and The Explorers Club. In 2020, the Marine Technology Reporter Top 100 List recognized her amongst their top 10 Ocean Influencers.
www.oceannews.com/seastate



» Dr. Jyotika Virmani



The graphic features a dark blue background with a stylized blue swirl logo at the top. Below the logo, the text "blue innovation SYMPOSIUM" is written in white. In the center, the text "The Next Wave in Ocean Tech" is displayed in a large, light blue font. To the right, there is a large, white, semi-transparent text area containing the date "February 2nd", the time "2-4 pm", and the word "Virtual". At the bottom, a blue button-like shape contains the text "REGISTER NOW" in white. Below this button, the website "BlueInnovationSymposium.com" is written in white.

ASHTead TECHNOLOGY APPOINts NEW CFO AND EXPANDS MANAGEMENT TEAM

Ashtead Technology has appointed a chief financial officer (CFO) and five managers for newly created roles across its international team.

The appointments underline the integrated subsea technology and services company's strategic growth plans to cement its leading position in the global offshore energy market and build on its recent success in new and emerging markets, including in offshore wind and decommissioning.

Ingrid Stewart, the new CFO, brings 23 years of corporate finance experience to the Aberdeenshire headquartered business which employs 170 people around the world.

Ms. Stewart spent eight years with EnerMech Group as corporate development director where she managed the completion and integration of multiple acquisitions for the firm, as well as developing and executing long-term strategies. Prior to this, she was a member of the senior UK management team at Simmons & Company International, becoming the investment bank's first ever female corporate finance director in 2009.

A specialist in subsea construction, IMR and decommissioning services, Ashtead Technology has acquired five businesses since 2017 and, as a result, boasts one of the largest equipment fleets in the industry and a depth of associated services capability.

In her new role, Ms. Stewart will work with the senior team to position the company for further growth and further leverage existing capability. Commenting on her appointment, Ms. Stewart commented: "After watching the business successfully grow through acquisition over the past few years and increase its foothold in the offshore renewables and decommissioning sectors, I am thrilled to be joining the talented



» Ingrid Stewart, Ashtead Technology's new CFO

team at Ashtead Technology. The company has significant growth potential and I'm looking forward to supporting its future aspirations."

The new Aberdeenshire based managerial hires across Ashtead Technology include Lili Hughes, as group QHSE manager, Stephen Booth as decommissioning BD manager and asset integrity project manager Michael Gibson. In addition, Mark Vela has joined as US operations manager in Houston, and Dan Davies has taken up his new role as NDT market manager within the company's inspection solutions team in Bedfordshire, England.

Ashtead Technology CEO Allan Pirie said: "Ingrid's substantial corporate finance and energy industry experience will make a significant contribution to our growth ambition as we further integrate and invest in our global operations to support the increase in business in offshore wind, decommissioning, and oil and gas.

"Bolstering our management team in the UK and the US will ensure we are well equipped to support our clients as we navigate the current challenges and capitalize on the opportunities presented by the energy transition and the blue economy."

MARLINK GROUP SIGN DEFINITIVE AGREEMENT TO ACQUIRE ITC GLOBAL

Marlink Group, backed by Apax Partners (France), has signed a definitive agreement to acquire 100% of ITC Global, the leading provider of satellite communications solutions, from Panasonic. Upon completion of the acquisition, ITC Global will become a cornerstone of the Marlink Group, supporting the expansion of Marlink's global leadership in the energy and enterprise markets.

ITC Global brings an unparalleled expertise in managed, high-value, high-performance satellite network solutions to the fast-growing Marlink Group. The

company's strong reputation in the Energy, Enterprise and Maritime Passenger markets will enable the Group to further expand its leadership position in these highly demanding market segments. In addition, the Marlink Group will leverage the complementarity of ITC Global to diversify and strengthen its commercial operations in the US, UK and Australia further geographically.

Most importantly, their respective customers will benefit greatly from the combined Group's enhanced capabilities and strength as a sustainable leading

provider for their business-critical remote connectivity solutions. The acquisition will provide the Marlink Group with synergistic platforms to offer best-in-class managed satcoms services and further develop its industry-

leading Smart Network Solutions for its customers.

The closing of the transaction is subject to customary regulatory approvals and is expected in the first quarter of 2021.



» ITC Global will become a cornerstone of the Marlink Group, supporting the expansion of Marlink's global leadership in the energy and enterprise markets.

A.P. MOLLER-MAERSK AND THE OCEAN CLEANUP EXTEND RELATIONSHIP

The Ocean Cleanup's mission is to develop advanced technologies to rid the world's oceans of plastic. To achieve this goal, they aim to stop the inflow via rivers and clean up what has already accumulated in the ocean. Its ultimate goal is reaching a 90% reduction of floating ocean plastic by 2040.

"As a responsible maritime operator, we are committed to ensuring that the oceans can remain a healthy environment for generations to come. We are therefore very pleased to

not just prolong but broaden the partnership agreement initiated back in 2018," said Mette Refshauge, VP, Corporate Communications & Sustainability, Maersk.

Besides Maersk Supply Service support with vessel operations and offshore project management, Maersk will now support The Ocean Cleanup with logistics end-to-end handling services, ranging from worldwide shipment from different locations to airfreight, container & special transport, customs clearance

and warehouse and storage management.

"We will have a transport & supply chain manager fully embedded in The Ocean Cleanup's office in Rotterdam. That program manager will serve as the single channel for them to engage with the full range of Maersk's supply chain and transport services globally and will help The Ocean Cleanup to develop their own supply chain management capacity over time," added Mette.

"Maersk's support over the last three years has been invaluable to furthering our mission. We are grateful to not only renew this partnership, but to strengthen it with their end-to-end logistics service. This contribution to our mission will not only help us clean more plastic from the ocean, but it will help us to effectively deploy more Interceptors river cleaning systems, and develop

our next products made of certified plastic from the Great Pacific Garbage Patch," said Lonneke Holierhoek, Director of Science & Operations at The Ocean Cleanup.

As part of the partnership agreement, Maersk will also assist The Ocean Cleanup in deploying scientific sensor technology aboard Maersk's own fleet to map plastic floating in the oceans and help the organization have a better understanding of the severity of the problem they are working to solve.

The goal is to assist The Ocean Cleanup in mapping concentrations of harmful plastic in the world's oceans to better focus The Ocean Cleanup's efforts. "What better way to map the oceans than to harness one of the world's largest fleets?" suggested Robin Townley, Head of Special Project Logistics at Maersk.



» Maersk will also provide The Ocean Cleanup with end-to-end supply chain management services for both ocean and river clean up systems. (Photo credit: Maersk)

DNV GL TO CHANGE NAME TO DNV

DNV GL, the assurance and risk management company, will change its name to DNV on March 1, 2021. The move comes after a comprehensive review of the company's strategy as it positions itself for a world in which many of DNV's markets are undergoing fundamental change. The present name has been in place since the 2013 merger between DNV (Det Norske Veritas) and GL (Germanischer Lloyd). The name simplification is a natural consequence of a successfully completed merger and of having operated as a fully integrated company for several years now.

Remi Eriksen, Group President and CEO, said, "We merged two leading companies with complementary strengths and market positions, and combining the two names was the right solution in 2013. However, it was not a name that rolled off the tongue, and many customers already refer to the company as DNV."

Our brand is used by many of our customers to build trust towards their stakeholders, and a simpler name will be an even stronger trust mark for our customers in the future, but still carries with it all our strengths and proud 157-year-old legacy with a purpose to safeguard life, property and the environment."

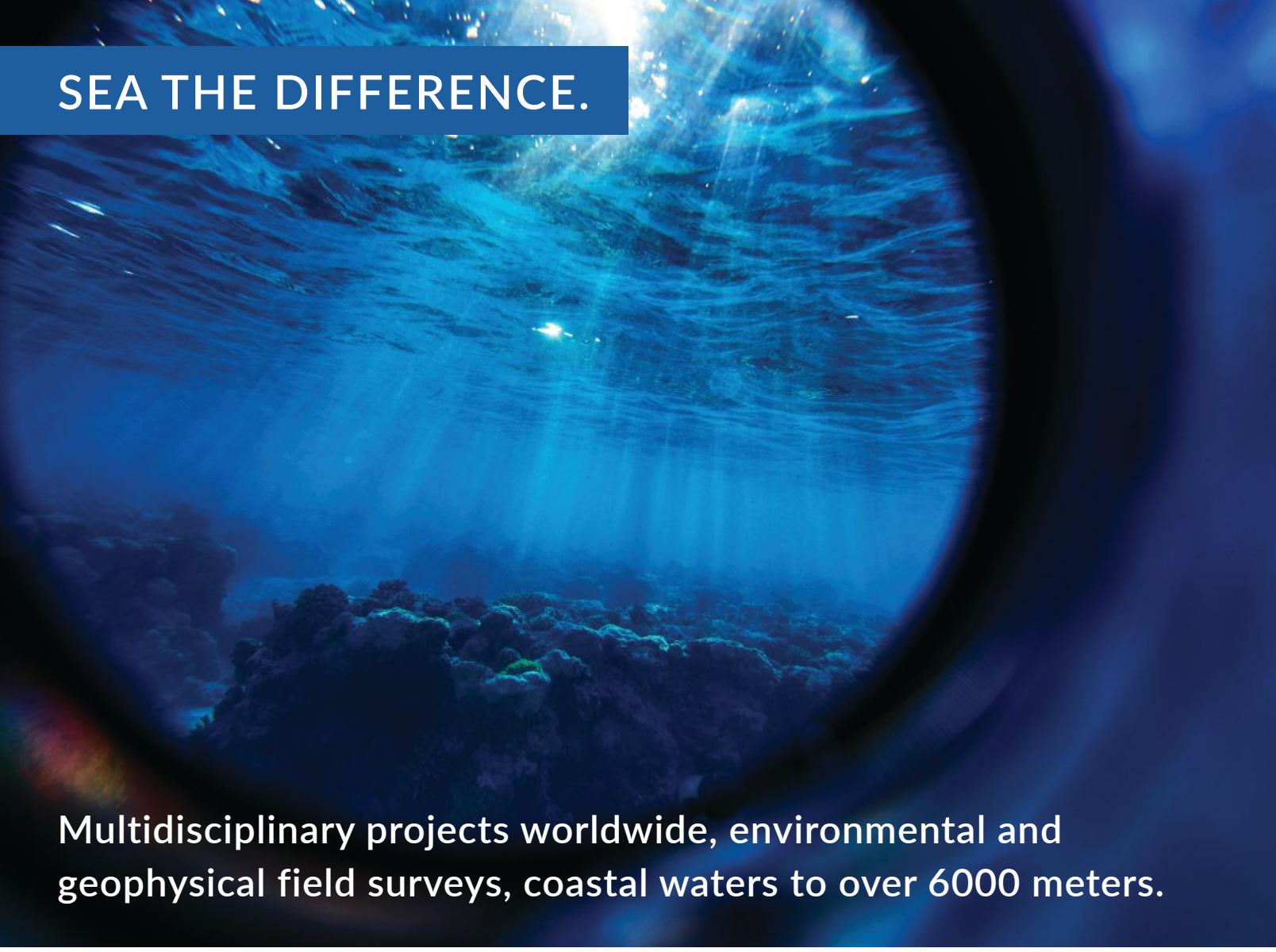
The 2020s has been called the decade of transformation or the "exponential decade", where the pace of the energy transition will be set and where food, health and transport systems will change immensely and digital technologies underpinning industry 4.0 will mature from experimentation into large-scale application. Most importantly, this is the decade where humanity will succeed or fail to deliver on the Sustainable Development Goals.

As companies take on the complexities of digitalization and decarbonization, they need trust and assurance. Assurance is not only



a service, but also the fundamental value created as a result of the services delivered by DNV. DNV's ambition is to shape the future of assurance with more digitalized services and by leading the assurance of digitalization in the form of assuring data, digital twins and digitized processes.

"Our strategy not only positions us for significant growth in a world increasingly in need of a trusted voice, but also positions us to shape the future of assurance," said Eriksen. "DNV will offer the best, most efficient and digitalized ways of delivering services - be it classification, certification, verification, inspection, advisory, or digital solutions."



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The range includes the Hunter system (AUV Imaging and Laser), the Scout system (Observation Class ROV Imaging and Laser Profiling), the Pathfinder system (Work Class ROV Imaging and Laser Profiling) and the Prowler I & II systems (Towed Vehicle Imaging Range and Scale Measurement).



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